Oklahoma Ag in the Classroom

7th & 8th Grade Curriculum

Brad Henry
Governor

STATE OF OKLAHOMA
SECRETARY OF AGRICULTURE

Terry L. Peach
Cabinet Secretary

Dear Educators:

Thank you for your support of the Oklahoma Ag in the Classroom program. Without your interest and dedication we could have never achieved the advances we have made and see developments such as this new curriculum for 7th and 8th grade students.

The Oklahoma Department of Agriculture, Food, and Forestry along with our partners at Oklahoma State University and the Oklahoma Department of Education long ago saw the need for providing our students with a more complete education. Specifically we recognized our state's need for including agricultural facts into our school systems where the students are increasingly removed from farming backgrounds.

As these students are destined to one day becoming state leaders, decision makers and voting citizens of the State of Oklahoma, it is important that they have some real world knowledge of the agricultural industry. Also, by including nutritional facts and lessons within the curricula developed, we believe we are helping lead in the national fight against childhood obesity.

Again, thank you for your commitment to this vital program. Our state's agriculture industry and future depends on well-educated young people to take us into the next 100 years.

Sincerely,

Terry L. Peach

Terry L. Peach
Secretary of Agriculture

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Lesson P.A.S.S. Standards and Agricultural Issues

Page Number	TITLE OF LESSON IN ALPHABETICAL ORDER	LANGUAGE ARTS				SOCIAL STUDIES			SCIENCE PROCESS					SCIENCE CONTENT			MATHEMATICS PROCESS					MATHEMATICS CONTENT					AGRICULTURE THEMES							
		Reading - Literature	Writing - Grammar	Oral Language	Visual Literacy	World Studies	Geography	U S History	1. Observe - Measure	2. Classify	3. Experiment	4. Interpret - Communicate	5. Inquiry	Physical	Life	Earth - Space	1. Problem Solving	2. Communicate	3. Reasoning	4. Connections	5. Representation	1. Algebraic Reasoning	2. Number Sense	3. Geometry	4. Measurement	5. Data Analysis - Statistics	Ag and the Environment	Animals	Biosecurity	Biotechnology	Culture and History	Economics	Nutrition	Plants
18	Agriculture - It Doesn't Just Happen	X	X	X		X	X	X																			X	X	X	X		X	X	X
102	Are You Thirsty	X	X								X	X	X	X	X		X	X	X	X			X				X							
5	Biomass: The Energy of the Future	X	X	X	X																									X				X
21	Busting the Prairie	X	X		X	X	X	X																							X			
78	Corn Field Math																X	X	X	X	X	X	X		X	X								X
29	Corn in Legend and Myth	X	X	X		X	X	X																							X			X
66	Corn in Ancient America					X	X	X																							X			X
32	Cotton Pickin'	X	X			X	X	X																							X	X		X
32	Dear George	X	X	X	X	X	X	X																							X	X		
109	The Disappearing Honeybees											X			X		X	X	X	X	X		X			X	X							X
146	Eat Your Flowers										X	X	X		X																		X	X
114	Fit With Fiber											X	X		X		X	X	X	X	X		X			X							X	X
43	George Washington and the First Census of Agriculture	X	X	X		X	X	X																							X	X		
50	The History of Ethanol in America	X	X	X		X	X	X																			X			X	X			X
69	How Far Did It Travel					X	X	X									X	X	X	X	X		X		X	X	X					X		X
149	How Germs Spread								X		X	X	X		X													X	X					
153	If Not for the Pollinators									X	X	X	X		X												X							X
119	Manure Happens								X		X	X	X	X			X	X	X	X	X		X		X		X							
82	Measuring Exponential Growth																X	X	X	X	X		X			X	X	X						

Lesson P.A.S.S. Standards and Agricultural Issues

		LANGUAGE ARTS				SOCIAL STUDIES			SCIENCE								MATHEMATICS										AGRICULTURE THEMES							
									PROCESS					CONTENT			PROCESS					CONTENT												
Page Number	TITLE OF LESSON IN ALPHABETICAL ORDER	Reading - Literature	Writing - Grammar	Oral Language	Visual Literacy	World Studies	Geography	U S History	1. Observe - Measure	2. Classify	3. Experiment	4. Interpret - Communicate	5. Inquiry	Physical	Life	Earth - Space	1. Problem Solving	2. Communicate	3. Reasoning	4. Connections	5. Representation	1. Algebraic Reasoning	2. Number Sense	3. Geometry	4. Measurement	5. Data Analysis - Statistics	Ag and the Environment	Animals	Biosecurity	Biotechnology	Culture and History	Economics	Nutrition	Plants
123	Plotting the Plight of the Cattle											X			X				X		X		X			X		X	X					
9	Pollinator Habitats	X	X	X	X																						X							X
73	Preparing for Drought					X	X	X																			X							
13	Preventing Disease in Meat Animals	X	X	X																								X	X					
126	The Role of Fire in Healthy Prairie, Brush and Forest Lands								X	X	X	X	X	X	X	X	X		X	X	X		X	X		X	X							
86	Surveying: 19 Chains and 50 Links																X	X	X	X	X		X	X	X						X	X		
159	Symbiosis: Help, Hinder or Destroy	X	X	X	X					X		X	X		X												X							X
134	They Don't Just Eat Grass											X	X	X				X	X		X				X	X		X						
139	U.S. Agriculture and the World Market											X					X	X			X		X		X	X						X		
162	What is Drought?								X		X	X	X	X	X	X											X							
93	Oklahoma Wheat on the World Market	X		X		X	X	X									X	X	X	X	X		X			X						X		X
54	Where Has All the Farm Land Gone	X	X	X		X	X	X																			X							
164	Will Your Car Run on Grass?								X		X	X	X	X	X												X			X				X
62	World Trade	X	X	X		X	X	X																								X		

Language Arts

Biomass: The Energy of the Future

Skills: Language Arts

Objective: Students will use research skills to gather information on renewable fuels and compile information on a chart for comparison.

Background:

Biomass is any organic material made from plants or animals. Biomass contains stored energy from the sun. Plants absorb the sun's energy in a process called "photosynthesis." The chemical energy in plants gets passed on to animals and people that eat them. Unlike fossil fuel, it is a renewable energy source.

Domestic biomass resources include:

- Agricultural residues — leftover material from crops, such as the stalks, leaves, and husks of corn plants
- Forestry wastes — chips and sawdust from lumber mills, dead trees, and tree branches
- Municipal solid waste — household garbage and paper products
- Food processing and other industrial wastes — black liquor, a paper manufacturing by-product
- Energy crops — fast-growing trees and grasses developed just for this purpose

Biofuels are fuels derived from biomass. One such fuel is ethanol. Many agricultural products, through current technology, can be converted to ethanol. Agricultural products specifically grown for conversion to biofuels include corn, wheat, and soybeans. The conversion of non-grain crops to biofuels is also being researched. One non-grain crop being researched is switchgrass, a perennial grass that grows in abundance all across Oklahoma.

Biogas is any gas derived from biomass. Syngas is one type of biogas. It involves heating biomass with little to no oxygen present. Syngas can be burned in more efficient gas turbines to make electricity or mixed with chemical catalysts to make liquid fuels.

Biofuels produce the greenhouse gas carbon dioxide, just like fossil fuels. The difference is that the plants used in the production of biofuels remove carbon from the atmosphere as they grow. For this reason, if biofuel replaces fossil fuel, it reduces the amount of carbon released to the atmosphere.

Background sources: Cleaner Energy Partnership; US Department of Energy; USDA Agricultural Research Service

P.A.S.S.

GRADE 6
Reading — 1.1a; 3.1b,3a; 5.1ab,2a
Writing — 2.7
Oral Language — 1.2; 2.1
Visual Literacy — 3

GRADE 7
Reading — 1.1; 3.1a; 5.1ab,2a
Writing — 2.8
Oral Language — 1.2 ; 2.1
Visual Literacy — 3.1

GRADE 8
Reading — 1.1; 3.1a,3b; 5.1a,2a
Writing — 2.8
Oral Language — 1.2; 2.1
Visual Literacy — 3.1

Resources Needed

computer or library access

Vocabulary

biofuel — fuel made from living organisms
biogas — gas made from living organisms
biomass — any organic material made from plants and/or animals
domestic — made or produced in the home country
energy — usable power (as heat or electricity
ethanol — a colorless, limpid, volatile, flammable, water-miscible liquid produced by the fermentation of sugars from certain grains and grasses
organic — of, relating to, or obtained from living things
photosynthesis — the formation of carbohydrates in living plants from water and carbon dioxide, by the action of sunlight on the chlorophyll.
renewable — replanted and grown for a usable supply
residue — that which is left after part is taken away

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Activities

1. Read and discuss the background information and vocabulary.
   — Students will discuss their own knowledge about new fuel technologies.
   — Students will discuss personal experiences with electric or hybrid cars, burning wood for heat or cooking, and other experiences with alternative fuels.
2. Read the story included with this lesson, or have a student read the story to the class.
   — Discuss the different uses for biogas presented in the story.
3. Hand out the "Worksheet for Biomass Research."
   — Each student will select one of the areas for research listed on the worksheet.
   — Review "How Reliable Are Your Sources?" in the "Resources" section.
   — Students will conduct research in the area selected.
   — As students complete their research, they will enter the information onto the worksheet.
4. Students will present their gathered information to the class.
   — As students listen to the presentations, they will enter the new information from other categories on their own worksheets.
5. Students will discuss the likelihood that any of the different biomass sources might become usable fuels in the next 5-10 years.
   — Students will share their own opinions of the different biomass sources.
   — Students will discuss potential long range problems or concerns for each biomass source.
   — Survey students to find which biomass source is most favorable.
6. Each student will write an advertisement promoting the biomass source researched.

Extra Reading for Students

Carless, Jennifer, *Renewable Energy: A Concise Guide to Green Alternatives*, Walker, 1993.
Peterson, Christine, *Alternative Energy*, Children's, 2004
Povey, Karen D., *Biofuels — Our Environment*, KidHaven, 2006.
Renewables Are Ready — A Guide to Teaching Renewable Energy in Junior and Senior High School Classrooms, Union of Concerned Scientists, 1994.

A Biogas Story

Leah lives on a farm with her mother and father. They raise corn on their farm to feed their pigs. Every morning and evening Leah helps her father and mother feed the pigs.

The pigs are extremely important to the family's livelihood. On Saturday, they pick out the biggest pig and butcher it. On Sunday, they go to the outdoor market in the village to sell the meat. They also buy things they need.

Leah's family lives on a farm in the country. There is no electricity in her house, but it has lights and a stove. The house is run on biogas. Leah's family makes the biogas on their farm.

Every day, Leah and her parents gather corn stalks from the fields and corn cobs that the pigs don't eat. They collect manure from the pig pens. They also save their own waste.

There is a large container in the back yard. All the waste is put into the container. The family is careful not to let in any air.

As the waste decays, it produces biogas. The biogas flows through a pipe into Leah's house. It supplies fuel for the lights. It also supplies fuel for the stove, which Leah's mother uses to cook food and keep the house warm. The biogas is clean and doesn't make any smoke.

Leah's father empties the container when the waste has decayed. The waste (residue) that is left makes a good fertilizer, which he spreads on his fields.

The corn grows tall to feed the pigs.

This story was modified from "The Energy Exchange," The NEED Project, March 2006.

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Name ______________________________

Worksheet for Biomass Research

BIOMASS	RESEARCH FACTS	CURRENT AVAILABILITY	ADVANTAGES OF USE	PROBLEMS WITH USE
Wood — forestry wastes				
Crops — corn, sorghum, wheat				
Woody crops — small poplar trees				
Perennial grasses — switchgrass, Bermudagrass, bahiagrass, apiergrass				
Agricultural residues from crops				
Municipal waste — garbage				
Landfill gas				

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Pollinator Habitats

Skills: Language Arts

Objective: Students research, interview experts and design pollinator habitats.

Background:

Pollination is the transfer of pollen grains from the anther to the stigma of the same or another flower. Pollination is required to produce seeds and fruits in up to 80 percent of the world's flowering plants, including 2/3 of the world's food plants. Exposure to pollinators may also maintain and promote genetic diversity in crops and other plants. There are over 100,000 species of pollinators, including mammals, birds, insects and other invertebrates.

In recent years the population of native pollinators has declined in the US and in Oklahoma. Some possible reasons for the decline include disease spread by non-native species of mites, pesticide use, loss of pollinator habitat and disruptions in migration corridors pollinators have typically followed in search of pollen.

Migratory pollinators require a continuous supply of nectar sources to maintain their energy requirements for migration. In some areas development or agriculture has disrupted traditional corridors, and the pollinators have to find alternative routes or discontinue migration. Some migratory pollinators include monarch butterflies and hummingbirds. New research shows that each spring, as monarch butterflies travel north from Mexico, the adults lay their eggs and die. The eggs hatch and pupate into new adults, which continue north into Canada. By fall, it is actually fifth- or sixth-generation adult monarchs that complete the cycle back to Mexico. Monarchs are one species of about 180 butterflies and skippers that have been counted in Oklahoma.

Home gardens, farms, parks, open spaces, even outdoor classrooms and schoolyards can be designed to help provide and improve pollinator habitat. Some ways to improve habitat include providing water, food resources, nest sites and nest-building materials. Avoiding pesticides is also important.

The best food for pollinators comes from native plants. Some highly specialized pollinators may depend on only one or a few plant types for food, shelter, or reproduction. In addition, native plants are better suited to the growing conditions of a region and generally require less care.

Pollinators benefit from food resources, but nest sites, overwintering sites, and other resources may be needed even more.

P.A.S.S.

GRADE 6
Reading — 1.1; 3.1b; 5.1ab,2ad
Writing — 1.1; 2.3a,4a,7
Oral Language — 1.1; 2.2
Visual Literacy — 3

GRADE 7
Reading — 1.1; 3.1c; 5.1abc,2a
Writing — 1.1; 2.2abc,3a,4b,8
Oral Language — 1.2; 2.2
Visual Language — 3.1

GRADE 8
Reading — 1.1; 3.1b; 5.1abc,2a
Writing — 1.1; 2.2b,3b,5ac
Oral Language — 1.1,2; 2.2
Visual Literacy — 3.1

Materials

computer and library access

index cards

plant and insect reference books

seed catalogs

Experts

OSU County Extension educator (listed in the phone book under county government)

Oklahoma Conservation Commission (listed in phone book according to county)
http://www.conservation.ok.gov/

Oklahoma Department of Wildlife Conservation
405-521-3856
http://www.wildlifedepartment.com/

OSU Department of Entomology and Plant Pathology
405-744-5527

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Birds, bats, and butterflies require a water source. Butterflies require hiding places for pupae. Butterflies and bees benefit from a damp salt lick (a damp or muddy area of soil in which sea salt or wood ashes are mixed). Some bees and wasps require mud as nest-building material. Other bees use dead trees or tree limbs or open patches of bare earth as nest sites.

Overwintering sites are also in short supply for many pollinators, especially in areas with extensive urban and suburban development. Many homeowners attempt to keep a neat yard and garden area by cleaning up dead leaves and brush that could serve as winter shelter for pollinators. To aid pollinators in finding suitable overwintering habitat, homeowners could consider leaving cut plant stems exposed and leaving twigs and brush in small piles. Artificial nest sites can be built for some pollinators.

Prairie restoration, establishment of wildlife preserves, and encouragement of diverse wildlife landscaping rather than monoculture lawns, are other examples of ways to help pollinators.

Background Sources: National Biological Information Infrastructure, Xerces Society

Activities

1. Read and discuss background and vocabulary.
2. Students brainstorm to determine the best sources for developing a list of native and migratory pollinators and information about pollinator needs. (online sources, library).
   — Review “How Reliable Are Your Sources?” in the “Resources” section.
   — Students divide into research groups to develop a list of native and migratory pollinators and to find as much information as possible about pollinator needs.
   — Students use index cards to keep research notes
3. Use the list at left to find an expert on native pollinators and their habitats.
   — Students may invite experts to visit your class or arrange interviews by phone, via email or by writing letters.
   — Students prepare detailed, specific questions in advance, based on their research.
   — Students use their questions to conduct the interview. Bundle questions for mailing if the interview is to be conducted by mail.
   — Students take detailed notes of the experts’ responses to questions.
4. Students work in groups to design habitats, based on what they learn from their research and interviews with experts.
   — Students select flowers from seed catalogs (look online or order free catalogs through the mail) or gardening books. Many

seed catalogs specifically list plants attractive to butterflies and other pollinators.

— Students use technology to present their designs to the class, using visual aids such as charts, drawings, etc.

— Students discuss the pros and cons of each design and develop a class habitat plan, using the best ideas from each design.

— Students write reflective paragraphs about what they learned from the activity.

5. Students research online, in the library or by interviewing experts to find what pollinates these Oklahoma crops: alfalfa, soybeans, peanuts, cotton, wheat, sorghum, pecans.
6. Students research to find what plants attract the official state insect (the Black Swallowtail).
7. Students build artificial nesting boxes, based on what they learned from their research and interviews. (Instructions for one example of a bee nesting box are included with this lesson.)

— Students keep notes as they build the boxes.

— Students write detailed instructions from their notes.

— Students prepare demonstrations, with visual aids, to teach younger students how to build the boxes.

Extra Reading

Buchmann, Stephan L, Gary Paul Nabhan, and Paul Mirocha, *The Forgotten Pollinators*, Island, 1997.

Crossingham, John, and Bobbie Kalman, *What Is Migration?* Crabtree, 1997.

Hauth, Katherine B, and Kay Sather, *Night Life of the Yucca-The story of a Flower and Moth*, Roberts Rinehart, 1996.

Schaefer, Lola M., *Butterflies: Pollinators and Nectar-Sippers*, Bridgestone, 2001.

Nabhan, Gary Paul, *Conserving Migratory Pollinators and Nectar Corridors in Western North America*, 2004.

Vocabulary

diverse — differing from one another

genetic diversity — many different versions of otherwise similar organisms in an ecosystem.

habitat — the place or type of place where a plant or animal naturally or normally lives or grows

invertebrate — lacking a backbone

migration — passing from one region or climate to another, usually on a regular schedule for feeding or breeding

migration corridor — a stretch of nature that facilitates the migration of animals

monoculture — the cultivation or growth of a single crop or organism especially on agricultural or forest land

nectar — a sweet liquid that is secreted by the nectaries of a plant and is the chief raw material of honey

pesticide — an agent used to destroy pests

pollen — a mass of microspores in a seed plant appearing usually as a fine dust

pollination — the transfer of pollen from an anther to the stigma

pupae — an intermediate stage of a metamorphic insect that occurs between the larva and the imago, is usually enclosed in a cocoon or protective covering, and undergoes internal changes by which larval structures are replaced by those typical of the imago

pupate — to become a pupa : pass through the stage of the pupa

stigma — part of the pistil of a flower which receives the pollen grains and on which they germinate

wildlife preserve — a protected area of importance for wildlife, flora, fauna or features of geological or other special interest, which is reserved and managed for conservation and to provide special opportunities for study or research.

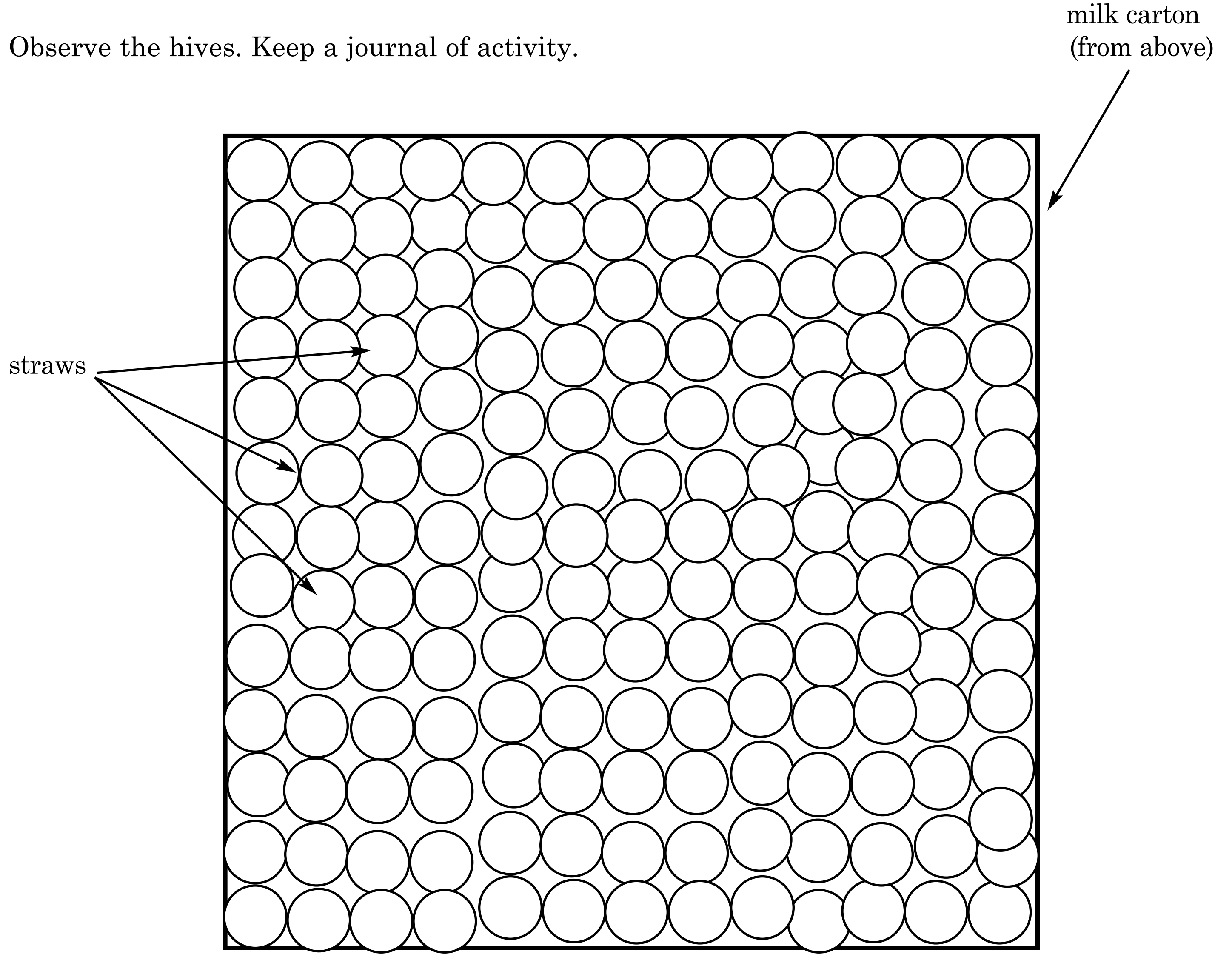
Bee Nesting Box

Materials needed: empty pint milk cartons, white glue, paper drinking straws, metric rulers, string, scissors,paint

Procedure:

1. Clean the milk carton.
2. Cut the carton to 10 cm high, with the bottom intact.
4. Cut each straw in half.
5. Cover the inside of the carton with glue.
6. Fill the carton with upright straws.
8. Trim straws so they are even across the top of carton. It should look like a honeycomb when complete.
9. Place the hive on its side to dry
10. When dry, hang the hive outdoors in a shady tree (away from children's play areas).

Observe the hives. Keep a journal of activity.



Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Preventing Disease in Meat Animals

Skills: Language Arts

Objective: To develop research and interpretation skills while learning about livestock diseases.

Background:

An important function of the US Department of Agriculture (USDA), the Centers for Disease Control and Prevention (CDC), the US Food and Drug Administration (FDA), and other government agencies, is to safeguard the health of American livestock and consumers. Epidemiologists are scientists employed by agencies like these to monitor disease outbreaks in human and animal populations. They often travel to the site of an outbreak and collect data regarding symptoms, the number of those affected, how widespread the disease is in the population, commonalities among those affected, and other clues as to the source and cause of the disease. Once the disease is identified, public health officials are better prepared to help the sick and control the spread of the disease, preventing additional cases.

Even in the absence of a disease outbreak, animal and human health is a top priority, and many routine procedures are in place to prevent the occurrence or spread of disease. Health inspectors check the cleanliness of restaurants and make sure food is being prepared at the right temperatures and handled in a sanitary way. Government inspectors and veterinarians check the conditions of processing plants and the health of the animals being harvested. Information on how to handle animals and foods safely (lessening the chances of contamination) is passed on to producers and consumers. Imported animals are quarantined, and surveillance measures are in place to monitor any potential threats to our food supply.

Activities

1. Read and discuss background.
2. Lead a discussion about root words associated with farm animals. (Bovine = cattle; equine = horse; porcine = pork; ovine = sheep; caprine = goats)
   — Hand out copies of the worksheet.
   — Students work in groups to complete the table by predicting which animal may be infected by which disease.

P.A.S.S.

GRADE 6
Reading — 1.1a,2b; 5.1,2
Writing — 1; 2.2,7; 3.1
Oral Language — 2

GRADE 7
Reading — 1.1,2b; 5.1,2
Writing — 1; 2.8; 3.1
Oral Language — 2

GRADE 8
Reading — 1.1; 5.1,2
Writing — 1; 2.8; 3.1
Oral Language — 2

3. Students select an animal disease from the worksheet to research.
   — Review "How to Write a Research Paper" and "How Reliable Are Your Sources?" in the "Resources" section.
   — Suggest categories to get students started, e.g., cause of disease (bacteria, virus, etc.), incubation period, symptoms, treatment, species and number of animals affected annually, areas of state/country/world where disease occurs or is most problematic, etc.
   — Students use online search engines or library reference resources to conduct research.
   — Each student will write a short report over his/her chosen disease.
   — Students will exchange papers for peer editing.
   — Students will share their reports with the class via oral presentations.
   — Students review predictions from the the tables they completed in Activity # 2 to see how well they did with their predictions.
4. Students will use online search engines to research local, state, national and international agencies that focus on livestock or food safety.
   — What are the specific roles of the different agencies?
   — How are the agencies funded?
   — What careers are available within each agency?
5. Students use online search engines to research new agencies, regulations, or career opportunities in which food safety have appeared since the 2001 terrorist attacks?
   — Have any livestock diseases been used as bioweapons?
   — Why would a country's livestock be a target for war or terrorist attacks?

Vocabulary

epidemiology — the study of the causes of diseases and how they are spread (and controlled)

quarantine — period of isolation from other animals, usually in a special facility designated for such purposes

surveillance — monitoring a population for the occurrence of a particular disease

Extra Reading

Friedlander, Mark P., *Outbreak: Disease Detectives at Work*, Lerner, 2001.

Goldsmith, Connie, *Invisible Invaders: Dangerous Infectious Diseases,* Twenty-first Century, 2006.

Tracy, Kathleen, *Robert Koch and the Study of Anthrax,* Mitchell Lane, 2004.

Sheen, Barbara, *Mad Cow Disease,* Lucent, 2004.

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Name ____

Livestock Diseases

Place an X in the box below the farm animal you think is affected by the disease in the first column.

LIVESTOCK DISEASE	poultry	horses	sheep	cattle	swine
fowl cholera					
rinderplast					
fowl typhoid					
glanders					
avian tuberculosis					
hog cholera					
scrapie					
leptospirosis					
bovine spongiform encephalopathy (bse)					
listriosis					
brucellosis					
equine encephalomyelitis					
equine infectious anemia					
pseudorabies					
equine influenza					
Q fever					
equine rhinopneumonitis					
West Nile virus					
foot and mouth disease					

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Name ____________________

Livestock Diseases (answers)

Place an X in the box below the farm animal you think is affected by the disease in the first column.

LIVESTOCK DISEASE	poultry	horses	sheep	cattle	swine
fowl cholera	X				
rinderplast					X
fowl typhoid	X				
glanders		X			
avian tuberculosis	X				
hog cholera					X
scrapie			X		
leptospirosis				X	X
bovine spongiform encephalopathy (bse)				X	
listriosis			X		
brucellosis				X	X
equine encephalomyelitis		X			
equine infectious anemia		X			
pseudorabies		X	X	X	X
equine influenza		X			
Q fever			X	X	
equine rhinopneumonitis					
West Nile virus	X				
foot and mouth disease				X	

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Language Arts and Social Studies

Agriculture — It Doesn't Just Happen

Skills: Language Arts, Social Studies

Objective: Students learn about agricultural research and build their own research skills by gathering information about agricultural research projects and using the information in a variety of presentations.

Background:

The Agricultural Research Service (ARS) is the chief scientific research agency for the US Department of Agriculture (USDA). The USDA established the ARS in 1953.

ARS research develops solutions to problems related to food and agriculture. These problems range from protecting crops and livestock from costly pests and diseases to improving the quality and safety of agricultural commodities and products. ARS researchers work to find the best nutrition sources for humans, from infancy to old age. They also look for ways to sustain natural resources. Ensuring profitability for producers and processors while keeping costs down for consumers is another goal. In addition to serving this broad range of customers, ARS provides research to support federal action and regulatory agencies.

The agency's research is carried out through about 100 locations nationwide and a few key sites overseas. In Oklahoma, ARS sites are located in Lane (South Central Agricultural Research Laboratory), Woodward (Rangeland and Pasture Research), El Reno (Grazinglands Research), and Stillwater (Plant Science and Water Conservation Research). Approximately 2,000 of the 7,000 ARS employees are scientists.

The agency's national programs are divided among three major areas:

1. Animal Production, Product Value, and Safety — improving productivity, value, and safety of meat and dairy products and improving human lives through nutrition.
2. Natural Resources and Sustainable Agricultural Systems — developing new practices and technologies that conserve natural resources and balance agricultural production with environmental quality.
3. Crop Production, Product Value, and Safety — improving productivity, value, and safety of crops that are the economic backbone of US agriculture.

P.A.S.S.

GRADE 6
Reading — 1.1a; 3.1a,3c; 5.1a
Writing — 2.2a,7,3.1
Oral Language — 1.2; 2.2
Social Studies — 1.3; 2.3

GRADE 7
Reading — 1.1; 3.1a,3a; 5.1a
Writing — 1.2; 2.2b,3a,7a.8; 3.1
Oral Language — 1.1; 2.2
Social Studies — 1.1

GRADE 8
Reading — 1.1; 3.1a,3a; 5.1a
Writing — 1.2; 2.2d,3b,7a,8; 3.1
Oral Language — 1.1; 2.2
Social Studies — 1.1

Resources Needed

computer and/or library access

miscellaneous materials for presentations (poster boards, desks, microphones for interviews/news reports

samples of products for research

Vocabulary

acronym — a word formed from the first letter of several words.
ARS — Agricultural Research Service
commodity — a product of agriculture or mining
CSREES — Cooperative State Research, Education and Extension Service
ERS — Economic Research Service
NASS — National Agricultural Statistics Service
natural resources — materials and capacities supplied by nature
livestock — animals kept or raised; especially : farm animals kept for use and profit
product — something produced
profitability — the ability to produce an excess of returns over expenditures
research — careful study and investigation for the purpose of discovering and explaining new knowledge
sustain — to give support or relief to
USDA — United States Department of Agriculture

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Oklahoma Ag in the Classroom
Oklahoma 4-H Programs
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Oklahoma State University
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The goal of ARS is to lead America toward a better future through agricultural research and information. It is one of four agencies in USDA's Research, Education and Economics mission area. The others are Cooperative State Research, Education and Extension Service, Economics Research Service, and National Agricultural Statistics Service.

Source: Agricultural Research Service, US Department of Agriculture, http://www.ars.usda.gov/main/main.htm

Activity

1. Students read background independently.
 — Lead class discussion based on background and vocabulary.
2. Students will locate the four ARS sites in Oklahoma on an Oklahoma map. (An Oklahoma map is included in the "Resources" section.)
 — Students will label the maps with sites and specialty areas (listed in the background).
3. Use the acronyms in the vocabulary list as an introduction to acronyms.
 — Students list other familiar acronyms.
4. Students use an online search engine or other resources to find the Web site for the US Department of Agriculture's Agricultural Research Service.
 — Each student will select one agricultural research project from one of the three areas listed in the background.
 — Each student will write a thesis statement, with supporting details, about the project selected.
5. Write the three ARS program areas on the chalkboard, an overhead projector or chart paper.
 — List projects students have researched under correct headings.
 — Discuss projects and how they affect our daily lives.
6. Students will work individually or in pairs to gather information to complete one of the presentations listed in the "Presentation Prompts" page included with this lesson. More than one group may select the same presentation topic.
 — Presentations should be concise and follow the prompt.
 — Students must use correct grammar and good speaking skills.
 — Students should use their creativity to sell their presentations. Preparation of costumes, visuals, and necessary props is a must.

Extra Reading

Gilpin, Daniel, *Food and Clothing* (History of Invention Set), Facts on File, 2004.
Jones, Carol, *Cheese (From Farm to You)*, Chelsea, 2002.
Myers, Jack, *What Makes Popcorn Pop?* Boyds Mills, 1994.
Nelson, Marilyn, *Carver: A Life in Poems*, HB, 2001.

Name ______________________________________

Presentation Prompts

1. Each year dozens of improved products and new varieties of fruits, nuts, and vegetables emerge from the laboratories and greenhouses of USDA's Agricultural Research Service and make their way into the marketplace. Write a commercial to sell one of these products.

2. CNN has just asked you for an interview on how agricultural research contributes to everyday products. Take it away.

3. If you were an ARS research scientist, what types of food or nonfood products would you like to develop? Convince the USDA to give you grant money for this project.

4. On the Radio: Pretend you are being interviewed about your soybean research by your local radio station. Tell how soybeans contribute to daily life.

5. You have been selected to plan a classroom program on grains at your local elementary school. Suggest/discuss/demonstrate a hands-on activity you could feature.

6. Some of the most successful research is sponsored through multidisciplinary partnerships. (Example: horticulturists and nutritionists working together with the food industry.) As an ARS scientist, explain how you could develop a type of healthy product through a partnership.

7. Be creative. Design your own presentation using information from the USDA and/or Agricultural Research Service.

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Busting the Prairie

Planning a Homestead Community

Skills: Social Studies, Language Arts

Objective: Students will plan and design an imaginary homestead community and a handbill to advertise it.

Background:

The public domain is land owned by the US government that is not reserved for some specific use. At one time 75 percent of the continental United States, about 2 billion acres, was public domain. This included land ceded by the 13 original states, the Louisiana Purchase of 1803, the Spanish cession of Florida in 1819, land acquired through the Oregon Compromise in 1846, the Mexican cession in 1848, the Texas Purchase of 1850 and the Gadsden Purchase, 1807. Alaska was purchased from Russia in 1867.

For three centuries, most Americans lived within easy reach of cheap land. They often made no attempt to buy it but simply built a log cabin or sod house anywhere on the public domain they chose to squat. They cleared a spot large enough for crops and a garden, pulled out the stumps, built roads, laid out towns, and established churches and schools.

Squatting on government land was illegal, but enforcing the law was difficult. In 1841, the US Congress passed the Preemption Act which allowed squatters to purchase the land they already occupied for $1.25 an acre. For the poor man even this arrangement was too risky. It meant that if he couldn't raise the money at the proper time, he would lose all the work his family had put into developing the land.

In 1862, President Abraham Lincoln signed the Homestead Act, which granted 160 acres of public land in the West free to "any person who is the head of a family, or who has arrived at the age of twenty-one years, and is a citizen of the United States, or who shall have filed his declaration of intention to become such." The homesteader had to pay a $14 filing fee, live on the land for five years, and make certain improvements. By 1900 about 600,000 farmers had received clear title under the Act to lands covering about 80 million acres. The Act was repealed in 1977.

P.A.S.S.

GRADE 6
Social Studies — 1.1,2; 2.1; 4.2
Reading — 1.1b; 2.1; 3.1ab,2c,4d; 4.3ad; 5.1ab,2a
Writing — 2.7
Visual Literacy — 3

GRADE 7
Social Studies — 1.1; 4.3,5; 5.4
Reading — 1.1,2,3bcd; 2.1; 3.1a; 4.3a; 5.1ab 5.2a
Writing — 2.8
Visual Literacy — 3.1

GRADE 8
Social Studies — 1.1,2; 2.1,3; 9.9
Reading — 1.1,3bcd; 3.1a,4d; 4.2a,3ac; 5.1a,2a
Writing — 2.8
Visual Literacy — 3.1

Many of the homesteaders were immigrants from Europe. They learned of the free government land through letters from family members who had already settled in America. Government immigration bureaus and the railroads put out handbills advertising the free land as well. The success of the railroads depended on people coming out west to settle. They needed the business provided by farmers shipping out produce to sell and shipping in the materials they needed to maintain their farms.

Land on the Great Plains was the last to be settled. The climate was harsh, and the Indians were still hostile at that time. The prairie farmer needed a cast iron or steel plow to cut and turn the sod and stout draft animals, either oxen or heavy horses, to pull the plows. The work of the family was the homesteader's most valuable resource. Few had the money to hire extra help.

Corn was the most important crop. It was fed to work animals and to swine raised for meat and lard. Besides corn, the prairie farmer grew wheat, oats, clover and grass for feeding the animals. Each farm also had a potato patch, orchard, berry patch and vegetable garden. Food was processed on the farm and stored in a smokehouse, cellar or pantry. A barn was necessary for storage and stables.

Water sometimes had to be hauled 10 miles or more until the homesteader could dig a well. In the spring, homesteaders stayed home because the roads were too muddy for travel. If the weather was clear, they went to town on Saturday to transact business. The town provided services, goods and entertainment.

The area we know as Oklahoma was not included in the first lands offered for homesteading. In 1862, this area was held by several Indian tribes. These lands were not open for homesteading until Congress passed the Indian Allotment Act of 1887, which divided the Indian lands among individual members of the tribes. The land that was left over was opened for non-Indian settlement at that time.

Resources Needed

computer and library access

large sized paper, markers and other materials for use in creating a handbill

Activities

DISCUSSION

1. Share background information either by reading it aloud or having students take turns reading sections to the class.
   — Discuss the vocabulary as it pertains to the background.

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Oklahoma Ag in the Classroom
Oklahoma 4-H Programs
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Stillwater, OK 74078
405-744-8889 • www.agclassroom.org/ok

2. Lead a discussion of the Homestead Act, using the following questions as starters:
 — What groups of people might have wanted to take advantage of the opportunity to homestead?
 — Would you (students) be willing to leave family and belongings behind to homestead in a new land?
 — What are some pros and cons to this adventure?

ACTIVITY ONE: PLAN A COMMUNITY

1. Hand out copies of the handbill included in this lesson.
 — Read through the handbill with students, and explain that it was used to persuade people to move to Minnesota and take advantage of land offered for homesteading.
 — Students will brainstorm about occupations that would be needed to start a community (farmers, merchants, teachers, mechanics, etc.).
2. Divide students into groups of 3-5 students.
 — Hand out the "Community Planning" worksheet.
 — Each group will use the worksheet to plan an imaginary community.
 — Students will develop computer or other presentations to present their communities to the class.

ACTIVITY TWO: DEVELOP A HANDBILL

1. One of the ways the government advertised the free land for homesteading was through handbills put out by the government or the railroad. Discuss handbills as a means of advertising.
 — How does that method of advertising compare with advertising today.
 — Are handbills still in use today?
2. Students will work individually to design handbills on large paper to advertise the communities their groups have planned.
 — Handbills should include the community's name, a reply address, a description of the community and other important information.
 — Students should be prepared to present and explain their handbills.
 — Post the handbills around the school, and have other students vote on the best handbill.

CHALLENGE ACTIVITY: IMAGERY

1. Provide copies of the reading included in this lesson, "The Homestead in Perspective," an essay by Mari Sandoz.
 — Read the selection together as a class.
 — Review definitions of unfamiliar words.

Vocabulary

binder — a machine that fastens something together
cession — a ceding or giving up of lands or rights to another person, group, government or country
cultivate — to loosen or break up the soil
draft horses — horses used for pulling or hauling
furrow — a trench in the earth made by or as if by a plow
handbill — advertisements for products, equipment, services, and land
harrow — a cultivating tool that has spikes, teeth, or disks and is used for breaking up and smoothing the soil
heel fly — the adult stage of the common cattle grub
hoe — a farm or garden tool with a thin flat blade at nearly a right angle to a long handle that is used especially for weeding and loosening the earth
homesteader — a person who accepted a 160 acre tract of US public land to farm
husk — to strip the outer leaves and silk from corn
immigrant — a person who comes into a new country to settle
nonviolent — peaceful
origins — ancestry
plow — a farm machine used to cut, lift, and turn over soil
prairie — a large area of level or rolling grassland
process — the method of preserving foods for later use
public domain — land owned by the US government that is not reserved for some specific use.
remedy — a medicine or treatment that cures or relieves

(Continued on next page.)

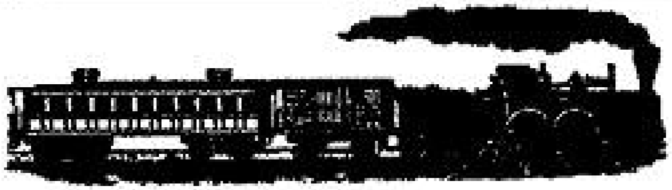
Vocabulary (Cont.)

rhythmic — a movement or activity in which some action repeats regularly
shock — a bunch of sheaves of grain or stalks of corn set on end (as in a field)
sod — the grass-covered and herb-covered surface of the ground
spade — a digging tool like a shovel made so that it can be pushed into the ground with the foot
sprouts — edible young shoots especially from recently germinated seeds
squatter — someone who settles on public land in order to get title to it.
thrust — to cause to enter or pierce something by pushing
type — a particular kind, class, or group
vegetarian — a person who refrains from eating meat and lives on a diet made up of vegetables, fruits, grains, nuts, and sometimes eggs or dairy products
weed — to remove unwanted plants from

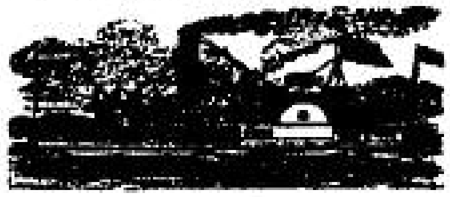
2. Discuss the use of imagery in this selection.
   — Students will identify some of the mental pictures the writer paints.
   — Discuss simile, metaphor and personification.
3. Students will identify the underlined examples of figurative language in the reading as simile, metaphor or personification.
4. Discuss the author's purpose in her use of imagery. (To give us a vivid picture of the homesteaders' lives.)
5. Each student will select one example of imagery in the selection and draw a picture to illustrate it.
   — The student will include the words his/her drawings are meant to illustrate somewhere in the drawing.

Extra Reading

Avi, *The Barn,* Orchard, 1995.
Bunting, Eve, and Greg Shed, *Dandelions*, Harcourt Brace, 1995.
Greenwood, Barbara, and Heather Collins, *A Pioneer Sampler: The Daily Life of a Pioneer Family in 1840*, Ticknor & Fields, 1995.
Gregory, Kristina, *The Legend of Jimmy Spoon*, Odyssey, 1993.
Katz, William Loren, *Black Women of the Old West*, Atheneum, 1995.
McGaw, Judith A., *Early American Technology: Making & Doing Things From the Colonial Era to 1850*, University of North Carolina Press, 1994.
Mierau, Christina, *Accept No Substitutes!: The History of American Advertising*, Lerner, 2001.
Miller, Brandon Marie, *Buffalo Gals, Women of the Old West*, Lerner, 1995.
Murphy, Jim, *My Name is America: The Journal of Augustus Pelletier — The Lewis and Clark Expedition*, Scholastic, 2003.
Wilder, Laura Ingalls, *First Four Years*, Harper Collins, 1971.
Wilder, Laura Ingalls, *Little Town on the Prairie*, Harper Collins, 1981.



EMIGRATION



UP THE MISSISSIPPI RIVER

The attention of Emigrants and the Public generally, is called to the now rapidly improving

TERRITORY OF MINNESOTA

Containing a population of 150,000, and goes into the Union as a State during the present year. According to an act of Congress passed last February, the State is munificently endowed with Lands for Public Schools and State Universities, also granting five percent, on all sales of U. S. Lands for Internal Improvements. On the 3d March, 1857, grants of Land from Congress was made to the leading Trunk Railroads in Minnesota, so that in a short time the trip from New Orleans to any part of the State will be made in from two and a half to three days. The

CITY OF NININGER,

Situated on the Mississippi River, 35 miles below St. Paul, is now a prominent point for a large Commercial Town, being backed by an extensive Agricultural, Grazing and Farming Country; has fine streams in the interior, well adapted for Milling in all its branches; and Manufacturing **WATER POWER** to any extent.

Mr. **JOHN NININGER,** (a Gentleman of large means, ideas and liberality, speaking the various languages,) is the principal Proprietor of **Nininger.** He laid it out on such principles as to encourage all **MECHANICS,** Merchants, or Professions of all kinds, on the same equality and footing: the consequence is, the place has gone ahead with such rapidity that it is now an established City, and will annually double in population for years to come.

Persons arriving by Ship or otherwise, can be transferred without expense to Steamers going to Saint Louis; or stop at Cairo, and take Railroad to Dunleith (on the Mississippi). Steamboats leave Saint Louis and Dunleith daily for **NININGER,** and make the trip from Dunleith in 36 to 48 hours.

NOTICES.

1. All Railroads and Steamboats giving this card a conspicuous place, or *gratuitious insertion* in their cards, **AIDS THE EMMIGRANT** and forwards their own interest.
2. For authentic documents, reliable information and all particulars in regard to Occupations, Wages, Preempting Lands (in neighborhood), Lumber, Price of Lots, Expenses &c., apply to

THOMAS B. WINSTON, 27 Camp street, New Orleans.
ROBERT CAMPBELL, St. Louis.
JOSEPH B. FORBES, Dunleith.

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Name ______________________________

Community Planning

Use the form below to plan your community. Include as many details as possible about the people and your community. Refer to the handbill as an example.

1. Name of your community:

2. Description: (Include geographic features, population, available farmland, water, etc.)

3. Transportation available: (railroad, stagecoach, steamboat, roads, etc.)

4. Occupations and types of people needed.

5. Other categories or details about your community.

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Name ______________________________

The Homestead in Perspective

Homesteaders were not a type, not as alike as biscuits cut out with a baking-powder can. They varied as much as their origins and their reasons for coming west. . . . A nervous-fingered murderer who fled west under a new name might join fences with a nonviolent River Baptist or a vegetarian who wouldn't kill a rabbit eating up his first sprouts of lettuce, no matter how hungry the settler might be.

With two fairly good draft horses, preferably three or four against the tough rooting, and a sod plow, the settler could break the prairie himself. Or he could hire it done, usually by exchange of work with some of his neighbors. . . .

. . . Sometimes corn, beans or potatoes were dropped in the furrow behind the sod plow and covered by the next round but more often the corn was planted later by a man, a woman or an energetic boy or girl. With an apron or a bag tied on for the seed and a spade in the hand, the planter started. At every full man's step or two steps for the shorter-legged, the spade was thrust down into the sod, worked sideways to widen the slit, two kernels of corn dropped in, the spade swung out and the foot brought down on the cut to seal it. All day, up and down the sod ribbons, the rhythmic swing of step and thrust was maintained. To be sure, the spade arm was mighty work-sore the next morning, but every homesteader's child learned that the remedy for that was more work.

Millions of acres were planted this way, sometimes with beans and pumpkin seeds mixed with the corn for a stretch. Good breaking grew few weeds except a scattering of big sunflowers so the sod field was little care. . . .

. . . All of us knew children who put in twelve-, fourteen-hour days from March to November. We knew seven-, eight-year-old boys who drove four-horse teams to the harrow, who shocked grain behind the binder all day in heat and dust and rattlesnakes, who cultivated, hoed and weeded corn, and finally husked it out before they could go to school in November. And even then there were the chores morning and evening, the stock to feed, the cows to milk by lantern light.

. . . The eldest daughter of a sizable family was often a serious little mother by the time she was six, perhaps baking up a 49-pound sack of flour every week by the time she was ten. . . .

Almost from their first steps, the homesteader's children had to meet new situations, make decisions, develop a self-discipline if they were to survive. . . . They learned to rescue themselves in adulthood as they had once scrabbled under the fence when the heel flies drove the milk cows crazy. What they didn't have they tried to make for themselves, earned money to buy, or did without.

Excerpts from "The Homestead in Perspective," an essay by Mari Sandoz.

1. Identify the five underlined examples of figurative language as metaphor, personification or simile.
2. What is the author's purpose in using images? How does the use of imagery help convey the author's meaning?

TERM	DEFINITION	EXAMPLE
Metaphor	Comparing two things by using one kind of object or using in place of another to suggest the likeness between them.	Her hair was silk.
Personification	Giving something human qualities	The stuffed bear smiled as the little boy hugged him close.
Simile	A figure of speech comparing two unlike things that is often introduced by like or as	The sun is like a yellow ball of fire in the sky.

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Name ______________________________

The Homestead in Perspective (answers)

Homesteaders were not a type, not as alike as biscuits cut out with a baking-powder can. **(simile)** They varied as much as their origins and their reasons for coming west. . . . A nervous-fingered **(personification)** murderer who fled west under a new name might join fences **(metaphor)** with a nonviolent river Baptist or a vegetarian who wouldn't kill a rabbit eating up his first sprouts of lettuce, no matter how hungry the settler might be.

With two fairly good draft horses, preferably three or four against the tough rooting, and a sod plow, the settler could break the prairie **(metaphor)** himself. Or he could hire it done, usually by exchange of work with some of his neighbors. . . .

. . . Sometimes corn, beans or potatoes were dropped in the furrow behind the sod plow and covered by the next round but more often the corn was planted later by a man, a woman or an energetic boy or girl. With an apron or a bag tied on for the seed and a spade in the hand, the planter started. At every full man's step or two steps for the shorter-legged, the spade was thrust down into the sod, worked sideways to widen the slit, two kernels of corn dropped in, the spade swung out and the foot brought down on the cut to seal it. All day, up and down the sod ribbons **(metaphor)**, the rhythmic swing of step and thrust was maintained. To be sure, the spade arm was mighty work-sore the next morning, but every homesteader's child learned that the remedy for that was more work.

Millions of acres were planted this way, sometimes with beans and pumpkin seeds mixed with the corn for a stretch. Good breaking grew few weeds **(metaphor)** except a scattering of big sunflowers so the sod field was little care. . . .

. . . All of us knew children who put in twelve-, fourteen-hour days from March to November. We knew seven-, eight-year-old boys who drove four-horse teams to the harrow, who shocked grain behind the binder all day in heat and dust and rattlesnakes, who cultivated, hoed and weeded corn, and finally husked it out before they could go to school in November. And even then there were the chores morning and evening, the stock to feed, the cows to milk by lantern light.

. . . The eldest daughter of a sizable family was often a serious little mother **(metaphor)**by the time she was six, perhaps baking up a 49-pound sack of flour every week by the time she was ten. . . .

Almost from their first steps, the homesteader's children had to meet new situations, make decisions, develop a self-discipline if they were to survive. . . . They learned to rescue themselves in adulthood as they had once scrabbled under the fence when the heel flies drove the milk cows crazy. What they didn't have they tried to make for themselves, earned money to buy, or did without.

— Mari Sandoz

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Corn in Legend and Myth

Skills: Language Arts, Social Studies

Objective: Students will compare myths and legends about corn and use their creative abilities to act them out.

Background:

Corn is a grass, native to the Americas. The exact origin is unknown, but tiny ears of corn have been discovered at ancient village sites and in tombs of early Americans. Evidence of corn in central Mexico suggests it was used there as long as 7000 years ago, where it was domesticated from wild grass. Cultivated corn is known to have existed in what is now the southwestern US for at least 3000 years. In the United States, many of the various Native American tribes have traditionally grown corn — also known as maize — and used it for both food and utilitarian purposes. Eastern tribes shared their knowledge of corn production with early European settlers, an act which saved many from starvation.

Early American colonists dried corn and ground it as meal for flour. They used the ground corn in porridge, cake and bread. Fresh, or sweet corn, the kind we like to eat as corn on the cob, was not developed until the 1700s. Before then corn was only used in its dried form.

Along with wheat and rice, corn is one of the world's major grain crops. It is the largest grain crop grown in the US. About 9 percent of all the corn grown is used to produce food for humans. These foods include corn meal and other food products such as cooking oils, margarine, and corn syrups and sweeteners (fructose). Sixty four percent of all corn grown is used as feed for livestock.

Corncobs have been used in the manufacturing of nylon fibers and as a source for producing degradable plastics. Ethanol, a renewable fuel made from corn, has shown the possibility of becoming a major renewable fuel for the world's automotive industry.

Corn can be produced in much of Oklahoma, but primary production is in the Panhandle area. In Oklahoma, corn is harvested for either grain or silage with most of the grain going to dairies, animal feeding operations, and poultry operations. In an average year, around 25 million bushels are grown for grain in Oklahoma, with a yield of 130 bushels per acre. One bushel of corn is equal to 56 pounds.

Corn is pollinated by wind and is typically planted in 30-inch rows. A single seed (or kernel) of corn may produce a plant which yields more than 600 kernels of corn per ear. On one acre of land, anywhere from 22,000 to 35,000 individual plants may be grown.

Hybrid corn is developed to produce from one to two ears per plant. Ears per plant is often determined by moisture availability. Through better soil conservation practices, fertilizer use, better seed quality, and water availability, corn yields have increased 125 percent since 1950.

P.A.S.S.

GRADE 6
Reading — 1.1a; 3.1b; 4.4b; 5.1b
Writing — 2.6b
Oral Language — 2.2
Social Studies — 1.1; 3.2

GRADE 7
Reading — 1.1; 3.1; 4.4b; 5.1b
Writing — 2.6b
Oral Language — 2.2
Social Studies — 1.1; 4.2

GRADE 7
Reading — 1.1; 3.1; 4.4b; 5.1a
Writing — 2.7a
Oral Language — 2.2
Social Studies — 1.1; 2.2

Materials

computer and/or resource materials

miscellaneous materials for dramatizations

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Oklahoma 4-H Programs
205 4-H Youth Development
Oklahoma State University
Stillwater, OK 74078
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Activities

1. Read and/or discuss background.
   — Discuss the vocabulary either before the discussion, as an introduction, or after the discussion, with a focus on context clues.
   — Ask students what they know about corn, early civilizations' dependence on it, and how corn influenced ancient beliefs, culture, and religion.
2. Divide students into groups of 3-4. Each group will use an online search engine or the library to find a myth/legend about the history of corn.
   — Students may select a myth or legend from the list included with this lesson or research to find their own myth or legend about corn.
   — Review "Are Your Sources Reliable?" included in the "Resource" section.
   — Students research online or in the library to find the legend and record where it originated.
3. Students will work together in their groups to prepare a skit, rap, song, etc., to present the myth or legend to the class.
   — Presentations should be no longer than three minutes and involve every group member.
   — Groups should prepare costumes, visuals, and necessary props for their presentations.
4. Provide each student with the worksheet included with this lesson listing corn myths and legends. There is space provided for students to record additional myths and legends.
5. As a conclusion, students will complete a Venn diagram using background information, their research and worksheet information to compare the history of corn through myth and legend and the role of corn in our lives today.

Extra Reading

Brown, Dale, ed., *Mound Builders and Cliff Dwellers*, Time-Life, 1992.

Courlander, Harold, and Enrico Arno, *People of the Short Blue Corn: Tales and Legends of the Hopi Indians*, Henry Holt, 1996.

Curry, Jane Louise, *The Wonderful Sky Boat: And Other Native American Tales from the Southeast*, McEldery, 2001.

Hunger, Sally M., and Joe Allen, *Four Seasons of Corn: A Winnebago Tradition (We Are Still Here)*, Lerner, 1996.

Johnson, Sylvia, *Tomatoes, Potatoes, Corn, and Beans: How the Foods of the Americas Changed Eating Around the World*, Atheneum, 1997.

Parke, Marilyn, and Sharon Panik, *A Quetzalcoatl Tale of Corn (Legends From Mexico and Central America)*, Good Apple, 1992.

Politi, Leo, *Three Stalks of Corn*, Aladdin, 1994.

Sherman, Pat, and R. Gergory Christie, *The Sun's Daughter*, Clarion, 2005.

Vocabulary

cultivate — to prepare land for the raising of crop

domesticated — adapted to living with human beings and serving their purpose.

ethanol — a colorless, volatile, pungent liquid made from corn which can be burned as a fuel.

maize — Native American name for corn. Also called Indian corn.

pollinated — pollen placed on the stigma of a plant for the purpose of creating seeds, flowers, fruit.

porridge — a soft cereal or meal boiled in water or milk until thick.

silage — the remaining part of the plant after the corn ears have been harvested. It is collected, stored in silos, and used for feed.

soil conservation — a protection from loss, waste, etc. of soil through efficient farming methods.

utilitarian — the quality or property of being useful.

Name ______________________________

Corn Myths and Legends

Name of Legend	Native American Culture	Place of Origin	Involvement of Humans and Animals	Religious Beliefs	Male-Female Roles
The Hermit, or the Gift of the Corn					
The Signs of Corn					
The Forgotten Ear of Corn					
How Corn Came to the Earth					
The Coming of Corn					
Corn and the Sauk and Mesquakie Indians					

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Cotton Pickin'

Before and After the Civil War

Skills: Social Studies, Language Arts

Objective: Students will examine the importance of cotton to the economy of the South before and after the Civil War.

Background:

Cotton is a soft fiber that grows around the seeds of the cotton plant. The seeds are sticky and sometimes difficult to separate from the cotton fiber. Before the invention of the cotton gin, in 1793, the process was extremely labor-intensive.

The cotton gin, a mechanical device which removes the seeds from cotton, could generate up to 50 pounds of cleaned cotton daily. This was double what could be cleaned by hand and helped make cotton production a lucrative business. It contributed to the economic growth of the Southern states of the US, a prime cotton-growing area. By 1860, cotton production represented more than half of all US exports. Some historians believe the invention also reinvigorated the slave economy and added decades to its life.

By the early part of the 19th Century, the Southern economy depended on the labor of African American slaves forced into providing cheap or free labor. In 1810 there were 1.2 million African American slaves in the US. By 1860 there were 4 million. Slaves were concentrated on the large plantations of about 10,000 big planters. Each of these plantations held 50-100 or more slaves.

The principal cotton-growing states in the South were South Carolina, Mississippi, Florida, Alabama, Georgia, Louisiana and Texas. These were the first seven states to declare their independence from the US, between December, 1860, and February, 1861. Civil War broke out in April, 1861.

After the Civil War, the price of cotton dropped nearly 50 percent. Many freed slaves remained dependent on white landowners because they had no land of their own. They stayed on the plantations and worked as sharecroppers in return for a share of the profits. Cotton plantations required vast labor forces to hand-pick cotton fibers from cotton plants, and it was not until the 1950s that reliable harvesting machinery was introduced into the South.

In the 1890s, the boll weevil moved into the southern US from Mexico and destroyed much of the cotton crop in the South, forcing many southern farmers to switch to other crops. Today there are 17 states producing cotton in the US. The top seven producers in 2006 were Texas, Arkansas, Georgia, Mississippi, California, Tennessee and North Carolina. Although Texas leads in total production, California has the highest yield per acre in the world. China is the world's largest producer of cotton.

P.A.S.S.

GRADE 6
Social Studies — 1.1,3
Reading — 1.1; 3.1b,2c,3a; 5.1ab
Writing — 1.2; 2.4a; 7

GRADE 7
Social Studies — 1.1; 4.3; 5.2
Reading — 1.1; 3.1a; 5.1ab
Writing — 1.1,; 2.2b,4b,8

GRADE 8
Social Studies — 1.1,3,5; 2.1,2; 6.3,4; 10.2; 11.2
Reading — 1.1; 3.1a; 5.1A
Writing — 1.1,2; 2.5a,8

Resources Needed

computer with internet connection and slideshow software

encyclopedia

poster board

note cards

map pencils

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China, the US and India together produce half the world's cotton. Other top producers include Brazil, Pakistan, Turkey, Australia and Uzbekistan.

Cotton is the most common natural textile in use today. The part of the cotton plant used for textiles is called the lint. The seeds of the cotton plant are also a valuable commodity. Cottonseed oil is used to make salad dressings, margarine and cooking oils.

Cotton and cottonseed ranked number seven in value of all Oklahoma agricultural commodities in 2005. It was among the first major crops grown by farmers when our state was new. There are 220,000 acres planted in cotton in Oklahoma.

Vocabulary

boll weevil — a usually grayish or brown weevil that feeds on the squares and bolls of the cotton plant
commodity — a product of agriculture
cotton — a soft fiber that grows around the seeds of the cotton plant
cotton gin — a machine that quickly and easily separates the cotton fibers from the seed pods and the sometimes sticky seeds
cottonseed oil — a brown-yellow oil with a nutlike odor obtained from the seed of the cotton plant.
export — a commodity conveyed from one country or region to another for purposes of trade
fiber — a slender and very long natural or synthetic unit of material (as wool or cotton) usually able to be spun into yarn
labor-intensive — having high labor costs per unit of output
lint — cotton
lucrative — producing wealth
plantation — a large farm or estate on which cotton, tobacco, coffee or sugar cane is cultivated, usually by resident laborers.
sharecropper — a farmer who works land for the owner in return for a share of the value of the crop
textile — cloth, especially a woven or knit cloth

Activities

1. Read and discuss background and vocabulary.
2. Hand out copies of the US map included in the "Resources" section.
   — Students will use map pencils and develop map legends to show the seven cotton states that seceded in 1860-61 (South Carolina, Mississippi, Florida, Alabama, Georgia, Louisiana and Texas) and the top seven cotton-producing states in the US in 2006 (Texas, Arkansas, Georgia, Mississippi, California, Tennessee and North Carolina).
   — Which of the seven cotton states that seceded are among the top US cotton-producing states today?
   — Which of the top cotton-producing states in the US today are not Southern states?
3. Students will select one of the topics below and conduct research via the internet or encyclopedia. See "How Reliable Are Your Sources?" in the "Resources" section to review online sources.
   — How was cotton produced and harvested before and after the Civil War? Students use a Venn diagram to illustrate the comparison and present findings in a slide show presentation.
   — Identify at least three turning points in the Civil War, and show how cotton production influenced the economy at each point. Complete a time line on poster board listing the turning points and the impact of cotton production.
   — Describe the impact of the dependence on cotton in the Southern States. Work with a group to create a skit depicting a scenario at the end of the Civil War showing how dependent the society was on cotton production.
4. Review "How to Write a Research Paper" in the "Resources" section.
   — Students will use their research notes to write informative essays on the subjects they have chosen to research above.

Extra Reading for Students

Hopkinson, Deborah, *Up Before Daybreak: Cotton And People In America* Scholastic, 2006.

McMullan, Margaret, *How I Found the Strong*, Houghton Mifflin, 2005.

McPherson, James M., *Fields of Fury: The American Civil War,* Atheneum, 2003.

Williams, Sherley Anne, and Carole Byard, *Working Cotton,* Voyager, 1997.

Dear George

Using Census Data

Skills: Language Arts, Social Studies

Objective: Students use Census of Agriculture information to compose a letter about agriculture in the US and translate correspondence about agriculture from George Washington into modern language.

Background:

In 1791 President George Washington received a letter from an Englishman named Arthur Young requesting information on land values, crops, yields, livestock prices, and taxes in the US. By personally conducting a mail survey and compiling the results, Washington was able to gather enough information to reply fully to his English correspondent. This was, in effect, the nation's first agricultural survey.

Between September 24 and November 18, 1791, Washington sent Young three letters that provided agricultural statistics on an area extending roughly 250 miles from north to south and 100 miles from east to west. The strip ran through an area which is today Pennsylvania, West Virginia, Maryland, Virginia and the District of Columbia, where most of the young country's population lived at that time.

Washington's reports to Young reflect some of the same concerns farmers have today. He worried that prices weren't keeping up with the cost of raising crops. He worried that some farmers weren't good stewards of the land. He worried about the cost of transporting agricultural goods to markets and improving those routes.

Washington asked Congress to establish a National Board of Agriculture in 1776, but Congress rejected the idea at that time.

The issue wasn't raised again until 1839, when Commissioner of Patents Henry Ellsworth persuaded Congress to designate $1,000 from the Patent Office Fund for "collecting and distributing seeds, carrying out agricultural investigations, and procuring agricultural statistics."

In 1840, the first Census of Agriculture collected detailed agricultural information to provide the first nationwide inventory of agricultural production.

The US Department of Agriculture (USDA) was established by Abraham Lincoln in 1862, and its first crop report appeared in

P.A.S.S.

GRADE 6
Social Studies — 1.1,2; 3.1
Reading — 1.1a ; 3.1a,4d; 4.4a
Writing — 2.4a,6a,7,8
Oral Language — 1.2; 2.2
Visual Literacy — 3

GRADE 7
Social Studies — 1.1; 2.4; 6.1
Reading — 1.1; 3.1a,2a; 4.4a
Writing — 2.4b,6a,8,9
Oral Language — 1.2 2.2
Visual Literacy — 3.1

GRADE 8
Social Studies — 1.1,2,5; 2.1
Reading — 1.1; 3.1a,2a,4; 4.4a
Writing — 2.5a,7d,8,9
Oral Language — 1.2; 2.2
Visual Literacy

July, 1863. The National Agricultural Statistics Service (NASS) traces its roots all the way back to 1863, when USDA established a Division of Statistics.

During the Civil War, USDA collected and distributed crop and livestock statistics to help farmers assess the value of the goods they produced. At that time, commodity buyers usually had more current and detailed market information than did farmers, a circumstance that often prevented farmers from getting a fair price for their goods.

Today NASS is responsible for conducting the Census of Agriculture. The Census of Agriculture is a complete accounting of agricultural production in the US and is the only source of uniform, comprehensive agricultural data for every county in the nation. From 1840 to 1920 the Census of Agriculture was taken every 10 years. Since 1925 the census has been taken every five years, in the years ending in 2 and 7. In addition, NASS field offices in every state produce a wide variety of reports throughout the year, along with an annual report. The reports are used by producers, researchers, the news media, people involved in financial markets and many others. These reports are compiled only for the top agricultural commodities from a sampling of state producers contacted at random. In contrast, the Census of Agriculture reports on every agricultural commodity produced in the state, based on surveys collected from every producer.

Resources Needed

US map

Activities

1. Read and discuss background and vocabulary.
   — Lead a discussion about the differences between the way information was shared in George Washington's time (by letter) compared with the way we acquire information today.
   — Ask students where they would find the kind of information Arthur Young asked George Washington to provide.
2. Provide each student with the Census of Agriculture data included with this lesson and a copy of the modern-day version of the letter Arthur Young might have written to George Washington.
   — Students will use the data to compose a reply.
   — Students will include information about the following topics in their letters: land value, crops, yields, livestock prices.
3. Divide students into groups.
   — Each group will select either a commodity or a state or region and use the census data to develop promotional brochures, posters or Power Point presentations.
4. Provide students with the excerpts from George Washington's letters to Arthur Young and others included with this lesson.
   — Students will rewrite the excerpts in modern English.

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5. Students will design surveys to gather information about their school.
   — Students will present the information to local audiences in a variety of forms — charts, graphs, prose, oral presentations, etc.
6. Students will design surveys about agriculture in another state or country.
   — Make arrangements to connect with a classroom in another state or country.
   — Divide your class into two groups.
   — One group will use email to correspond with the other class while the other will use the US Postal Service.
   — Track responses on a map of the US or the world.
   — Students will discuss advantages and disadvantages of each method of correspondence.

Lesson adapted from "Arthur Young and the President," lesson plan from the National Agricultural Statistics Service, USDA, http://www.nass.usda.gov/Education_&Outreach/Lesson_Plans/index.asp

Extra Reading

Adler, David A, *George Washington: An Illustrated Biography*, Holiday House, 2005.

Benson, Kathleen, and James Ransome, *Building a New Land: African Americans in Colonial America,* Amistad/Harper Collins Children's, 2002.

Bial, Raymond, *Where Washington Walked*, Walker & Co., 2005.

Diouf, Sylviane, *Growing Up in Slavery*, Milbrook, 2002.

Haskins, Jim, *The Geography of Hope: Black Exodus From the South After Reconstruction*, 21st Century/Millbrook, 2000.

McMullan, Margaret, *How I Found the Strong*, Houghton Mifflin, 2005.

Miller, Brandon Marie, *Growing Up in Revolution and the New Nation 1775 to 1800*, Lerner, 2003.

Robb, Don, and Christine Joy Pratt, *This is America: The American Spirit in Places and People*, Charlesbridge, 2006.

Watkins, Richard, *Slavery: Bondage Through History*, Houghton Mifflin, 2002.

Vocabulary

agriculture — the science or occupation of cultivating the soil, producing crops and raising livestock

analyze — to study or find out the nature and relationship of the parts of something

assess — to set a value on (as property) for tax purposes

bale — a large bundle of goods tightly tied for storing or shipping

bushel — any of various units of dry capacity

census — a counting of the population (as of a country, city, or town) and a gathering of related statistics done by a government every so often

comprehensive — including much or all

contemptible — the state of being despised

correspondent — one who communicates with another by letter

cwt — abbreviation for hundredweight, a unit of weight equal to 100 pounds

data — facts about something that can be used in calculating, reasoning or planning

husbandry — wise management of resources

livestock — animals kept or raised; especially farm animals kept for use and profit

statistics — a branch of mathematics dealing with the collection and study of numerical data; also, a collection of such numerical data

survey — to gather information from or about

uniform — of the same form with others

yield — the amount or quantity produced or returned

Name ______________________________________

Dear George

Use the Census of Agriculture data provided by your teacher to compose a response to this letter.

June 29, 2007

Dear George,

It was nice to get your letter and to hear all about your school, your town and your friends. I loved the photos you sent of your family's camping trip. What a beautiful place!

It's always interesting to hear about life in your country. I hope I get to visit there sometime. I would also love for you to come visit me. As you know, my family has a farm. When I am not in school, I am usually helping with that.

What is farming like in your country? What kinds of crops grow there? Are there some crops that your country produces more than any other? How much is produced in a year? What kind of livestock do you raise? What is the selling price? How much does farm land cost? Is it more expensive in certain parts of the country? Does the price stay the same, or does it go up and down from one year to the next?

As you can see, I have many questions. Thank you again for your letter. I look forward to hearing from you again.

Your Friend,
Art

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Farm Real Estate: Average Value per Acre, by Region and State, January 1, 2002-2006

State	2002	2003	2004	2005	2006
	dollars	*dollars*	*dollars*	*dollars*	*dollars*
NORTHEAST	**3,000**	**3,200**	**3,550**	**4,110**	**4,500**
Connecticut	8,500	9,500	10,200	10,800	11,400
Delaware	3.700	4,000	6,000	8,400	10,200
Maine	1,600	1,750	1,850	1,950	2,050
Maryland	4,000	4,150	5,700	7,900	8,900
Massachusetts	8,100	9,300	9,900	10,500	11,600
New Hampshire	2,800	3,100	3,250	3,450	3,700
New Jersey	8,600	9,100	9,750	10,500	10,900
New York	1,610	1,700	1,780	1,920	2,050
Pennsylvania	3,250	3,450	3,650	4,220	4,790
Rhode Island	8,300	9,300	10,200	11,200	12,500
Vermont	1,900	2,050	2,150	2,300	2,450
LAKE STATES	**1,870**	**2,010**	**2,220**	**2,520**	**2,840**
Michigan	2,470	2,680	2,920	3,150	3,500
Minnesota	1,500	1,600	1,800	2,100	2,400
Wisconsin	2,150	2,300	2,500	2,850	3,200
CORN BELT	**2,030**	**2,130**	**2,300**	**2,720**	**3,040**
Illinois	2,350	2,430	2,610	3,330	3,800
Indiana	2,460	2,570	2,770	3,140	3,630
Iowa	1,920	2,010	2,220	2,650	2,930
Missouri	1,380	1,470	1,580	1,790	1,980
Ohio	2,600	2,740	2,930	3,180	3,480
NORTHERN PLAINS	**576**	**594**	**632**	**735**	**834**
Kansas	665	685	715	850	930
Nebraska	760	775	825	940	1,090
North Dakota	415	425	455	505	560
South Dakota	430	460	500	605	710
APPALACHIAN	**2,250**	**2,370**	**2,560**	**3,110**	**3,470**
Kentucky	1,830	1,900	2,000	2,500	2,750
North Carolina	2,900	3,100	3,300	3,940	4,250
Tennessee	2,300	2,400	2,500	2,850	3,070
Virginia	2,530	2,700	3,200	4,050	4,900
West Virginia	1,330	1,400	1,500	1,950	2,150
SOUTHEAST	**2,140**	**2,270**	**2,420**	**3,530**	**4,420**
Alabama	1,700	1,760	1,860	2,400	2,750
Florida	2,720	2,900	3,100	5,400	7,280
Georgia	2,050	2,200	2,350	3,200	3,900
South Carolina	1,900	2,050	2,150	2,400	2,600
DELTA STATES	**1,390**	**1,460**	**1,580**	**1,790**	**1,960**
Arkansas	1,410	1,480	1,650	1,870	2,050
Louisiana	1,440	1,500	1,580	1,770	1,900
Mississippi	1,330	1,400	1,480	1,690	1,850
SOUTHERN PLAINS	**755**	**788**	**832**	**1,000**	**1,190**
Oklahoma	680	705	745	900	970
Texas	775	810	855	1,030	1,250
MOUNTAIN	**500**	**523**	**550**	**698**	**944**
Arizona	1,400	1,500	1,600	2,330	3,350
Colorado	700	730	775	940	1,090
Idaho	1,240	1,280	1,360	1,750	2,440
Montana	370	390	410	510	760
Nevada	465	480	500	650	1,000
New Mexico	250	260	265	360	520
Utah	1,040	1,100	1,150	1,460	2,070
Wyoming	285	300	315	370	420
PACIFIC	**2,240**	**2,350**	**2,480**	**3,120**	**3,290**
California	3,400	3,600	3,800	5,090	5,390
Oregon	1,150	1,200	1,250	1,350	1,420
Washington	1,390	1,480	1,530	1,650	1,750

Source: Land Values and Cash Rents, 2006 Summary, Agricultural Statistics Board, NASS, USDA, http://usda.mannlib.cornell.edu/usda/current/AgriLandVa/AgriLandVa-08-04-2006.pdf

Crop Summary: Production, United States, 2006

Crop	Unit	2006
GRAINS & HAY		*1,000*
barley	bushel	180,051
corn for grain	bushel	10,534,868
corn for silage	ton	104,849
hay, all	ton	141,666
oats	bushel	93,764
proso millet	bushel	10,195
rice	cwt	193,736
rye	bushel	7,193
sorghum for grain	bushel	277,538
sorghum for silage	ton	4,642
wheat, all	bushel	1,812,036
OILSEEDS		
canola	pound	1,394,332
cottonseed	ton	7,632
flaxseed	pound	11,019
mustard seed	pound	28,220
peanuts	pound	3,474,450
rapeseed	pound	1,100
safflower	pound	191,405
soybeans for beans	bushel	3,188,247
sunflower	pound	2,143,613
COTTON, TOBACCO & SUGAR CROPS		
cotton, all	bale	21,729
sugarbeets	ton	33,765
sugarcane	ton	29,489
tobacco	pound	726,724
DRY BEANS, PEAS & LENTILS		
Austrian winter peas	cwt	259
dry edible beans	cwt	24,247
dry edible peas	cwt	13,203
lentils	cwt	3,244
wrinkled seed peas	cwt	590
POTATOES		
coffee (Hawaii)	pound	7,300
ginger root (Hawaii	pound	4,300
hops	pound	57,687
peppermint oil	pound	7,248
potatoes, all	cwt	434,683
spearmint oil	pound	2,038
sweet potatoes	cwt	16,441
taro (Hawaii)	pound	4,500

Source: Crop Production 2006 Summary, Agricultural Statistics Board, NASS, USDA, January, 2007, http://usda.mannlib.cornell.edu/

Livestock: Average Prices Received by States, 2005

dollars per cwt

	lambs	**hogs**	**beef cattle**
Alabama	79.10	44.00	84.00
Alaska	79.10	82.00	95.60
Arizona	75.00	59.20	93.40
Arkansas	79.10	47.90	89.10
California	74.80	50.70	70.40
Colorado	74.30	53.60	110.00
Connecticut	110.00	45.00	70.00
Delaware	79.10	42.50	85,80
Florida	79.10	44.50	80.00
Georgia	79.10	52.00	68.60
Hawaii	79.10	89.80	50.90
Idaho	70.30	48.90	81.30
Illinois	68.00	51.40	86.90
Indiana	71.30	49.00	85.20
Iowa	69.70	52.00	89.00
Kansas	75.60	46.90	90.10
Kentucky	79.10	49.10	90.90
Louisiana	79.10	43.60	67.20
Maine	110.00	45.00	79.00
Maryland	79.10	42.50	85.80
Massachusetts	110.00	45.00	72.00
Michigan	69.00	46.70	73.20
Minnesota	73.20	50.70	79.10
Mississippi	79.10	46.60	76.80
Missouri	75.00	45.50	98.00
Montana	76.80	53.10	104.00
Nebraska	72.50	51.80	92.30
Nevada	70.00	46.60	93.80
New Hampshire	110.00	45.00	77.00
New Jersey	79.10	40.00	55.00
New Mexico	75.00	47.50	87.00
New York	83.10	43.30	49.90
North Carolina	79.10	50.70	77.90
North Dakota	71.50	51.30	99.20
Ohio	73.70	49.40	83.30
Oklahoma	73.00	43.90	104.00
Oregon	66.90	53.20	85.90
Pennsylvania	81.10	47.30	75.70
Rhode Island	110.00	45.00	70.00
South Carolina	79.10	50.50	87.10
South Dakota	79.70	50.90	95.90
Tennessee	79.10	47.40	83.10
Texas	76.50	45.40	89.90
Utah	73.80	55.90	94.00
Vermont	110.00	45.00	75.00
Virginia	74.90	46.60	84.80
Washington	66.50	48.90	103.00
West Virginia	72.80	46.60	72.00
Wisconsin	70.40	47.10	66.70
Wyoming	75.70	46.60	102.00
US Average	79.40	50.20	68.60

Source: Agricultural Prices, 2005 Summary, July, 2006, Agricultural Statistics Board, NASS, USDA, http://usda.mannlib.cornell.edu/usda/current/AgriPricSu/AgriPricSu-07-21-2006_revision.pdf

George Washington on Agriculture

Long before cell phones, email and fax machines, people relied heavily on letters for sharing all kinds of information. The following are quotes from letters George Washington wrote to an English agriculturalist, Arthur Young, and others. Read the quotes, and then rewrite them in modern English, as though you were writing them to a friend today. Try to guess the meaning of unfamiliar words by reading them in context. Also notice the punctuation, capitalization and spelling that is different from what is considered correct today.

1. I have a prospect of introducing into this Country a very excellent race of animals also, by means of the liberality of the King of Spain. One of the Jacks which he was pleased to present to me (the other perished at sea) is about 15 hands high, his body and Limbs very large in proportion to his height; and the Mules which I have had from him appear to be extremely well formed for Service. I have likewise a Jack and two Jennets from Malta, of a very good size, which the Marquis de la Fayette sent to me. The Spanish Jack seems calculated to breed for heavy, slow draught; and the other for the Saddle or lighter carriages. From these, altogether, I hope to secure a race of extraordinary goodness, which will stock the Country. Their longevity and cheap keeping will be circumstances much in their favor. I am convinced, from the little experiments I have made with ordinary Mules, (which perform as much labor, with vastly less feeding than horses) that those of a superior quality will be of the best cattle we can employ for the harness. And indeed, in a few years, I intend to drive no other in my carriage: having appropriated for the sole purpose of breeding them, upwards of 20 of my best Mares.

   George Washington
   (Letter to Arthur Young, December 4, 1788)

2. . . . Of hogs many, but as these run pretty much at large in the Woodland (which is all under the fence) the number is uncertain. . . .

   George Washington
   (Letter to Arthur Young, December 12, 1793)

3. Every improvement in husbandry should be gratefully received and peculiarly fostered in this Country, not only as promoting the interests and lessening the labour of the farmer, but as advancing our respectability in a national point of view; for in the present State of America, our welfare and prosperity depend upon the cultivation of our lands and turning the produce of them to the best advantage.

   George Washington
   (Letter to Samuel Chamberlain, April 3, 1788)

4. When I speak of a knowing farmer, I mean one who understands the best course of crops; how to plough, to sow, to mow, to hedge, to Ditch and above all, Midas like, one who can convert everything he touches into manure, as the first transmutation towards Gold; in a word one who can bring worn out and gullied lands into good tilth in the shortest time.

   George Washington
   (Letter to George William Fairfax, June 30, 1785)

5. To tell a farmer . . . that his Cattle & ca. Ought to be regularly penned in summer and secured from bad weather in winter, and the utmost attention paid to the making of manure for the improvement of his fields at both seasons; that his oxen should be well attended to, and kept in good and fit condition, thereby enabling them to perform the labor which they must undergo; to remind him of these things would, I say, be only observing what every Farmer must be thoroughly sensible of his duty enjoins . . . .

George Washington
(Letter to William Pearce, September 23, 1793)

6. I think it would be no unsatisfactory experiment to fat one bullock altogether with Potatoes; another, altogether with Indian meal; and third with a mixture of both: keeping an exact account of the time they are fatting, and what is eaten of each, and of hay, by the different steers; that a judgement may be formed of the best and the least expensive mode of stall feeding beef for market, or for my own use.

George Washington
(Letter to William Pearce, December 7, 1794)

7. No wheat that has ever yet fallen under my observation, exceeds the White which some years ago I cultivated extensively; but which, from inattention during my absence from home of almost nine years has got mixed or degenerated as scarcely to retain any of its original characteristic properties. But if the march of the Hessian Fly, Southerly, cannot be arrested. . . this White Wheat must yield the palm to the yellow bearded, which alone, it seems, is able to resist the depredations of that destructive insect. This makes your present of it to me more valuable. It shall be cultivated with care.

George Washington
(Letter to John Beale Bordley, August 17, 1788)

Source: The George Washington Papers at the Library of Congress, 1741-1799

George Washington and the First Census of Agriculture

Skills: Social Studies, Language Arts

Objective: Students will read excerpts from a letter George Washington wrote about agriculture in the US in 1771 and compare his evaluation with agricultural data over time.

Background:

In 1791 President George Washington received a letter from an Englishman named Arthur Young requesting information on land values, crops, yields, livestock prices, and taxes in the US. By personally conducting a mail survey and compiling the results, Washington was able to gather enough information to reply fully to his English correspondent. This was, in effect, the nation's first agricultural survey.

Between September 24 and November 18, 1791, Washington sent Young three letters that provided agricultural statistics on an area extending roughly 250 miles from north to south and 100 miles from east to west. The strip ran through an area which is today Pennsylvania, West Virginia, Maryland, Virginia and the District of Columbia, where most of the young country's population lived at that time.

Washington's reports to Young reflect some of the same concerns farmers have today. He worried that prices weren't keeping up with the cost of raising crops. He worried that some farmers weren't good stewards of the land. He worried about the cost of transporting agricultural goods to markets and improving those routes.

Washington asked Congress to establish a National Board of Agriculture in 1776, but Congress rejected the idea at that time.

The issue wasn't raised again until 1839, when Commissioner of Patents Henry Ellsworth persuaded Congress to designate $1,000 from the Patent Office Fund for "collecting and distributing seeds, carrying out agricultural investigations, and procuring agricultural statistics."

In 1840, the first Census of Agriculture collected detailed agricultural information to provide the first nationwide inventory of agricultural production.

The US Department of Agriculture (USDA) was established by Abraham Lincoln in 1862, and its first crop report appeared in

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GRADE 6
Social Studies — 1.1
Reading — 1.1,3ab; 3.1b
Writing — 2.7
Oral Language — 1.2; 2.3

GRADE 7
Social Studies — 1.1; 5.2
Reading — 1.1; 3.1a
Writing — 2.8
Oral Language — 1.2

GRADE 8
Social Studies

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July, 1863. The National Agricultural Statistics Service (NASS) traces its roots all the way back to 1863, when USDA established a Division of Statistics.

During the Civil War, USDA collected and distributed crop and livestock statistics to help farmers assess the value of the goods they produced. At that time, commodity buyers usually had more current and detailed market information than did farmers, a circumstance that often prevented farmers from getting a fair price for their goods.

Today NASS is responsible for conducting the Census of Agriculture. The Census of Agriculture is a complete accounting of agricultural production in the US and is the only source of uniform, comprehensive agricultural data for every county in the nation. From 1840 to 1920 the Census of Agriculture was taken every 10 years. Since 1925 the census has been taken every five years, in the years ending in 2 and 7. In addition, NASS field offices in every state produce a wide variety of reports throughout the year, along with an annual report. The reports are used by producers, researchers, the news media, people involved in financial markets and many others. These reports are compiled only for the top agricultural commodities from a sampling of state producers contacted at random. In contrast, the Census of Agriculture reports on every agricultural commodity produced in the state, based on surveys collected from every producer.

Resources Needed

overhead projector or smart board

Activities

1. Read and discuss background and vocabulary.
2. Use an overhead projector or smart board to show students the excerpts from George Washington's letters to Arthur Young found on the issue pages included with this lesson.
   — Explain that the excerpts are examples of the way people spoke and wrote in George Washington's day and may be difficult to understand.
   — Read through each excerpt and discuss for meaning.
3. Provide copies of the issue pages.
   — Students will work in pairs or groups to answer the questions on the issue pages.
   — Students will use the census data provided with each issue paper to answer the questions and prepare statements that compare modern day agriculture in the US with agriculture in the US in 1791.
   — Students will share their findings with the class.
4. Students will select the appropriate graph form and graph the information found on the charts. A guide to graphing is included in the "Resources" section.

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5. Students will prepare discussion questions for classroom discussion of the issues. Some sample discussion questions follow:
   — Why was agriculture so important to President Washington, as leader of a new nation, that he personally conducted a survey to gather information about it?
   — Washington told Arthur Young that at that time labor was more valuable to the American farmer than land. Who were the laborers?
   — What special circumstances existed then that do not exist today? (slavery)
   — Who are today's agricultural laborers? (students, family members, immigrants)
   — What special issues exist today related to labor?
   — What has happened since 1791 to change farm labor and the value of land in our country? (industrial revolution, mechanization of much farm labor, population growth making land more valuable, increase in the size of houses people require, westward expansions, people moving away from the farm)

Lesson adapted from: "The Fact Finders," lesson plan from the National Agricultural Statistics Service, USDA, http://www.nass.usda.gov/Education_&_Outreach/Lesson_Plans/index.asp

Extra Reading

Adler, David A, *George Washington: An Illustrated Biography*, Holiday House, 2005.

Benson, Kathleen, and James Ransome, *Building a New Land: African Americans in Colonial America,* Amistad/Harper Collins Children's, 2002.

Bial, Raymond, *Where Washington Walked*, Walker & Co., 2005.

Diouf, Sylviane, *Growing Up in Slavery*, Milbrook, 2002.

Haskins, Jim, *The Geography of Hope: Black Exodus From the South After Reconstruction*, 21st Century/Millbrook, 2000.

McMullan, Margaret, *How I Found the Strong*, Houghton Mifflin, 2005.

Miller, Brandon Marie, *Growing Up in Revolution and the New Nation 1775 to 1800*, Lerner, 2003.

Robb, Don, and Christine Joy Pratt, *This is America: The American Spirit in Places and People*, Charlesbridge, 2006.

Watkins, Richard, *Slavery: Bondage Through History*, Houghton Mifflin, 2002.

Vocabulary

agriculture — the science or occupation of cultivating the soil, producing crops, and raising livestock

analyze — to study or find out the nature and relationship of the parts of something

assess — to set a value on (as property) for tax purposes

census — a counting of the population (as of a country, city, or town) and a gathering of related statistics done by a government every so often

comprehensive — including much or all

contemptible — the state of being despised

correspondent — one who communicates with another by letter

data — facts about something that can be used in calculating, reasoning or planning

husbandry — wise management of resources

livestock — animals kept or raised; especially farm animals kept for use and profit

statistics — a branch of mathematics dealing with the collection and study of numerical data; also, a collection of such numerical data

survey — to gather information

uniform — of the same form with others

Name ____________________________

Issue # 1: Cost of Labor

President George Washington to Arthur Young, 1791, in response to questions about agriculture in the US

> South of Pennsylvania, hired labor is not very common, except it be at harvest, and sometimes for cutting grass. The wealthier farmers perform it with their own black Servants, whilst the poorer sort are obliged to do it themselves. That labour in this Country is higher than it is in England, I can readily conceive. The ease with which a man can otain land, in fee, beyond the Mountains, to which most of that class of people repair, may be assigned as the primary cause of it. But high wages is not the worst evil attending the hire of white men in this Country, for being accustomed to better fare than I believe the labourers of almost any Country, adds considerably to the expence of employing them; whilst blacks, on the contrary, are cheaper; the common food of them (even when well treated) being bread, made of the Indian Corn, Butter milk, Fish (pickled herrings) frequently, and meat now and then; with a blanket for bedding: In addition to these, ground is often allowed them for gardening, and priviledge given them to raise dung-hill fowls for their own use. With the farmer who has not more than two or three Negros, little difference is made in the manner of living between the master and the man; but far otherwise is the case with those who are owned in great numbers by the wealthy; who are not always as kind, and as attentive to their wants and usage as they ought to be; for by these, they are fed upon bread alone, which does not, on an average, cost more than seven dollars a head pr. Ann.

(Excerpt of letter from the George Washington Papers at the Library of Congress, 1741-1799)

Summaraize Washington's opinion of the cost of farm labor in the US in 1791.

Compare labor costs today in the different regions, as shown in the following chart.

Where are labor costs highest?

Where are labor costs lowest?

What observations can you make about the cost of labor today, as compared with the cost of labor in 1791?

What trends do you notice in the labor force of then versus today?

What other trends do you notice in the data?

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Hired Farm Workers: Wage Rates by Region and United States, 2002-2006

dollars per hour

	2002	2003	2004	2005	2006
NORTHEAST I	9.36	10.12	9.81	10.19	10.20
Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, Vermont					
NORTHEAST II	9.29	9.59	9.59	10.00	9.65
Delaware, Maryland, New Jersey, Pennsylvania					
APPALACHIAN I	8.21	8.66	8.94	8.89	9.35
North Carolina, Virginia					
APPALACHIAN II	7.50	8.04	8.14	9.03	9.30
Kentucky, Tennessee, West Virginia					
SOUTHEAST	8.18	8.26	8.56	9.05	9.10
Alabama, Georgia, South Carolina					
FLORIDA					
8.67	9.53	9.14	9.33	9.42	
LAKE	9.73	9.70	9.77	10.35	10.35
Michigan, Minnesota, Wisconsin					
CORNBELT I	8.90	9.34	9.98	10.10	10.63
Illinois, Indiana, Ohio					
CORNBELT II	8.81	9.30	9.72	11.16	10.65
Iowa, Missouri					
DELTA	7.77	7.48	8.17	7.70	8.32
Arkansas, Louisiana, Mississippi					
NORTHERN PLAINS	9.32	9.31	9.76	10.12	10.20
Kansas, Nebraska North Dakota, South Dakota					
SOUTHERN PLAINS	7.57	8.01	9.34	8.38	9.60
Oklahoma, Texas					
MOUNTAIN I	8.13	8.24	8.84	8.91	9.55
Idaho, Montana, Wyoming					
MOUNTAIN II	8.79	8.97	9.40	8.75	9.80
Colorado, Nevada, Utah					
MOUNTAIN III	8.25	8.18	7.75	8.28	8.50
Arizona, New Mexico					
PACIFIC	9.47	9.62	9.81	9.62	10.85
Oregon, Washington					
CALIFORNIA	9.35	9.13	9.28	10.12	10.10
Hawaii	11.02	11.56	11.52	11.73	12.47
US	8.93	9.05	9.30	9.61	9.95

Source: "Farm Labor, May 2007, Agricultural Statistics Board, NASS, USDA, http://usda.mannlib.cornell.edu/usda/current/FarmLabo/FarmLabo-05-18-2007.pdf

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Name ______________________________

Issue # 2: Use of the Land

President George Washington to Arthur Young, 1791, in response to questions about agriculture in the US

> An English farmer must entertain a contemptible opinion of our husbandry, or a horrid idea of our lands, when he shall be informed that not more than 8 or 10 bushels of Wheat is the yield of an Acre; but this low produce may be ascribed, and principally, too, to a cause which I do not find touched by either of the Gentlemen whose letters are sent to you, namely, that the aim of the farmers in this Country (if they can be called farmers) is not to make the most they can from the land, which is, or has been cheap, but the most of the labor, which is dear, the consequence of which has been, much ground has been scratched over and none cultivated or improved as it ought to have been; Whereas a farmer in England, where land is dear and labor cheap, finds it his interest to improve and cultivate highly, that he may reap large crops from a small quantity of ground. That the last is the true, and the first an erroneous polisy, I will readily grant, but it requires time to conquer bad habits, and hardly anything short of necessity is able to accomplish it. That necessity is approaching pretty rapid strides.

Excerpt of a letter from the George Washington Papers at the Library of Congress, 1741-1799

Washington criticizes farmers of his day for taking the nation's abundant land for granted and not caring for it properly. American farmers learned the hard way that this resource was not limitless, although it may have seemed so in Washinton's time.

Why was Washington upset? Did farmers learn from their mistakes? If so, when?

Look at the chart that follows to find the yield per acre of wheat and some other crops since Washington's time. Prepare a statement describing the difference beween now and then.

Prepare a statement describing the difference in yield surrounding an event in US history. (Civil War, Homestead Act, etc.)

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Acreage and Production of Corn, Wheat, Oats and Barley, 1866 to 2006

year	corn acreage 1,000 acres	corn yield million bushels	wheat acreage 1,000 acres	wheat yield million bushels	oats acreage 1,000 acres	oats yield million bushels	barley acreage 1,000 acres	barley yield million bushels
1866	30,017	731	15,408	170	7,935	232	754	18
1871	42,002	1,142	22,230	272	11,061	306	1,348	28
1876	55,277	1,478	28,283	309	14,589	327	1,978	41
1881	63,026	1,245	36,795	406	16,916	446	2,201	49
1886	73,911	1,783	36,312	514	24,426	682	3,027	74
1891	78,855	2,336	41,090	678	27,756	837	3,590	94
1896	89,074	2,671	40,828	523	30,248	775	4,131	97
1901	94,422	1,716	50,847	763	30,891	800	4,963	124
1906	95,624	3,033	46,230	741	33,688	1,023	6,744	179
1911	101,393	2,475	49,894	618	37,149	886	7,613	145
1916	100,561	2,425	53,510	635	39,098	1,139	7,623	159
1921	103,155	2,928	64,566	819	45,539	1,045	7,074	133
1926	99,452	2,547	56,616	832	42,854	1,152	7,917	166
1931	106,866	2,576	57,704	942	40,193	1,124	11,181	200
1936	93,154	1,506	49,125	630	33,654	793	8,329	148
1941	85,357	2,652	55,935	942	38,161	1,183	14,276	363
1946	87,585	3,217	67,105	1,152	42,812	1,478	10,380	265
1951	80,729	2,926	61,873	988	35,233	2,278	9,424	257
1956	75,247	3,445	49,768	1,005	33,333	1,151	12,852	377
1961	65,405	3,598	51,571	1,232	23,886	1,010	12,806	392
1966	65,828	4,117	49,867	1,312	17,861	801	10,205	393
1971	63,819	5,540	48,453	1,640	15,734	878	*	*
1976	71,300	6,266	70,771	2,142	11,946	546	*	*
1981	72,719	8,235	80,642	2,785	9,407	510		
1986	69,200	7,072	60,700	2,092	*	*	12,000	611
1991	68,800	7,475	57,700	1,981	*	*	*	*
1996	73,147	9,293	62,850	2,282	2,687	155	6,787	397
2001	68,808	9,507	48,653	1,958	1,905	117	4,289	250
2006	70,648	10,535	46,810	1,812	1,576	94	2,951	180

Census data not found for that crop that year

Data compiled from "Bicentennial Edition: Historical Census of the United States, Colonial Times to 1970," http://www.census.gov/compendia/statab/past_years.html; and "Reports by Commodity," USDA — National Agricultural Statistics Service, http://www.nass.usda.gov/QuickStats/indexbysubject.jsp?Pass_group=Crops+%26+Plants

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

The History of Ethanol in America

Skills: Social Studies, Language Arts

Objective: Students will explore the production of biofuels from the 1850's to the present.

Background:

Ethanol is a clear, colorless chemical compound made from the sugars found in crops such as corn, sugar beets and sugar cane.

In the 1850s nearly 90 million gallons of ethanol were produced every year in the US. At that time it was used as a fuel for lamps. It could also be consumed as an alcoholic beverage. In 1862 the Union Congress put a $2 per gallon excise tax on alcoholic beverages to help finance the Civil War. The tax made ethanol too expensive to use for lighting, so people started using kerosene and methanol instead.

In 1896, Henry Ford built his first automobile, the quadricycle, to run on pure ethanol. In 1906, the liquor tax was repealed, and Ford declared ethanol the fuel of the future. Ford designed his Model T to run on a mixture of gasoline and ethanol.

During World War I, ethanol use increased rapidly, not only as a fuel but in the manufacture of war materials also. The year 1919 brought Prohibition, and a denaturing process was developed which made ethanol poisonous and undrinkable. In the 1920s ethanol was replaced as a booster to gasoline by other products.

Prohibition ended in 1933, and ethanol production rose to 600 million gallons a year to meet the needs of World War II. After the war, production once again declined because there were no more government contracts. Farmers began exporting grain formerly used to make ethanol to help feed countries whose agriculture had been destroyed by the war. Large supplies of cheap foreign oil made gasoline less expensive than ethanol.

In the 1970s the US placed embargoes on gasoline supplies from foreign sources, and interest in ethanol as an alternative fuel rose again. Concerns about global warming and dependence on foreign oil have caused interest in ethanol as an alternative fuel source to grow in recent years. In 2006, 112 ethanol plants, mostly in the Midwest, produced about 5 billion gallons of ethanol.

Unlike gasoline, ethanol is biodegradable. It quickly breaks down into harmless substances if spilled. When small amounts of ethanol are added to gasoline, usually less than 10 percent, there

P.A.S.S.

GRADE 6
Social Studies — 1.1,3; 2.2; 4.2
Reading — 1.1; 3.1b,2a; 5.1ab,2a
Writing — 1.2; 2.3a,7
Oral Language — 1.1,2; 2.1,2

GRADE 7
Social Studies — 1.1; 2.4; 5.2; 6.1
Reading — 1.1; 3.1a,2a,3d; 5.1ab,2a
Writing — 1.2; 2.3a,8
Oral Language — 1.1,2; 2.1.2

GRADE 8
Social Studies — 1.1,2,3,5; 2.2
Reading — 1.1; 3.1a,2a.3b; 5.1a,2a
Writing — 1.2; 2.3b,8
Oral Language — 1.1,2; 2.1,2

Grains and grasses suitable for biofuel production

forestry products
corn
soybeans
sugarcane
sugar beets
barley
wheat
rice
sorghum
sunflowers
potatoes
switchgrass

Resources Needed

Computer and library access

physical, political and product maps of the US

geographical references (see “Extra Reading for Students.)

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are many advantages. Ethanol reduces the emissions of carbon monoxide and other toxic pollution. It keeps engines running smoothly without the need for lead or other chemical additives. Because ethanol is made from crops that absorb carbon dioxide and give off oxygen, it helps reduce the total volume of greenhouse gas emissions.

There are several ways to make ethanol from crops. One process uses yeast to ferment the sugars and starch in crops like corn, barley, wheat, rice, sorghum, sunflower, potatoes, sugar cane and sugar beets. Currently, most ethanol produced in the US is made from corn because corn is plentiful and cheap.

Since ethanol is created by fermenting sugar, sugar crops are the easiest ingredients to convert into ethanol. Brazil, the world's largest producer of ethanol, makes most of its ethanol from sugar cane. Many cars in Brazil are engineered to operate entirely on ethanol made from sugar cane.

A new experimental process breaks down cellulose in woody fibers to make "cellulosic ethanol." With this process ethanol can be produced from trees, grasses, and crop wastes. Trees and grasses require less energy for production than grains, since grains must be replanted every year.

Switchgrass, a grass that is native to Oklahoma, is of special interest to researchers for use in ethanol production. It has been chosen by the US Department of Energy as one of the main perennial crops for use in the production of ethanol. Switchgrass is a seeded, warm season grass native throughout North America.

Switchgrass converts and stores more solar energy per acre than any of the grain crops currently used to produce ethanol for fuel. It holds 66 percent more potential energy than corn. Switchgrass can be grown on marginal cropland and uses water and fertilizer efficiently. Since it is perennial, it comes back every year without replanting. At harvest, it would yield approximately 300-700 gallons per acre, compared to corn, at approximately 350 gallons per acre.

Background sources: Cleaner Energy Partnership; Energy Information Administration, US Department of Energy; USDA Agricultural Research Service

Activities

1. Read and discuss the background information and vocabulary.
   — Student will discuss some of the events that impacted the ups and downs of ethanol production in US history.
2. Students use online search engines or the library to locate parts of the US where the crops used in ethanol production (listed at left) are produced.
   — Students locate areas on maps.
   — Students use resources/maps to compare and contrast the

growing areas for these grains and grasses.

3. Provide copies of the reading included with this lesson.
   — Students create a graphic organizer of the reading into historical timelines.
   — Review "How to Write a Research Paper" and "How Reliable Are Your Sources?" in the "Resources" section.
   — Students work in groups of two or three to research online or in the library the historical periods mentioned in the reading.
   — Students will each write a one-page paper on one of the historical periods and related issues listed on the reading page.
   — Each group will select an event from their research to dramatize as though they are reporters reporting it as news.
4. Students discuss the impact of switchgrass and other crops used for making alternative fuels on the economy of Oklahoma, the US and on the world market.
   — Could this alternative fuel curb our dependency on oil imports?
   — What would be the impact on the environment?
   — How soon might alternative fuels show significant impacts on our society as a whole?

Extra Reading for Students

Bridgman, Roger, *1000 Inventions and Discoveries*, DK, 2003.
Carless, Jennifer, *Renewable Energy: A Concise Guide to Green Alternatives*, Walker, 1993.
DK State-by-State Atlas, DK, 2004.
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O'Hearn, Michael, *Henry Ford and the Model T* (Inventions and Discovery), Capstone, 2006.
Peterson, Christine, *Alternative Energy*, Children's, 2004.
Povey, Karen D., *Biofuels — Our Environment*, KidHaven, 2006.
Stanchak, John, *Civil War,* DK, 2001.
Wilson, Janet, *Imagine That!*, Stoddart Kids, 2001.
Zarzycki, Daryl Davis, *Henry Ford: Cars for Everyone* (Robbie Readers), Mitchell Lane, 2004.
Zuehlke, Jeffrey, *Henry Ford* (History Maker Bios), Lerner, 2007.

Extra Reading for Teachers

Renewables Are Ready – A Guide to Teaching Renewable Energy in Junior and Senior High School Classrooms, Union of Concerned Scientists, 1994.
Paul, Greg, *Biodiesel: Growing a new energy economy*, Chelsea Green Publishing Company, 2005.

Vocabulary

biofuel — fuel made from living organisms
denaturing — to make (alcohol, etc.) unfit as food or drink without spoiling for other uses
embargo — any restriction imposed on commerce by law; especially, a prohibition of trade in a particular commodity
ethanol — a colorless, limpid, volatile, flammable, water-miscible liquid produced by the fermentation of sugars from certain grains and grasses
fossil fuel — oil, coal, natural gas – nonrenewable energy sources from ancient life
fermentation — turning sugar into alcohol or lactic acid during anaerobic respiration
lignin — the cementing agent that holds plant cell walls together
marginal cropland — land with conditions that make it difficult for growing crops
perennial — living over a period of many years
petroleum — an oily liquid solution of hydrocarbons occurring naturally in the rock strata of certain geological formations
switchgrass — a panic grass (Panicum virgatum) native to North America and used as rangeland forage and hay

Name ______________________________

The History of Ethanol in America

Ethanol is a clear, colorless chemical compound made from the sugars found in crops such as corn, sugar beets and sugar cane.

In the 1850s nearly 90 million gallons of ethanol were produced every year in the US. At that time it was used as a fuel for lamps. It could also be consumed as an alcoholic beverage. In 1862 the Union Congress put a $2 per gallon excise tax on alcoholic beverages to help finance the Civil War. The tax made ethanol too expensive to use for lighting, so people started using kerosene and methanol instead.

In 1896, Henry Ford built his first automobile, the quadricycle, to run on pure ethanol. In 1906, the liquor tax was repealed, and Ford declared ethanol the fuel of the future. Ford designed his Model T to run on a mixture of gasoline and ethanol.

During World War I, ethanol use increased rapidly, not only as a fuel but in the manufacture of war materials also. The year 1919 brought Prohibition, and a denaturing process was developed which made ethanol poisonous and undrinkable. In the 1920s ethanol was replaced as a booster to gasoline by other products.

Prohibition ended in 1933, and ethanol production rose to 600 million gallons a year to meet the needs of World War II. After the war, production once again declined because there were no more government contracts. Farmers began exporting grain formerly used to make ethanol to help feed countries whose agriculture had been destroyed by the war. Large supplies of cheap foreign oil made gasoline less expensive than ethanol.

In the 1970s the US placed embargoes on gasoline supplies from foreign sources, and interest in ethanol as an alternative fuel rose again. Concerns about global warming and dependence on foreign oil have caused interest in ethanol as an alternative fuel source to grow in recent years. In 2006, 112 ethanol plants, mostly in the Midwest, produced about 5 billion gallons of ethanol.

1. Develop a timeline of the events mentioned above.
2. Write a one-page paper on one of the following historical periods and related issues.

   1850s — Ethanol was widely used as fuel for lighting lamps. What other fuels were used as lighting or to meet other fuel needs? What fuels were used for cooking? What were some other fuel needs?

   Civil War — How did the excise tax on ethanol effect the daily lives of people during the war? What other daily hardships were caused by the war? What is an excise tax?

   1908 — Repeal of liquor tax and Henry Ford's Model T

   The uses for ethanol and other fuels during World War I

   The impact of Prohibition on the production of ethanol

   The uses for ethanol and other fuels during World War II

   The oil embargo of the 1970s and its effects on the US

   The resurgence of interest in ethanol as an alternative fuel today

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Where Has All the Farmland Gone?

Exploring Agricultural Land Use

Skills: Social Studies, Language Arts

Objective: Students will look at issues related to land use worldwide.

Background:

Since the dawn of settled agriculture, humans have been altering the landscape to secure food, create settlements, and pursue commerce and industry. Croplands, pastures, urban and suburban areas, industrial zones, and the area taken up by roads, reservoirs, and other major infrastructure all represent conversion of natural ecosystems. These transformations of the landscape are the defining mark of humans on Earth's ecosystems, yielding most of the food, energy, water, and wealth we enjoy.

Historically, expansion of agriculture into forests, grasslands, and wetlands has been the greatest source of ecosystem conversion. Within the last century, however, expansion of urban areas with their associated housing, roads, power grids, and other infrastructure, has also become a potent source of land transformation.

In some developed nations, including the United States, agricultural lands themselves are being converted to urban and industrial uses. Rapid expansion of urbanization has resulted in significant losses of agricultural lands. Cultivable land per capita in China has declined approximately 20 percent since 1978, mostly due to rural industrialization and small-town growth. In the US, total cropland area reached a 57-year low in 2002.

Urban and built-up areas now occupy more than 471 million hectares worldwide — about 4 percent of land area. Almost half the world's population — some 3 billion people — live in cities. Urban populations increase by another 160,000 people daily, adding pressure to expand urban boundaries into agricultural areas.

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P.A.S.S.

GRADE 6
Social Studies — 1.1,2,3
Reading — 1.1a; 3.1b; 5.1ab
Writing — 2.7
Oral Language — 1.2

GRADE 7
Social Studies — 1.1,3; 2.3; 4.5; 5.2; 6.1
Reading — 1.1; 3.1a; 5.1ab
Writing — 2.8
Oral Language — 1.2

GRADE 8
Social Studies — 1.1,2
Reading — 1.1; 3.1a; 5.1a
Writing — 2.8
Oral Language — 1.2

Suburban sprawl magnifies the effect of urban population growth, particularly in North America and Europe. In the United States, the percentage of people living in urban areas increased from 65 percent of the nation's population in 1950 to 77 percent in 2000. The area covered by cities quadrupled in size during roughly the same period.

Urban migration in developing countries takes place on such a scale that we now have a new category of cities — megacities — with populations over 10 million. By 2015 there will be 23 megacities, including Beijing, China; Cairo, Egypt; Mumbia, India; Lagos, Nigeria; Mexico City, Mexico; and Sao Paulo, Brazil. In 12 years, nearly three out every four city dwellers will live in a megacity.

Background Sources: Mock, Gregory, "Domesticating the World, Conversion of Natural Ecosystems," World Resources 2000-2001; "Major Uses of Land in the United States, 2002," Economic Research Service, US Department of Agriculture; "Farmland Protection Issues," American Farmland Trust, http://www.farmland.org

Resources Needed

overhead projector or smart board

computer and/or library access

Activities

1. Read and discuss the background information and vocabulary.
   — Students locate megacities listed in the background on a world map.
2. Hand out copies of "Some Facts About Agricultural Land Use," included with this lesson, or use an overhead projector.
   — Read the statements aloud, or provide time for students to read independently.
   — Lead a discussion about the loss of agricultural land worldwide and in the US. Ask: "Why does it matter that we are losing agricultural land?
3. Hand out copies of "What Would You Do?" provided with this lesson.
   — Divide students into groups of four or five.
   — Students will discuss the situations and answer the questions in groups.
   — Discuss the situations as a class.
   — Each student will select one of the issues and write a paper defending his/her position.
4. Hand out the "Land Use and Ecosystems in Select Countries" chart along with the worksheet. Note: The percentages on the chart may differ some from those in background information due to differences in methodologies for gathering statistics.

Oklahoma Ag in the Classroom is a program of the Oklahoma Cooperative Extension Service, 4–H Youth Development, in cooperation with the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education.

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— Students will answer the questions on the worksheet.
— Students will match the countries to regions, based on the land use statistics provided.

5. Lead a discussion about the chart.
   — What numbers are surprising?
   — What correlations can students find between the percentage of cropland areas compared with percentages of other ecosystems.
6. Students will locate the countries listed on a world map.
7. Review "How Reliable Are Your Sources?" in the "Resources" section. Each student will select one of the countries listed and research online, in an encylopedia or in the library to find additional information about land use in that country. Students will answer some of the following questions:
   — What are the major agricultural products?
   — Are the major agricultural products animal or plant-based?
   — How much of the food supply is imported from other countries?
   — How much is exported?
   — What are the major cities, and how large are they?
   — What is the rate of population growth?

Extra Reading

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DK Children's World Atlas, DK, 2003.
Freeman, Deena, *How People Live*, DK, 2003.
Fridell, Ron, *The War on Hunger: Dealing With Dictators, Deserts and Debt*, Millbrook, 2003.
Gifford, Clive, *The Kingfisher Geography Encyclopedia*, Kingisher, 2003.
National Geographic Student Atlas of the World, National Geographic, 2002.

Vocabulary

big box store — a large chain store having a boxlike structure
commerce — the exchange or buying and selling of commodities on a large scale involving transportation from place to place
cropland/natural vegetation mosaic — areas where cropland and natural vegetation are mixed together
cultivable — capable of being used for the raising of crops
degradation — the state of passing from a higher grade to a lower
ecosystem — a system made up of an ecological community of living things interacting with their environment especially under natural conditions
erosion — the state of being worn away by the action of water, wind, or glacial ice
grassland — an ecological community in which the characteristic plants are grasses
hectare — a unit of area, equal to 10,000 square metres, commonly used for measuring land area; 1 hectare = 2.4710439 U.S. survey acres
infrastructure — the system of public works of a country, state, or region
megacity — a city with populations over 10 million
salinization — containing a large proportion of salt.
soil compaction — the condition of soil when its particles are pressed very tightly together
sprawl — the spreading of urban developments (as houses and shopping centers) on undeveloped or agricultural land near a city
suburban — the residential area on the outskirts of a city or large town
temperate — having a moderate climate which especially lacks extremes in temperature
tropical — of, relating to, occurring in, or suitable for use in the tropics
urban — of, relating to, characteristic of, or constituting a city
wetlands — land or areas (as marshes or swamps) that are covered often intermittently with shallow water or have soil saturated with moisture

Some Facts About Agriculture and Land Use

1. The world’s population is growing by about 1.6 percent per year, and some experts believe it will double by the end of the 21st century. To feed the growing population, farmers will need more land for growing crops or much higher yields on current land.

2. Nearly one-third of the world's land surface is now in use for agriculture, and millions of acres of natural ecosystems are converted each year. All totaled, agriculture has displaced one-third of temperate and tropical forests and one-quarter of natural grasslands.

3. About 85 percent of agricultural land contains areas judged to have been degraded by erosion, salinization, compaction, and other factors, Soil degradation has already reduced global agricultural productivity by 13 percent in the last 50 years,

4. Urban and built-up areas now occupy more than 471 million hectares worldwide — about 4 percent of land area. Almost half the world's population — some 3 billion people — live in cities. Urban populations increase by another 160,000 people daily, adding pressure to expand urban boundaries into agricultural areas.

5. Farm and ranch land is desirable for building because it tends to be flat, well drained and affordable.

6. The food and farming system in the US is important to the balance of trade and the employment of nearly 23 million people.

7. Far more farmland is being converted than is necessary to provide homes for a growing population. Urban areas in the US have increased at twice the rate of population growth since 1945. Over the past 20 years, the average acreage per person for new housing almost doubled.

8. Three times the current population of the world could fit in the state of Oklahoma. The State of Oklahoma has an area of 69,903 square miles. One square mile will accomodate 278,784 people if each person is allowed 100 square feet. At that rate the state of Oklahoma could accomodate a 19.49 billion people — almost three times the Earth's current population of 6.4 billion.

9. Farm and ranch lands provide food and cover for wildlife, help control flooding, protect wetlands and watersheds, and maintain air quality. They can absorb and filter wastewater and provide groundwater recharge.

10. Total cropland area in the US reached a new 57-year low in 2002. Every minute of every day, we lose two acres of agricultural land to development.

11. Cultivable land per capita in China has declined approximately 20 percent since 1978, mostly due to rural industrialization and small-town growth.

12. Global consumption of livestock products has more than doubled in the past 30 years. Demand for livestock products in developing countries grew three times faster than in industrialized countries. Because many developing countries lack modern transportation infrastructure for shipping food (particularly meat, which must be kept refrigerated), most of the expanded production of livestock and feed grains to feed their populations will have to be close to home.

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Name ________________________________

What Would You Do?

1. Your family is moving to a new town. You have two choices. The first is a house in town that is near shopping, work and schools. You will have to share a room with your sibling. The other is to buy a lot on the outskirts of town and build a new home on land surrounded by wheat fields. You will have your own room. What is your vote?
   Discuss the impact of each option on you personally.
   Discuss the impact of each option on agriculture, the environment and the local economy.

2. You are a rancher in Brazil. The demand for beef in your country is growing more every year. The population of the nearby city is growing as well. A developer has made a very generous offer to buy your ranch so he can build apartments to meet the demand for housing. You can take the money and buy land in the rainforest and continue your cattle operation there. What do you do?
   Discuss the impact of your choice on you personally.
   Discuss the impact of your choice on agriculture, the environment and the local economy.

3. You own a pineapple plantation in a beautiful area in Costa Rica that is becoming a popular area for tourism. You have many employees. A wealthy developer wants to buy your land and build a resort. Several of the other plantation owners have already moved their operations to Thailand. What do you do?
   Discuss the impact of your choice on you personally.
   Discuss the impact of your choice on agriculture, the environment and the local economy.

4. A big box store wants to build on land at the edge of town that is surrounded by farms. A citizens' group has petitioned to bring the required zoning change up for a vote of the people in the county. Most of the businesses in your town depend on the farming economy. The traffic from the new store could disrupt the surrounding farming operations. How will you vote?
   Discuss the impact of your choice on you personally.
   Discuss the impact of your choice on agriculture, the environment and the local economy.

5. Your favorite tennis shoes are made in Mexico by a company you find out has bought up large amounts of farm land to build its factories, displacing many small farmers from the land. You could buy a different brand, but they aren't as cool, and they cost more. What do you do?
   Discuss the impact of your choice on you personally.
   Discuss the impact of your choice on agriculture, the environment and the local economy.

6. Your family has moved into a new housing development in an area that is surrounded by farms. Dust from the farm causes your asthma to flare up, and sometimes the noise from the farm machinery wakes you up when you want to sleep late on weekends. A group from your housing development is gathering signatures for a petition to put restrictions on the farming operation. Do you think your parents should sign it?
   Discuss the impact of your choice on you personally.
   Discuss the impact of your choice on agriculture, the environment and the local economy.

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Land Use and Ecosystem Areas in Select Countries

Country	Total land area (hectares)	forests %	shrublands, savanna, grasslands %	cropland and crop/natural vegetation mosaic %	urban and built-up areas %	sparse or barren vegetation; snow and ice %	wetlands and water bodies %
Ecuador	28,356	33	36	24	.1	5	2
Afghanistan	65,209	0	73	11	.1	15	0
Australia	774,122	4	88	6	.1	0	1
China	959,696	11	43	29	.1	15	1
Ethiopia	110,430	5	72	16	0	7	1
France	55,150	17	3	79	.6	0	1
India	328,759	8	18	68	.2	4	1
Argentina	278,040	3	58	32	.1	6	1
Brazil	854,740	48	25	25	.1	0	2
Czech Rep	7,886	22	0	76	1	0	0
Egypt	100,145	0	1	3	0	95	1
Greece	13,196	15	18	61	.2	0	5
Thailand	51,312	31	9	59	.2	0	2
Iran	163,319	1	49	9	.1	40	1
Ireland	7.028	1	0	91	.4	0	7
Israel	2,106	1	33	36	2.1	26	3
Bermuda	5	0	28	0	0	0	72
Japan	37,780	57	17	20	1.3	0	5
Kenya	58,037	5	67	20	0	6	2
Mexico	195,820	29	53	17	.1	1	1
Nigeria	92,377	2	74	19	.1	1	3
Cuba	11,086	23	24	44	.4	0	9
Somalia	63,766	0	88	2	0	10	0
Canada	997,061	38	25	7	0	21	10
Fiji	1,827	0	0	0	0	0	100
Turkey	77,482	10	33	55	.1	0	2
Belize	2,296	60	6	29	0	0	5
United States	936,352	27	40	25	.8	3	3
World	13,328,979	24	37	20	.2	16	3

Source: World Resources Institute. 2007. EarthTrends: Environmental Information. Available at http://earthtrends.wri.org. Washington DC: World Resources Institute.

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Name ______________________________

Land Use Around the World

Use the "Land Use and Ecosystem Areas in Select Countries" chart to answer these questions:

1. Of the countries listed, which country has the largest total land area?

2. Which has the least total land area?

3. Name the countries with over 50 percent of land in cropland and crop/natural vegetation mosaic.

4. Name the countries with less than 25 percent in cropland and crop/natural vegetation mosaic.

5. Name the country with the largest percentage of land in urban and built up areas?

6. Name the countries with 0 percent land in cropland and crop/natural vegetation mosaic.

7. Name the countries with over 50 percent wetlands and water bodies.

8. Name the countries with over 50 percent sparse or barren vegetation; snow and ice.

Place countries from the previous page in the correct region below. Locate each country on a world map.

Sub-Saharan Africa	Middle East and Northern Africa	Europe	Central America & Caribbean	South America	Asia	Oceania	North America

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Name ________________________________

Land Use Around the World (answers)

Use the "Land Use and Ecosystem Areas in Select Countries" chart to answer these questions:

1. Of the countries listed, which country has the largest total land area? **China**

2. Which has the least total land area? **Bermuda**

3. Name the countries with over 50 percent of land in cropland and crop/natural vegetation mosaic.
   France, India, Czech Republic, Ireland, Turkey

4. Name the countries with less than 25 percent in cropland and crop/natural vegetation mosaic.
   Ecuador, Afghanistan, Australia, Ethiopia, Argentina, Egypt, Iran, Japan, Kenya, Mexico, Nigeria, Somalia, Canada

5. Name the country with the largest percentage of land in urban and built up areas?
   Israel

6. Name the countries with 0 percent land in cropland and crop/natural vegetation mosaic.
   Bermuda, Fiji

7. Name the countries with over 50 percent wetlands and water bodies.
   Bermuda, Fiji

8. Name the countries with over 50 percent sparse or barren vegetation; snow and ice.
   Egypt

Sub-Saharan Africa	Mid East and N Africa	Europe	Central America & Caribbean	South America	Asia	Oceania	N America
Ethiopia	Afghanistan	France	Mexico	Ecuador	China	Australia	US
Kenya	Egypt	Czech Republic	Cuba	Argentina	India	Fiji	Canada
Nigeria	Israel	Greece	Belize	Brazil	Japan		Bermuda
Somalia	Turkey	Ireland			Thailand		

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World Trade

Skills: Social Studies, Language Arts

Objective: Students will use research skills to learn about world trade and the organizations which govern trade.

Background:

International trade is defined as the exchange of goods and services across international boundaries or territories. This trade represents a significant share of the Gross Domestic Product (GDP) for most countries. While international trade has been present throughout much of history, its economic, social, and political importance has been on the rise in recent centuries due, in large part, to industrialization, advanced transportation, globalization, multinational corporations, and outsourcing.

Trade and marketing are vital to American agriculture. The US exports agricultural products to countries that can't grow crops and livestock as efficiently as American farmers or can't grow them at all, due to their lack of space, viable soil, or climate restrictions. The US also imports products from other countries that produce different, less expensive, or better quality goods.

Government trade policies influence the volume of trade between nations. In domestic trade, goods may move freely from one part of the nation to another. In international trade, governments often place artificial barriers against the free movement of goods from one country to another. Several organizations, policies, and/or agreements maintain and control fair trading between the United States and other countries.

Activities

1. Read together and discuss the background information and the vocabulary.
2. Review "How Reliable Are Your Sources?" in the "Resources" section. — Students will work in pairs or groups to select and research one of the following topics.
    - World Trade Organization (WTO)
    - European Union (EU)
    - Organization of Economic Cooperation and Development (OECD)
    - General Agreement on Tariffs and Trade (GATT)
    - Reciprocal Trade Agreements Act
    - WTO Agriculture Agreement (1986-94)
    - North American Free Trade Agreement (NAFTA)
    - Free Trade Area of the Americas (FTAA)
    - Gross Domestic Product
    - Central America Free Trade Agreement (CAFTA)

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P.A.S.S.

GRADE 6
Social Studies — 1.3; 4.2
Reading — 1.1a; 3.1b; 5.1a,2a
Writing — 2.7
Oral Language — 1.2; 2.1

GRADE 7
Social Studies — 1.1; 4.1,2
Reading — 1.1; 3.1a; 5.1a,2a
Writing — 2.8
Oral Language — 1.2; 2.1

GRADE 8
Social Studies — 1.1,2
Reading — 1.1; 3.1a; 5.1a,2a
Writing — 2.8
Oral Language — 1.2; 2.1

Resources Needed

computer access

encyclopedias and other reference books

note cards

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Vocabulary

dumping — production of excessive amounts of goods and "dumping" the goods on another foreign country.
export — any good or commodity, transported from one country to another country.
globalization — affecting or relating to the earth as a whole; world-wide.
gross domestic product (GDP) — the market value of all final goods and services produced within a country in a given period of time.
import — any good or commodity brought into one country from another country.
industrialization — the change in social and economic organization resulting from the replacement of hand tools by machine and power tools and the development of large scale industrial production.
outsourcing — raw materials supplied to other companies, states, or countries for the production of finished products.
subsidize — the providing of supplemental financial support for farmers for agriculture products grown.
tariff — a tax placed on a specific good or set of goods imported from a country.
trade barriers — government laws, regulations, policy, or practices that either protect domestic products from foreign competition or artificially stimulate exports of particular domestic products.

— Students use note cards to record the following information about the organization or agreement: topic, years of operation, main goals or issues, agriculture connection, interesting information related to agriculture, countries involved.
— Students report their findings to the class.

3. As groups report on their research, students will use the worksheet table included in this lesson to record information.
— Use a world map to color in or track the trade organizations and agreements between the United States and other countries.
— After all reports are complete, lead a discussion on prospects for new trade agreements, surprises about trade and how agricultural exports benefit American farmers and the US economy.
4. Using their completed worksheets, each student will write a question or statement on one side of a note card and the answer to the question on the opposite side.
— Divide students into two equal groups.
— Form two large circles with one inside the other.
— Students in the inside circle faces a student in the outside circle.
— Students in the inside circle begins by asking their questions to the students facing them.
— Students in the outside circle attempt to answer.
— Students in the outside circle then ask their questions.
— When the first round of questions is complete, both groups shift to the left by one student.
— Each student is now facing a different student.
— Rotation continues until the review is complete.

Extra Reading for Students

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January, Brendan, *Globalize It! The Stories of the IMF, the World Bank, the WTO — and Those Who Protest,* Millbrook, 2004.
Woods, Michael and Mary Woods, *Ancient Agriculture: From Foraging to Farming*, Runestone, 2000.
The World Almanac for Kids — 2006, World Almanac, 2005.

Extra Reading for Teachers

Aksov, M. Ataman, and John C. Beghin, *Global Agricultural Trade and Developing Countries,* World Bank, 2004.
Colyer, Dale, P. Lynn Kennedy, William A. Amponsah, Stanley M. Fletcher, and Curtis M. Jolly, editors, *Competition in Agriculture: The United States in the World Market*, Haworth, 2006
Ingco, Merlinda, *Agriculture and the WTO: Creating a Trading System for Development*, World Bank, 2005.

Name ______________________________

World Trade Organizations and Agreements

As groups report on their research, use this table to record the information.

	Years of Operation	Main Goals or Issues	Agriculture Connection	Interesting Information Related to Agriculture	Countries Involved
World Trade Organization (WTO)					
European Union (EU)					
Organization of Economic Cooperation and Development (OECD					
General Agreement on Tariffs and Trade (GATT					
Reciprocal Trade Agreements Act					
WTO Agriculture Agreement (1986-94)					
North American Free Trade Agreement (NAFTA)					
Central America Free Trade Agreement (CAFTA)					
Free Trade Area of the Americas (FTAA)					
Gross Domestic Product					

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Social Studies

Corn in Ancient America

Skills: Social Studies

Objective: Students will develop an understanding of the importance of corn to the survival of early civilizations of the Americas.

Background:

Corn is a grass, native to the Americas. The exact origin is unknown, but tiny ears of corn have been discovered at ancient village sites and in tombs of early Americans. Evidence of corn in central Mexico suggests it was used there as long as 7000 years ago, where it was domesticated from wild grass. Cultivated corn is known to have existed in what is now the southwestern US for at least 3000 years. In the United States, many of the various Native American tribes have traditionally grown corn — also known as maize — and used it for both food and utilitarian purposes. Eastern tribes shared their knowledge of corn production with early European settlers, an act which saved many from starvation.

Early American colonists dried corn and ground it as meal for flour. They used the ground corn in porridge, cake and bread. Fresh, or sweet corn, the kind we like to eat as corn on the cob, was not developed until the 1700s. Before then corn was only used in its dried form.

Along with wheat and rice, corn is one of the world's major grain crops. It is the largest grain crop grown in the US. About 9 percent of all the corn grown is used to produce food for humans. These foods include corn meal and other food products such as cooking oils, margarine, and corn syrups and sweeteners (fructose). Sixty four percent of all corn grown is used as feed for livestock.

Corncobs have been used in the manufacturing of nylon fibers and as a source for producing degradable plastics. Ethanol, a renewable fuel made from corn, has shown the possibility of becoming a major renewable fuel for the world's automotive industry.

Corn can be produced in much of Oklahoma, but primary production is in the Panhandle area. In Oklahoma, corn is harvested for either grain or silage with most of the grain going to dairies, animal feeding operations, and poultry operations. In an average year, around 25 million bushels are grown for grain in

P.A.S.S.

GRADE 6
Social Studies — 1.1; 3.2

GRADE 7
Social Studies — 1.1; 4.1; 5.2

GRADE 8
Social Studies — 1.1; 2.2

Oklahoma, with a yield of 130 bushels per acre. One bushel of corn is equal to 56 pounds.

Corn is pollinated by wind and is typically planted in 30-inch rows A single seed (or kernel) of corn may produce a plant which yields more than 600 kernels of corn per ear. On one acre of land, anywhere from 22,000 to 35,000 individual plants may be grown.

Hybrid corn is developed to produce from one to two ears per plant. Ears per plant is often determined by moisture availability. Through better soil conservation practices, fertilizer use, better seed quality, and water availability, corn yields have increased 125 percent since 1950.

Activities

1. Read or discuss the background information and vocabulary with students.
2. Discuss and list the early Native American civilizations of North and Central America (Mayan, Incan, mound builders, cliff dwellers, Pueblo, Aztec, Olmec, Zuni, Anasazi, Cahokia, etc.)
   — Discuss locations of civilizations on your list.
   — Students find locations on a world map.
   — Students use encyclopedias or other resources to find the approximate dates of each civilizations and develop a time line for the civilizations.
3. Divide students into groups for discovery and study.
   — Each group chooses one of the civilizations listed in previous discussion.
   — Review “Are Your Sources Reliable?” from the “Resources” section.
   — Groups use resource materials, including websites, to discover and report on the importance of corn for their chosen civilizations. Assign one of the following questions to each group:
   - How and where did the people plant corn?
   - How was corn used in people’s daily lives (food, products, storage, etc.)?
   - Who took care of the corn (planting, weeding, harvesting, storage)?
   - What were some beliefs about corn? Were there any ceremonial rituals associated with corn?
   - How did the abundance or lack of corn affect the growth or demise of the culture/civilization?
   - Track the movement of corn from the region where it originated.
   - How did European colonists adapt corn to their needs?

Resources Needed

computer and/or resource materials

large class map of North and Central America

atlas or access to maps for individual students

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— Students will report on selected civilizations by recording information on a class graph, with the questions along the side and the civilizations listed on the bottom.

— Students compare and contrast the information gathered.

— Lead a discussion about the importance of corn in our lives today. Could we live without corn and corn byproducts? Are there any corn rituals/ceremonies still practiced today?

Extra Reading

Aveni, Anthony, The First Americans, *The Story of Where They Came From and Who They Became*, Scholastic, 2005.

Bial, Raymond, *Corn Belt Harvest*, Houghton-Mifflin, 1991.

Braman, Arlette, and Michelle Nidenoff, *Secrets of Ancient Cultures: The Maya — Activities and Crafts From a Mysterious Land,* Jossey-Bass, 2003.

Brown, Dale, ed., *Mound Builders and Cliff Dwellers*, Time-Life, 1992.

Ciment, James, *Scholastic Encyclopedia off the North American Indian,* 1996.

Curry, Jane Louise, *The Wonderful Sky Boat: And Other Native American Tales from the Southeast*, McEldery, 2001.

Fussell, Betty, *Story of Corn*, University of New Mexico, 2004.

Hakim, Joy, *The First Americans, Third Edition: Prehistory - 1600 (A History of the US, Book 1)*, Oxford, 2002.

Hamilton, Virginia, and Barry Moser, *In the Beginning: Creation Stories From Around the World,* Harcourt, 1991.

Hunger, Sally M., and Joe Allen, *Four Seasons of Corn: A Winnebago Tradition (We Are Still Here)*, Lerner, 1996.

Johnson, Sylvia, *Tomatoes, Potatoes, Corn, and Beans: How the Foods of the Americas Changed Eating Around the World*, Atheneum, 1997.

Landau, Elaine, *Corn (True Books — Food and Nutrition)*, Children's 2000.

Mann, Elizabeth, and Amy Crehore, *Macchu Picchu: The Story of the Amazing Inkas and their City in the Clouds (Wonders of the World Book)*, Mikaya, 2000.

Nielsen, Michelle L., *The Biography of Corn (How Did That Get Here?)*, Crabtree, 2007.

Rhoads, Dorothy, *The Corn Grows Ripe,* Puffin, 1993.

Shemie, Bonnie, *Mounds of Earth and Shell: Native Sites: The Southeast,* Children's, 1994.

Wells, Rosemary, *Through the Hidden Door,* Puffin, 2002.

Wood, Tim, The Incas (See Through History), Viking, 1996.

Vocabulary

cultivate — to prepare land for the raising of crop

domesticated — adapted to living with human beings and serving their purpose.

ethanol — a colorless, volatile, pungent liquid made from corn which can be burned as a fuel.

maize — Native American name for corn. Also called Indian corn.

pollinated — pollen placed on the stigma of a plant for the purpose of creating seeds, flowers, fruit.

porridge — a soft cereal or meal boiled in water or milk until thick.

silage — the remaining part of the plant after the corn ears have been harvested. It is collected, stored in silos, and used for feed.

soil conservation — a protection from loss, waste, etc. of soil through efficient farming methods.

utilitarian — the quality or property of being useful.

How Far Did It Travel?

Exploring the Geography of Food

Skills: Social Studies, Math

Objective: Students compare the distances food travels from farm to table.

Background:

Food consumed in America travels an average 1,300 miles from the farm to our tables. Most farmers, ranchers, and other producers of agricultural raw materials sell their output to collection points, such as grain terminals or stockyards. The terminal or stockyard sells these materials to processing companies, which make them into the products we buy in the grocery store — packages of hamburger meat, bags of wheat flour, boxes of cereal, hot dogs, frozen dinners, etc.

From the final processor, finished food products are moved by truck or rail to warehouses, usually located near a city. Most modern warehouses have storage areas for frozen and refrigerated food and are equipped to control temperature and humidity.

Warehouses can assemble full truckloads of products originating from many different suppliers for shipment to one large retailer or to many smaller outlets in a given region. This process reduces transportation costs when compared to shipping a small quantity of one item directly from the producer to the retailer. If the retail outlet is large enough to accept complete truckloads directly from the manufacturer, direct shipments from the factory are sometimes made.

Processors of perishable foods (dairies, ice cream manufacturers, wholesale bread bakeries, meat packers) usually maintain their own fleets of trucks for carrying fresh products directly to their retail customers.

Fresh produce is distributed through terminal markets, wholesalers or food cooperatives. A terminal market is a central market, generally located in a major city, where several brokers, wholesalers, distributors and/or jobbers are grouped together. Produce from several production regions is assembled and shipped to grocery stores, restaurants and chain store warehouses. The market may be owned by the state, city or private companies. Terminal markets for Oklahoma include markets in Dallas,

P.A.S.S.

GRADE 6
Social Studies — 1.1,2,3; 4.2
Math Process — 1.3; 2.2; 3.3; 4.1; 5.4
Math Content — 2.3; 5.1

GRADE 7
Social Studies — 1.1,2,3,4; 5.2
Math Process — 1.3; 2.2; 3.3; 4.1; 5.4
Math Content — 2.1b; 4.2a

GRADE 8
Social Studies — 1.1,6
Math Process — 1.3; 2.2; 3.3; 4.1; 5.4
Math Content — 2.1b; 5.1

Resources Needed

Oklahoma road map (available from the Oklahoma Department of Tourism)

internet access

local farmer's market brochures (if available)

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Organic or Local?

Sales of organic food in the US has grown from $5.4 billion in 1998 to $13.8 billion in 2005 and was expected to hit $16 billion by the end of 2006. To meet the growing demand, some organic growers have increased production and begun shipping food longer distances. Large producers of conventionally-grown foods have also started growing foods that are legally certified organic and distributing them nationwide. Large distributors of organic foods buy food from all over the country and even from foreign countries.

This situation creates a paradox for consumers who choose organically-grown food because they believe it is better for the environment. Shipping food long distances, even food that is organically grown, means burning large amounts of fossil fuels. Food shipped long distances also requires more elaborate packaging, much of which is manufactured using fossil fuels and ends up in local landfills.

Food produced and sold locally, such as that found in local farmer's markets, does not require long-distance shipping and is usually not extensively packaged. Some grocery stores also sell locally-grown foods, both organic and conventionally-grown. Locally-grown food may also be purchased from pick-your-own operations or from roadside markets.

Kansas City, Denver and Houston. The principal advantage of terminal markets is the ability to market large volumes of produce. Produce must be packaged in containers that are compatible with the handling and loading methods of the market. Use of terminal markets requires the grower to have sufficient volumes of produce available to transport efficiently.

A wholesaler is an individual or a business firm which buys large quantities of produce from a grower or another dealer for resale and distribution. The wholesaler may sell to a retail store, an institutional buyer or to another wholesaler. Wholesalers differ from brokers because they take delivery and assume ownership of the produce.

A broker is an individual or firm which acts as an agent for the buyer or seller in negotiating a contract. The broker does not assume title of the produce but facilitates agreements between buyers and sellers. In Oklahoma, watermelon growers sometimes rely upon brokers to find buyers for their product.

Cooperative and private packing facilities are organized by growers or other individuals to construct marketing facilities to achieve marketing efficiency through greater total volume. Cooperatives are often organized where there is a concentration of small to mid-sized growers of one or several related crops in one area.

Background Sources: "Food Industry," Grolier Electronic Publishing, 1993; Tilley, Daniel, Douglas Moesel and James R. Sleper, "Fresh Produce Marketing Alternatives for Oklahoma Fruit and Vegetable Growers," OSU Extension Fact Sheet No. 473.

Activities

1. Read and discuss background and vocabulary.
   — Students use the background to develop a flow chart showing the movement of food from farm to table.
2. Students work independently or in groups to complete the following activity.
   — Hand out copies of the "Table of Weighted Average Source Distance Estimations* for Produce" (included with this lesson) and Oklahoma road maps.
   — Students use internet search engines, local farmer's market brochures or other references, to find the nearest supplier of each product listed. (A list of Oklahoma farmer's markets can be found on the "Made in Oklahoma" Web site: http://www.madeinoklahoma.net/Okgrown/allfarm.asp)
   — Students look on the map for the city where the product is grown.

— Students use the map scale to determine mileage between that city and your hometown.
— Students write the mileage in the appropriate column.
3. Students graph the distance for each product.
4. Students create a comparison table that shows miles saved by buying each product locally.
— Students call a local gas station to find out the price per gallon for diesel fuel. (Semi-trailer trucks that deliver food usually run on diesel fuel).
— Students research online or contact an expert to find the average miles per gallon a semi-truck gets on the highway.
— Students add a column to their tables that shows how many gallons of fuel would be saved if each truckload of that product did not have to be shipped to your location.
— Students justify and discuss reasoning with a partner, in a small group or as a class.
5. Students discuss advantages (fresher food, support for local growers, savings in energy) and disadvantages (not all foods available at all times of year) of buying locally-grown food as opposed to food distributed in the conventional manner.

Extra Reading

D'Amico, Joan, *The United States Cookbook: Fabulous Foods and Fascinating Facts From All 50 States*, Jossey-Bass, 2000.

Jango-Cohen, Judity, *The History of Food (Major Inventions Through History)*, 21st Century, 2005.

Rendon, Marcie R., and Cheryl Walsh Bellville, *Farmer's Market: Families Working Together*, Carolrhoda, 2001

Silverman, Buffy, *Follow That Food: Distribution of Resources*, Raintree, 2006.

Vocabulary

broker — a person who acts as an agent in the purchase and sale of property
chain store — any of a number of stores under the same ownership selling the same lines of goods
conventional — following, agreeing with, or based on a way of doing things that is widely accepted and followed
cooperative — an association owned by and operated for the benefit of those using its services
distributor — an agent or agency for marketing goods
fossil fuel — a fuel (as coal, oil, or natural gas) that is formed in the earth from plant or animal remains
jobber — a person who buys goods and then sells them to usually smaller dealers
outlet — a market for a product; an agency (as a store or dealer) through which a product is marketed
output — something produced
paradox — a statement that seems to go against common sense but may still be true
perishable — likely to spoil or decay
raw materials — materials that can be converted by manufacture, processing, or combination into a new and useful product
retailer — someone who sells in small amounts to people for their own use
stockyards — a yard in which livestock are kept temporarily for slaughter, market, or shipping
terminal market — a metropolitan market which handles all agricultural commodities
warehouse — a building for the storage of goods
wholesaler — someone who sells, usually in large amounts, for resale

Name ______________________

Table of Weighted Average Source Distance Estimations* for Produce

1. Use an internet search engine (Search for "Oklahoma-grown food"), local farmer's market brochures, or other references, to find the nearest supplier of each product.
2. After finding a farm that raises the product, look for the nearest town on an Oklahoma map. Determine how many miles are between that town and your town.
3. Write the mileage in the correct column.

PRODUCE TYPE	CONVENTIONAL SOURCE ESTIMATION (MILES)	LOCAL SOURCE ESTIMATION (MILES)
Apples	1,555	
Broccoli	2,095	
Cabbage	754	
Carrots	1,774	
Cauliflower	2,118	
Celery	1,788	
Grapes	2,143	
Lettuce (iceberg)	2,040	
Lettuce (Romaine)	2,055	
Onions	1,675	
Peaches	1,674	
Peppers (bell)	1,261	
Potatoes	1,239	
Spinach	2,086	
Strawberries	1,093	
Sweet Potatoes	1,093	
Tomatoes	1,369	

Distance found by calculating the distance from the middle of each state that produces the product to a point in the middle of the US (Chicago) and then doing a weighted average.

Source: Leopold Center for Sustainable Agriculture

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Preparing for Drought

Skills: Social Studies

Objective: Students form subcommittees to propose plans for drought management and relief.

Background:

March 1, 2005, through September 10, 2006, was the driest period on record in Oklahoma. Rainfall was 19 inches below normal, according to precipitation records from the Oklahoma Mesonet. The drought wiped out more than half the state's wheat crop in 2005, the worst harvest in more than 50 years. The drought also provided Oklahoma its worst wildfire season on record.

The drought in Oklahoma was part of a severe worldwide drought affecting the central and eastern United States, Europe and the Horn of Africa. It caused severe food shortages in east Africa, the threat of wildfires in the Central and Eastern United States and abnormally dry conditions in Australia and Europe. Thirty-seven people died (seven in the United States and 30 in east Africa), and damage from food and water shortages, wildfires, etc., came to over $1million. Between 40-50 million people were affected by the drought. Drought conditions also affected the Caribbean, central Europe and Asia.

Drought is defined as a period of time when there is not enough water to support agricultural, urban, human, or environmental water needs. Drought usually refers to an extended period of below-normal rainfall but can also be caused by anything that reduces the amount of liquid water available. Although what is considered "normal" varies from one region to another, drought is a recurring feature of nearly all the world's climatic regions.

Agricultural drought occurs when there is not enough moisture for crop or range production. This condition can arise even in times of normal precipitation, depending on soil conditions or agricultural techniques.

The effects of drought vary according to regional vulnerability. For example, subsistence farmers are more likely to migrate during drought because they do not have alternative food sources. Areas with populations that depend

P.A.S.S.

GRADE 6
Social Studies — 1.1; 2.1,3; 3.2

GRADE 7
Social Studies — 1.1,2; 2.2,4; 3.2,3; 4.2,5; 5.1,2; 6.1

GRADE 8
Social Studies — 1.1,2; 2.1

Resources Needed

computer access

reference books

world map

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Subsistence Farming

Subsistence farming usually refers to farming which produces enough to feed the family that works a piece of land but not enough for the family to trade at a market.

In the early days of American history, nearly every family practiced subsistence agriculture, with each family growing just enough to feed itself. With advances in agricultural technology over the years, one American farmer can now feed nearly 130 people. Advanced methods also help modern American farmers survive adverse conditions such as drought and flooding.

Subsistence agriculture is frequently organic, often simply for lack of money to buy industrial inputs such as fertilizer, pesticides, farm machinery, and genetically modified seeds. It is not necessarily beneficial for the environment.

One form of subsistence agriculture is shifting cultivation, a practice common in the tropics. In this agricultural system, farmers typically abandon a given plot when soil fertility wanes and move on to more fertile land, often using slash and burn techniques. A considerable fallow period follows on the abandoned land. This was a technique also used by native Americans and in early American history, when land was considered plentiful.

Subsistence farming persists today in sub-Saharan Africa and other developing parts of the world.

Source: "Subsistence Agriculture," *Wikipedia, The Free Encyclopedia.*

on subsistence farming as a major food source are more vulnerable to drought-triggered famine.

Background Sources: Oklahoma Climatological Survey; *Wikipedia, the Free Encyclopedia;* US Drought Monitor, University of Nebraska at Lincoln,

Activities

1. Read and discuss background. Use the following questions as the basis for discussion.
   — What is drought? How is drought different from low average precipitation?
   — What is a subsistence farmer? Where do subsistence farmers live? Why are subsistence farmers more vulnerable to the effects of drought than those with alternative resources?
   — What are some effects of drought on agriculture? (Crops dry up. No feed for animals. Cattlemen sell their cattle because they can't feed them. Farmers go out of business) How does that affect you? (less food in grocery stores, higher food prices, limited variety of food, lower quality of food)
2. Explain to students they have been appointed to serve on an international task force to help farmers around the world deal with drought.
   — As a class, brainstorm the type of information that would be needed to compile a drought response plan for farmers.
   — Assign each student to a subcommittee within the task force.
   — Divide the students into five groups.
   — Give each group one of the task cards included with this lesson.
   — Review "How Reliable Are Your Sources?" in the "Resources" section.
   — Students use encyclopedias, books and online resources to find the information needed to complete the tasks.
   — Students outline their research findings and provide a table of contents which organizes notes into user-friendly categories.
   — Groups complete their subcommittee reports.
   — Each group compiles a coherent summary of their notes that addresses the following question: "If you could implement only one policy change, what would your group decide as the best course to address the possibility of drought?" Each group should be prepared to explain its decision.

— All group notes and summaries should be combined to create a “Drought Preparedness Task Force Action Plan.”

— In a future class, students present their finding to the entire committee and assess the feasibility of each subcommittee’s proposals.

3. Using an online search engine, students research to identify five areas around the world where drought has occurred in the past 25 years.
4. Oklahoma’s most recent drought in 2005-2006 occurred at the same time as a drought on the Horn of Africa. Identify countries in the horn of Africa. (Djibouti, Ethiopia, Eritrea Somalia)

   — Find the latitudes and longitudes of these countries and compare them with Oklahoma’s latitude and longitude.

   — Look in an encyclopedia to find descriptions of these countries’ climates. Are they similar or different from Oklahoma’s climate.

   — Look in an encyclopedia to find what crops normally grow in these countries. How are the crops grown there similar or different from those grown in Oklahoma.

Extra Reading

Allaby, Michael, and Richard Garrett, *Droughts*, Facts on File, 2003.

Fridell, Ron, *The War on Hunger*, 21st Century, 2003.

Gifford, Clive, *Flooding and Drought*, Smart Apple, 2005.

Gifford, Clive, *The Kingfisher Geography Encyclopedia*, Kingfisher, 2003.

Kerley, Barbra, *A Cool Drink of Water,* National Geographic.

Mead, Alice, *Year of No Rain*, Farrar, Straus and Giroux

Windham, Jeannette P., *On the Horn of Africa: Let’s Travel to Somalia Together*, Global Age, 1995.

Woods, Michael, and Mary B. Woods, *Droughts*, Lerner, 2006.

Vocabulary

developing country — a country with a relatively low standard of living and an undeveloped industrial base. In developing countries, there is low per capita income, widespread poverty, and low capital formation.

drought — A long period of unusually dry weather.

drought tolerant — something (a plant) that will survive in the typical or somewhat less than typical amount of rainfall in a region.

famine — an extreme general shortage of food

fallow — land for crops allowed to lie idle during the growing season

genetically-modified seeds — seeds whose genetic material has been altered using techniques which transfer molecules from one plant to another to allow the expression of certain traits, such as resistance to pests, herbicides or harsh environmental conditions; improved shelf life; increased nutritional value, etc.

organic — of, relating to, or obtained from living things

precipitation — water or the amount of water that falls to the earth as hail, mist, rain, sleet, or snow

slash-and-burn — the cutting and burning of forests or woodlands to create fields for agriculture or pasture for livestock, or for a variety of other purposes

subsistence — the minimum (as of food and shelter) necessary to support life

vulnerable — open to attack or damage

Name____________________

Preparing for Drought

Committee 1

You are the Engineering Modification Subcommittee. Your task is to research and report on the following topics: What are some good farming practices to use to minimize the effects of drought? What inventions, technological modifications, plowing techniques or other measures are available that help farmers conserve water? What are the advantages and disadvantages to using these measures? How would these measures help in the instance of a drought?

Committee 2

You are the Drought-Tolerant Crops Subcommittee. Your task is to research and report on the following topics: What does the term "drought-tolerant" mean? What characteristics make a plant drought-tolerant? What traditional crops are best able to survive drought? What varieties of drought-tolerant traditional crops are available? What are the advantages and disadvantages of using these crops?

Committee 3

You are the Native Land Management Subcommittee. Your task is to research and report on the following topics: What hazards do drought place on native grasslands, shrublands and forests? How can these hazards be minimized? How does drought affect native plants and trees? What effect would wild/grass fires have on farmers?

Committee 4

You are the Livestock Subcommittee. Your task is to research and report on the following topics: How does drought impact farm animals? How will animals be fed when there is no pasture available? What farm animals are best equipped to withstand drought? What would be the economic impact to farmers of switching from one kind of livestock to livestock that is better able to withstand drought? What changes would they have to make in their farm operations?

Committee 5

You are on the Community Impact Subcommittee. Your task is to research and report on the following topics: What is subsistence farming? What is the economic impact on the community if subsistence crops fail due to drought? What is the economic impact on a community whose economy depends on farmers who sell their crops to other countries? What can communities do to prepare for the possibility of crop failure?

Committee 6

You are on the International Response Subcommittee. Your task is to research and report on what countries not affected by drought can do to help countries that are affected. Provide some examples of what other countries have done in the past and list some international organizatons already set up to provide drought relief. List types of aid available, for example, monetary, technical, etc.

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Math

Corn Field Math

Skills: Math

Objective: Students use number sense, measurement, and data analysis to construct drawings and compute multi-step problems dealing with whole numbers, fractions, and percents.

Background:

Corn is a grass, native to the Americas. The exact origin is unknown, but tiny ears of corn have been discovered at ancient village sites and in tombs of early Americans. Evidence of corn in central Mexico suggests it was used there as long as 7000 years ago, where it was domesticated from wild grass. Cultivated corn is known to have existed in what is now the southwestern US for at least 3000 years. In the United States, many of the various Native American tribes have traditionally grown corn — also known as maize — and used it for both food and utilitarian purposes. Eastern tribes shared their knowledge of corn production with early European settlers, an act which saved many from starvation.

Early American colonists dried corn and ground it as meal for flour. They used the ground corn in porridge, cake and bread. Fresh, or sweet corn, the kind we like to eat as corn on the cob, was not developed until the 1700s. Before then corn was only used in its dried form.

Along with wheat and rice, corn is one of the world's major grain crops. It is the largest grain crop grown in the US. About 9 percent of all the corn grown is used to produce food for humans. These foods include corn meal and other food products such as cooking oils, margarine, and corn syrups and sweeteners (fructose). Sixty four percent of all corn grown is used as feed for livestock.

Corncobs have been used in the manufacturing of nylon fibers and as a source for producing degradable plastics. Ethanol, a renewable fuel made from corn, has shown the possibility of becoming a major renewable fuel for the world's automotive industry.

Corn can be produced in much of Oklahoma, but primary production is in the Panhandle area. In Oklahoma, corn is harvested for either grain or silage with most of the grain going to dairies, animal feeding operations, and poultry operations. In an average year, around 25 million bushels are grown for grain in Oklahoma, with a yield of 130 bushels per acre. One bushel of corn is equal to 56 pounds.

Corn is pollinated by wind and is typically planted in 30-inch rows. A single seed (or kernel) of corn may produce a plant which

P.A.S.S.

GRADE 6
Math Process — 1.3,5,6; 2.2; 3.1,3; 4.1; 5.1,4
Math Content — 2.1,3; 4.3; 5.1

GRADE 7
Math Process — 1.3,5,6; 2.2; 3.1,3; 4.1; 5.1,4
Math Content — 1.1,2; 2.1b,2bc; 4.1a

GRADE 8
Math Process — 1.3,5,6; 2.2; 3.1,3; 4.1; 5.1,4
Math Content — 1.1a,2.1b; 4.3b

Resources Needed

computers and/or resource materials

calculators

graph paper

rulers

compasses

protractors (useful)

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yields more than 600 kernels of corn per ear. On one acre of land, anywhere from 22,000 to 35,000 individual plants may be grown.

Hybrid corn is developed to produce from one to two ears per plant. Ears per plant is often determined by moisture availability. Through better soil conservation practices, fertilizer use, better seed quality, and water availability, corn yields have increased 125 percent since 1950.

Activities

1. Read and discuss the background information and vocabulary.
2. Hand out the worksheet for students to complete.
   — Students will work in pairs or groups to solve the math problems.
   — Students will check answers after completing the first two before continuing.
   — In a class discussion, students will agree or disagree with the reasoning of other classmates and explaing their positions.

Extra Reading

Bial, Raymond, *Corn Belt Harvest*, Houghton-Mifflin, 1991.

Fussell, Betty, *Story of Corn*, University of New Mexico, 2004.

Hunger, Sally M., and Joe Allen, *Four Seasons of Corn: A Winnebago Tradition (We Are Still Here)*, Lerner, 1996.

Johnson, Sylvia, *Tomatoes, Potatoes, Corn, and Beans: How the Foods of the Americas Changed Eating Around the World*, Atheneum, 1997.

Landau, Elaine, *Corn (True Books — Food and Nutrition)*, Children's 2000.

Nielsen, Michelle L., *The Biography of Corn (How Did That Get Here?)*, Crabtree, 2007.

Rhoads, Dorothy, *The Corn Grows Ripe,* Puffin, 1993.

Vocabulary

cultivate — to prepare land for the raising of crop

domesticated — adapted to living with human beings and serving their purpose.

ethanol — a colorless, volatile, pungent liquid made from corn which can be burned as a fuel.

hybrid — an offspring of parents with different genes especially when of different races, breeds, species, or genera

maize — Native American name for corn. Also called Indian corn.

pollinated — pollen placed on the stigma of a plant for the purpose of creating seeds, flowers, fruit.

porridge — a soft cereal or meal boiled in water or milk until thick.

silage — the entire above-ground portion of the corn plant (including ear) that is harvested by cutting and chopping the plant before it reaches maturity. It is stored in silos or packed into above-ground pits and used for feed.

soil conservation — a protection from loss, waste, etc. of soil through efficient farming methods.

utilitarian — the quality or property of being useful.

Name ____________________

Corn Field Math

Use your calculator and other mathematical tools to solve the following problems. Compare your methods with a partner.

1. a)An acre of land is 43,560 sq. ft. How long is one side of a square acre?

   b)If the rows are 2.5 ft. apart, how many rows are there?

   c)How many corn plants will be in each row if there are 22,000 plants in a square acre?

2. Each corn plant produces one ear of corn. There are 600 kernels per ear. How many kernels are produced on 1 acre of land?

WAIT: CHECK YOUR ANSWERS TO THE FIRST TWO PROBLEMS BEFORE CONTINUING.

3. There are 135 bushels of corn produced per acre. How many kernels of corn are in a bushel?

4. A farmer has 640 acres planted in corn. How many bushels of corn will this yield if each plant produces two ears?

5. Corn is selling for $2.40 a bushel. Farmer A's plants produce two ears per plant, while Farmer B's plants produce one. Compare their earnings per acre.

6. The yield has increased by 125% or by a factor of 2.25 since 1950. It is 135 bushels today. What was it in 1950? Explain in writing how you completed your answer.

7. The farmer decided to plant his 320 acres in three different varieties of corn. Use graph paper to construct a model of the farmer's land. Label each section, and complete the calculations. Show your work. Discuss your work on this question with a partner or in a cooperative group.

   a)Variety A produces one ear per plant. The farmer planted 1/3 of his 320 acres in Variety A. How many bushels of corn can he expect from Variety A?

   b)Variety B produces two ears per plant. The farmer planted half of his 320 acres in Variety B. How many bushels of corn can he expect from Variety B?

   c)Variety C produces 1 ears per plant. The farmer planted the rest of his acreage in Variety C. How many bushels of corn can he expect from Variety C?

   d)What is the total yield the farmer can expect for the entire 320 acres?

   e)How much would the farmer receive from the sale of his corn at $2.40 a bushel?

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Name ______________________________

Corn Field Math (answers)

1. a)An acre of land is 43,560 sq. ft. How long is one side of a square acre?

   √43,460 = 208.71 ft per side.

   b)If the rows are 2.5 ft. apart, how many rows are there?

   208.71 ÷ 2.5 = 83.48

   c)How many corn plants will be in each row if there are 22,000 plants in a square acre?

   22,000 ÷ 83.48 = 263.54

2. Each corn plant produces one ear of corn. There are 600 kernels per ear. How many kernels are produced on 1 acre of land?

   22,000 x 600 = 13,200,000

3. There are 135 bushels of corn produced per acre. How many kernels of corn are in a bushel?

   13,200,000 ÷ 135 = 97,777.77

4. A farmer has 640 acres planted in corn. How many bushels of corn will this yield if each plant produces two ears?

   640 x 135 = 86,400 x 2 = 172,800 (2 ears per plant)

5. Corn is selling for $2.40 a bushel. Farmer A's plants produce two ears per plant, while Farmer B's plants produce one. Compare their earnings per acre.

   Farmer A: $2.40 x 270 = $648; Farmer B: $2.40 x 135 = $324

6. The yield has increased by 125%, or by a factor of 2.25, since 1950. It is 135 bushels today. What was it in 1950? Explain in writing how you completed your answer.

   x + (125%)x = 135; 2.25x = 135; 135 ÷ 2.25 = 60; x = 60

7. The farmer decided to plant his 320 acres in three different varieties of corn. Use graph paper to construct a model of the farmer's land. Label each section, and complete the calculations. Show your work. Discuss your work on this question with a partner or in a cooperative group.

   a)Variety A produces 1 ear per plant. The farmer planted 1/3 of his 320 acres in Variety A. How many bushels of corn can he expect from Variety A?

   1/3 x 320 = 106.66 acres x 135 bushels = 14,399.1 bushels

   b)Variety B produces 2 ears per plant. The farmer planted half of his 320 acres in Variety B. How many bushels of corn can he expect from Variety B?

   xx x 320 = 160 acres x 270 bushels = 43,200 bushels

   c)Variety C produces 1 ? ears per plant. The farmer planted the rest of his acreage in Variety C. How many bushels of corn can he expect from Variety C?

   1/6 x 320 = 53.33 acres x (135 x 1.5) = 10,799.325 bushels

   d)What is the total yield the farmer can expect for the entire 320 acres?

   14,399.1 + 43,200 + 10,799.325 = 68,398.425 bushels

   e)How much would the farmer receive from the sale of his corn at $2.40 a bushel?

   68,398.425 x $2.40 = $164,156.22

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Measuring Exponential Growth

Skills: Math

Objective: Students reinforce math skills while learning about best practices for protection of water quality in the management of animal feeding operations.

Background:

Many of the animal products you buy at the supermarket are from animals raised in animal feeding operations (AFOs). These are places where many animals (usually of the same type) are raised in confined situations.

The people who manage AFOs take steps to manage the wastewater from these facilities so it can benefit crops as fertilizer rather than wash into ponds and lakes. Wastewater from AFOs is filled with nutrients from the manure of the animals, as well as anything else washed down the drain (bedding, spilled feed, etc.).

Nutrients that get into ponds and lakes act as fertilizer to the algae in the ponds, just as nutrients on land act as fertilizer to plant life. When too much wastewater from AFOs enters ponds, lakes, or other surface water, the algae multiplies rapidly, covering the surface of the water. This is called an “algal bloom.” When the algae die, bacteria in the water decompose the algae. It takes a great deal of aerobic bacteria to decompose an algal bloom. In the process the oxygen levels in the water decline, killing fish and other aquatic life. This process is called “eutrophication.”

To prevent eutrophication, and to keep the manure nutrients for use as fertilizer for crops, AFOs often have large holding lagoons for animal waste. Some AFOs even compost the waste. In cases where many more nutrients are available than the surrounding fields need, some states (such as Oklahoma) have manure transfer programs to move manure to places where it can be used effectively.

Another use for wastewater is as an alternative to petroleum-based natural gas. Anaerobic digesters recover methane from liquid waste which can be used to produce electricity at the same time that it reduces methane emissions.

P.A.S.S.

GRADE 6
Math Process — 1.2; 2.2; 3.3; 4.1; 5.1,4
Math Content — 2.4; 5.2

GRADE 7
Math Process — 1.2; 2.2; 3.3; 4.1; 5.1,4
Math Content — 2.1b,3a; 5.1

GRADE 8
Math Process — 1.2; 2.2; 3.3; 4.1; 5.1,4
Math Content — 2.1b,2a; 5.1

Resources Needed

calculators

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Vocabulary

aerobic — a process or organism that requires oxygen
AFO — animal feeding operation; a place where animals are confined in large numbers and fed (rather than grazing in large pastures)
algal bloom — the quick growth of algae due to excess nutrients in the environment
anaerobic — a process or organism that does not require oxygen
binary fission — the reproduction process for bacteria; asexual
eutrophication — the depletion of oxygen in a pond or lake due to the decomposition of algal blooms by aerobic decomposers; leads to the death of aquatic life
exponential growth — growth of population at increasing rate due to increasing size
fecal — having to do with manure
generation — number of doublings of a bacterial population
lagoon — an enclosure built to hold liquid waste
methane — a gas byproduct of digestion, released by bacteria in the gut

Activity

1. Read and discuss background and vocabulary.
2. Hand out the worksheet included with this lesson for students to complete.
   — Students make a table to show results of their calculations.
   — Students compare and justify findings with a partner or in a small group. Students will be prepared to explain their reasoning.
3. Review the different kinds of graphs. (See "Graphs" in the "Resources" section.)
   — Students will select a graph and explain why it would be the best tool for graphing the information from the previous question.

Extra Reading

Eberts, Marjorie, *Nature*, McGraw-Hill, 1996.
Farrell, Jeanette, *Invisible Allies: Microbes That Shape Our Lives,* Farrar, Straus and Giroux, 2005.
Fowler, Allan, *If It Weren't for Farmers*, Children's, 1994.
Sayre, April Pulley, *Lake and Pond,* 21st Century, 1997.
Toupin, Laurie, *Freshwater Habitats: Life in Freshwater Ecosystems*, Franklin Watts, 2005.

Name ______________________________

Measuring Exponential Growth of E coli

One way to tell if there is manure contamination of a water supply is to check for the presence of *Escherichia coli* bacteria, commonly referred to as *E. coli*. This bacteria is found in the intestines of all animals, including humans, and is an indicator of fecal contamination. Bacteria reproduce in a process called binary fission. The bacteria makes a copy of its one chromosome (Humans have 46.), grows longer, and then splits in half. Their population doubles with every generation. This is called exponential growth. Some bacteria, like *E. coli*, can divide every 20 minutes. The number of bacteria present after a certain number of generations is:

$$2^{\text{number of generations}}$$

since one cell divides into two each time. So after 15 generations, one bacteria will have become:

$$2^{15} = 32{,}768 \text{ bacteria}$$

In other words, every five hours, one *E. coli* bacteria becomes 32,768 *E. coli* bacteria! If you want to determine how many bacteria you would end up with if you started out with more than one bacteria, you would just multiply that starting number by the formula above:

$$\text{starting number of cells X } 2^{\text{number of generations}}$$

If you started with 15 *E. coli* bacteria, after five hours you would have:

$$15 \text{ x } 2^{15} = 491{,}520 \text{ bacteria.}$$

1. To see how fast *E. coli* grows, use the information above to calculate the number of bacteria in the first 25 generations.

2. Since *E. coli* divide every 20 minutes until optimal conditions have been reached, how long would it take one *E. coli* to go through 25 generations?

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Measuring Exponential Growth of E coli (answers)

One way to tell if there is manure contamination of a water supply is to check for the presence of *Escherichia coli* bacteria, commonly referred to as *E. coli*. This bacteria is found in the intestines of all animals, including humans, and is an indicator of fecal contamination. Bacteria reproduce in a process called binary fission. They simply make a copy of their one chromosome (humans have 46), get longer, and then split in two. Their population doubles with every generation. This is called exponential growth. Some bacteria, like *E. coli*, can divide every 20 minutes. The number of bacteria present after a certain number of generations is:

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since one cell divides into two each time. So after 15 generations, one bacteria will have become:

$$2^{15} = 32{,}768 \text{ bacteria}$$

In other words, every five hours, one *E. coli* bacteria becomes 32,768 *E. coli* bacteria! If you want to determine how many bacteria you would end up with if you started out with more than one bacteria, you would just multiply that starting number by the formula above:

$$\text{starting number of cells X } 2^{\text{number of generations}}$$

If you started with 15 *E. coli* bacteria, after five hours you would have:

$$15 \text{ x } 2^{15} = 491{,}520 \text{ bacteria.}$$

1. To see how fast *E. coli* grows, students use the information above to calculate the number of bacteria in the first 25 generations.

1 = 2	**2 = 4**	**3 = 8**	**4 = 16**
5 = 32	**6 = 64**	**7 = 128**	**8 = 25**
9 = 512	**10 = 1024**	**11 = 2048**	**12 = 4096**
13 = 8192	**14 = 16, 384**	**15 = 32, 768**	**16 = 65, 536**
17 = 131,072	**18 = 262, 144**	**19 = 524,288**	**20 = 1,048,576**
21 = 2,097,152	**22 = 4,194,304**	**23 = 8,388,608**	**24 = 16,777,216**
25 = 33,554,432			

2. Since *E. coli* divide every 20 minutes until optimal conditions have been reached, how long would it take one *E. coli* to go through 25 generations?
   8 hours, 20 minutes

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Surveying: 19 Chains and 50 Links

Skills: Math

Objective: Students will use geometric skills to practice the art of surveying.

Background:

Surveying is the technique of measuring to determine the position of points or of marking out points and boundaries. These points may be above, beneath, or on the earth's surface.

Surveying is as old as civilization. It dates back to early Egypt. Every year, after the Nile River flooded and washed out farm boundaries, new boundaries were fixed by surveying. Three of the four presidents on Mount Rushmore started as surveyors — George Washington, Thomas Jefferson, and Abraham Lincoln.

From colonial times and through the 1800s surveying was performed using a crude transit, or compass, and a chain. The chain was designed by Edmund Gunter in the late 1500s and is sometimes referred to as "Gunter's chain." The most common chain used was 66 feet long and had 100 links. Each link was equal to 7.92 inches. The compass was mounted on a tripod or a single pole, called a "Jacob's Staff." These tools were cumbersome to carry and difficult to maneuver through thick brush. More modern methods of surveying include the Theodolite and electronic distance measurement, GPS (Global Positioning System), and robotic surveying systems.

When land was surveyed early in our history, it was laid out in townships. A township is a square section of land that measures six miles by six miles. Each township contained 36 sections. Each section was 640 acres, or one mile by one mile. Most pioneer farmers couldn't plant a whole section. Generally settlers started with 80 acres, with several pioneer families living on a single section of land.

When the government had surveyed the land, they set up a land office, where they sold the land at auctions. Another way the settlers acquired land was from the railroad companies. The government gave land to the railroad companies to encourage them to build railroad lines in the new territories. The railroad companies would sell some of the land to farmers.

In May of 1862, Congress passed the Homestead Act. It provided that any person over 21, who was the head of a family and either a

P.A.S.S.

GRADE 6
Math Process — 1.1,3,4,5; 2.3; 4.1; 5.4
Math Content — 2.3; 3.1a; 4.3

GRADE 7
Math Process — 1.1,3,4,5; 2.3; 4.1; 5.4
Math Content — 2.1b; 3.1a,3a; 4.2a

GRADE 8
Math Process — 1.1,3,4,5; 2.3; 4.1; 5.4
Math Content — 2.1b; 3.1; 4.3a

citizen or an alien and intended to become a citizen, could obtain the title to 160 acres (65 hectares) of public land if he lived on the land for five years and improved it. Settlers could also pay $1.25 per acre in place of the residence requirement. It was thought that the land was worthless until improved, and homesteaders should not have to pay for the land if they were willing to improve it by turning in into farms.

The Homestead Act attracted thousands of settlers to the West. From 1862 until 1900, it provided farms and new homes for between 400,000 and 600,000 families. As families arrived, the federal government had to survey the land.

For "No Man's Land" and the "Unassigned Lands" of Oklahoma, the Indian Meridian and Indian Base Line were established at approximately twelve miles west of the 97th meridian. As provided in 1866, with treaties between the US government and the Choctaw and Chickasaw nation, Indian land east of the 98th meridian was surveyed according to the public land survey system of the US General Land Office. Established in 1785, this system of land survey used a mathematically-determined method to divide the public domain into standard units called "sections." From the Initial Point (Fort Arbuckle — approximately six miles west of the present town of Davis), a north-south line (Indian Meridian) and east-west line (Indian Base) were drawn. Eventually all the mapping and surveying would become boundary lines from which thousands made the Land Run of 1889 into the "Unassigned Lands" of Oklahoma.

Background Sources: Bradley, Harold W., "Homestead Act," *World Book Encyclopedia*; Straus, E. G., "Gunter 's Chain," *World Book Encyclopedia;* "A Brief History of Land Surveying," http://www.plsurvey.com; "Surveying Land," http://www.campsilos.org; Chapman, Berlin B., *Indian Meridian*, Archives and Manuscripts Division, Oklahoma Historical Society, 1967

Resources Needed

ruler

yard/meter sticks

protractor

calculator

yarn/string

construction stakes

hammer

10' or 25' measuring tool

computer access

Activities

1. Read together and discuss the background information to familiarize students with surveying and its purpose.
   — Students will give examples of the uses of surveying today.
2. Discuss the Homestead Act of 1862.
   — Introduce/discuss the vocabulary.
   — Were the original purposes for the Homestead Act successful?
   — What problems or concerns arose?
3. Hand out Worksheet A and review with students.
   — Discuss the terminology of measurement used in surveying.
   — Compare the measurements to standard or metric units used today.
   — Students complete Worksheet A using the information given.
   — Discuss the problems or concerns students had relating to the conversion of measurements.
4. Hand out Worksheet B and review with students.

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— Discuss the surveying terminology of townships and sections.
— Divide students into groups of three or four.
— Students will work together to complete the surveying.
— Students will complete Worksheet B, using their geometric skills to physically stake out plots on the school grounds.
— Students will use protractors to accurately find the angles on their plots.
— Students will exchange work areas with another group and check the accuracy of that group's survey work.
— Discuss the problems of physically completing this activity rather than doing it on paper.
— What would have been some problems with surveying land in the early 1800s?

5. If going outside to complete the surveying activity isn't an option,use the following as a substitute.
   Materials needed: protrator, masking tape to mark corners (vertices), measuring tape, yard stick or rulers
   —Follow instructions for Activity 3.
   — Instead of stakes to mark corners (vertices), place a piece of masking tape on the floor, and use a pen or marker to mark a dot.
   —Use the measuring equipment and protractors to find the angles and measurements for each side of the geometric figure.

Modifications for Worksheet B:

1. Survey a square plot of land with sides of 10 links. (A link equals 7.92 inches.) Draw and label your plot when finished surveying.
2. Survey a triangular plot of land. The plot forms a right triangle whose base is 2 ft. long and contains a 60 degree angle. Draw and label your plot when finished with the measurements of all 3 sides and angles.
3. Your choice! Complete the survey of a plot which is a geometric polygon and has 6 or fewer sides. Be sure to draw and label a diagram of your plot

Extra Reading for Students

McGaw, Judith A., *Early American Technology: Making & Doing Things From the Colonial Era to 1850*, University of North Carolina Press, 1994.

Home, Robert K., *Of Planting and Planning: The Making of British Colonial Cities*, Routledge, 1996

Lasky, Kathryn, *The Journal of Augustus Pelletier: The Lewis and Clark Expedition (My Name is America)*, Scholastic, 2000.

Extra Reading for Teachers

Kolodny, Annette, *The Lay of the Land: Metaphor as Experience and History in American Life and Letters*, University of North Carolina Press, 2005.

Vocabulary

boundary — anything marking a limit or border

chain — a 66 foot length in surveying made up of 100 links

compass — instrument for showing direction by using a magnetic needle which always points north

domain — land or territory belonging to one government or person

Global Positioning System (GPS) — A system of satellites, computers, and receivers that is able to determine the latitude and longitude of a receiver on Earth by calculating the time difference for signals from different satellites to reach the receiver

hectare — metric measure of surface equal to 10,000 square meters or 2.471 acres

meridian — any of the lines of longitude running north and south on a map or globe

robotic — an automated device to take the place of human manual work

transit — a surveying instrument for measuring horizontal angles

Name ________________________________

Surveying: 19 Chains and 50 Links A

Surveying units:

- Chain = 66 ft. or 20 meters (100 links)
- Link = 7.92 inches
- Rod/perch/Jacob's pole = 16.5 feet
- 80 chains = 1 mile
- 100 square chains = 10 acres square
- 1 chain = the width of many rural roads
- Furlong/furrowlong = 660 ft.
- Mile = 5280 ft. or 1760 yds.
- Township = square of land 6 miles by 6 miles
- Township = 36 sections
- Section = 640 acres or 1 mile square

Use the above information to complete the activities below. Please show your computations.

1. Draw a township, including the 36 sections. (.25 inches = 1 mile)

2. Most early settlers could only farm 80 acres. How many 80-acre plots are included in a township?

3. A Jacob's pole is 3 fathoms or 16.5 feet long.
   a. How many poles would equal 1 chain?

   b. How many links would equal one pole?

4. Surveyors used stakes to mark the end of each chain. If they were surveying a square plot of 10 acres per side, how many stakes would they need?

5. How many chain lengths would be needed to survey a township? (perimeter measurement)

6. How many chains and links would be needed to plot a distance of 8000 feet?

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Name ________________________________

Surveying: 19 Chains and 50 Links A (answers)

Surveying units:

Chain = 66 ft. or 20 meters (100 links)
Link = 7.92 inches
Rod/perch/Jacob's pole = 16.5 feet
80 chains = 1 mile
100 square chains = 10 acres square
1 chain = the width of many rural roads

Furlong/furrowlong = 660 ft.
Mile = 5280 ft. or 1760 yds.
Township = square of land 6 miles by 6 miles
Township = 36 sections
Section = 640 acres or 1 mile square

Use the above information to complete the activities below. Please show your computations.

1. Draw a township, including the 36 sections. (.25 inches = 1 mile)
   Answer: Each side of the township should measure 1 ? inches.

2. Most early settlers could only farm 80 acres. How many 80-acre plots are included in a township?
   Answer: Each section = 640 acres ÷80 acres = 8 farm plots
   36 sections (1 township) x 8 farms = 288 plots

3. A Jacob's pole is 3 fathoms or 16.5 feet long.
   a. How many poles would equal 1 chain?
   Answer: 1 chain = 66 ft.
   66 ft. ÷ 16.5 ft. = 4 poles
   b. How many links would equal one pole?
   Answer: 1 link = 7.92 in   1 pole = 16.5 ft. or 198 in.
   198 in. ÷ 7.92 in. = 25 links

4. Surveyors used stakes to mark the end of each chain. If they were surveying a square plot of 10 acres per side, how many stakes would they need?
   Answer: 10 chains per side
   4 corner stakes + 9 stakes per side
   9 stakes x 4 sides + 4 corners = 40 stakes

5. How many chain lengths would be needed to survey a township? (perimeter measurement)
   Answer: 80 chains per mile   6 miles x 4 sides = 24 miles perimeter
   24 miles x 80 chains = 1920 chain lengths

6. How many chains and links would be needed to plot a distance of 8000 feet?
   Answer: 1 chain = 66 ft.   8000 ft. ÷ 66 ft = 7986 ft. (121 chains)
   8000 – 7986 = 14 ft. or 168 inches
   168 in ÷ 7.92 in = 21.21 links
   Final answer: 121 chains and 21.21 link

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Name ______________________________

Surveying: 19 Chains and 50 Links B

As a surveyor, you will be marking out sections of land. All angles and measurements need to be exact.

1. Survey a square plot of land with sides of 25 links. (A link equals 7.92 inches.) Draw and label your plot when finished surveying.

2. Survey a triangular plot of land. The plot forms a right triangle whose base is 3 ft. long and contains a 60-degree angle. Draw and label your plot when finished with the measurements of all three sides and angles.

3. Your choice! Complete the survey of a plot which is a geometric polygon and has 6 or fewer sides. Be sure to draw and label a diagram of your plot with angles and sides.

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Name ______________________________

Surveying: 19 Chains and 50 Links B (answers)

As a surveyor, you will be marking out sections of land. All angles and measurements need to be exact.

1. Survey a square plot of land with sides of 25 links. (A link equals 7.92 inches.) Draw and label your plot when finished surveying.
   Answer: 25 links x 7.92 in = 198 inches or 16.5 ft. or 5.5 yds
   Drawing: a square with 90 degree angles

2. Survey a triangular plot of land. The plot forms a right triangle whose base is 3 ft. long and contains a 60 degree angle. Draw and label your plot when finished with the measurements of all 3 sides and angles.
   Answer: The angles of the right triangle should be 30, 60, and 90 degrees respectively. The sides of the triangle should follow the formula 3 squared + "b" squared = "c" squared with "c" being the hypotenuse of the triangle.

3. Your choice! Complete the survey of a plot which is a geometric polygon and has 6 or fewer sides. Be sure to draw and label a diagram of your plot with angles and sides.
   Answers: Each group will vary depending on the choice of design.

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Oklahoma Wheat on the World Market

Skills: Math, Social Studies, Language Arts

Objective: Students compute profit and loss in a wheat trading market and graph their market activity.

Background:

Wheat is a grass that is cultivated worldwide. Globally, it is the most important human food grain and is second only to maize in total production. Wheat is Oklahoma's most valuable agriculture export.

Wheat grain is a staple food used to make flour for leavened, flat and steamed breads as well as cookies, cakes, pasta, and noodles. Three crops; wheat, rice and corn, account for over 75 percent of our grain consumption. Wheat is also used for fermentation in making alcoholic beverages. Wheat is sometimes planted as a forage crop for livestock. The straw can be used as fodder for livestock. In less-developed countries, straw can also be used as a construction material for roofing thatch.

International trade is defined as the exchange of goods and services across international boundaries or territories. This trade represents a significant share of the Gross Domestic Product (GDP) for most countries. While international trade has been present throughout much of history, its economic, social, and political importance has been on the rise in recent centuries, due, in large part, to industrialization, advanced transportation, globalization, multinational corporations, and outsourcing.

Trade and marketing are vital to American agriculture. The US exports agricultural products to countries that can't grow crops and livestock as efficiently as American farmers or can't grow them at all, due to their lack of space, viable soil, or climate restrictions. The US also imports products from other countries that produce different, less expensive, or better quality goods.

Government trade policies influence the volume of trade between nations. In domestic trade, goods may move freely from one part of the nation to another. In international trade, governments often place artificial barriers against the free movement of goods from one country to another. Several organizations, policies, and/or agreements maintain and control fair trading between the US and other countries.

The United States is the world's leading wheat exporter. Our largest export of wheat, from October, 2006, to January, 2007, was to Egypt, with 876,409 tons shipped. Generally, the US, Canada, Australia, the European Union, and Argentina account for over 70 percent of world wheat exports. In 2002-03, however, that share dropped to 63 percent. This was due to the increased wheat exports of Russia, Ukraine, and India.

P.A.S.S.

GRADE 6
Social Studies — 1.3; 4.2
Math Process — 1.3; 2.1; 3.3; 4.1; 5.1,4
Math Content — 2.3; 5.1,3
Reading — 1.1a; 3.1b; 5.2a
Oral Language — 1.2

GRADE 7
Social Studies — 1.1; 4.1,2
Math Process — 1.3; 2.1; 3.3; 4.1; 5.1,4
Math Content — 2.1ab
Reading — 1.1; 3.1a; 5.2a
Oral Language — 1.2

GRADE 8
Social Studies — 1.1,5
Math Process — 1.3; 2.1; 3.3; 4.1; 5.1,4
Math Content — 2.1ab; 5.1,2b
Reading — 1.1; 3.1a; 5.2a
Oral Language — 1.2

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Oklahoma Ag in the Classroom
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Vocabulary

biofuel — a fuel (as wood or ethanol) composed of or produced from biological raw materials

cultivated — planted and grown

export — goods or commodities transported from one country to another country

fermentation — chemical breaking down of a substance (as in the souring of milk or the formation of alcohol from sugar) produced by an enzyme and often accompanied by the formation of a gas

fodder — coarse food for cattle, horses, and sheep as cornstalks, hay, and straw

globalization — affecting or relating to the earth as a whole; world-wide

import — goods or commodities brought into one country from another country

industrialization — the change in social and economic organization resulting from the replacement of hand tools by machine and power tools and the development of large scale industrial production

leaven — to produce fermentation in by means of yeast or other ferment

outsourcing — supplying raw materials to other companies, states, or countries for the production of finished products.

The diversity of exporting countries provides significant stability to world wheat trade and prices. In the Northern Hemisphere, most of the wheat production is grown as winter wheat. Parts of Canada, Kazakhstan, Russia, and the United States have large spring wheat production, which is planted much later in the crop year. Other countries, like Australia and Argentina in the Southern Hemisphere, plant winter wheat after the Northern Hemisphere's spring wheat. With wheat being planted and harvested at different times, a shortfall in one area of the world can be quickly responded to by other wheat-producing areas.

Background Sources: Vocke, Gary, Edward W. Allen, and Mir Ali, "Wheat Backgrounder," USDA, 2005; "Grain Trade," *Encyclopedia Britannica*, Eleventh Edition, Wikipedia, 2007; "Wheat," *Wikipedia, the Free Encyclopedia*, http://en.wikipedia.org/wiki/Wheat

Activities

1. Read and discuss background and vocabulary.
2. Follow the directions included in this lesson to set up the "Wheat Market Trading Game" for students to play.
   — To divide students into groups, use popsicle sticks in eight different colors, with three per color.
   — For each group of three, mark one "buyer," one "seller," and one "transaction person."
   — Students draw the sticks as they come into the room.
   — Students arrange themselves into groups according to the colors they have drawn.
   — Provide each group with a copy of the instructions for playing.
3. Use the following questions to lead a post-game discussion:
   — What was the most frequent price for wheat in each round?
   — In which round was the price spread the greatest?
   — Who determines the market price for wheat, buyers or sellers?
   — How does supply and demand determine the market for wheat?
4. Students will complete a graph of their choosing to show buying and selling activity. A review of graphing is included in the "Resources" section.
   — Follow the steps for a complete graph; title, labels, mean, mode, median, etc.
   — Display the graphs.
   — Discuss information gained.

This activity was adapted from Schults, Mindella, "The Wheat Market Game," *Teacher's Manual for Economics Readings for Students in Ninth Grade Social Science*, Pittsburgh Public Schools, 1967.

Extra Reading

Burgess, John, *World Trade — Exploring Business and Economics*, Chelsea House, 2001.

Landau, Elaine, *Wheat (True Books — Food and Nutrition)*, Children's, 2000.

The World Almanac for Kids — 2006, World Almanac, 2005.

Wheat Market Trading Game

Preparations

1. Prepare cards ahead of time, as follows.
   — Copy the cards from the pages that follow on heavy cardstock paper. Use a different color card for each group, if possible.
   — Cut cards apart.
   — Separate groups of cards.
   — You will need 14 transaction cards, 32 buy cards, and 32 sell cards in the following distribution:

# of Transactions		Buy Cards		Sell Cards	
Transactions	# of Cards	Buy Price	#	Sell Price	#
1	4	$3.50	2	$3.50	4
2	5	$3.70	2	$3.70	6
3	3	$3.90	2	$3.90	6
4	2	$4.10	2	$4.10	4
		$4.30	4	$4.30	4
		$4.50	4	$4.50	2
		$4.70	4	$4.70	2
		$4.90	4	$4.90	2
		$5.10	4	$5.10	2
		$5.30	4		

   — The teacher can handle the cards or assign one student to be the buyer, one the seller, and one the transaction person.
   — Shuffle each set of cards.
   — Place the cards in the front of the room with a place card by each stack — one marked "transaction," one marked "buy," and one marked "sell."
2. Prepare a copy of the score sheet for each group of students.
3. Make an overhead copy of the "Class Tally Sheet," included withe this lesson, or draw one on the board.

Getting Ready to Play

1. Divide the class into groups of three students each. (The activity works best in a class of 20 or more students.)
   — Each group will need a score sheet.
   — Each group consists of a Buyer, a Seller, and a Transaction Person (TP). Students may change positions at the beginning of each round.
2. You may decide to complete between three and five rounds of play.
   — Stop after each round of play to calculate each group's gain or loss.
   — After each round, have each group announce how many transactions they completed and whether they had a gain or loss. The students should see a correlation between the number of transactions completed and a gain.

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Wheat Market Trading Game

Start of Play — Round 1

1. Inform students as follows:
   — You will be acting as buyers and sellers of wheat on the world market.
   — For each round of transactions you will have a gain or a loss, depending on the card you draw.
2. The transaction person (TP) from each group draws a card.
   — TP returns to his/her seat.
   — On the group score sheet, the TP circles the number of transactions the group gets to complete during round 1 and crosses out all other numbers, e.g., if the card says the group will complete two transactions during this round of play, TP circles the number two under transactions and crosses out the numbers three and four.
3. The buyer from each group draws a Buyer card.
   — Buyer returns to his/her seat.
   — Buyer records the price per bushel on the group's score sheet.
   — Buyer records the value of 10 bushels of wheat.
4. The seller from each group draws a Seller card.
   — Seller returns to his/her seat.
   — Seller records the price per bushel on the score sheet.
   — Seller records the value of 10 bushels of wheat.
5. The group determines whether it had a gain or loss for each transaction.
   — If the group sold its wheat for more than what they bought it for, they made a gain on that transaction, e.g, Bought Wheat – Sold Wheat = Gain or Loss.
6. After each transaction, students use tally marks to record the price for which they sold their wheat on the "Class Tally Sheet."
7. Students return all buying and selling cards to the stacks.
8. Reshuffle.
9. Begin the next transaction round with those groups who can still participate.
   — Groups that participate in only one transaction must return their transaction cards.
10. Continue play until all groups have completed all transactions.
    — Complete the gain or loss total for round 1.

Rounds 2-5

1. Continue play as before for the next rounds, reshuffling cards and drawing new transaction cards at the beginning of each new round.
2. Complete the Grand Total gain or loss at the end of the game.

Game Cards

Copy on cardstock and cut. You will need 14 transaction cards, 32 buy cards, and 32 sell cards

TRANSACTION CARD You are authorized to complete ONE transaction during this round of play. Return your Transaction Card to the stack when finished.	TRANSACTION CARD You are authorized to complete TWO transactions during this round of play. Return your Transaction Card to the stack when finished.	TRANSACTION CARD You are authorized to complete THREE transactions during this round of play. Return your Transaction Card to the stack when finished.
TRANSACTION CARD You are authorized to complete FOUR transactions during this round of play. Return your transaction card to the stack when finished.	BUY CARD You are authorized to BUY 10 bushels of wheat. The price is $5.30 per bushel for a total of $53.00 for the 10 bushels.	BUY CARD You are authorized to BUY 10 bushels of wheat. The price is $5.10 per bushel for a total of $51.00 for the 10 bushels.
BUY CARD You are authorized to BUY 10 bushels of wheat. The price is $4.90 per bushel for a total of $49.00 for the 10 bushels.	BUY CARD You are authorized to BUY 10 bushels of wheat. The price is $4.70 per bushel for a total of $47.00 for the 10 bushels.	BUY CARD You are authorized to BUY 10 bushels of wheat. The price is $4.50 per bushel for a total of $45.00 for the 10 bushels.
BUY CARD You are authorized to BUY 10 bushels of wheat. The price is $4.30 per bushel for a total of $43 for the 10 bushels.	BUY CARD You are authorized to BUY 10 bushels of wheat. The price is $4.10 per bushel for a total of $47.00 for the 10 bushels.	BUY CARD You are authorized to BUY 10 bushels of wheat. The price is $3.90 per bushel for a total of $39 for the 10 bushels.

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BUY CARD You are authorized to BUY 10 bushels of wheat. The price is $3.70 per bushel for a total of $37 for the 10 bushels.	BUY CARD You are authorized to BUY 10 bushels of wheat. The price is $3.50 per bushel for a total of $35 for the 10 bushels.	SELL CARD You are authorized to SELL 10 bushels of wheat. The price is $5.10 per bushel for a total of $51 for the 10 bushels sold.
SELL CARD You are authorized to SELL 10 bushels of wheat. The price is $4.90 per bushel for a total of $49 for the 10 bushels sold.	SELL CARD You are authorized to SELL 10 bushels of wheat. The price is $4.70 per bushel for a total of $47.00 for the 10 bushels sold.	SELL CARD You are authorized to SELL 10 bushels of wheat. The price is $4.50 per bushel for a total of $45.00 for the 10 bushels sold.
SELL CARD You are authorized to SELL 10 bushels of wheat. The price is $4.30 per bushel for a total of $43.00 for the 10 bushels sold.	SELL CARD You are authorized to SELL 10 bushels of wheat. The price is $4.10 per bushel for a total of $41.00 for the 10 bushels sold.	SELL CARD You are authorized to SELL 10 bushels of wheat. The price is $3.90 per bushel for a total of $39.00 for the 10 bushels sold.
SELL CARD You are authorized to SELL 10 bushels of wheat. The price is $3.50 per bushel for a total of $35.00 for the 10 bushels sold.	SELL CARD You are authorized to SELL 10 bushels of wheat. The price is $3.70 per bushel for a total of $37.00 for the 10 bushels sold.	

Name ______________________________

Class Tally Sheet

Price per bushel	Round 1	Round 2	Round 3	Round 4	Round 5	Total for Rounds Played
$3.50						
$3.70						
$3.90						
$4.10						
$4.30						
$4.50						
$4.70						
$4.90						
$5.10						
$5.30						

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Group________________________________

Group Score Sheet

Transaction Number	BUY Price of 1 bushel	SELL Price of 1 bushel	BUY Price of 10 bushels	Sell Price of 10 bushels	GAIN from transaction	LOSS from transaction
1						
2						
3						
4						
Total for Round 1	NA	NA	NA	NA		
1						
2						
3						
4						
Total for Round 2	NA	NA	NA	NA		
1						
2						
3						
4						
Total for Round 3	NA					
1						
2						
3						
4						
Total for Round 4	NA					
1						
2						
3						
4						
Total for Round 5	NA					
Grand Total for all Rounds	NA	NA	NA	NA	GAIN (for all rounds)	LOSS (for all rounds)

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Math and Science

Are You Thirsty?

The effects of pollution on drinking water

Skills: Science, Math, Language Arts

Objective: Students will construct models to visualize the amount of usable water in Oklahoma and the effects of pollution.

Background:

Americans sometimes take for granted the availability of clean, plentiful and cheap water. The percentage of the earth's water available for our use is only a small fraction of the total. If five gallons (2,280 tablespoons) represents all the world's water, 35 tablespoons represent water available for humans and other species to use. Take away the ice caps and glaciers and a mere 8.04 tablespoons remain.

Water can be polluted by many sources. These sources are classified according to the way they enter the environment. Point source pollutants can be traced to their original source. Point source pollutants are discharged directly from pipes or spills. Raw sewage draining from a pipe directly into a stream is an example of a point source water pollutant. Nonpoint source pollutants cannot be traced to a specific original source. These pollutants can only be traced to a general area. Nonpoint sources of pollution include runoff from backyards, parking lots, farms, mines, construction sites, etc.

Point source pollution is easier to control because its source is easier to locate. In recent years we have done a better job controlling point source pollution through strict regulations and stiff penalties for polluters. For this reason, nonpoint source pollution has emerged as a greater threat.

Agriculture has been one source of nonpoint source pollution, through contamination by sediment, fertilizers, herbicides, insecticides, and animal waste. Conservation of water and other natural resources is important to those involved in agriculture because their livelihood depends on it. As a result, the agriculture industry works continually to reduce nonpoint source pollution from agriculture through active research, new technology and farming practices, and regulations for waste management. Precision agriculture, integrated pest management, soil conservation, erosion control and organic farming are some of the methods which decrease the need for chemicals in farming operations. Animal waste (manure) is managed as a source of

P.A.S.S.

GRADE 6
Science Process — 3.1,2,6; 4.2; 5.4
Life Science — 4.1; 5.1,2
Math Process — 1.3; 4.1
Math Content — 2.2,3
Reading — 1.1a; 3.1b,2a
Writing — 2.7

GRADE 7
Science Process — 1.1; 3.1.2.6; 4.2; 5.4
Physical Science — 1.1
Math Process — 1.3; 4.1
Math Content — 2.1ab
Reading — 1.1; 3.1a,2a
Writing — 2.8

GRADE 8
Science Process — 1.1; 3.1,2,6; 4.2; 5.4
Physical Science — 1.1
Math Content — 2.1ab
Reading — 1.1; 3.1a,2a
Writing — 2.8

nutrients for crops, and the agriculture industry is working to make the best use of this valuable resource before it becomes a pollutant.

Other nonpoint source pollutants include runoff from lawns, runoff from oil, grease, and toxic chemicals from roadways, parking lots, and other surfaces, and sediment from improperly managed construction sites, other areas from which foliage has been cleared, or eroding stream banks.

Background Source: Oklahoma Department of Environmental Quality, http://www.ega.gov; "Pollution Prevention Fact Sheet: Landscaping and Lawn Care," Stormwater Manager's Resource, Center for Watershed Protection, http://www.stormwatercenter.net/Pollution_Prevention_Factsheets/LandscapingandLawnCare.htm

Resources Needed

plastic one-gallon container

eye dropper

small metal bucket

water

clear measuring cup

food coloring (1 color)

calculators

small plastic bags, one per student

large clear container (e.g, large pickle jar)

coffee filter paper

netting or cheese cloth

string or large rubber bands

Activities

Read and discuss the background information and vocabulary.

ACTIVITY 1

1. Pass out copies of "The World's Water Supply," included with this lesson.
2. Discuss the differences in percentages of water at surface, subsurface, and other water locations.
3. Students will complete the questions at the bottom of the page.
4. Students will discuss their problem-solving methods in small groups or with partners and justify their answers.

ACTIVITY 2

1. Students will refer to Question # 3 from "The World's Water Supply" handout as they complete the "Drop in the Bucket" activity included with this lesson.

ACTIVITY 3 — Students will conduct the following activity to consider how pollutants enter the water supply.

1. Fill a large transparent bowl with one gallon of tap water.
2. Place items in bags from the list at the beginning of the story "River — Our Precious Water," included with this lesson. Divide items in such a way that each student will have an item to add to the bowl, e.g., divide each substance into 2-3 separate bags.
3. Label the outside of each bag with the letter and pollution contributor, e.g., "A. natural runoff;" "B. family," "C. farmer," etc.
4. Distribute bags to students, and instruct them to add their "pollutants" to the water when instructed to do so. (Remind students to exercise caution when mixing unlike ingredients together.)
5. Read the story.
   — Students will consider the progression of the settlement and history of the United States as they listen to the story.
6. As you read the story, one student at a time will contribute the contents of one of the bags to the bowl of water.

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7. At the close of the activity, ask "Who is responsible for water pollution?" (all of us — home owners, businesses, commuters, farmers, litterers, etc.)
8. Review causes of water pollution from the background discussion (lawn and agricultural fertilizers, sediment, building construction, etc.).
9. Students will discuss ways they personally can help reduce nonpoint source pollution. (Don't litter. Leave grass clippings on the lawn to reduce the need for lawn fertilizer. Have soil tested and use no more fertilizer than necessary. Walk or bike when possible instead of riding in the car. Dispose of chemicals properly.)

ACTIVITY 4

1. Discuss the function of water treatment plants, uncultivated fields, rocks, and sand as filters for ground water.
2. Students will predict which pollutants from the previous activity can be easily stopped by filtration and which would end up in our water supply.
3. Attach one of the coffee filters to the top of the pickle jar. Leave some slack so the water has time to run through while larger objects are trapped on top.
4. Slowly pour the contents of the bowl from the previous activity into the gallon jar.
5. Ask students the following questions:
   — Is the liquid in the jar drinkable?
   — What could be done to make it safe for drinking?
   — If the trapped litter left in the filter were buried for 6 to 8 weeks would it decompose into the soil?
   — If it did decompose would it be toxic to the ground water?

CONCLUSION

1. Students will make inferences and draw conclusions using evidence drawn from all three activities and their life experiences.

Extra Reading

Ditchfield, Christin, *Water* (True Books: Natural Resources), Children's, 2003.

Donald, Rhonda Lucas, *Water Pollution* (True Book: Environment), Children's, 2002.

Maze, Stephanie, *I Want to be an Environmentalist*, Harcourt Paperbacks, 2000.

Toupin, Laurie, *Freshwater Habitats: Life in Freshwater Ecosystems,* Franklin Watts, 2005

Vocabulary

erosion — the wearing away by the action of water, wind, or glacial ice
fertilizer — a substance (as manure or a chemical) used to make soil produce larger or more plant life
herbicide — a chemical substance used to destroy or stop plant growth
insecticide — a chemical used to kill insects
integrated pest management
livelihood — what one has to have to meet one's needs
nonpoint source pollutant — pollutants that cannot be traced to a specific original source
nutrient — furnishing nourishment
organic farming — a form of agriculture which avoids or largely excludes the use of synthetic fertilizers and pesticides, plant growth regulators, and livestock feed additives
point source pollutant — pollutants that can be traced to their original source
pollute — to spoil (as a natural resource) with waste made by humans
raw sewage — wastewater contaminated with feces and urine
runoff — water from rain or snow that flows over the surface of the ground and finally into streams
sediment — material (as stones and sand) deposited by water, wind, or glaciers
soil conservation — management strategies for prevention of soil being eroded from the earth's surface
toxic — of, relating to, or caused by a poison or toxin
waste management — the collection, transport, processing, recycling or disposal of waste materials, usually ones produced by human activity

Name ______________________________

The World's Water Supply

Location	Water Volume (cubic miles*)	Percentage Total Water
Surface Water		
Freshwater lakes	30,000	.009
Salt lakes and inland seas	25,000	.008
Rivers and streams	300	.0001
Total for surface water (Rounded to nearest thousandths)	55,300	.017
Subsurface Water		
Soil moisture	16,000	.005
Groundwater within depth of ? mile	1,000,000	.31
Deep-lying groundwater	1,000,000	.31
Total for subsurface water	2,016,000	.625
Other Water Locations		
Ice caps and glaciers	7,000,000	2.15
Atmosphere	3,100	.001
Oceans	317,000,000	97.2
Total for other water locations	324,003,100	99.351
*A cubic mile of water equals 1.1 trillion gallons		
Total (rounded)	**326,000,000**	**100.00**

1. What is the ratio of surface water to subsurface water?

2. If all the ice caps and glaciers were to melt into the oceans, what would be the percentage increase in the water volume of the oceans?

3. If 5 gallons (2,280 tablespoons) represents all of the world's water, 35 tablespoons represent fresh water available for humans and other species to use. If you take away the ice caps and glaciers, a mere 8.04 tablespoons remain.

   a.) What percentage of all the world's water is the fresh water total?

   b.) If ice caps and glaciers are not counted, what percentage of all the world's water does the 8.04 tablespoons represent?

Adapted from "Water of the World," Raymond Nace, U.S. Department of the Interior/ Geological Survey, Publication 1984-421-618/107.

Name ______________________________

The World's Water Supply (answers)

Location	Water Volume (cubic miles*)	Percentage Total Water
Surface Water		
Freshwater lakes	30,000	.009
Salt lakes and inland seas	25,000	.008
Rivers and streams	300	.0001
Total for surface water (Rounded to nearest thousandths)	55,300	.017
Subsurface Water		
Soil moisture	16,000	.005
Groundwater within depth of ? mile	1,000,000	.31
Deep-lying groundwater	1,000,000	.31
Total for subsurface water	2,016,000	.625
Other Water Locations		
Ice caps and glaciers	7,000,000	2.15
Atmosphere	3,100	.001
Oceans	317,000,000	97.2
Total for other water locations	324,003,100	99.351
*A cubic mile of water equals 1.1 trillion gallons		
Total (rounded)	326,000,000	100.00

1. What is the ratio of surface water to subsurface water?
   Answer: 55,300 / 2,016,000 = 1 / 36.5

2. If all the ice caps and glaciers were to melt into the oceans, what would be the percentage increase in the water volume of the oceans?
   Answer: 317,000,000 + 7,000,000 = 324,000,000
   7,000,000 / 324,000,000 x 100% = 2.16 %

3. If 5 gallons (2,280 tablespoons) represents all of the world's water, 35 tablespoons represent fresh water available for humans and other species to use. If you take away the ice caps and glaciers, a mere 8.04 tablespoons remain.
   a.) What percentage of all the world's water is the fresh water total?
   Answer: 35 ÷ 2,280 x 100 = 1.5%

   b.) If ice caps and glaciers are not counted, what percentage of all the world's water does the 8.04 tablespoons represent?
   Answer: 8.04 ÷ 2,280 x 100 = .3 %

Adapted from Water of the World, Raymond Nace, U.S. Department of the Interior/ Geological Survey, Publication 1984-421-618/107.

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A Drop in the Bucket

Materials Needed: 1 gallon container, eye dropper, small metal bucket, water

1. Fill the gallon container so that it is nearly full.
   This represents the earth's total water supply (100 percent).

2. Pour one ounce (1/8 cup) of water from the gallon container into the measuring cup.
   This represents all the earth's land water (.65 percent). Land water, for the purpose of this activity, is defined as the water found on and under the earth's land surface that is potentially available for use by humans. This water may or may not be drinkable. Some land water is found in saline lakes. These lakes contain such high concentrations of salts that the water is not potable.

   The water remaining in the gallon jug represents the water stored in the oceans, seas and polar ice caps (99.35 percent).

3. Remove a dropper full of water from the land water.
   The water in the dropper represents all good quality water found in the world's freshwater lakes, rivers and ground water.

4. Put a drop of food coloring into the measuring cup to show that the remaining land water is not drinkable without treatment.

5. Release one drop from the water dropper into a small metal bucket. Students must be very quiet so that they can hear the sound of the drop hitting the bottom of the bucket.
   This drop in the bucket is Oklahoma's share of the world's water. This one drop is precious and must be managed carefully and wisely.

Source: "Teaching Aquifer Protection," Clemson University Cooperative Extension

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A. leaves, small twigs — natural runoff
B. powder detergent — family
C. soil, cow manure — farmer
D. paper, pencils — business
E. gravel, wood chips, insulation — builder
F. candy wrappers, pop cans, pieces of foil, plastic bags, etc. — litterer
G. motor oil/solvents — backyard mechanic
H. vinegar (acid rain) — commuter

In the beginning there was the river. Trees grew. Fish grew. One by one, the animals came to drink the water. (Add substance A)

One morning a person appeared. He paddled down the river in a canoe. He knew the river was good. He returned with his family. (Add substance B.)

After a while, more people came. They made friends with the first people. They planted gardens on the banks of the river. (Add substance C.)

Many more people arrived. They wanted to live on the river too. They brought goods to trade with the others. (Add substance D.)

The new people cleared the land. They used the timber to build houses. (Add substance E.)

More and more people came. Towns began to grow. The people used the river for fishing, cooking, washing, and traveling. (Add substance F.)

New inventions changed life for the people. Steamboats took the place of sailing ships. Automobiles took the place of horses. Trains ran beside the waters. (Add substance G.)

The towns grew bigger and faster. More and more warehouses and factories were built. Businesses boomed. (Add substance H.)

The animals no longer came to drink. The fish disappeared. There were too many needs. But the people remembered how it had been. The people wanted a change. They tore down some of the factories and listened to the needs of the water. They planted trees and discussed ways to protect the water supplies.

Time passed. The river rested. The trees grew.

One day a person appeared. She paddled up the river in a canoe. She saw that the river was good. She returned with her family. Again, fish grew big. People took care of the water. There was enough for all.

Life had returned to the river. The people had learned to protect and use the water wisely.

Adapted from *River*, by Debby Atwell, Houghton Mifflin, 1999.

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

The Disappearing Honeybees

Tracking Honeybee Decline

Skills: Math, Science

Objective: Students use graphing and other math skills to track the number of honeybee colonies present in the US since 1978.

Background:

Pollinators are important to us. Without pollination, one-third of the foods we are accustomed to eating could not grow. This includes the majority of fruits, many vegetables (or their seed crops) and even legumes such as alfalfa and clover, which are fed to the livestock we eat as meat.

Many of the foods we grow and eat in the US are from crops that first grew in other parts of the world. Some of these foods depend on another import for pollination — the domestic honeybee.

The Spanish brought the first European honeybee colonies to the Americas in the 16th Century. English colonists brought more honeybees in 1622. Soon honeybees had escaped into the wild and were buzzing all over North America. Native Americans called them "the white man's fly."

MAJOR CROPS DEPENDENT ON POLLINATORS

Crop category	Dependence on insect pollination	Proportion of pollinators that are honeybees
alfalfa, hay and seed	100%	60%
apples	100%	90%
almonds	100%	90%
citrus	20%-80%	10%-90%
cotton (lint and seed)	20%	80%
soybeans	10%	50%
onions	100%	90%
broccoli	100%	90%
carrots	100%	90%
sunflower	100%	90%

Source: Compiled by Congressional Research Service, using values reported in Morse, RA, and NW Calderone, *The Value of Honey Bees as Pollinators of US Crops in 2000*, March 2000, Cornell University, http://www.masterbeekeeper.org/pdf/pollination.pdf

P.A.S.S.

GRADE 6
Math Process — 1.2,6; 2.1; 3.3; 4.1; 5.1,4
Math Concept — 2.3; 5.2
Science Process — 4.2,3
Life Science — 4.1

GRADE 7
Math Process — 1.2,6; 2.1; 3.3; 4.1; 5.1,4
Math Concept — 2.2c; 5.1
Science Process — 4.2,3

GRADE 8
Math Process — 1.2,6; 2.1; 3.3; 4.1; 5.1,4
Math Concept — 5.1
Science Process — 4.2,3
Life Science — 3.2

Resources Needed

calculators

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Where are the Bees?

Beginning in 2006, researchers began to notice that the number of honeybees available for pollination were in decline all over the US. Bees would fly off in search of pollen and nectar and simply never return to their colonies. Nobody could understand why. The behavior is very unusual for a social insect like the honeybee, because honeybees are very colony-oriented. They want to take care of the queen, so to leave the colony and not come back is highly unusual. Researchers called the condition "colony collapse disorder."

Investigators are exploring a variety of possible causes, including viruses, a fungus and poor bee nutrition.

Mites have also damaged bee colonies, and the insecticides used to try to kill mites harm the ability of queen bees to spawn as many worker bees. Queens are also not living as long as they did in the past.

Source: Barrionevo, Alexei, "Honeybees Vanish, Leaving Keepers in Peril," *The New York Times*, http://www.nytimes.com/2007/02/27/business/27bees.html?

A Cornell University study has estimated that honeybees annually pollinate more than $14 billion worth of seeds and crops. Growers have tried without success to find other methods for spreading pollen. Some of the more extreme methods include giant blowers, helicopters and mortar shells.

Beekeepers truck tens of billions of bees around the country every year, moving from field to field. Profits from renting beehives to farmers for pollination exceed those from the production of honey. In 2007 the price for renting a bee colony was about $135.

A typical bee colony ranges from 15,000 to 30,000 bees. In the past 50 years, the population of domesticated honeybees has dropped 50 percent. In some parts of the country, farmers are starting to worry that there are not enough honeybees available to pollinate their crops.

The honeybee decline is mostly the result of diseases spread as a result of mites and other parasites. One of the greatest problems is the non-native varroa mite. The varroa mite feeds much like a tick on the body of a bee. One sign of infection is deformed wings. Varroa mites probably originated in Eastern or Chinese honeybee populations and were carried to the US on a ship in 1987. They quickly infested European honeybees.

The varroa mite also transmits disease, particularly viruses. Left untreated, a varroa mite infestation can wipe out a bee colony within a few months.

Another major bee pest is the tracheal mite, which gets inside adult bees and clogs their breathing tubes. The tracheal mites also impede the bees' ability to fly, making them useless as pollinators. Tracheal mites were first reported in the Isle of Wight in the British Isles but are believed to have entered the US via Mexico in 1984.

Both the varroa and tracheal mites puncture holes in bees' bodies. The holes serve as pathways for viruses that kill the bees.

Researchers have had some mite-control success by increasing the ventilation of managed bee colonies. Most colonies are airtight by design, to protect honeybees from the elements. Other forms of mite control include increased attention to grooming behaviors and chemical treatments.

Activities

1. Read and discuss background and vocabulary.
   — Use the table of major crops dependent on insect pollinators to lead a discussion of the impact of pollinator loss on the food supply.
   — Ask students to list the foods in the table they have eaten in the past week. Note: alfalfa hay is a major food for meat

animals like beef cattle. Cottonseed oil is an ingredient in mayonnaise, salad dressings and other products. Sunflower seed oil is also used in some salad dressings.

2. Discuss the different kinds of graphs. (See "Graphs" in the Resource section.")
   — Divide students into groups.
   — Provide students with copies of the table included with this lesson, "Honeybee Colonies in the US."
   — Students work in groups to read and complete the instructions/questions following the table.
   — Students display what they have learned.
   — Students use their graphs to agree or disagree with the reasoning of their classmates.
   — Did reported domesticated bee colonies decline more in Oklahoma than they did nationwide?
   — What other reasons besides those presented in the background might have caused the numbers to decline? (fewer people interested in beekeeping, fewer plants available for pollinating)
   — Students will discuss their procedures with a partner.
   — Students will write explanations of their thoughts and answers.
3. Students will write paragraphs comparing the decline in bee colonies in Oklahoma with the decline in the US during the years 1978 and 2003.

Extra Reading

Bishop, Holley, *Robbing the Bees*, Free Press, 2006.
Horn, Tammy, *Bees in America, How the Honey Bee Shaped a Nation*, 2006.

Vocabulary

domesticated — adapted to living with human beings and serving their purposes
feral — having escaped from domestication and become wild
legume — any of a large family of herbs, shrubs, and trees that have fruits which are dry single-celled pods that split into two pieces when ripe, that bear nodules on the roots that contain nitrogen-fixing bacteria, and that include important food plants (as peas, beans, or clovers)
nomad — a member of a people that has no fixed home but wanders from place to place
parasite — a living thing which lives in or on another living thing in parasitism
pollinate — to place pollen on the stigma of
wild — living in a state of nature and not under human control and care

Name ______________________________

Honeybee Colonies in the US

The table below shows the number of honeybee colonies kept for honey production reported to the National Ag Statistics Service in the US and in Oklahoma between 1978 and 2006. After 2003, Oklahoma colonies were no longer listed separately to avoid disclosing data for individual beekeeping operations.

	US	Oklahoma
2006	2,392,000	not listed separately
2005	2,413,000	not listed separately
2004	2,556,000	not listed separately
2003	2,599,000	3,000
2002	2,574,000	3,000
2001	2,506,000	4,000
2000	2,620,000	7,000
1999	2,688,000	6,000
1998	2,633,000	4,000
1997	2,631,000	4,000
1996	2,564,000	4,000
1995	2,648,000	4,000
1994	2,770,000	5,000
1993	2,876,000	6,000
1992	3,030,000	9,000
1991	3,181,000	9,000
1990	3,210,000	9,000
1989	3,443,000	9,000
1988	3,219,000	10,000
1987	3,190,000	10,000
1986*	3,205,000	15,000
1981	4,213,000	48,000
1980	4,141,000	44,000
1979	4,163000	55,000
1978	4,081,000	60,000

*Data for 1982-5 unavailable

Source: Honey, February, 2007, Agricultural Statistics Board, NASS, USDA, http://usda.mannlib.cornell.edu/usda/current/Hone/Hone-02-28-2007.pdf

Select the appropriate graph (bar, double bar, circle, line, pictograph, histograph, stem 'n leaf), and graph the numbers of bee colonies from 1978-2006 in the US and Oklahoma. On the back of your graph, answer the following questions:

1. Based on this table, the number of bee colonies in the US was largest in what year? In Oklahoma?
2. Using the years of the largest colonies from the US and Oklahoma, compute the percentage of DECLINE in the following years: 1990, 1995, 2000, 2003.
3. Compare, as a percent, the total number of colonies in Oklahoma to those in the US for the following years: 1978, 1986, 1993, 2003.
4. How did the decline in bee colonies in Oklahoma between 1978 and 2003 compare with the decline in the US? Was there a steady decline for both groups? What are some possible reasons for your findings?

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Name ______________________________

Honeybee Colonies in the US (answers)

The table below is the number of honeybee colonies kept for honey production reported to the National Ag Statistics Service in the US and in Oklahoma between 1978 and 2006. After 2003, Oklahoma colonies were no longer listed separately to avoid disclosing data for individual beekeeping operations.

	US	Oklahoma
2006	2,392,000	not listed separately
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2003	2,599,000	3,000
2002	2,574,000	3,000
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1979	4,163000	55,000
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*Data for 1982-5 unavailable

Source: Honey, February, 2007, Agricultural Statistics Board, NASS, USDA, http://usda.mannlib.cornell.edu/usda/current/Hone/Hone-02-28-2007.pdf

Select the appropriate graph (bar, double bar, circle, line, pictograph, histograph, stem 'n leaf), and graph the numbers of bee colonies from 1978-2006 in the US and Oklahoma. On the back of your graph, answer the following questions:

1. Based on this table, the number of bee colonies in the US was largest in what year? (1981) In Oklahoma? (1978)

2. Using the years of the largest colonies from the US and Oklahoma, compute the percentage of DECLINE in the following years: 1990, 1995, 2000, 2003.

Year	US	OK
1990	24%	85%
1995	27%	94%
2000	28%	88%
2003	28.3%	95%

3. Compare, as a percent, the total number of colonies in Oklahoma to those in the US for the following years: 1978, 1986, 1993, 2003.
   1978: 1.5%; 1986: .5%; 1993: 0.2%; 2003: 0.1%

4. How did the decline in bee colonies in Oklahoma between 1978 and 2003 compare with the decline in the US? Was there a steady decline for both groups? What are some possible reasons for your findings?

Fit With Fiber

Graphing Cereal

Skills: Science and Math

Objective: Students gather and graph information about favorite breakfast cereals.

Background:

Fiber is present in all plants that are eaten for food, including fruits, vegetables, grains, and legumes. Fiber passes through our bodies undigested. It is therefore not absorbed into the bloodstream. Instead of being used for energy, fiber is excreted from our bodies.

Not all fiber is the same, One way to categorize fiber is by how easily it dissolves in water. Soluble fiber forms a gel when mixed with liquid, while insoluble fiber does not. Insoluble fiber passes through our intestines largely intact. The skin of a plum is an example of insoluble fiber, while the pulp is a source of soluble fiber. Both kinds of fiber are important in a healthy diet. They help the body function more efficiently and reduce the risk of heart disease, diabetes, and diverticular disease.

SOME SOURCES OF FIBER

SOLUBLE FIBER	INSOLUBLE FIBER
oatmeal	whole wheat breads
nuts and seeds	barley
legumes — dried peas, beans lentils	couscous
apples	brown rice
pears	bulgur
strawberries	whole grain cereal
blueberries	tomatoes
blackberries	carrots
plums	zucchini

Source: Harvard School of Public Health, http://www.hsph.harvard.edu/nutritionsource/fiber.html

P.A.S.S.

GRADE 6
Science Process — 4.1,2,3; 5.2,3
Life Science — 4.1
Math Process — 1.2,6; 2.2; 3.3; 4.1; 5.4
Math Content — 2.3; 5.1
Health — 1.8,11

GRADE 7
Science Process — 4.1,2; 5.2,3
Life Science — 4.1
Math Process — 1.2,6; 2.2; 3.3; 4.1; 5.4
Math Content — 2.1b
Health — 1.8,11

GRADE 8
Science Process — 4.2,3; 5.2,3
Life Science — 3.1
Math Process — 1.2,6; 2.2; 3.3; 4.1; 5.5
Math Concept — 2.1b; 5.1
Health — 1.8,11

Materials

computer access

cereal boxes (five different examples)

compass

protractor

ruler (straight edge)

map pencils

Oklahoma-Grown Fiber

An important source of insoluble fiber is the hard winter wheat grown by Oklahoma farmers and fby armers in 42 states throughout the United States. US farmers grow nearly 2.4 billion bushels of wheat on 63 million acres of land. Oklahoma is normally the second ranking state in winter wheat production. Hard red winter wheat, the primary class of wheat, is grown on over 6 million acres in every county of the state. In an average year, over 160 million bushels of wheat are harvested, with a yield of around 35 bushels per acre. Some of the wheat grown in Oklahoma is used to produce flour in the state's flour mills. The rest is exported to other states or foreign countries. About forty-five 24-ounce boxes of wheat flakes cereal can be made from a bushel of wheat.

Many crops grown in Oklahoma are sources of soluble and insoluble fiber. Hard red winter wheat, our number one crop in 2006, is used to make whole wheat breads and cereals. Some other crops grown in our state that are good sources of fiber include vegetables, like tomatoes and squash; legumes, like black-eyed peas and lima beans; and fruits, like peaches, plums, apricots, strawberries, blackberries, apples and pears.

Children over the age of two should consume an amount of fiber equal to or greater than their age, plus five grams per day. For example, a 12-year old would need to consume 17 grams of fiber per day. The average American eats only 14-15 grams of dietary fiber a day.

Background Sources: Harvard School of Public Health; "Kids Health" Web site; Nutrition.about.com; AskDr.Sears.com; General Mills Foods; Oklahoma Wheat Commission; Oklahoma Department of Agriculture, Food and Forestry; Glencoe Life Science

Activities

1. Read and discuss background.
   — Ask for a show of hands to determine how many students ate breakfast.
   — As a class, figure what percentage of the class ate breakfast.
2. Discuss graphing, using the information on the Circle Graph page and the information on graphs found in the "Resources" section.
3. Show students the five cereal boxes you have brought to class.
   — Poll the class regarding their favorites among the five.
   — Use tally marks to keep track on the chalkboard.
   — Students follow instructions on the worksheet to record the results of the poll on the circle graph.
4. Analyze the nutritional information of the cereal choices.
   — Make a copy ahead of time of a nutritional value label from a cereal box.
   — Draw arrows on the label pointing to fiber, calories, serving size, fats and carbohydrates, so students will know what to look for.
   — Show students the nutrition charts on cereal boxes you have brought to class.
   — Discuss the information.
   — Students use an online search engine to find the company that produces the five cereals.
   — Students find the nutritional information for each cereal.
   — Students chart the amount of dietary fiber in each of the cereals chosen.

— Students use the information to make a bar graph showing the amount of dietary fiber in each cereal. (In a bar graph the x-axis variable is divided into parts. The parts can be numbers or nutritional information. The y-axis is a number and increases continuously along the axis.)

5. Students analyze the graphs and decide which cereals have the healthiest amount of dietary fiber.
   — Students reflect on and justify the reliability of their graphs.
6. Students find the first ingredient listed for each cereal.
   — Discuss why the first ingredient is listed first. (The ingredients with largest quantities are listed first.)
   — Students will read through the list of ingredients to find those that might be considered sweeteners (sugar, fructose, corn syrup, etc.)
   — Discuss how near to the beginning of the list sugars are listed.
7. Discuss additional nutritional facts for each cereal, including calories in each serving, serving size, fats and carbohydrates.
   — Students complete a second circle graph, which will show the daily percentages of sugar and calories/carbohydrates/fat from each serving of cereal.
   — Students discuss findings and explain why they agree or disagree with the graphs presented.
8. Have newspapers delivered to your class (usually free for classrooms).
   — Students will find examples of graphs in the newspapers and cut them out.
   — Discuss other places students have seen graphs used (magazines, doctor's offices, informational brochures, textbooks, etc.)
9. Each student will write a letter home explaining the benefits of fiber and suggesting some fiber-rich foods to add to the household grocery list.

Vocabulary

bulgur — dried cracked wheat

diabetes — an abnormal bodily condition in which less than the normal amount of insulin is produced

diverticular — an abnormal pouch or sac opening from a hollow organ (as the intestine or bladder)

fiber — mostly indigestible material in food that stimulates the intestine to move its contents along

insoluble — impossible or difficult to dissolve

soluble — capable of being dissolved in a liquid

Extra Reading

Haduch, Bill, and Rick Stromoski, *Food Rules! The Stuff You Munch, Its Crunch, Its Punch, and Why You Sometimes Lose Your Lunch,* Puffin, 2002.

Inglis, Jane, *Fiber (Food Facts)*, Carolrhoda, 1993.

Lackey, Jennifer, *The Biography of Wheat (How Did That Get Here?)* Crabtree, 2007.

Royston, Angela, *Water and Fiber for a Healthy Body (Body Needs)*, Heinemann, 2003.

VanCleave, Janice, *Janice VanCleave's Food and Nutrition for Every Kid*, Jossey-Bass, 1999.

Waxman, Laura Hamilton, *W.K. Kellogg (History Maker Bios)*, Lerner, 2006.

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Circle Graph

Graphs display data as an easy-to-understand visual reference. Sometimes the translation of data into text becomes confusing. Graphs make it easier to understand complex information or view the results of an experiment. A bar graph uses rectangular blocks, or bars, of varying sizes to show the relationships among variables. One variable is divided into parts. It can be numbers, such as the number of students preferring certain cereals, or a category, such as the type of cereal preferred. Circle graphs show the parts of a whole. Circle graphs are sometimes called pie graphs. Each piece of the pie visually represents a fraction of the total. Each piece can represent what percent of the class chose which cereal.

1. First determine the total of the parts (total of votes for the five top cereals).
2. From the total votes for each of the five cereals, determine what fraction they are of the total.
3. Assume 360 degrees in a circle.
4. Determine what fraction of 360 each part would be. To determine this, set up a ratio and solve for x: part/whole = x/360 x= the degrees of the circle that each cereal represents for the class.)
5. Use a compass to mark the center of the circle.
6. Draw a straight line from the center to the edge of the circle.
7. Use a protractor and the angles you calculated to divide the circle into parts. Place the center of the protractor over the center of the circle and line the base of the protractor over the straight line. Continue around the circle until 100% is complete.
8. Color each piece of the pie graph and label.

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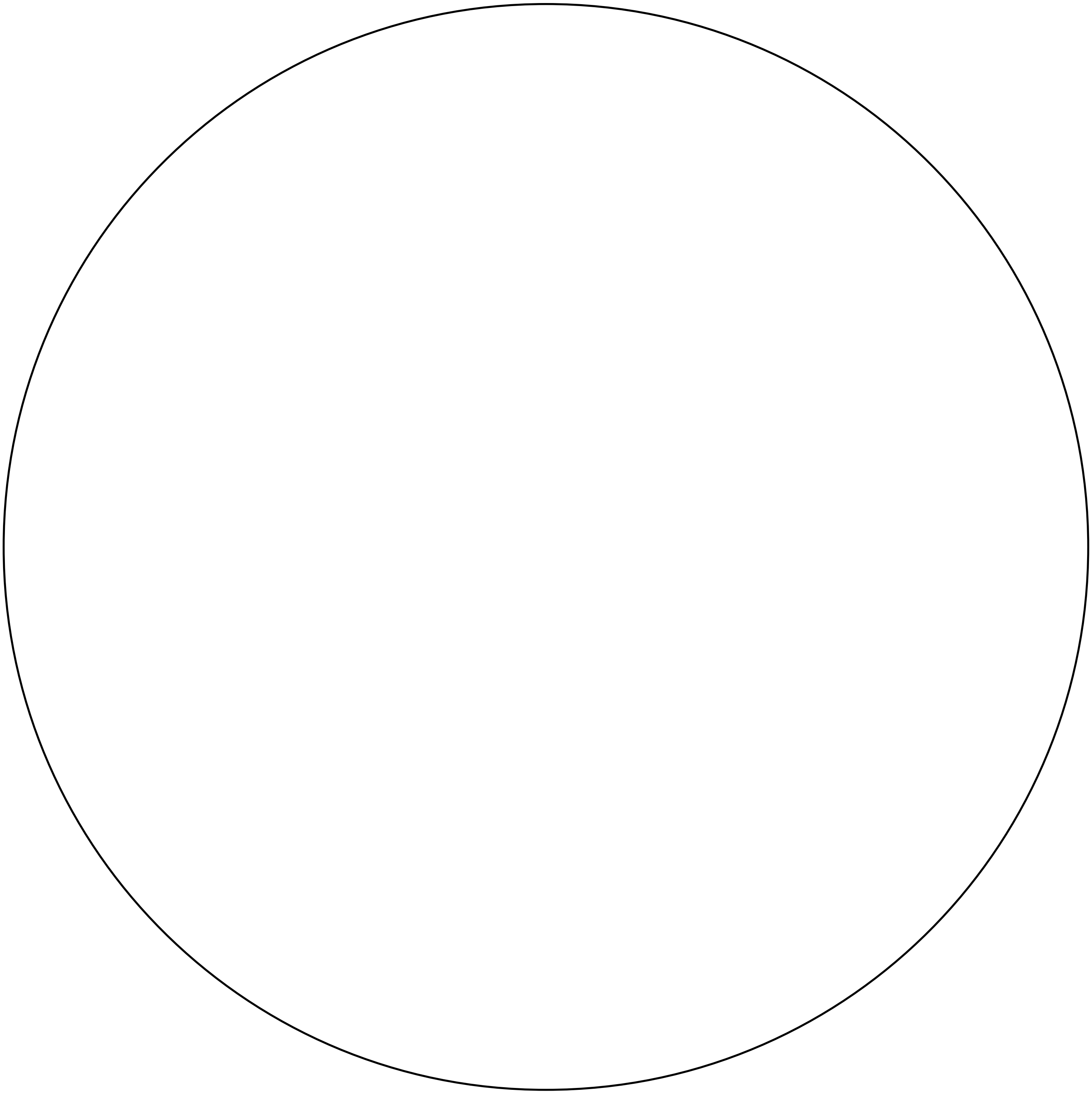
Name____



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Manure Happens

Managing Nutrients in Livestock Manure

Skills: Science, Math

Objective: Students reinforce math and science skills while learning about the nutrients found in livestock manure.

Background:

In addition to meat, livestock and poultry operations produce another valuable commodity — manure. Animal manure can be a valuable fertilizer when properly used on field crops. Besides providing macro- and micronutrients to the soil, manure supplies organic matter to improve the soil's physical and chemical properties. It also increases infiltration of water, keeps nutrients in the soil, helps hold the soil in place, and promotes growth of beneficial organisms.

What we normally consider livestock manure is actually a mixture of feces, urine, soil, bedding material, and wash water. Its characteristics depend upon the type of animal being raised, its diet and bedding, the manure handling system, and even the climate. The nutrients in manure, such as nitrogen and phosphorus, occur in both organic and inorganic forms, though organic nutrients must first be converted or mineralized to inorganic forms before plants can use them. This conversion process is carried out by micro-organisms and other biota in the soil.

Application on crop land is the most common and efficient method of handling livestock manure. However, without proper management, manure application over a period of years can cause a build-up of nutrients and salts in the soil. Excess manure can contaminate groundwater when soluble nitrate and salts leach through the soil. Runoff from manured land can carry phosphorus, nitrogen, organic sediments, and pathogens to surface water bodies. As the runoff decomposes in surface water, it absorbs oxygen and can cause fish to suffocate.

Good nutrient management involves manure application rates that are based on the actual nutrient content of the manure and the specific requirements of the crops being grown. Nutrient content in manure can vary, so regular testing of soil and manure is important for maintaining a proper balance.

Background Sources: Zhang, Hailin, "Fertilizer Nutrients in Animal Manure, Oklahoma Cooperative Extension Service Fact Sheet PSS 2228; "Manure Nutrient Management," Irrigation Branch, Alberta Agriculture and Food, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/irr5716

P.A.S.S.

GRADE 6

Science Process — 1.1,2,3; 3.1,2,3,4,5; 4.1,3; 5.1,3

Physical Science — 1.1

Math Process — 1.2,3; 2.2; 3.3; 4.1; 5.1

Math Content — 2.3; 5.3

GRADE 7

Science Process — 1.1,2,3; 3.1,2,3,4,5; 4.1,3; 5.1,3

Physical Science — 1.1

Math Process — 1.2,3; 4.1; 5.1

Math Content — 2.1ab,2b; 5.1

GRADE 8

Science Process — 1.1,2,3; 3.1,2,3,4,5; 4.1,3; 5.1,3

Physical Science — 1.2

Math Process — 1.2,3; 4.1; 5.1

Math Content — 2.1b; 5.2b

Resources Needed

manure (Available from horse stables, fairgrounds, etc. Check with students whose families raise farm animals. DO NOT USE MANURE FROM DOGS OR CATS.)

garden soil

soil testing kit

Petri dishes

surgical gloves

calculators

Vocabulary

application — something put or spread on a surface
beneficial — producing results that are good for health and happiness
biota — the plants and animals of a region
feces — bodily waste discharged through the anus
infiltration — the act of passing into or through by filtering
inorganic — being or composed of matter that does not come from plants or animals either alive or dead
leach — to pass a liquid through to carry off the soluble components
livestock — animals kept or raised; especially farm animals kept for use and profit
macronutrient — a chemical element (as nitrogen, phosphorus, or potassium) of which relatively large quantities are essential to the growth and health of a plant
manure — animal excrement or other substance put on or into the soil to fertilize
micronutrient — a chemical element (as iron, zinc, manganese, zinc) essential in minute amounts to the growth and health of an animal or plant
mineralize — to convert into mineral or inorganic form
nitrate — a salt or ester of nitric acid
nitrogen — a colorless, tasteless, odorless gaseous chemical element forming nearly four-fifths of the atmosphere
nutrient — of food value
organic — of, relating to, or derived from living organisms
pathogen — a specific causative agent (as a bacterium or virus) of disease
phosphorus — a nonmetallic chemical element, normally a white, phosphorescent, waxy solid, becoming yellow when exposed to light
runoff — water from rain or snow that flows over the surface of the ground and finally into streams
sediment — material deposited by water, wind, or glaciers
soluble — capable of being dissolved in a liquid
urine — waste material that is secreted by the kidneys, is rich in the end products of protein breakdown, and is usually a yellowish liquid in mammals but semisolid in birds and reptiles

Activity

1. Read and discuss lesson background.
2. Students will use the "Scientific Method Format" included in the "Resources" section to test for the presence of nutrients in garden soil, manure and a mixture of the two. Students will design their own experiments to test the effects over time of air, temperature and other factors on manure. Some possibilities are listed below:
   — Place samples outdoors and expose them to the air.
   — Leave samples uncovered indoors
   — Keep samples covered.
   — Place samples in the refrigerator.
   — Place samples in the oven.
   — Test the water retention of garden soil with and without manure.
   — Test the difference between store-bought bagged manure and fresh manure acquired from a horse farm or other animal operation.
   — Test manure from different animals.
3. Discuss findings. Were results consistent? Discuss the importance to farmers of testing to make sure they use the correct amount of manure and other fertilizers in the soil.
4. Before handing out the worksheet included with this lesson, list the following animals on the chalkboard: cow, pig, sheep, chicken, horse.
   — Students will predict which animal produces the largest amount of manure and which animal's manure contains the highest level of nitrogen.
   — Students compare their predictions with the weights listed in the table.
   — Students use calculators to complete the worksheet.
   — Students compare findings from the first two questions with a partner before completing the last three questions.
   — Students explain in writing how they found the percentages, including calculations from a decimal to a percent.
5. Each student will write a paragraph discussing the differences in the pigs listed and compare/contrast the differences in percentage of body weight excreted as nitrogen.

Extra Reading for Students

Bial, Raymond, *A Handful of Dirt*, Walker, 2000.
Eberts, Marjorie, *Nature*, McGraw-Hill, 1996.
Stille, Darlene R., Soil, *Digging into Earth's Vital Resource*, Compass Point, 2005.

Name ________________________________

Typical Amounts of Nitrogen Found in the Manure of Some Livestock Species

Animal	Animal Weight (lb)	Total Nitrogen (lb/yr)	Percentage of Body Weight Excreted as Nitrogen
dairy cow	1400	210	
beef calf	500	62	
beef cow	1000	124	
horse	1000	99	
nursery pig	35	5.7	
finishing pig	200	33	
sow	275	23	
boar	350	28	
sheep feeder	100	16	
laying hen	4	1.05	
broiler	2	0.85	

Source: "Nutrient Value of Fresh Livestock Manure," Washington State University, http://gardening.wsu.edu/stewardship/compost/manure/manure3.htm

1. Complete the table by calculating the total nitrogen excreted per animal per year as a percentage of its body weight.

2. What animal produces the most nitrogen per pound of body weight?______________________________

WAIT: Compare your findings with a partner before completing the last three questions.

Mean = the sum of the data divided by the total number of values in the set.
Median = the value in the middle when all values are arranged from lowest value to highest
Mode = value in a set of data that occurs most often.

3. What are the mean, ____________median, _____________and mode _____________of the animal weights?

4. What are the mean, ____________median, _____________and mode _____________of the total nitrogen in the manure per year?

5. What are the mean, ____________median, _____________and mode _____________of the percentages?

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Name ____________________________________

Typical Amounts of Nitrogen Found in the Manure of Some Livestock Species (answers)

Animal	Animal Weight (lb)	Total Nitrogen (lb/yr)	Percentage of Body Weight Excreted as Nitrogen
dairy cow	1400	210	**15**
beef calf	500	62	**12.4**
beef cow	1000	124	**12.4**
horse	1000	99	**9.9**
nursery pig	35	5.7	**16.28**
finishing pig	200	33	**16.5**
sow	275	23	**8.36**
boar	350	28	**8**
sheep feeder	100	16	**16**
laying hen	4	1.05	**26.25**
broiler	2	0.85	**42.5**

Source: "Nutrient Value of Fresh Livestock Manure," Washington State University, http://gardening.wsu.edu/stewardship/compost/manure/manure3.htm

1. Calculate the total nitrogen excreted per animal per year as a percentage of its body weight. (answers above)

2. What animal produces the most nitrogen per pound of body weight? (broiler chickens)

WAIT: Compare your findings with a partner before completing the last three questions.

Mean = the sum of the data divided by the total number of values in the set.
Median = the value in the middle when all values are arranged from lowest to highest
Mode = value in a set of data that occurs most often.

3. What are the mean, <u>442.36</u> median, <u>275</u> and mode <u>1000</u> of the animal weights?

4. What are the mean, <u>54.78</u> median, <u>28</u> and mode <u>no mode</u> of the total nitrogen in the manure per year?

5. What are the mean, <u>16.69%</u> median, <u>15%</u> and mode <u>no mode</u> of the percentages?

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Plotting the Plight of the Cattle

Skills: Math, Science

Objective: Students will interpret and hypothesize reasons for trends in epidemiological data.

Background:

Bovine spongiform encephalopathy (BSE), commonly (and erroneously) referred to as "mad cow disease," is a rare fatal disease that affects the central nervous system of cattle. "Spongiform" refers to the spongy appearance of a brain affected by BSE, when viewed under a microscope. BSE is in the same family of diseases as scrapie in sheep and goats, chronic wasting disease in deer and elk, and Creutzfeldt-Jakob disease in humans.

BSE is not a contagious disease and is not passed among cattle through direct contact. In the US there have been two reported cases of BSE in cattle. Those cases were in cattle imported into the US from other countries. No meat from BSE-infected cattle has ever entered the US food supply. The US Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) aggressively monitors the US cattle population to prevent the introduction and spread of BSE into US herds. In addition, the beef industry works vigorously to ensure the safety of beef in the US.

Cattle get BSE by eating contaminated feed. In the past, cattle feed included offal (the parts not used by humans) from slaughtered animals. The substance that causes BSE is found in the brain, spinal cord, and retinas of cattle infected with BSE. BSE could also have originated from cattle feed contaminated with scrapie-infected sheep products. The US Food and Drug Administration (FDA) no longer allows the use of offal in cattle feed.

Symptoms of BSE in cattle include aggression, nervousness, loss of balance, loss of weight, and abnormal posture. This behavior in infected cattle is what led to the name "mad cow disease."

Sources: Centers for Disease Control, USDA Food Safety and Inspection Service, World Health Organization, The National Creutzfelt-Jakob Disease Surveillance Unit

P.A.S.S.

GRADE 6
Math Process — 3.3; 5.1,4
Math Content — 5.1
Science Process — 4.1, 4.2, 4.3

GRADE 7
Math Process — 3.3; 5.1,4
Math Content — 2.1a
Science Process — 4.1, 4.2, 4.3
Life Science — 3.1; 4.2

GRADE 8
Math Process — 3.3; 5.1,4
Math Content — 5.1
Science Process — 4.1, 4.2, 4.3
Life Science — 3.2

Materials

graph paper

calculators

world map

Vocabulary

contagious — able to be passed on by contact between individuals
degenerative —
epidemiology — the study of the causes of diseases and how they are spread (and controlled)
fatal — causing death
necropsy — an autopsy performed on an animal
offal — the waste or by-product of a process; especially : the inside organs of and parts trimmed from an animal killed and prepared for food
scrapie — a usually fatal spongiform encephalopathy especially of sheep that is caused by a prion and is characterized by twitching, intense itching, excessive thirst, emaciation, weakness, and finally para
surveillance — monitoring a population for the occurrence of a particular disease

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Oklahoma Ag in the Classroom
Oklahoma 4-H Programs
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Activity

1. Read and discuss background.
2. Provide students with the table included in this lesson.
   — Students will determine the total number of cases per year and the highest and lowest number of cases per year.
   — Lead a discussion of graphing. (See "Graphs" in the "Resource" section.
   — Assign a country to each student to graph.
   — Using the data from the table, students will make a graph of the annual
   incidence rate (number of cases diagnosed or identified by surveillance) of BSE per million cattle over 24-months-old in their assigned countries.
   — Students will compare their graphs and list trends noted by country and worldwide.
3. Lead a discussion about possible reasons for trends.
   — On which continents are numbers increasing?
   — On which continents are numbers decreasing?
   — Why are the numbers reported per million cattle instead of the total number of infected animals?
   — Why are cattle under 24 months old not counted in the report?
   — What are some reasons the numbers of cases would increase? (infection spreading, long incubation period, etc.)
   — What are some reasons the numbers of cases would decrease? (better surveillance and notification, better knowledge of disease, more cooperation between health authorities and livestock breeders, etc.)
4. Research one of the countries listed on the table to discover what their BSE surveillance methods are, how they report suspected BSE, and what they are doing to decrease or eliminate the problem of BSE in their country.

Extra Reading

Hoff, Brent, and Carter Smith, Mapping Epidemics: A Historical Atlas of Disease

Sheen, Barbara, *Mad Cow Disease,* Lucent, 2004. Franklin Watts, 2000.

BSE Cases Worldwide

Annual incidence rate (per million cattle over 24 months old) of BSE in selected countries for the years 1989-2005 (rounded to the nearest tenth)

Country/Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2.1
Belgium	0	0	0	0	0	0	0	0	0.6	3.7	1.8	5.5	28.2	25.8	10.5	7.9	1.4
Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.1	0.1
Czech Rep	0	0	0	0	0	0	0	0	0	0	0	0	2.9	2.5	5.8	10.3	12
Denmark	0	0	0	0	0	0	0	0	0	0	0	1.1	6.8	3.4	2.4	1.3	1.3
Finland	0	0	0	0	0	0	0	0	0	0	0	0	2.4	0	0	0	0
France	0	0	0.5	0	0.1	0.3	0.3	1.1	0.5	1.6	2.8	14.7	19.7	21	12	4.7	2.7
Germany	0	0	0	0	0	0	0	0	0	0	0	1.1	20	17	8.7	10.9	5
Greece	0	0	0	0	0	0	0	0	0	0	0	0	3.3	0	0	0	0
Ireland	4.4	4.1	5	5.1	4.6	5.4	4.6	20.3	21.4	20.8	22.8	38.2	61.8	88.4	57.8	43.3	24
Israel	0	0	0	0	0	0	0	0	0	0	0	0	0	6.3	0	0	0
Italy	0	0	0	0	0	0	0	0	0	0	0	0	14.1	10.6	9.9	2.3	2.4
Japan	0	0	0	0	0	0	0	0	0	0	0	0	1.4	1	2	2.5	3.6
Luxembourg	0	0	0	0	0	0	0	0	10	0	0	0	0	14.5	0	*	10.9
Netherlands	0	0	0	0	0	0	0	0	1	1	1	1.1	10.3	13.2	10.9	3.4	0.8
Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3	1.5	3.6	*
Portugal	0	0	0	0	0	15.1	18.8	38.9	37.6	159.4	199.5	187	137.9	107.8	137.2	94.9	53
Slovakia	0	0	0	0	0	0	0	0	0	0	0	0	18.3	18.7	6.7	24.6	43.4
Slovenia	0	0	0	0	0	0	0	0	0	0	0	0	4.3	4.4	4.4	9.2	4.6
Spain	0	0	0	0	0	0	0	0	0	0	0	0.6	24.2	38	46.3	38.9	27.8
Switzerland	0	1	9.2	15.5	30.3	67.6	73.6	48.5	45.4	16	58.7	40.6	49.1	27.9	24.9	3.8	3.7
U.K.	1264.1	2507	4467.2	6636.1	6264.1	4277.8	2582	1416.8	794.4	585.7	416.4	270.6	232.8	228.2	122.3	68.8	45.7
U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

* = no data available

Source: World Organization of Animal Health, http://www.oie.int/eng/info/en_esbrincidence.htm and http://www.oie.int/eng/info/en_esbincidence.htm

The Role of Fire in Healthy Prairie, Brush and Forest Lands

Skills: Science, Math

Objective: Students learn the three elements necessary for fire and explore the role of fire in keeping native plant communities healthy.

Background:

The fires that raced across our state during the winter of 2005-06 were frightening and costly. Although the dry weather conditions and high winds caused them to spread, most would not have started without the carelessness of people. People cause 9 out of 10 fires. Some of the main causes of uncontrolled fires in Oklahoma are arson, untended campfires, lit cigarettes, improper burning of debris and playing with matches or fireworks.

Fire sometimes destroys property and threatens lives, but it does not destroy the land or its wildlife or plant communities. It only causes changes in the vegetational form from one stage of plant succession to another. In the days before people lived on this continent, lightning started fires. All types of vegetation in Oklahoma evolved with fire as a major influence on their development. As a result, indigenous plants and animals are adapted to cope with periodic fire. Some plants need fire to complete their life cycles.

Early explorers such as Washington Irving and Thomas Nuttall found Native Americans using fire in all parts of the area now known as Oklahoma. Native Americans used fire to manage their food source — the herds of bison, elk, and other wildlife that helped make up the diverse prairie ecosystem. They also used fire to maintain prairie openings in forested regions. Early settlers followed this example for awhile but gradually stopped burning. As land use changed, particularly to farming annual crops, the land was broken up into small ownerships, so regular burning was no longer practical.

Today land owners recognize the importance of burning to maintain the health of the land. About 2.5 million acres of native prairie, shrubland and forestland are

P.A.S.S.

GRADE 6
Science Process — 1.1,2,3; 2.1,2; 3.1,2,3,4,5; 4.1,5; 5.1,2,3,4
Physical Science — 2.1
Life Science — 4.1
Earth Science — 5.1
Math Process — 1.1,2,3,4,6; 3.3; 4.1; 5.1,2,4
Math Content — 2.3; 3.1a; 5.1,2,3

GRADE 7
Science Process — 1.1,2,3; 2.1,2; 3.1,2,3,4,5; 4.1,5; 5.1,2,3,4
Life Science — 3.1; 4.2
Earth Science — 5.1
Math Process — 1.1,2,3,4,6; 4.1; 5.1,2,4
Math Content — 2.1b; 3.2

GRADE 8
Science Process — 1.1,2,3; 2.1,2; 3.1,2,3,4,5; 4.1,5; 5.1,2,3,4
Physical Science — 1.1
Life Science — 3.2
Math Process — 1.1,2,3,4,6; 4.1; 5.1,2,4
Math Content — 2.1b; 5.1,2ab

Prescribed Fire Associations

Fire can be dangerous and should be used only with caution and proper training. Oklahoma landowners and other concerned citizens form Prescribed Fire Associations to conduct prescribed burns under strictly-controlled conditions. Members of these associations attend burning workshops and participate on fire crews to gain experience with controlling fires. Prescribed burning requires knowledge of weather, fire behavior, fuels and ecology along with good judgment and experience. Most prescribed fires are conducted during the winter or spring.

The most important preparation for a prescribed burn is preparing a fire break. A fire break is an area where no fuel is available for a fire to burn. Most landowners clear a firebreak area by bulldozing or plowing. If an existing road is available, that can also act as a fire break, as can natural barriers such as streams, canyons or rock outcrops.

Weather variables important to planning for a prescribed fire include relative humidity, air temperature and wind speed. Wind speed and direction can change almost instantly, so landowners must be careful not to start a prescribed fire within 12 hours of a weather front or when winds are variable in direction.

The amount of water in dried grass is directly related to relative humidity and can change dramatically within one hour. Changes in relative humidity will drastically change fire behavior and combustibility of fuels. The amount of time since a rain and the amount of tree or shrub cover will also impact fuel moisture and fire behavior. A fire that can be conducted safely at 40 percent relative humidity will pose safety risks at 20 percent relative humidity.

intentionally burned in Oklahoma each year. That is 6 percent of the total land area in our state.

Prescribed burning is an important means for keeping the ecosystems of Oklahoma's native plant communities healthy. Fire is considered an ecological driver. It gets things going. Fire facilitates nutrient cycling, water cycling, and soil health. It helps maintain watershed function, water quality, and water yield.

Cattle producers use prescribed fire to eliminate standing dead forage and provide livestock with green forage of higher nutritive value. Fire releases phosphorus and potassium from dormant standing forage. The blackened surface generally greens up earlier than nonburned areas, thus providing earlier grazing. Cattle play the part in the prairie ecosystem that bison and other game played long ago. When cattle graze, they reduce the length of the grass. This actually helps prevent the spread of wildfire if it occurs.

Prescribed fire is also beneficial to wildlife. It even helps maintain the habitat for some endangered or threatened species. It helps manage some disease-carrying organisms and control non-native or undesirable plant species, plant diseases, insects and some animal parasites. Prescribed fire is an economically and ecologically sound alternative to herbicide use to reclaim native prairies, shrublands or forests. It also reduces the probability of wildfire.

Background Source: Bidwell, Terrence G., John R. Weir, J.D. Carlson, Ronald E. Masters, Samuel D. Fuhlendorf, Jack Waymire, and Steve Conrady, "Using Prescribed Fire in Oklahoma," Oklahoma Cooperative Extension Service Fact Sheet No. E-927, Division of Agricultural Sciences and Natural Resources, Oklahoma State University, 2003.

Activities

1. Read and discuss background.
   — Brainstorm reasons for wildfires.
   — Using a Venn diagram, list the similarities and differences between wildfires and prescribed fires.

ACTIVITY 1

1. Hand out copies of the worksheet, "Preferred Weather Conditions for Prescribed Fires," included with this lesson.
   — Students will track the weather forecast for five days to determine whether conditions are favorable or unfavorable for burning, using the information provided on the worksheet.

— Students use the data gathered to graph temperatures, relative humidity and wind speeds.
— Students find the mean, medium and mode of the weather data they have gathered.

ACTIVITY 2

1. Hand out copies of the "Fire Triangle" worksheet included with this lesson.
   — Students will work in pairs to complete the worksheet.
   — When all students are finished, lead a discussion about the three things needed for fire to burn.
   — Draw the fire triangle on the board or have a student volunteer do it.
   — Ask students under what conditions they think it would be easy to start a fire.
   — Under what conditions would starting a fire be difficult?
2. Show students the candle and the jar and ask how they might test what happens when one of the three elements of the fire triangle are limited. (This can be a teacher-led class demonstration or can be conducted under supervision in groups at a lab table.)
   — Students record predictions and observations at every step of the demonstration.
   — Place a tealight candle in a jar and light it.
   — Students identify the three elements of fire present in the burning candle: candle=fuel; air in jar= oxygen; flame=heat.
   — Students predict what will happen if you seal the jar with the lid.
   — Seal the jar to cut off the supply of oxygen. As the flame consumes the oxygen in the jar's air, the flame will go out.
   — Students discuss the cause for the flame going out.
   — Explain that cutting off oxygen is one way to manage a fire. Discuss ways to cut off the supply of oxygen in a fire.
   — Open the jar, relight the candle, and put the lid back on. This time, when the flame starts to go out, reopen the lid to let more oxygen in. The candle should reignite.
   — Explain that this illustrates what happens when the wind picks up during a fire. The fire may reignite or burn out of control.
   — Take the lid completely off, and allow the candle to burn until all the fuel is consumed and the fire extinguishes itself.

Resources Needed

tealight candles

lighter

matches

paper

scissors

jar with lid

fresh grass

dead grass

disposable aluminum baking dish

newspapers (sometimes available free to classrooms, computer access or other resource for locating weather forecasts

Ag in Your Community

Invite a member of a local Prescribed Fire Association to class to discuss the reasons for prescribed fires and precautions taken by landowners to control fires. (Contact your local NRCS or Conservation District Office.)

Vocabulary

arson — the illegal burning of a building or other property
debris — carelessly discarded refuse; litter.
diverse — differing from one another
ecosystem — a system made up of an ecological community of living things interacting with their environment especially under natural conditions
indigenous — produced, growing, or living naturally in a particular region or environment
nutrient cycling — all the processes by which nutrients are continously transferred from one organism to another in an ecosystem.
plant succession — a gradual process incurred by the change in the number of individuals of each species of a community and by establishment of new species populations that may gradually replace the original inhabitants.
prairie — a large area of level or rolling grassland
water cycling — the continuous circulation of water within the Earth's hydrosphere, usually driven by solar radiation.
watershed

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— Students estimate how much time it will take.

3. Place a corn or potato chip in the aluminum baking dish and light it.
   — See how long it takes to burn.
   — What fuel in the chip made it burn? (vegetable oil, found in all plants)
   — Place the green grass and dead grass in the baking dish and light them. Which burns faster?

ACTIVITY 3

One consideration for planning a prescribed fire is making sure the smoke does not cross a road or drift into areas where people are present. Fire planners use a trajectory 30 degrees in each direction to determine how far smoke will travel, based on the direction the wind is blowing.

1. Hand out the "Wind Trajectory Map."
   — Students follow the directions to determine which burn site is least likely to allow smoke to drift into the school or the road.
   — On the back of the worksheet, students draw a simple map of their schoolyard.
   — Students determine the wind direction.
   — Students find the safest spot for burning, based on the wind direction and the smoke trajectory.
2. Divide students into groups and take them outdoors. Each group must select a location on the schoolyard for an imaginary prescribed burn. Each group should:
   — Determine which way the wind is blowing.
   — Locate a spot on the schoolyard some distance from the school building.
   — Mark off a line in the direction the wind is blowing.
   — Mark off two 30-degree trajectory lines on either side of the line.
   — Would the smoke from the burn site reach the school?
   — Students justify their reasoning.

Extra Reading

Alianor True, ed. *Wildfire: A Reader*. Island Press, 2001.
Beil, Karen, *Fire in Their Eyes: Wildfires and the People Who Fight Them,* Harcourt, 1999.
Morrison, Taylor, *Wildfire*, Houghton Mifflin, 2006.
Pyne, Stephen J., *America's Fires: Management on Wildlands and Forests,* Forest History Society, 1997.

Name ________________________________

Preferred Weather Conditions for Prescribed Fire

wind speed	5-15 mph
relative humidity	30-60%
temperature	55-65 degrees F

Check the weather forecast for the next five days to determine which day would be best for a prescribed fire. Besides the conditions listed in the table above, check for variable winds and the movement of a front, which could change conditions quickly. Develop a table below showing the conditions for the next five days.

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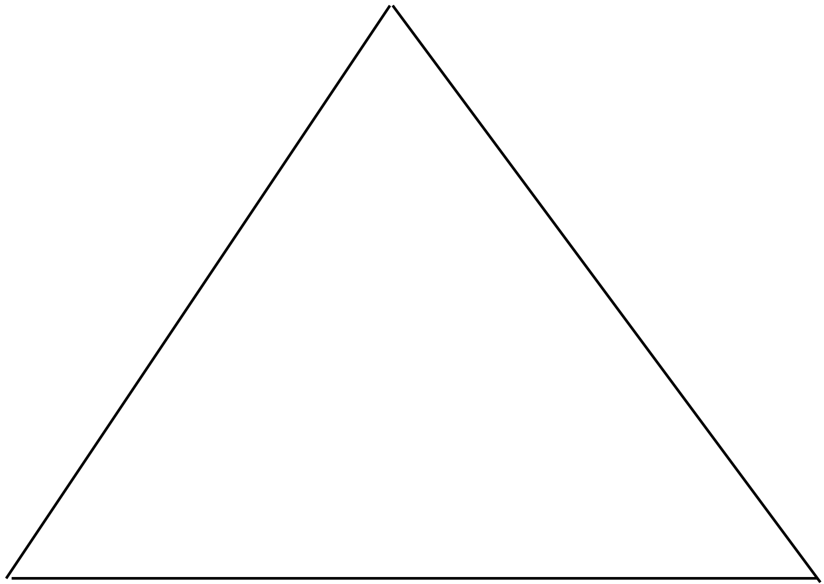
Name____________________________________

Fire Triangle

Fires need heat, fuel, and oxygen to burn. This is known as the "fire triangle." Label each of the three sides of the triangle below with one of the components needed for fire. Draw a picture to illustrate each component.



Initially, the heat is provided by an ignition source, which can be human or natural. Name one natural and one human-caused sources of heat for fire ignition.

Natural: Human:

Fires need fuel to burn. In a forest or grassland, what sort of fuels might you expect to find? Name two potential fuels:

1.

2.

Oxygen is available in the air. Weather has a great influence on when fires occur and on how they spread. Hot temperatures and dry winds can create severe fire conditions by affecting fuel, moisture, and oxygen. What can dry winds do to fuels to make them more likely to burn?

If you cut off any one of these three elements, a fire will not burn. What are some ways that firefighters might cut off each of the three parts of the fire triangle?

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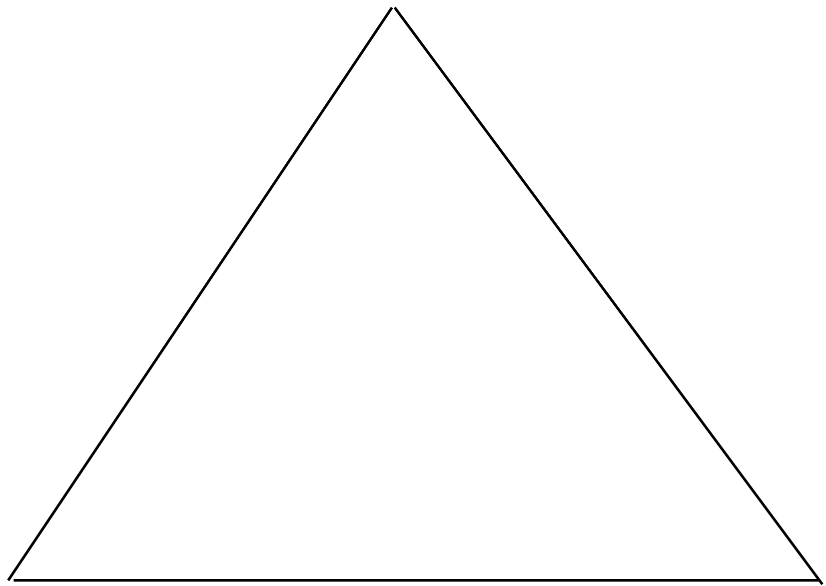
Name______________________________

Fire Triangle (answers)

Fires need heat, fuel, and oxygen to burn. This is known as the "fire triangle." Label each of the three sides of the triangle below with one of the components needed for fire. Draw a picture to illustrate each component.



Initially, the heat is provided by an ignition source, which can be human or natural. Name one natural and one human-caused source of heat for fire ignition.

Natural: **lightning, sparks from rocks falling volcanic activity, spontaneous combustion of plants**

Human: **playing with matches, untended campfires, arson, lit cigarettes, improper burning of debris**

Fires need fuel to burn. In a forest or grassland, what sort of fuels might you expect to find? Name two potential fuels:

1. **dry grass**
2. **dry wood**

Oxygen is available in the air. Weather has a great influence on when fires occur and on how they spread. Hot temperatures and dry winds can create severe fire conditions by affecting fuel, moisture, and oxygen. What can dry winds do to fuels to make them more likely to burn? **Remove the moisture**

If you cut off any one of these three elements, a fire will not burn. What are some ways that firefighters might cut off each of the three parts of the fire triangle?
Remove fuel by plowing up grass or burning an area in the path of the fire; remove heat by dousing the fire with water; Remove oxygen by smothering the fire with chemicals

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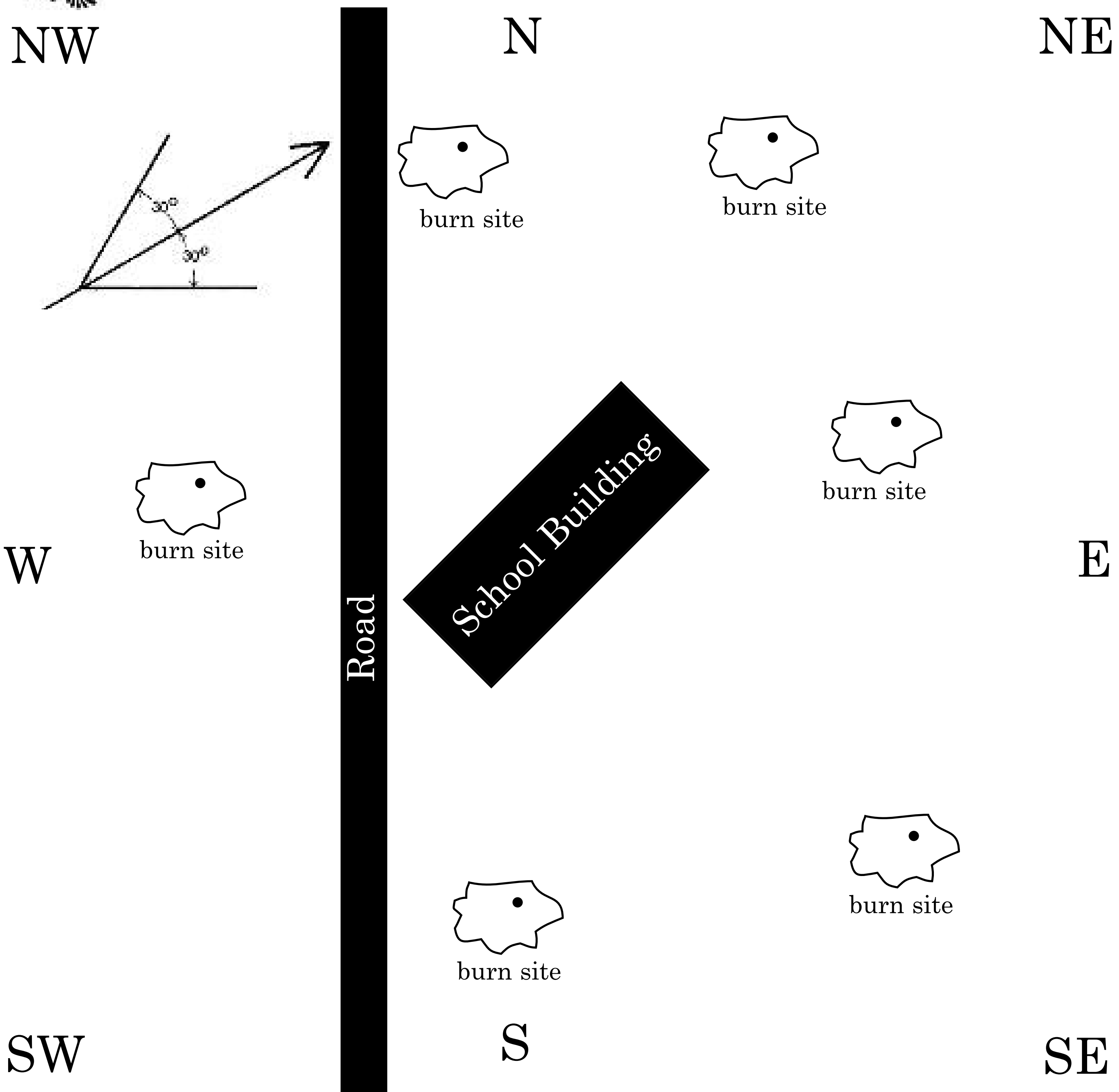
Name________________________________

Wind Trajectory Map



The wind is blowing 10 mph from the northeast. The wind speed is safe for a prescribed burn, but you must make sure the smoke does not drift into a nearby school or into the road.

1. Draw a straight line from each burn site in the direction the wind is blowing.
2. Draw trajectory lines 30 degrees from the straight lines.
3. Circle the sites which are safe for burning without the danger of smoke drifting into the school or the road.

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They Don't Just Eat Grass

Skills: Math and Science

Objective: To compare and contrast the different energy values of feeds by graphing the net energy for maintenance and percentage of fat for a variety of feed types.

Background:

Just as humans eat food for energy and nutrients, so do livestock. Food eaten by animals is called "feed." Animal feed provides energy, usually in the form of carbohydrates (such as grains), fat, and fiber; protein for the development and maintenance of muscles and the synthesis of hormones and enzymes; and vitamins and minerals, important for the growth and maintenance of bones and other body systems. There are two basic kinds of commercially-available animal feed: supplements, which are designed to be fed along with hay or other forage materials; and complete feeds, which are designed to be the only source of food for the animal.

The type and amount of feed necessary depends on the species, size, and "job" of the animal (plow horse, milk cow, beef steer, etc.) Nutritional needs are different for animals that are monogastric (one stomach) than they are for those that are ruminants (have rumens). There is no "one size fits all" feed. While cattle are often fed medicated feeds that prevent bloating or other conditions, horses are generally not fed medicated feed. Copper can be toxic to sheep, so many products fed to other species should not be fed to sheep because they are too high in copper. Generally, larger animals or animals that are working, bred, lactating, or growing have higher nutrient requirements than those animals that are just being maintained at their current condition.

There are many tables and books of research data that help livestock producers determine the nutrient and energy requirements of their animals. Once the nutrient and energy requirements are determined, the producer may have feed custom-mixed for his/her livestock or may buy commercial feed. Commercial feeds are labeled with the species for which they are intended, a guaranteed analysis of the nutrients, the feed ingredients, and directions for use (how much to feed per unit of weight, etc.) Even when a feeding routine is in place, other factors come into play. Extreme heat or cold, wind chill, moisture, illness, stress, parasite infestation and other factors affect nutritional and energy requirements. Monitoring feed requirements and intake is

P.A.S.S.

GRADE 6
Science Process — 4.1,2,3; 5.3
Physical Science — 1.1; 2.1
Life Science — 4.1
Math Process — 5.1,4
Math Content — 5.1

GRADE 7
Science Process — 4.1,2,3; 5.3
Physical Science — 1.1
Life Science — 4.1
Math Process — 5.1,4

GRADE 8
Science Process — 4.1,2,3; 5.3
Physical Science — 1.2
Math Process — 5.1,4
Math Content — 5.1

Oklahoma Ag in the Classroom is a program of the Oklahoma Cooperative Extension Service, 4–H Youth Development, in cooperation with the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education.

Oklahoma Ag in the Classroom
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Vocabulary

bloating — swelling by filling with or as if with water or air
carbohydrates — sugars, starches, cellulose, etc; chemicals with the ratio of 1 carbon:2 hydrogens:1 oxygen
enzymes — proteins that act as biological catalysts by speeding up chemical reactions in organisms, such as helping to break down nutrients in the digestive process
fiber — indigestible substance (cellulose, lignin, etc.) found in the cell walls of plants
forage — herbaceous plant material
hormones — chemicals made in one part of the body that act on a different part of the body (ex: pituitary gland secretes hormones that act on reproductive organs); regulate metabolism, growth, etc.
lactating — producing milk
megacalories — 1 megacalorie = 1000 kilocalories; 1 kilocalorie = 1 Calorie, which is what food energy is measured in (ex: soda has 140 Calories a can); 1 Calorie is the amount of energy it takes to heat one kilogram of water 1 degree Celsius; large animal energy needs are measured in megacalories (Mcal)
minerals — inorganic elements needed by livestock that must be provided in the diet since they cannot be synthesized by the animal or their microbes
monogastric — having one stomach
protein — substance made of amino acids that makes up a large portion of the body — muscles, organs, skin, etc.
roughage — a feed with more than 18 percent indigestible fiber on a dry-matter basis
rumen — one of the compartments of the complex stomach of ruminants such as cattle; site of fermentation
ruminant — a cud-chewing mammal
silage — fermented forage used as animal feed
vitamins — a group of dissimilar organic substances necessary for growth and maintenance that cannot be synthesized by most animals and that are only needed in small amounts

just one of the many responsibilities of raising livestock.

Background sources: Damron, Stephen W., *Introduction to Animal Science: Global, Biological, Social and Industry Perspectives,* 3rd ed., 2006. Freeman, David W., “Feed Tag Information for Commercial Feeds for Horses.” OSU Extension Fact Sheet F-3919. Freeman, David W., “Ration Formulation for Horses.” OSU Extension Fact Sheet F-3997

Activity

1. Read and discuss background and vocabulary.
2. Discuss graphing. (See “Graphs” in the “Resources” section.)
3. Hand out copies of the “Net Energy for Maintenance Table” provided with this lesson.
   — Discuss which graph type would work best with the information presented.
   — Randomly assign to each student one category of feed type from the table (roughages, grazed forages, etc.)
   — Students use two different colors to plot the net energy maintenance (NEm) and percentage fat of each feed on the same graph.
   — Students explain in writing why they chose the graphing method they chose. Is there another graph that would work just as well?
4. After completing their graphs, students will answer the questions on the worksheet included with this lesson.
   — Students may work in groups or individually.
   — Discuss answers as a class.

Extra Reading

Damerow, Gail, *Barnyard in your Backyard: A Beginner’s Guide to Raising Chickens, Ducks, Geese, Rabbits, Goats, Sheep, and Cows,* Storey, 2002.
Hill, Cherry, *Cherry Hill’s Horse Care for Kids: Grooming, Feeding, Behavior, Stable and Pasture, Health Care, Handling and Safety, Enjoying*, Storey, 2002.

Net Energy for Maintenance Table

Choose one of the categories of feed from the table below. Use two different colors to plot the net energy maintenance (NEm) and percentage fat of each feed on the same graph.

NEm = Net energy for maintenance, expressed in megacalories (Mcal) per 100 pounds (cwt) of feed; energy used to work muscles, maintain and repair tissue, keep a steady temperature, maintain homeostasis (a steady internal environment) but not grow or produce milk.

ROUGHAGE

TYPE OF FEED	NEm (Mcal/cwt)	% fat in feed
alfalfa hay, early bloom	59	2.9
alfalfa hay, full bloom	52	2.3
alfalfa cubes	55	2.0
Bermuda hay, early bloom	49	1.9
Bermuda hay, full bloom	39	1.8
corn silage	77	3.1
cotton seed hulls	45	1.9
fescue hay, early bloom	55	4.8
fescue hay, full bloom	52	3.5
peanut hulls	36	1.5
prairie hay	50	2.0
rice hulls	35	3.9
sorghum silage	58	2.7
sunflower seed hulls	42	2.2
wheat straw	43	1.8

Source: Lalman, David. "Nutritive Value of Feeds for Beef Cattle,"
OSU Extension Fact Sheet F-3018.

GRAZED FORAGE

Type of Feed	NEm (Mcal/cwt)	%fat in feed
native range, Jan-March	42	1.7
native range, April-June	74	3.2
native range, July-Aug	65	3.0
native range, Sept-Oct	58	2.5
native range, Nov-Dec	52	2.2

BY-PRODUCT FEEDS

distillers grains w/soluble corn	104	10.6
soybean hulls	84	2.6
wheat bran	74	4.5

FEED GRAINS

corn grain, whole	99	4.3
corn grain, steam flaked	106	4.1
milo, cracked, rolled, or ground	74	4.5
milo, steam flaked	102	3.1

HIGH PROTEIN MEALS/SEEDS

cottonseed, whole	108	17.8
soybean meal, 48%	98	1.2
soybeans, whole	106	18.8
sunflower seeds, high oil	142	42.0

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Name ________________________________

They Don't Just Eat Grass

Use the "Net Energy for Maintenance Table" and work with a partner to answer the following questions:

1. Which category of feedstuffs (roughage, feed grains, etc.) have the highest NEm?

2. Which category of feedstuffs have the highest percentage of fat?

3. For the hays and forages, does the season or cutting (early versus late bloom) affect the amount of energy and fat available?

4. Should it take more energy to produce meat, milk, etc., than to maintain weight?

   What is a possible reason for your answer? Discuss your thoughts with your partner.

5. How might this feed information be used by a producer?

6. If hay costs were the same and you had a herd of horses that were in good condition and didn't need to gain weight, which hay would you buy?

   Why?

7. The NEm is calculated on a "dry matter" basis. In other words, the samples are dehydrated first and then the megacalories are determined. Why do you suppose it is done that way?

8. Is there a direct correlation between the amount of NEm in a feed and the percentage of fat in the feed?

   Why or why not?

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Name ______________________________

They Don't Just Eat Grass (answers)

Use the "Net Energy for Maintenance Table" and work with a partner to answer the following questions:

1. Which category of feedstuffs (roughage, feed grains, etc.) have the highest NEm?
   high protein meals/seeds

2. Which category of feedstuffs have the highest percentage of fat?
   high protein meals/seeds

3. For the hays and forages, does the season or cutting (early versus late bloom) affect the amount of energy and fat available?
   hay — The early bloom has more net energy and fat content.
   grazed forage — April-June is the highest

4. Should it take more energy to produce meat, milk, etc., than to maintain weight?
   yes

   What is a possible reason for your answer? Discuss your thoughts with your partner.

5. How might this feed information be used by a producer?
   Knowing the time of year, energy and fat content in the feed could help the producer tailor the feed to his/her specific needs (maintenance or production)

6. If hay costs were the same and you had a herd of horses that were in good condition and didn't need to gain weight, which hay would you buy?
   Bermuda hay

   Why?
   lowest in fat content

7. The NEm is calculated on a "dry matter" basis. In other words, the samples are dehydrated first and then the megacalories are determined. Why do you suppose it is done that way?
   Water aids in body maintenance and digestion, but has no nutritional or energy value.

8. Is there a direct correlation between the amount of NEm in a feed and the percentage of fat in the feed?
   No. Early bloom alfalfa hay 59 X .029 = 1.711; Full bloom alfalfa hay 52 X .023 = 1.196

   Why or why not?
   Fat does not supply all of the energy in a feed?

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

US Agriculture and the World Market

Skills: Math, Science

Objective: Students interpret agricultural import and export data in tabular form, determine percentages, convert values between measurement systems and graph information from tables.

Background:

More than likely you are wearing something that was not made in the United States. Your shoes may have been made in Mexico or your shirt in Turkey or China. Perhaps you have eaten bananas from Costa Rica or grapes from Chile. Because of world trade, countries can buy goods from, or sell goods to, other countries of the world. There are rules to be followed regarding trade, and an international organization, the World Trade Organization (WTO), works to keep world trade as fair and equal as possible for all countries.

Creating goods for export to other countries stimulates a country's economy. New jobs are created, and living standards are raised. There is less reliance on foreign aid. Because of trade, consumers get a larger selection of products, and the competition can help keep quality up and prices down. Manufacturers also have more markets in which to sell their product.

Some people are wary of global trade, however. Imported goods that are similar to what is produced domestically may increase competition and cause citizens to lose their jobs. To help prevent this and alleviate such fears, some countries add tariffs to imported goods to bring the price up so they are more expensive than domestically-produced goods. Unfortunately, tariffs make it harder for poor countries to sell their goods.

Agricultural subsidies are payments made to farmers by the government. Farmers who get subsidy payments can sell their goods for less money and still have enough income to support their families. Subsidies help keep food prices low for consumers, but farmers from countries without subsidies cannot sell their goods for as little as the subsidized farmers and so find it difficult to find markets for their products. World trade is a complicated matter; it is not always easy to make it fair for all involved.

Background sources: The World Bank, US Department of Agriculture Economic Research Service

P.A.S.S.

GRADE 6
Math Process — 1.6; 2.1; 3.3; 5.1,2,4
Math Content — 2.1,2; 4.2,3; 5.1,2
Science Process — 4.1,2,3

GRADE 7
Math Process — 1.6; 2.1; 3.3; 5.1,2,4
Math Content — 2.1a,2c, 4.2b, 5.1
Science Process — 4.1,2,3

GRADE 7
Math Process — 1.6; 2.1; 3.3; 5.1,2,4
Math Content — 2.1b; 5.1
Science Process — 4.1,2,3

Activities

1. Provide copies of the import and export charts included in this lesson along with the questions.
   — Students use the charts to answer the questions.
   — With a partner or in a small group, students discuss and justify their answers.
2. Students choose five products that the US imports AND exports.
   — Students select a graphing method to compare the values and/or volumes of those five products from one of the four time periods listed in the table (December 2006, January 2007, October-January 2006, or October-January 2007).
3. Using either export or import values, students select the most appropriate graphing method and graph the percent change for either time period listed (December-January, or 2006-2007) for all products. A review of graphing is included in the "Resources" section.

Resources Needed

calculators (optional)

graph paper

Vocabulary

export — to ship goods out of a country
import — to bring goods into a country
subsidy — financial aid that encourages the production of a product
tariff — tax on imported goods

Extra Reading for Students

Goldberg, Jake, *The Disappearing American Farm,* Franklin Watts, 1996.

January, Brendan, *Globalize It! The Stories of the IMF, the World Bank, the WTO — and Those Who Protest,* Millbrook, 2004.

Extra Reading for Teachers

Weiss, Tony, *The Global Food Economy: The Battle for the Future of Farming*, Zed Books, 2007.

OKLAHOMA AG IN THE CLASSROOM IS A PROGRAM OF THE OKLAHOMA COOPERATIVE EXTENSION SERVICE, 4–H YOUTH DEVELOPMENT, IN COOPERATION WITH THE OKLAHOMA DEPARTMENT OF AGRICULTURE, FOOD AND FORESTRY AND THE OKLAHOMA STATE DEPARTMENT OF EDUCATION.MM

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US Agricultural Exports Year-to-Date and Current Months

Item	Dec. 2006	Jan. 2007	Change Dec.-Jan.	Oct.-Jan. 2006	Oct.-Jan. 2007	Change '06-'07
Ag export values	**million dollars**	**million dollars**	**percent**	**million dollars**	**million dollars**	**percent**
live animals	105	28	-73	365	423	16
red meats & products	466	448	-4	1,590	1,873	18
poultry meats & products	241	237	-2	1,055	1,034	-2
dairy products	146	153	4	521	622	19
hides & skins	161	177	10	570	666	17
grains and feeds	1,860	1,917	3	5,972	7,248	21
wheat	398	464	17	1,581	1,560	-1
rice	128	122	-5	445	415	-7
corn	796	677	-15	1,845	2,897	57
animal feeds & oil meal	410	429	5	1,574	1,709	9
soybeans	821	1,003	22	3,125	3,896	25
vegetable oils	204	175	-15	583	730	25
fruits & products	305	309	1	1,217	1,330	9
fruits, fresh	222	232	4	943	1,001	6
fruits, prepared	83	77	-7	274	329	20
fruit juices	82	80	-3	271	309	14
vegetables & products	358	336	-6	1,253	1,377	10
vegetables, fresh	158	156	-1	514	597	16
vegetables, processed	200	180	-10	739	780	6
tree nuts and preparations	296	250	-15	1,372	1,346	-2
cotton & linters	239	240	0	1,142	834	-27
sugar & tropical products	217	213	-2	785	925	18
Volumes	**1,000 metric tons**	**1,000 metric tons**	**percent**	**1,000 metric tons**	**1,000 metric tons**	**percent**
red meats & products	197	196	0	688	784	14
poultry meats	221	207	-7	903	946	5
nonfat dry milk	17	17	0	66	78	18
wheat	1,918	2,274	19	57	54	-6
rice	323	296	-8	1,409	1,112	-21
coarse grains	5,140	4,513	-12	19,328	20,410	6
corn	4,785	4,024	-16	17,529	18,838	7
sorghum	315	408	29	1,634	1,310	-20
soybeans	3,060	3,676	20	13,027	15,146	16
oil meal	733	695	-5	2,594	2,834	9
vegetable oils	253	208	-18	687	899	31
fruits, fresh	222	252	13	991	952	-4
fruits, prepared or preserved	44	42	-4	162	173	7
fruit juices	81	81	0	376	306	-19
vegetables, fresh	174	151	-13	666	649	-3
vegetables, preserved or processed	169	153	-9	689	689	0
nuts & preparations	76	64	-16	351	368	5
cotton & linters	176	170	-3	922	610	-34

Source: Economic Research Service compiled from Census Bureau data, US Department of Commerce.)

US Agricultural Imports Year-to-Date and Current Months

Item	Dec. 2006	Jan. 2007	Change Dec.-Jan.	Oct.-Jan. 2006	Oct.-Jan. 2007	Change '06-'07
Ag import values	**million dollars**	**million dollars**	**percent**	**million dollars**	**million dollars**	**percent**
live animals	222	232	5	1,023	975	-5
red meats & products	431	430	0	1,796	1,717	-4
beef & veal	273	288	5	1,133	1,090	-4
pork	96	85	-11	436	390	-11
dairy products	228	221	-3	1,007	949	-6
cheese	101	71	-30	360	392	9
grains & feeds	467	474	1	1,660	2,008	21
grain products	309	316	2	1,205	1,376	14
oilseeds & products	317	298	-6	1,013	1,177	16
vegetable oils	272	247	-9	862	990	15
fruits & preparations	611	787	29	2,025	2,316	14
fruits, fresh or frozen	501	653	30	1,598	1,837	15
fruits, prepared	110	133	22	427	478	12
fruit juices	104	132	26	326	446	37
vegetables & preparations	620	760	23	2,497	2,533	1
vegetables, fresh or frozen	441	577	31	1,864	1,810	-3
vegetables, prepared	168	172	2	597	681	14
tree nuts & preparations	97	90	-8	404	392	-3
cotton & linters	0	1	448	4	3	-39
wine	347	340	-2	1,369	1,570	15
malt beverages	297	291	-2	975	1,223	25
essential oils	184	179	-3	730	700	-4
cut flowers & nursery stock	105	143	36	463	509	10
sugar & related products	230	204	-11	961	882	-8
confections	94	92	-1	389	411	5
cocoa & products	264	230	-13	942	931	-1
coffee & products	267	318	19	942	1,128	20
rubber, natural	119	159	34	609	659	8
Volume	**1,000 metric tons**	**1,000 metric tons**	**percent**	**1,000 metric tons**	**1,000 metric tons**	**percent**
wine 1/	70	71	0	269	303	13
malt beverages 1/	288	275	-4	920	1,171	27
cattle & calves	196	150	-24	988	841	-15
beef & veal	80	88	9	351	323	-8
dairy products	31	24	-21	122	117	-4
processed grains, e.g, feed	85	89	5	350	376	7
fruits, fresh or frozen	681	859	26	2,508	2,769	10
fruits, prepared	94	117	24	387	409	6
vegetables, fresh or frozen	483	606	26	1,964	1,949	-1
vegetable oils	288	253	-12	861	969	13
sugar & related products	280	239	-15	1,335	1,018	-24
cocoa & products	124	111	-10	443	416	-6
coffee & products	110	130	18	424	463	9

1/ = thousand hectoliters.
Source: Economic Research Service compiled from Census Bureau data, US Department of Commerce.)

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Name ______________________________

US Agriculture and the World Market

Use the January 2007 columns in the import and export tables to fill in the blanks below.

1. The value of US exports of live animal values is what percentage of imports? _____
2. The value of US exports of red meats and products is _____ % more/less (Circle one.) than that of imports.
3. US dairy product export values equal ________% of US import values.
4. The value of US grain and feed exports is ____ times that of grain and feed imports.
5. What percent less than US vegetable oil imports is the value of vegetable oil exports?____
6. What percent less than US fruit juice imports is the value of fruit juice exports?_____
7. The US exports almost _______ times as many tree nuts as it imports.
8. The US exports ______% of the volume of the prepared fruits it imports.
9. The US is only ______% short of having equal volumes of vegetable oil entering and leaving the U.S.

For the questions below:
  1 metric ton = 1,000 kg; 1 kg ≈ 2.2 pounds;
  1 American short ton = 2,000 pounds; 1 pound = 16 ounces; 1 dram ≈ 1.77g;
  1 stone = 14 pounds; 1 scruple ≈ 6.48 carats; 1 carat = 0.2 grams

10. How many *pounds* of rice did the US export in January, 2007? ______
11. How many *American short tons* of nonfat dry milk did the US export between October, 2006, and January 2007? ______
12. How many *ounces* of soybeans were exported in December 2006? __________
13. How many *drams* of cocoa and products were imported between October, 2005, and January, 2006? _____
14. How many *stones* of beef and veal were imported in December, 2006?_____
15. How many *carats* of dairy products were imported in January, 2007?_____
16. How many *scruples* of coffee and products were imported in January, 2007? _____

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Name ______________________________

US Agriculture and the World Market (answers)

Use the January 2007 columns in the import and export tables to fill in the blanks below.

1. The value of US exports of live animal values is what percentage of imports? 12%

2. The value of US exports of red meats and products is 4% more/less (Circle one.) than that of imports.

3. US dairy product export values equal 69% of US import values.

4. The value of US grain and feed exports is four times that of grain and feed imports.

5. What percent less than US vegetable oil imports is the value of vegetable oil exports? 29%

6. What percent less than US fruit juice imports is the value of fruit juice exports? 39%

7. The US exports almost three times as many tree nuts as it imports.

8. The US exports 36% of the volume of the prepared fruits it imports.

9. The US is only 18% short of having equal volumes of vegetable oil entering and leaving the U.S.

For the questions below:
1 metric ton = 1,000 kg; 1 kg ≈ 2.2 pounds;
1 American short ton = 2,000 pounds; 1 pound = 16 ounces; 1 dram ≈ 1.77g;
1 stone = 14 pounds; 1 scruple ≈ 6.48 carats; 1 carat = 0.2 grams

10. How many *pounds* of rice did the US export in January, 2007? 651,200,000

11. How many *American short tons* of nonfat dry milk did the US export between October, 2006, and January 2007? 85,800

12. How many *ounces* of soybeans were exported in December 2006? 107,712,000,000

13. How many *drams* of cocoa and products were imported between October, 2005, and January, 2006? 250,282,485,876

14. How many *stones* of beef and veal were imported in December, 2006? 12,571,429

15. How many *carats* of dairy products were imported in January, 2007? 120,000,000,000

16. How many *scruples* of coffee and products were imported in January, 2007? 100,308,641,975

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Science

Eat Your Flowers

Testing the effects of soil types on edible flowers

Skills: Science

Objective: Students grow flowers in different soil types to determine the effect on flavor.

Background:

The culinary use of flowers dates back thousands of years. The earliest recorded reference is from 140 BC. Flower cookery has been traced back to ancient Roman, Chinese, Middle Eastern and Indian cultures. Edible flowers were especially popular during the reign of England's Queen Victoria. Today many restaurant chefs and innovative home cooks garnish their entrees with flower blossoms for a touch of elegance.

Not every flower is edible, nor is every flower part. The stamen and pistil are not edible, but the petals of some flowers are.

Flowers are rich in nectar and pollen. Some are high in vitamins and minerals. Roses, especially rose hips, are very high in vitamin C. Marigolds and nasturtiums contain vitamin C, and dandelion blossoms contain Vitamins A and C. Flowers are also nearly calorie-free.

Vitamin C is a water-soluble vitamin that helps to absorb iron and keeps connective tissues healthy. It is a nutrient that is required in very small amounts. In addition to the flowers mentioned above, it is also found in strawberries, bell pepper and citrus fruits. The richest natural sources are fruits and vegetables. It is also present in some cuts of meat, especially liver.

Vitamin A, a fat-soluble vitamin, plays essential roles in vision, growth and development, the development and maintenance of healthy skin, hair, and mucous membranes, immune functions, and reproduction. Vitamin A can be found in foods such as sweet potato, carrot, kale, apricots, mango, turnip greens, and spinach.

Flowers grown in different locations can have different flavors because of different soil types, fertilizers and environmental conditions. Flowers may taste different at the end of the growing season and can vary from year to year.

Most growers cannot make a living growing only edible flowers. Edibles are usually grown in conjunction with cut flowers, herbs,

P.A.S.S.

GRADE 6
Science Process — 3.1,2,3,4,5,6; 4.1,3,5; 5:3
Life Science — 4.1

GRADE 7
Science Process — 3.1,2,3,4,5,6; 4.1,3,5; 5:3
Life Science — 3.1; 4.2

GRADE 8
Science Process — 3.1,2,3,4,5,6; 4.1,3,5; 5.3

Resources Needed

seed packets, seed catalogs and/or gardening books for reference

plant potting containers (small starter flats and small pots for transplanting bedding plants)

3 different growing media (sandy soil, clayey soil, soilless potting substrate)

marigold seeds

sunlit window area or grow-light plant stand

plant markers to label all plants and growing media

notebooks

Rules for Eating Flowers

- Eat flowers only when you are positive they are edible. If uncertain, consult a good reference book.
- Just because flowers are served with food does not mean they are edible.
- If pesticides are necessary, use only those products labeled for use on edible crops.
- Do not eat flowers from florists, nurseries or garden centers.
- Do not eat flowers picked from the side of the road.
- Remove pistils and stamens from flowers before eating. Eat only the flower petals of most edible flowers.
- Introduce flowers into your diet in small quantities, one species at a time.
- If you have allergies, introduce edible flowers gradually, as they may aggravate some allergies.
- Enjoy the different flavors and colors that edible flowers add to many foods.

Iowa State University

specialty lettuce, and/or other vegetables. Flowers complement other plants by attracting pollinators and other beneficial insects.

Some common edible flowers are:

basil — flavor is mild, similar to the leaves.

carnations — surprisingly sweet petals can add color to salads.

dandelions — sweetest when flowers are young; honey-like.

daylilies — slightly sweet with a mild vegetable flavor.

English daisy — mildly bitter taste, used mostly for decoration.

hibiscus — cranberry-like flavor; can be used in salads.

honeysuckle — sweet honey flavor.

pansy — slightly sweet, green or grassy flavor.

violets — sweet, perfumed flavor.

nasturtium — peppery taste.

squash blossoms — similar to squash.

Some **common poisonous flowers** are autumn crocus, azalea, buttercup, butterfly weed, calla lily, Christmas rose, daffodil, delphinium, clematis, foxglove, hydrangea, iris, jasmine, morning glory, lily of the valley, and wisteria, among others. Use a good reference book to make sure flowers are edible before eating them.

Background Sources: National Sustainable Agriculture Information Service; Iowa State University *Horticulture News*; Ursell, Amanda, *Complete Guide to Healing Foods,* "What's Cooking America?" www.whatscookingamerica.net; *Wikipedia, The Free Encyclopedia*, www.wikipedia.org

Activities

1. Read and discuss background.
   — Provide seed packets, seed catalogs and/or gardening books for students to see photographs of the edible flowers listed.
   — Provide samples of some edible flowers for students to taste. (See list in the background.)
2. Students will grow marigolds in three different kinds of growing media. Marigolds are recommended because they are quick to germinate and easy to grow. If time does not permit growing flowers in the classroom, students will plant the flowers in the classroom, grow them at home and communicate results.
   — Divide the class into three groups.
   — Provide copies of the "Scientific Method Format" from the "Resources" section.
   — Review the steps of the scientific method.
   — Each group will answer the question: "Can different growing media affect the flavor of an edible flower?"
   — Students write a hypothesis for the investigation.
   — Students design the experiment.
   — Students gather material.

— Each group will plant seeds in each of the three growing media.
— Plant the seeds. Follow package directions for growing.
— Each group will record the steps and care given its seeds into a notebook.
— Students will transplant the plants into larger pots as the plants grow.
— Groups will research information for accelerating bloom time and continue gathering data.
— When the flowers bloom, set up a blind "sensory room," where panelists (students) are separated.
— Students sample the flowers to compare flavors and to determine if there is a difference in taste of the flowers grown in the different media.
— Students analyze data to determine if the hypothesis is supported and if the soil type affects the flavor of the flower.
— Each group communicates its results to the class.

3. Students research online or in the library to develop a list of edible flowers.
   — Students visit a local greenhouse or florist to identify edible flowers.
4. Students research foods that contain Vitamins A and C.
   — Students will taste-test foods that contain Vitamins A and C (kiwifruit, papaya, Brussels sprouts, kale, mangoes, turnip greens) .
6. Provide food labels from canned fruit and vegetables.
   — Students search the RDAs for the amounts of Vitamins A and C in each food.
   — Students make bar graphs showing which of the foods provide the greatest percentage of recommended daily allowance (RDA) for each of the vitamins.

Extra Reading

Creasy, Rosalind, *The Edible Flower Garden,* Periplus, 1999.

McGee, Rose Marie Nichols, and Maggie Stuckey, *McGee and Stuckey's Bountiful Container: A Container Garden of Vegetables, Fruits, Herbs, and Edible Flowers,* Workman, 2002.

Vocabulary

culinary — of or relating to the kitchen or cooking

edible — fit or safe to be eaten

nectar — a sweet liquid given off by plants and especially by the flowers and used by bees in making honey

pesticide — a substance used to destroy pests

pistil — the seed-producing part of a flower consisting usually of stigma, style, and ovary

pollen — a mass of tiny particles in the anthers of a flower that fertilize the seeds and usually appear as fine yellow dust

stamen — an organ of a flower that consists of an anther and a filament and produces the pollen

water-soluble — capable of being dissolved in water

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How Germs Spread

Skills: Science

Objective: Students conduct a test to help them visualize the spread of germs.

Background:

I. HOW GERMS SPREAD

The most common way for infectious disease to spread is through the direct transfer of bacteria, viruses or other germs from one person to another. This can occur when an individual with the bacterium or virus touches, coughs on or kisses someone who isn't infected. These germs can also spread through the exchange of body fluids from sexual contact or a blood transfusion.

Animals carry many germs. Being bitten or scratched by an infected animal can make you sick. You can might also become infected by scooping your cat's litter box or by cleaning mouse droppings in your house or garage. The best way to prevent this is to wash your hands often.

Disease-causing organisms can also be passed along by indirect contact. Many germs can linger on an inanimate object, such as a tabletop, doorknob or faucet handle. When you touch the same doorknob grasped by someone ill with the flu or a cold, for example, you can pick up the germs he or she left behind. If you then touch your eyes, mouth or nose before washing your hands, you may become infected.

When you cough or sneeze, you expel droplets into the air around you. When you're sick with a cold or the flu — or any number of other illnesses — these droplets contain the germ that caused your illness. Crowded, indoor environments may promote the chances of droplet transmission.

Some disease-causing germs travel through the air in particles considerably smaller than droplets. These tiny particles remain suspended in the air for extended periods of time and can travel in air currents. If you breathe in an airborne virus, bacterium or other germ, you may become infected and show signs and symptoms of the disease. Tuberculosis and SARS are two infectious diseases usually spread through the air, in both particle and droplet forms.

Some germs rely on insects — such as mosquitoes, fleas, lice or ticks — to move from host to host. These carriers are known as vectors. Mosquitoes can carry the malaria parasite or West Nile virus, and deer ticks may carry the bacterium that causes Lyme disease.

Another way disease-causing germs can infect you is through food and water. *Escherichia coli (E. coli)* is a bacterium present in certain foods, such as undercooked hamburger or unwashed fruits or

P.A.S.S.

GRADE 6
Science Process — 1.2,3; 3.1,4,5,6; 4.1,2,4,5; 5.3,4
Life Science — 3.1,2; 4.2

GRADE 7
Science Process — 1.2,3; 3.1,4,5,6; 4.1,2,4,5; 5.3,4
Life Science — 2.1; 4.1

GRADE 8
Science Process — 1.2,3; 3.1,4,5,6; 4.1,2,4,5; 5.3,4
Life Science — 3.1,2

Resources Needed

phenolphthalein

bleach

water

clear plastic cups

500 ml beaker

25 ml graduated cylinder

reference books

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vegetables. When you eat foods contaminated with *E. coli,* chances are you'll experience an illness, also referred to as food poisoning.

II. WHAT IS A PANDEMIC?

A pandemic is an epidemic (an outbreak of an infectious disease) that spreads across a large region (for example a continent), or even worldwide. According to the World Health Organization, a pandemic can start when three conditions have been met:

1. A disease new to the population emerges.
2. The agent infects humans, causing serious illness.
3. The agent spreads easily and sustainably among humans.

A disease or condition is not a pandemic merely because it is widespread or kills many people; it must also be infectious.

One infectious disease that has begun to worry medical professional is the H5N1 avian influenza virus, commonly known as avian flu. The avian flu virus is found in wild birds, especially among waterfowl (ducks, geese, gulls). It is highly contagious and can infect domesticated birds, such as chicken, ducks, and turkeys. There have been no cases of avian flu reported in wild or domesticated birds in the US. The US Fish & Wildlife Service has an ongoing surveillance program to test wild birds for H5N1 virus.

Human infection from bird flu is rare but can happen when contact is made with the cages, equipment, water, or feed. Approximately 160 people have contracted avian flu worldwide, but there have been no reported cases in the United States.

Once an animal is sick, no one wants the disease to spread. That is where biosecurity comes into play. Biosecurity refers to management practices that reduce the chances infectious diseases will be carried onto a farm by animals or people.

The US Department of Agriculture (USDA) has safeguards in place to protect against the introduction of the avian flu and other diseases into the United States. All live birds imported into the US are quarantined and tested. Pet birds returning to the US from other countries (except Canada) also are tested and quarantined at a USDA facility.

Individual poultry producers in the US use these five biosecurity precautions:

1. Quarantine all new animals for at least 30 days.
2. Properly vaccinate all animals.
3. Wash hands before and after dealing with livestock and wash boots and clothing after visiting another farm and after dealing with sick animals.
4. Contact proper authorities if an animal is sick or acting oddly or if a suspicious person has been around.

What is a Germ?

The term 'germ' actually refers to any microorganism, especially those microorganisms that cause disease. Included in this category are certain viruses, bacteria, and fungi.

Viruses are simple organisms that are so tiny they can only be seen with a special, very powerful microscope called an "electron microscope." They are so simple that they are technically not even considered "alive," since they are not able to metabolize, grow, or reproduce on their own. Instead they must take over a host cell that provides these functions.

Bacteria are much larger in size and can live anywhere. There are bacteria in the soil, at the depths of the ocean, on the surfaces of teeth, and in the digestive tracts of humans and animals. Most bacteria are not pathogenic (disease-causing). In fact, many bacteria are very helpful to us. There are species that decompose trash, clean up oil spills, and even produce medicines.

Fungi are larger, plant-like organisms that lack chlorophyll (the substance that makes plants green and converts sunlight into energy). Since fungi do not have chlorophyll to make food, they have to absorb food from whatever they are growing on. Fungi can be very helpful — making bread rise, decomposing trash — but they can also be harmful if they steal nutrients from another living organism.

5. Limit all contact of animals with other animals (wild and domesticated) and with people from farms where proper hygiene is not practiced.

The USDA works closely with international organizations like the World Organization for Animal Health (OIE), the United Nations' Food and Agriculture Organization (FAO), and World Health Organization (WHO) to assist avian flu-affected countries with disease prevention, management, and eradication activities. By helping these countries prepare for, manage, or eradicate avian flu outbreaks, the USDA helps control the spread of the virus.

Background sources: US Department of Agriculture, Oklahoma State Department of Health, Communicable Disease Division; Nemours Foundation, Kids Health.

Activities

HOW GERMS SPREAD

1. Read and discuss the first section of the background, "How Germs Spread."
   — As you read, students will list the way germs can spread.
2. Conduct the following experiment to demonstrate how germs spread.
   — Prepare a mixture of 50 ml water and 50 ml bleach. Mark this cup on the bottom to distinguish it from the other cups, and set it aside. This will be the teacher's cup. CAUTION: Great care should be taken when handling bleach. This is a strong base and can cause irritation.
   — Give each student a clear plastic cup.
   — Each student will fill his/her cup with 100 ml of water. Instruct students to not drink from the cups.
   — Tell students an infected bird has entered the classroom, and one unknown person in the class will represent the infected bird.
   — Students will hypothesize as to whether the infected bird will affect other birds and, if so, to what extent.
   — Students will spend the next 5-10 minutes mingling and sharing water by pouring small amounts into each others' cups, being careful not to overfill the cups.
   — The teacher will use the cup prepared ahead of time to participate in the mingling without letting students know of the bleach addition.
3. After 5-10 minutes stop and ask these question:
   — Did you drink after each other?
   — Did you walk in the contaminated "droppings" of another?
   — Were you in the same area as other birds (students)?
   — Do you think you shared any germs?
4. Put 5ml (approximately one eye dropper full) of phenolphthalein into each student's cup.

Vocabulary

bacteria — a group of single-celled microorganisms that live in soil, water, the bodies of plants and animals, or matter obtained from living things and are important because of their chemical effects and disease-causing abilities

biosecurity — management practices that reduce the chances infectious diseases will be carried onto a farm by animals or people.

contagious — capable of being transmitted by bodily contact with an infected person or object

fungus — any of a kingdom of living things (as molds, rusts, mildews, smuts, and mushrooms) that lack chlorophyll, are parasitic or live on dead or decaying organic matter, and were formerly considered plants

germ — a microscopic living thing; especially : one that causes disease

pandemic — an outbreak of disease occurring over a wide area and affecting many individuals

pathogen — an agent that causes disease, especially a living microorganism such as a bacterium or fungus

population — a group of organisms of the same species populating a given area

quarantine — a strict isolation imposed to prevent the spread of disease

virus — any of various simple submicroscopic parasites of plants, animals, and bacteria that often cause disease and that consist essentially of a core of RNA or DNA surrounded by a protein coat. Unable to replicate without a host cell, viruses are typically not considered living organisms.

— Students will observe what happens: If the water turns pink, a germ (represented by the bleach) was shared.

5. Discuss:
   — Was your hypothesis correct? Did the infected bird infect other birds? To what extent?
   — Can germs be easily and unknowingly shared?
   — How did the contamination occur?
   — Reveal to students that the teacher was the "host bird," and explain that phenolphthalein is an indicator for bleach and turns pink when it comes into contact with bleach.
6. Refer students to their previous outlines of the background and ask: "How does this activity simulate the transfer of germs? Which kind of transfer does this activity represent?"
7. Evaluate the number of infections spread to other birds.
   — Use tally marks on the chalkboard to record the number of cups with pink water.
   — Students will create a data table to compare the number of students who shared the germ with the number of students (if any) who were germ-free.

WHAT IS A PANDEMIC?

1. Read and discuss the second part of the background, "What is a Pandemic?"
   — Discuss how an infectious disease like the avian flu might spread.
   — How might birds spread disease? (Birds walking in droppings. Birds stung by a mosquito which then stings you.)
2. Discuss the differences between viruses, bacteria and fungi. (See "What is a Germ?" included in this lesson.)
3. Review "How Reliable Are Your Sources?" in the "Resources" section.
   — Students work in groups to research the common diseases listed at left online or in the library.
   — Divide the list among the groups.
   — Students will determine if the diseases are viral, bacterial or fungal, if they infect humans, animals or both and which ones can be transferred from animals to humans, and vice versa.
   — As a class, develop a disease comparison chart to record group findings.

Common Diseases

influenza
measles
common cold
whooping cough
strep throat
athlete's foot
parvovirus
distemper
hepatitis
Newcastle disease
Lyme disease
brucellosis
tuberculosis
salmonella
blastomycosis
aspergillosis
ringworm

Extra Reading

Goldsmith, Connie, *Invisible Invaders: Dangerous Infectious Diseases*, Lerner, 2006.
Hooper, Mary, *Petals in the Ashes*, Bloomsbury Children's, 2005.
Reed, Jennifer, *The AIDS Epidemic: Disaster & Survival* (Deadly Disasters), Enslow, 2006.
Silverstein, Alvin, Virginia Silverstein, and Laura Silverstein Nunn, *Disease Update: The Flu and Pneumonia Update*, Enslow, 2006.
Snedden, Robert, *Fighting Infectious Diseases*, Heinemann, 2000.

If Not For the Pollinators

Matching Flowers With Their Pollinators

Skills: Science

Objective: Students match flowers to pollinators and construct models of flowers to demonstrate why different kinds of flowers need different kinds of pollinators.

Background:

Every third bite you take would not be there if not for the help of pollinators. Pollination is necessary for the production of seeds and fruits in up to 80 percent of the world's flowering plants. That includes two-thirds of the world's food plants — fruits, many vegetables (or their seed crops) and even legumes such as alfalfa and clover, which are fed as hay to the livestock we eat as meat. The remaining 1/3 of our food come from plants that can be pollinated by the wind — most grasses and some nuts, including pecans and other members of the hickory family.

Pollination is important to the US economy. In the US, pollination by insects contributes to $40 billion worth of products annually. Pollination by honeybees alone is valued at $19 billion, 143 times the total value of the honey produced by bees.

The pollination process works like this: The flowers use nutritious foods (pollen) to attract pollinating insects in hopes they will become dusted with bright yellow pollen and transfer the microscopic pollen grains from flower to flower. The pollen grains contain the sperm cells that must be transferred from the male parts of a flower (the anthers) to the top of the pistil (known as the stigma) which is on the female part of a flower. This transfer of pollen from flower to flower (or even within the same flower) is known as pollination. Once there, the pollen grains send down thin pollen tubes carrying the sex cells needed to unite (fertilize) with the ovules within the swollen ovary at the base of the flower. Once fertilized, these little green ovules rapidly become the seeds within the swollen edible part that we call the fruit, like the white flesh of an apple surrounding the dark brown seeds within the apple core.

There are over 100,000 species of pollinators. Most people know bees are pollinators, but wasps, butterflies, moths, ants, beetles, flies, midges, mosquitoes, and even some slugs do their part as well. Many mammals and birds carry pollen, which they pick up inadvertently while feeding on the nectar of plants.

There are over 3,500 native bee species in the US. Native bees pollinate many Oklahoma crops, including alfalfa, apples,

P.A.S.S.

GRADE 6
Science Process — 2.1,2; 3.1,2,3,4,5; 4.1,3,4,5; 5.1,3,4
Life Science — 3.2; 4.1,2; 5.2

GRADE 7
Science Process — 2.1,2; 3.1,2,3,4,5; 4.1,3,4,5; 5.1,3,4
Life Science — 2.2; 4.2; 5.2

GRADE 8
Science Process — 2.1,2; 3.1,2,3,4,5; 4.1,3,4,5; 5.1,3,4
Life Science — 3.1,2; 5.2

Resources Needed

graph paper

journals

clear straws and coffee stirrers

artificial flower petals

pipe cleaners

construction paper

stiff fabric

12 oz. and smaller clean plastic soda or water bottles in assorted shapes and sizes

colored water

blueberries, cantaloupes, cherries, cucumbers, sunflowers, and watermelon. Native bees nest in thick grass, soil, and wood, are rarely kept in hives, and generally do not make surplus honey or form large colonies. Examples of native pollinating bees are sweat bees, which take their name from their habit of landing on people and licking their skin; squash bees, which collect pollen only from cucurbits like squash, pumpkins, and gourds; and leafcutter bees, which prefer alfalfa, clover and other legume blossoms. Bumblebees and many other native bees perform buzz pollination, in which the bee grabs onto a flower's anthers and vibrates her flight muscles, releasing a burst of pollen from pores in the anther. This behavior is critical for the efficient pollination of tomatoes, peppers, watermelon and blueberries. Bumblebees are used in some greenhouse operations.

Not all pollinators are equal. Some are generalists; some are specialists. Some are brawny; some are feeble. Some have long tongues; some short. Some work at colder temperatures than others. Bees may deliberately collect pollen but have different collection techniques, which can greatly affect their efficiency as pollinators.

Flowers are often specifically adapted to one pollinator or a small group of pollinators because of floral structure, color, odor, nectar guides, etc. One flower, the bee orchid (Ophrys bombyliflora), looks like a female bee and even gives off the "scent" (pheromones) of a female bee. When the male comes to the flower the stamen comes down and taps him on the head, thus putting pollen on him. A collection of the traits in a flower that is aimed at attracting a particular type of pollinator is called a "pollination syndrome."

Background Sources: Carl Hayden Bee Research Center, US Department of Agriculture, Agricultural Research Service; kidsgardening.org; The Xerces Society; University of Florida Extension Service.

Wind Pollination

Most grasses and nuts, including the pecans that grow in Oklahoma, are pollinated by the wind. Plants that can be pollinated by the wind are called anemophilous. Plants pollinated by invertebrates are entomophilous, and plants pollinated by vertebrates are zoophilous. Anemophilous species do not develop scented flowers, nor do they produce nectar.

Activities

Read and discuss background and vocabulary.

ACTIVITY 1

1. Each student selects two foods — one fruit and one above-ground vegetable (such as tomatoes or zucchini).
   — For each food, students research in the library or online to find out what the blossom looks like on the plant that produces the food.
   — Students create simple charts to record information they find about the the flower: color, scent, size, shape, rewards (pollen or nectar), etc.
2. When students have completed their research, discuss these questions as a class:
   — What size is your flower? (tiny, small, average, very large)

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— Does the flower open during the daytime or at night? What kinds of pollinators are active by day? By night?

— What color is your flower? Do certain pollinators visit flowers of a certain color?

— Does your flower have an unusual shape, such as a long narrow tube, which, for example, a fuzzy fat bumblebee couldn't fit into?

3. Hand out the "Pollinator Syndromes " chart included with this lesson.

   — Students determine which pollinators most likely pollinate the flowers they have researched.

   — Students share information with the class.

   — Assign one student to record the information on the chalkboard and tally responses.

   — Students vote on the best candidate for the pollinator of each fruit and vegetable.

   — Students consult reference books to find correct answers.

ACTIVITY 2

1. Hand out copies of the "Flower Parts" and "Pollination Simulation" pages included with this lesson. Divide students into groups.

   — Review "Flower Parts."

   — Each group follows the directions on the "Pollination Simulation" worksheet to design 3-5 flowers.

2. Students use their flower models and the "Scientific Method Format" included in the "Resources" section to demonstrate the need for different kinds of pollinators by different kinds of flowers.

   — After all the flowers have been matched with a pollinator, discuss the simulation.

3. Students select the appropriate graph type, and graph results. See "Graphs" in the "Resources" section for explanations of the different kinds of graphs.

4. Students answer the following questions in their journals.

   — What did the various parts of the model represent?

   — Why was it specified that the top of the straw must be level with the stigma of the flower?

   — Why must a pollinator hone in on one type of flower and NOT be random about the flower it chooses?

Extra Reading

Buchmann, Stephan L, Gary Paul Nabhan, and Paul Mirocha, *The Forgotten Pollinators*, Island, 1997.

Hauth, Katherine B, and Kay Sather, *Night Life of the Yucca-The story of a Flower and Moth*, Roberts Rinehart, 1996.

Schaefer, Lola M., *Butterflies: Pollinators and Nectar-Sippers*, Bridgestone, 2001.

Vocabulary

brawny — having muscular strength

feeble — lacking in strength or endurance

invertebrate — an animal (as a worm, clam, spider, or butterfly) that lacks a backbone

generalist — something or someone with skills or interests that extend to several different fields

pollen — a mass of tiny particles in the anthers of a flower that fertilize the seeds and usually appear as fine yellow dust

pollination — placing pollen on the stigma of

pollination syndrome — a collection of the traits in a flower that is aimed at attracting a particular type of pollinator

migratory — having a way of life that includes moving from one country, place, or locality to another

simulation — the imitation by one system or process of the way in which another system or process works

specialist — something or someone with specific skills

vertebrate — an animal that has a spinal column

Pollination Syndromes

Flowers are often specifically adapted to one pollinator or a small group of pollinators because of floral structure, color, odor, nectar guides, etc. A collection of the traits in a flower that is aimed at attracting a particular type of pollinator is called a "pollination syndrome." Below are some of the traits that attract these common pollinators.

Bees

Both honeybees and native wild bees are attracted to flowers with bright lively colors (especially blues and yellows). They can't see the color red so won't visit blossoms that are red. The flowers may be massed into a group of many smaller flowers or may have a "landing platform" for the bees to stand upon while they drink nectar or collect pollen. Such bee flowers often have pleasing fresh scents that humans find attractive. There is abundant nectar and pollen.

Hummingbirds

Hummingbirds are attracted to flowers with red, pink or orange throats that are narrowly constricted so that only the hummingbird's narrow bill can enter to extract the abundant but dilute nectar. The flowers have no scent that people can detect. There is no landing platform on the flowers.

Bats

Unless you live in the American southwest (Texas, Arizona, New Mexico or southern California) you aren't likely to have picked a flower pollinated by bats. Most of this happens in the tropical rainforests. Bats are attracted to blossoms that are large and very sturdy. The flowers are always presented at night, as in the case of the century plant (the genus Agave). There is plenty of dilute nectar. The flowers are usually not brightly colored and don't smell very good. Some people think these flowers smell musty or fruity. Some bananas are pollinated by bats.

Butterflies

Blossoms built for butterflies have lively colors, especially pinks, blues and yellows. They are often grouped together in small masses. The floral tube is often narrowly restricted to just allow the butterfly's slender tongue (the proboscis) into the opening. These flowers have very pleasant floral scents and abundant nectar.

Moths

Not many of our crop plants are pollinated by moths. These flowers open during the evening or at night, when moths are active. They often have very sweet pleasant scents (like night-blooming jasmine) which we can smell from a long distance away. The flowers are almost always white and have abundant nectar but not much pollen. There may or may not be a landing area.

Flies

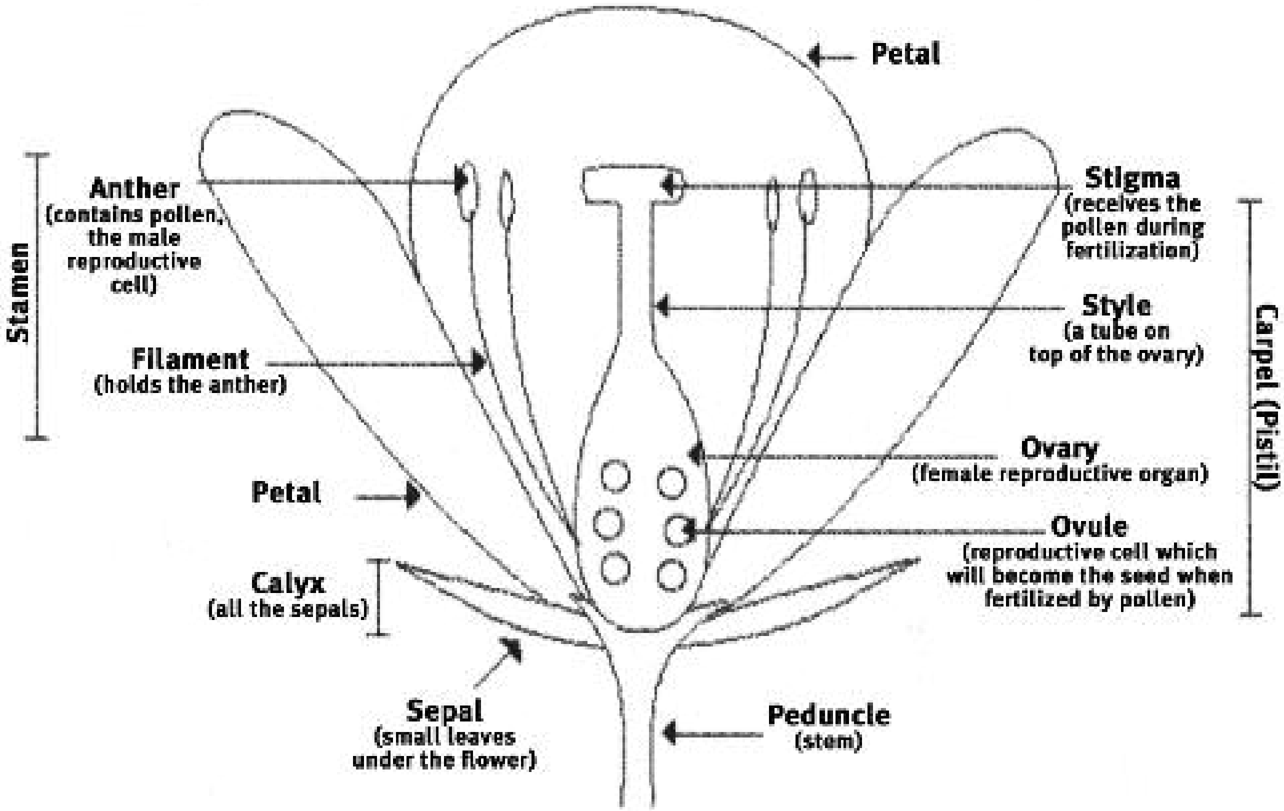
Flies, especially the flower flies in the family Syrphidae, are important pollinators. Their hairy bodies are great for transporting pollen grains around, helping to pollinate flowers and set fruit. Flies may visit many types of blossoms, especially big open masses like goldenrod. Some of the flowers they visit smell like rotting meat. Other flowers (like the Dutchman's Pipe) trap and hold flies inside for pollination. Flies (midges, in this case) are responsible for pollinating the cacao blossoms, whose seeds are ground up to make chocolate.

Beetles

There are more kinds of beetles alive today than any other kind of insects. They are usually generalists and often visit many types of flowers for food, especially in the tropics. They are called "mess and soil" pollinators because they generally wander around on the flower eating and chewing on everything. Very large flowers with numerous parts (such as a Magnolia) are pollinated by beetles. The blossoms often smell like overripe fruit. Beetles are not as important to crop plants as bees are.

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

The Parts of a Flower



anther — the part of the stamen of a flower that produces and contains pollen and is usually borne on a stalk
calyx — the usually green or leafy outside part of a flower consisting of sepals
corolla — the part of a flower that consists of the petals and encloses the stamens and pistil
filament — the anther-bearing stalk of a plant stamen
flower — the reproductive part of a plant . Flowers may be male or female only, or both male and female (complete).
ovary — one of the usually paired organs in the body of female animals that produces eggs and that in female vertebrates also produces sex hormones
peduncle — stem
petals — the inner ring of the flower leaves. Often white or brightly colored to attract pollinators.
pistil — the female flower organ, consisting of the seed-bearing ovary, stigma and style.
sepals — the outermost ring of the flower leaves; often green and leafy in structure.
specialist
stamen — the male part of a flower, usually consisting of the stalk-like filament and the pollen bearing anther.
stigma — the upper tip of the pistil of the flower, receives the pollen.
style — the stalk-like portion of the pistil between the stigma and the ovary.

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Pollination Simulation

Materials needed: clean plastic soda or water bottles, assorted shapes and sizes, 12 oz. and smaller; clear straws and coffee stirrers; artificial flower petals; construction paper; stiff fabric; colored water

Making the Flower

Review the parts of a flower. Use your imagination to create flowers, using the materials provided and the following restrictions:

1. The flower (corolla) must sit on top of the bottle.
2. The flower must include an opening for a straw.
3. The bottle (the “nectary”) must be covered with material so the quantity of “nectar” (juice) inside cannot be seen.
4. Each flower must have a stamen and a pistil.
5. The distance from the opening of the flower to the bottom of the bottle must be a different length from that of other flowers you or your group have made. (Use bottles of different sizes or fashion the flower so the distance from the opening to the bottom of the bottle is different each time.)
6. Each flower should have a different shape, based on what you have learned about the different kinds of pollinators and different pollination syndromes.

Preparing for Pollination Simulation

1. Assign a number to each flower.
2. Remove the flower top from the bottle.
3. Pour juice or colored water (to represent nectar) into each container.
4. Replace the flower top.
5. Use a straw to practice removing the nectar from the flower: Use your finger to create a vacuum so you can pull the nectar from the flower.
5\. Cut straws in different lengths to represent different kinds of pollinators.
6\. Mark straws at 1 ml (10 drops), 2 ml (20 drops), etc.

Pollination Simulation

1. Select a straw to represent a particular pollinator.
2. Place the straw in the flower, with the top of the straw at the top of the flower.
3. Use the straw to try drawing nectar from the flower. The top of the straw and your finger must start at the stigma.
4. To count as match, nectar must only be in the bottom 2 cm of the straw.
5. If you can produce a drop of nectar from the flower, put the straw aside and tag it with the number of the flower it matched.
6. Select a different straw, and go on to the next flower.

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Symbiosis: Help, Hinder or Destroy

Skills: Science/Language Arts

Objective: Students compare insect relationships according to their symbiosis class — parasitism, commensalism, mutualism.

Background:

Symbiosis means living together. Any two different organisms that live together are symbiotic, whether they benefit one another, harm one another, or have no effect on one another. There are three forms of symbiosis: parasitism, commensalism, and mutualism.

- Parasitism — one organism obtains food and shelter at the expense of another, sometimes destroying the host.
- Commensalism — one organism obtains "crumbs" left over from the host's food and is sheltered by the host.
- Mutualism — both parties benefit.

Agriculture is an example of mutualism. People have mutualistic relationship with food crops and livestock through agriculture. Through agriculture, people protect and fertilize crop plants for a greater yield, thus benefiting insects, which get food from the plants and facilitate flowering. Deer feed off the crop fields and are sheltered in the corn stalks. Insects can invade a farmers crop and devastate the area.

Over thousands of years animal agriculture has affected the biology and behavior of animals and people along with their quality of life. Animals graze areas that are unsuitable for growing crops, transforming grass, which people cannot digest, into protein (meat) that people can eat. Grazing of natural pastures is essential for the pastoral landscape, an important habitat for wild flora and fauna and much valued by humans for its aesthetic value.

Background sources: "Animal Agriculture Symbiosis, Culture or Ethical Conflict?" *Journal of Agricultural and Environmental Ethics*, Volume 19, #1, February 2006; *World Book Encyclopedia*, 1998.

Activities

1. Use the background information and vocabulary to familiarize students with the concept of symbiosis and the role agriculture plays in this shared relationship.
   — Students will write the vocabulary in their lab books or journals.

P.A.S.S.

GRADE 6
Science Process — 2.1,2; 4.1,2; 5.2,3,4
Life Science — 3.2; 4.1,2
Reading — 1.1a; 3.1b; 5.1a,2a
Writing — 1.2; 2.2d,7
Oral Language — 1.1
Visual Literacy — 3

GRADE 7
Science Process — 2.1,2; 4.1,2; 5.2,3,4
Life Science — 2.1,2; 4.2
Reading — 1.1; 3.1; 5.1a,2a
Writing — 1.2; 2.2b,8
Oral Language — 1.1
Visual Literacy — 3.1

GRADE 8
Science Process — 2.1,2; 4.1,2; 5.2,
Life Science — 3.1,2
Reading — 1.1; 3.1; 5.1a,2a
Writing — 1.2; 2.2d,8
Oral Language — 1.1
Visual Literacy — 3

Resources Needed

computer and/or library access

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Insect List

soil-searching wasp
brown fruit moth
Varroa mite
Acarina mite
African hive beetle
corn earworm
honey bee

Vocabulary

commensalism — a relation between two kinds of plants or animals in which one obtains a benefit (as food) from the other without damaging or benefiting it

fauna — the animals of a specified region or time

flora — the plants of a specified region or time

mutualism — association between different kinds of organisms that benefits both

organism — an individual living thing that carries on the activities of life by means of organs which have separate functions but are dependent on each other

proboscis — a tubular or snoutlike organ, as of some insects, worms, and mollusks

parasitism — a close association between living things of two or more kinds of which one is a parasite obtaining benefits from the other which is a host and is usually harmed in some way

symbiosis — the living together in close association of two different kinds of organisms

2. Hand out copies of the story included with this lesson.
   — Students will read the story independently, in pairs, or in groups.
   — Students list the symbiotic categories.
   — Students name symbiotic relationships found in the story.
   — Students describe the symbiotic relationships.
   Mutualism — plant and animal (yucca plant and yucca moth: Each needs the other to survive.)
   — animal and animal (aphid and ant: Ant protects aphid from the ladybugs and also eats caterpillars that eat the aphids' food. Ant gets sweet honeydew from the aphid.
   Parasitism — animal to plant (Aphids and yucca plant: Aphids suck juice from the plant and causes plant leaves to turn yellow and curl downward.)
3. Divide students into research groups to study insects which play a role in agriculture.
   — Students select one or more of the insects listed at left or choose other insects to research, using an online search engine or library reference sources.
   — Before research begins, students predict the insect's symbiotic relationship with agriculture.
   — Students identify the insect's symbiotic relationship with agriculture. Is the relationship harmful or beneficial to agriculture?
   — Students organize data about each insect in a class or an individual chart.
4. Discuss ways insects, other animals, or plants could show mutualism as a benefit to agriculture.
5. Students write a poem (cinquain, diamante, etc.) or draw a cartoon illustrating the researched insect's symbiotic relationship with agriculture.

Extra Reading for Students

Brett, Jan, *Honey . . ., Honey . . ., Lion!* Putnam Juvenile, 2005.
Facklam, Margery, *Partners for Life: The Mysteries of Animal Symbiosis*, Little Brown, 1989.
George, Jean Craighead, *Cry of the Crow,* HarperCollins, 1988.
Hauth, Katherine B., *Night Life of the Yucca — The Story of a Flower and a Moth*, Harbinger House, 1996.
MacLochlan, Patricia, Caleb's Story, HarperTrophy, 2002.
Silverstein, Alvin, *Symbiosis*, 21st Century, 1998.
White, E.B, and Garth Williams, *Charlotte's Web,* HarperCollins, 2006.

Extra Reading for Teachers

Burger, William C., *Flowers: How They Changed the World*, Prometheus, 2006.
Burger, William C., *Perfect Planet, Clever Species: How Unique Are We?* Prometheus, 2002.
Jackson, Louise E., Ecology in Agriculture (Physiological Ecology) by, Academic, 1997.

Name ________________________________

Symbiosis: A Flower and a Moth

In late May, after the rains fall, a plant with clusters of waxy, bell-shaped flowers emerges from the desert. As bats catch insects by the millions and owls search for mice, which search for seeds, the yucca flowers open.

A small silver-white yucca moth enters the yucca flower petal, folds her wings and rests. A male moth mates with the female and flies away.

The female moth recovers the golden pollen from each of the six stamens that circle the broad pistil in the center of the flower. She works the pollen into a ball approximately the size of her head. She carries this ball under her neck and flies into the night.

The moth is guided by the fragrance and whiteness of the waxy flowers. She must visit hundreds of flowers and plants while eluding the bats, which are also busy at night. She inserts her proboscis deep into young blossoms and lays eggs at the base of the pistil.

She packs a hunk of pollen into the tip of the pistil. As she moves up and down the pistil, she repeats her egg-laying, pollen-packing action. She must work quickly, because she lives for less than a week.

From each minute grain of pollen, a tube grows to reach an ovule in the chamber, which will house the moth's eggs until they hatch. Only yucca moths bring the pollen that the yucca plant needs for the ovules to become seeds that will grow into young yuccas. The yucca seeds are the only food that the moth's young will eat.

During the day, others will visit the yucca plant. Aphids suck juice from new blooms, while ants milk the aphids for droplets of sugary honeydew. As the sun heats the desert, and the yucca petals droop, the yucca's pistils swell with growing seeds. If the aphids, weather, or mule deer don't destroy the blossoms, the moth's eggs will hatch in about a week.

The moth's young eat some yucca seeds, but hundreds more of the seeds survive. In four to eight weeks, the full-grown larvae bore through their seed-pod caves, lower themselves to the ground on silk threads and burrow down to weave sticky cocoons.

Through the fall, the open yucca pods are shared with mice and ants. In the winter these same empty pods are capped with snow.

If no rain has fallen by May, the yucca moth will not appear. The yucca plant will not bloom. Instead, it will wait until the following spring, when the rains return. The stiff yucca leaves funnel water to its roots and also shade the wet roots when the sun returns. Soon the yucca plant will bloom, and during the night, a yucca moth will find it.

(Text adapted from *Night Life of the Yucca, The Story of a Flower and a Moth,* by Katherine B. Hauth.)

List the three kinds of symbiosis.

Which of the three kinds of symbiosis are represented in the story above?

Explain the symbiotic relationships.

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

What is Drought?

Skill: Science

Objective: Students will conduct an experiment to explore the effects of drought.

Background:

What is drought? Most of us think of drought as “no rainfall,” but it’s not that simple. Drought occurs when there is less rainfall than expected over an extended period of time, usually several months or longer. Drought is a normal part of climate, and it can occur almost anywhere on earth.

A shortage of rainfall can result in major impacts on agriculture, municipal water supplies, tourism and recreation, energy production, river navigation, and the environment. For farmers drought means you there is not enough water in the soil for crops to grow normally or for pastures to produce enough grass for livestock. For farmers who rely on irrigation to produce their crops, drought may be a shortage of water in reservoirs, streams, or groundwater, and irrigation may be restricted due to these shortages.

Drought has many causes. It could be lack of rainfall; it could be lack of snowfall from mountains far away; or it could be caused when water supplies aren’t sufficient to meet everybody’s needs.

Winds cause weather patterns to move around the globe, including the clouds that bring rain. Over the years, these patterns become routine, creating what we know as our climate. But sometimes these patterns change, and we receive less (or more) rainfall than we are expecting. In temperate locations like the US, the main winds are called the jet stream. These move around the atmosphere in a pattern of ridges and troughs. The behavior of jet streams change with each of the four seasons. In general, jet streams have regular patterns that are unique to each season of the year. But sometimes these jet stream patterns change and cause unusual weather, with some areas getting less (or more) precipitation than they are expecting. If an area has a jet stream pattern that has large ridges and/or troughs that remain in place for a long period of time, then the area will experience drought.

Background Source: National Drought Mitigation Center, University of Nebraska — Lincoln, http://www.drought.unl.edu/; Oklahoma Mesonet, http://www.mesonet.org/public/

P.A.S.S.

GRADE 6
Science Process — 1.1,2; 3.1; 4.1; 5.1,2,3
Physical Science — 1.1
Life Science — 4.2

GRADE 7
Science Process — 1.1,2; 3.1; 4.1; 5.1,2,3
Physical Science — 1.1
Life Science — 4.2
Earth Science — 5.1; 6.2

GRADE 8
Science Process — 1.1,2; 3.1; 4.1; 5.1,2,3
Physical Science — 1.2

Materials

Petri dish

1 tablespoon of water

2 tablespoons of garden soil (not potting medium)

thermometer

graph paper

Vocabulary

climate — the average weather conditions of a particular place or region over a period of years
drought — a period of dry weather, esp. a long one that is injurious to crops
ridge — an elongated raised or elevated region which has relatively high atmospheric pressure
temperate — having or associated with a climate that has four distinct seasons and is usually mild, without extremely cold or extremely hot temperatures
trough — an elongated and narrow or shallow hollow (as between waves or hills) with relatively low atmospheric pressure.

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Activities:

1. Read and discuss background and vocabulary.
2. Students discuss what effects drought might have on the soil.
3. Students use the "Scientific Method Format" included in the "Resources" section and work in pairs to conduct this experiment. If possible, have another class conduct the experiment at the same time to compare the climate in different classrooms.
   — Add 2 tablespoons of soil to a Petri dish.
   — Add 1 tablespoon of water to the Petri dish.
   — Use the thermometer to take the temperature of the soil at this time.
   — Set all the Petri dishes in the same area of the classroom.
   — Students take the temperature of the soil at the same time each day for five days.
   — Students make notes on how dry or moist the soil appears.
   — Students graph the temperature of the soil over the five days.
   — Create a graph with a color-coded key to display each pair of students' information across the five days.
3. Discuss findings.
   — How would the soil temperature affect the growth of crops.
   — Students research to find out.
   — Are some crops more affected than others?
4. When soil moisture is low and no rain comes, crops fail. Water stored in the soil acts as a reservoir of available water for plant use. When the soil profile has good soil moisture, crops can draw on this water to survive longer between rain events without stress. In drought conditions, even when it rains, the soil may not absorb enough moisture to make up for the deficit.
   — Students use the scientific method and design an experiment to discover how much moisture it takes for dry soil to recover moisture.
5. Students research the effects of temperature on Oklahoma's top crops: wheat, hay, peanuts, cotton, rye, corn, soybeans, oats.
   — Students determine which of Oklahoma's top crops are most likely to be affected by drought.
   — Students display data in a chart or graph.

Extra Reading

Collier, Michael, and Robert H. Webb, *Floods, Drought, and Climate Change*, University of Arizona, 2002.
Merrick, Patrick, *Droughts*, Child's, 1998.

Will Your Car Run on Grass?

How biomass becomes alcohol

Skills: Science

Objective: Students conduct experiments with yeast to learn what substances promote fermentation.

Background:

Biomass is organic (living or once-living) matter such as trees, rice plants, corn stalks, or even manure from humans or livestock. All living organisms get their energy from the sun, either directly or indirectly. Plants and other photosynthetic organisms, such as cyanobacteria and algae, get their energy from the sun. They use the sun's energy to convert water and carbon dioxide into carbohydrates (sugars) and oxygen (and they also release water in the process). Herbivores get energy from eating plants. Omnivores get energy from eating plants or other animals (which ate plants), etc. Because new plants can be grown, biomass is a renewable resource.

Most of the biomass used for energy production is products from wood — logs, bark, sawdust, etc. Wood products are used to generate electricity or heat ovens in wood-processing plants. This process alleviates disposal costs, saves landfill space, and cuts utility bills. Wood is also burned to heat homes in the form of logs or compressed wood pellets.

Solid waste (trash) can also be burned to generate electricity. However, most garbage is not biomass. A large portion of solid waste is plastic, which is made from natural gas and petroleum products. An American ton (2,000 pounds) of garbage has almost as much heat energy as 500 pounds of coal. It is not economical to burn garbage, compared with using other energy sources, but it does save landfill space.

Methane gas is colorless and odorless. It is produced as solid waste decays. Methane gas can cause explosions. Landfills are now required to collect methane gas. Most burn it off as it is collected, as it is not economical to collect and store it for fuel. Methane

P.A.S.S.

GRADE 6
Science Process — 1.1,3; 3.1,2,3,4,5; 4.1,3,4,5; 5.1,3,4
Physical Science — 1.1
Life Science — 4.1

GRADE 7
Science Process — 1.1,3; 3.1,2,3,4,5; 4.1,3,4,5; 5.1,3,4
Life Science — 4.2

GRADE 8
Science Process — 1.1,3; 3.1,2,3,4,5; 4.1,3,4,5; 5.1,3,4
Physical Science — 1.1

is mostly natural gas. Anaerobic digesters can be built to decompose biomass and collect the methane to burn it as fuel. Some waste treatment plants use the energy from the anaerobic digesters to run the plant.

Another biofuel is biodiesel, which is made by combining methanol with used cooking grease (animal fat or vegetable oil) or with oilseed crops like soybeans, sunflowers and canola. Biodiesel can also help decrease harmful emissions. It can be used as fuel for diesel engines.

One way to make biofuel is to ferment plants. Using processes similar to those used to make beer and wine, yeasts can be used to ferment starches in grain kernels (usually corn) to ethanol. Ethanol is usually added to gasoline and helps decrease carbon monoxide emissions. Currently the most common crop used in ethanol production is corn. One acre of corn can produce 300 gallons of ethanol.

Oklahoma State University, in cooperation with the Noble Foundation in Ardmore, is working on an alternative to corn — switchgrass. Switchgrass is a native prairie grass that grows all over Oklahoma. Unlike corn, the current varieties of switchgrass grow without tillage and planting. Switchgrass is perennial and requires less water and fertilizer than crops such as corn. Switchgrass can produce between 300 and 700 gallons of ethanol per acre. In addition, more net energy is gained from switchgrass than from corn. Ethanol from corn yields 34 percent more energy than it takes to grow and process the corn into biofuel. Ethanol from switchgrass nets over five times more than that amount.

In April 2007, Oklahoma had seven biodiesel stations and one ethanol station. Using biofuels helps the environment because the carbon dioxide released into the atmosphere from biofuels only replaces what the plants originally took out. This is in contrast to carbon dioxide harvested from underground fossil fuels and added to current atmospheric levels. (Carbon dioxide is one of the major greenhouse gases.) Use of biofuels also lower our dependence upon other countries for fuel supplies.

Background sources: The National Energy and Education Development Project, http://www.need.org; National Renewable Energy Laboratory (www.nrel.gov); U.S. Department of Agriculture (www.ars.usda.gov); The Noble Foundation (www.noble.org).

Resources Needed

hot water

baking yeast

clear glass, half-liter containers

stirrers

measuring spoons

flour

salt

sugar

vinegar

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Activities

1. Read and discuss background.
   — Ask how corn or switchgrass can be converted to a fuel for burning?
2. One way to make biofuel is by using yeasts to ferment plants.
   — Divide class into groups.
   — Hand out copies of the instruction sheet included with this lesson and the "Scientific Method Format" included in the "Resources" section.
   — Students will follow the directions on the instruction sheet to test different substances for their ability to promote fermentation.
   — Students will record their steps on the "Scientific Method Format."
3. Lead a discussion using these questions:
   — What is the evidence of reactions in any of the containers?
   — How are these observations related to fermentation?
   — Which of the substances tested was most helpful to yeast fermentation?
4. Students design experiments with other substances associated with biofuels (corn, grass) to test their ability to help yeast fermentation.
5. Students use the same ingredients from Activity # 2.
   — Students place the ingredients in small bottles and secure a balloon over the top of each one to observe the release of carbon dioxide.
6. In a large beaker place warm water, yeast, sugar, and flour as though making bread.
   — Make marks on the side of the beaker every 2 minutes so students can observe the growth of the mixture rising and the bubbles.

Extra Reading

Carless, Jennifer, *Renewable Energy: A Concise Guide to Green Alternatives*, Walker, 1993.

Peterson, Christine, *Alternative Energy*, Children's, 2004

Povey, Karen D., *Biofuels — Our Environment*, KidHaven, 2006.

Renewables Are Ready — A Guide to Teaching Renewable Energy in Junior and Senior High School Classrooms, Union of Concerned Scientists, 1994.

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Vocabulary

anaerobic — without oxygen
cyanobacteria — blue-green algae
decomposers — organisms that break dead organisms into their component parts
enzymes — proteins that speed chemical reactions; biological catalysts
fermentation — turning sugar into alcohol or lactic acid during anaerobic respiration
fossil fuel — nonrenewable energy sources from ancient life, e.g., oil, coal, natural gas
greenhouse gas — gases such as carbon dioxide and methane that trap warmth in the atmosphere and raise the earth's temperature over time
perennial — living over a period of many years
photosynthetic — an organism that derives its energy from the sun
renewable resource — energy resources that are replaceable or not used up, such as trees, water power, solar energy
tillage — plowing the ground to make it ready for planting

Instruction Sheet

1. Gather materials:

hot water	baking yeast	4 clear glass, half-liter containers
stirrers	measuring spoons	flour
salt	sugar	vinegar

2. Empty one packet of yeast into each of four half-liter (one pint) beakers of warm water.
3. Stir for one minute.
4. Add 10 ml (2 tsp) of flour to each beaker.
5. Stir again.
6. Add 5 ml (1 tsp) of salt to the first beaker.
7. Add 5 ml of sugar to the second beaker.
8. Add 5 ml of vinegar to the third beaker.
9. Leave the fourth beaker alone.
10. Stir each beaker again for one minute.
11. Wait 5 minutes.
12. Record observations.
13. Wait 15 minutes.
14. Record observations.
15. Predict what will happen to the solutions overnight.
16. Let the solutions sit overnight.
17. Record observations.

Activity adapted from "Newton's Apple," http://www.newton'sapple.tv/TeacherGuide

Resources

Graphs

Graphs display data as an easy-to-understand visual reference. Sometimes the translation of data into text becomes confusing. Graphs make it easier to understand complex information or view the results of an experiment.

SETTING UP A GRAPH

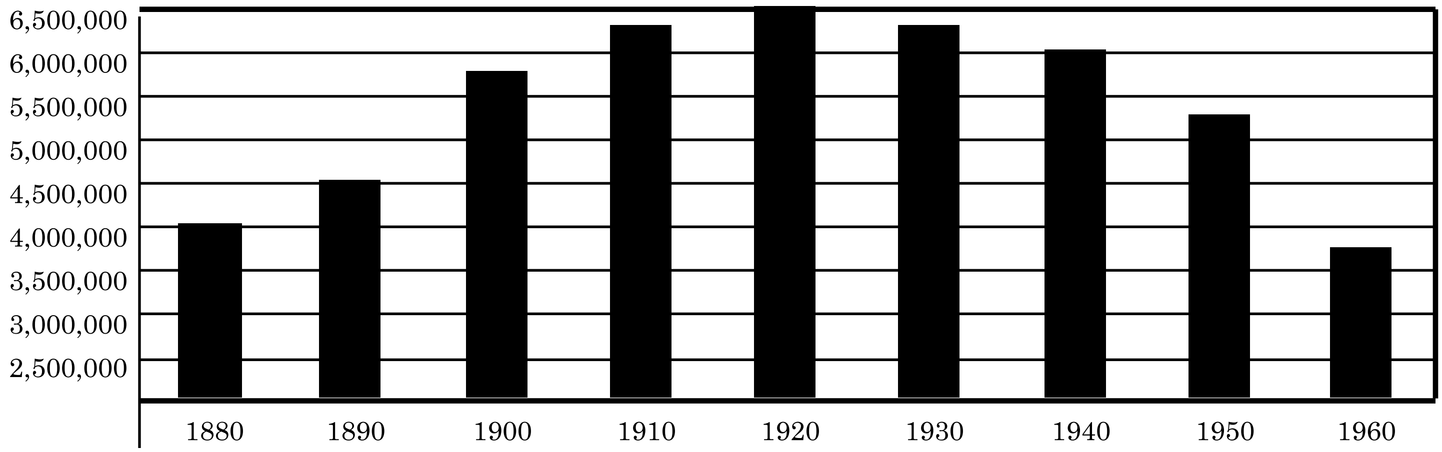
A bar or line graph requires a set of crossed lines or a grid. It becomes a "graph" when labels or details are given to the lines.

- Label the Axes: The reference lines on a graph are called axes. They are the horizontal (x) and vertical (y) lines that cross. If they have numbers, the lowest number is usually at the place where the axes cross. The data collected will determine how the axes are labeled.
- Choose the Scale: The numbers running along a side of the graph are the scale. The difference between numbers from one grid line to another is the interval. The interval will depend on the range of the data and the number of lines on the graph paper.
  — An interval of 1 will make the graph tall and skinny.
  — An interval of 100 will make the graph shorter and wider.
- Range: The range (difference between the highest and lowest numbers in the sample) will determine the interval. It is generally best to set the intervals at 1, 10, 20, 100, etc. — base 10 numbers.

COMPARING GRAPHS

Graphs that illustrate how data compare are: single-bar graphs, double-bar graphs, pictographs, and circle graphs. These graphs can illustrate the same kind of data at different times or places, different sets of data at the same time or place, or different kinds of data that make up 100 percent of one group of data.

Single Bar Graph: Number of Farms in the US, 1880-1960



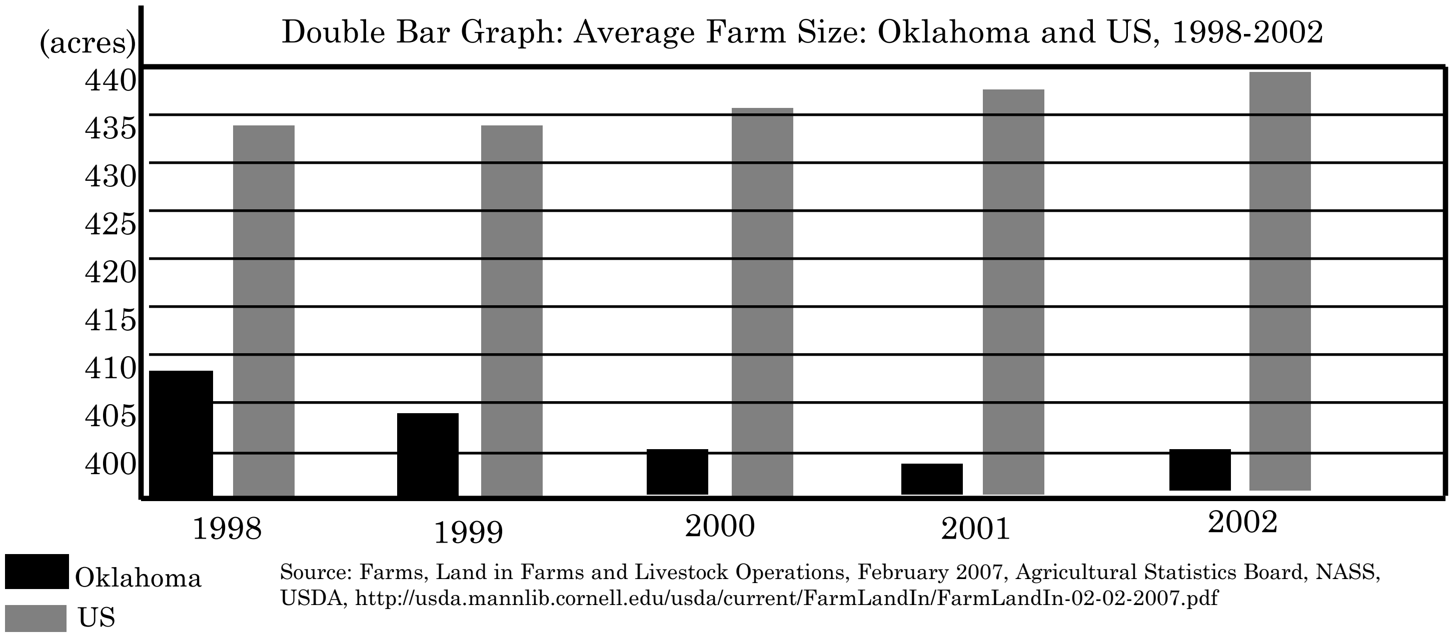
Single-Bar Graph: In a bar graph, the length of bars represent numbers from the collected data.

- Title the graph.
- Draw and label the axes.
- Choose increments for the scale.
- Label the "y" axes with the range of numbers.
- Label the "x" axes with the titles or category of data.
- Draw a bar to the height of each category.

page 1

Double-Bar Graph: A double-bar graph compares sets of data. This graph saves space and time by combining the information on one graph.

- Follow the same instructions as for the single-bar graph.
- Include both sets of data for each category.
- Include a “key” next to the graph to explain the two or more sets of data displayed.

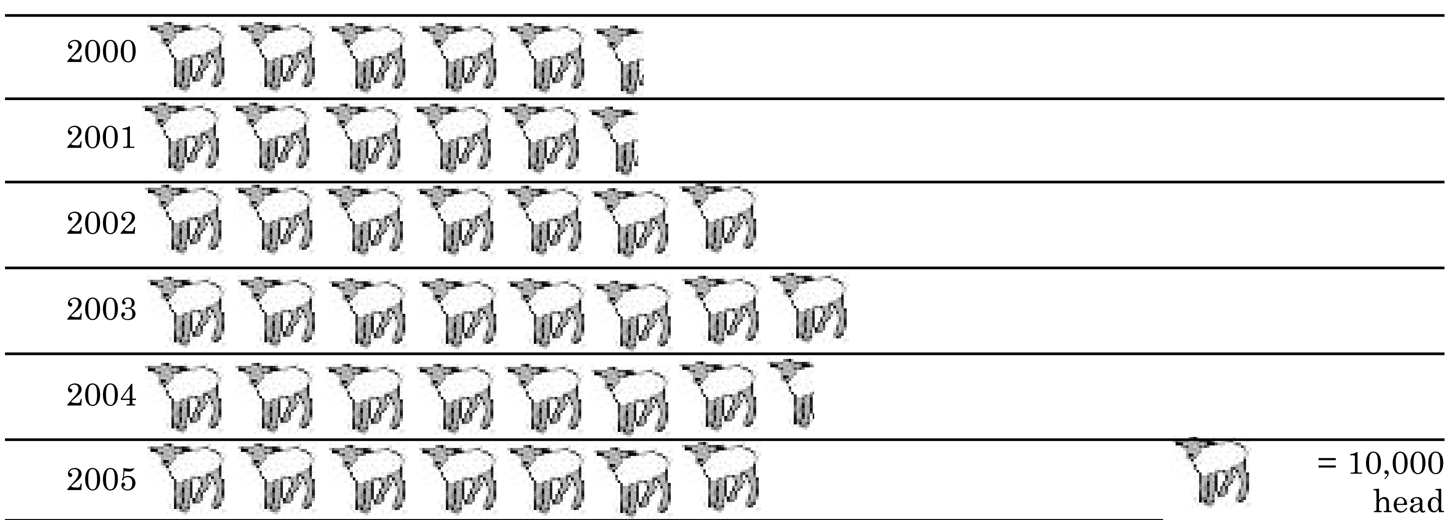


Source: Farms, Land in Farms and Livestock Operations, February 2007, Agricultural Statistics Board, NASS, USDA, http://usda.mannlib.cornell.edu/usda/current/FarmLandIn/FarmLandIn-02-02-2007.pdf

Pictograph: A pictograph is a visual tool which appeals to the eye while organizing data to be compared.

- Title the graph.
- Draw and label the axes.
- Choose a symbol for the data.
- Draw a key.
- Draw the appropriate number of symbols next to each item.

Pictograph: Sheep in Oklahoma, 2000-2005

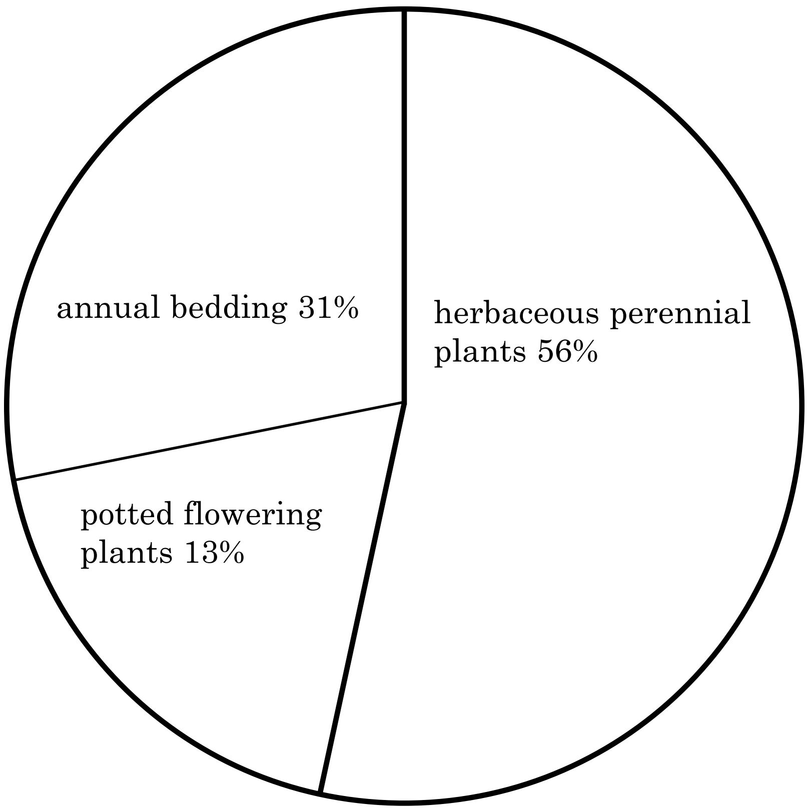


Source: Oklahoma Agricultural Statistics, 2006, USDA, Oklahoma Department of Agriculture, Food and Forestry, http://www.nass.usda.gov/ok/bulletin06/ok_annual_bulletin_2006.pdf

Circle Graph: Circle graphs or pie charts represent 100 percent of a group of data. Circle graphs can use symbols, drawings, colors or labels to denote sections.

- Title the graph.
- Draw a circle and mark the center.
- For each symbol, color, and/or category, write a fraction that shows what part it represents.
- Multiply each fraction by 360º to find out how many degrees of the circle you'll need for each category.
- Use a protractor to draw a central angle for the first category. Make sure it is the size calculated from the last step. Example 7/15 x 360º= 168º.
- Draw angles for the rest of the categories.
- Label each section and/or include a key.

Circle Graph: Oklahoma Floriculture — Wholesale Value of Sales by Category, 2005



Source: Oklahoma Agricultural Statistics, 2006, USDA, Oklahoma Department of Agriculture, Food and Forestry, http://www.nass.usda.gov/ok/bulletin06/ok_annual_bulletin_2006.pdf

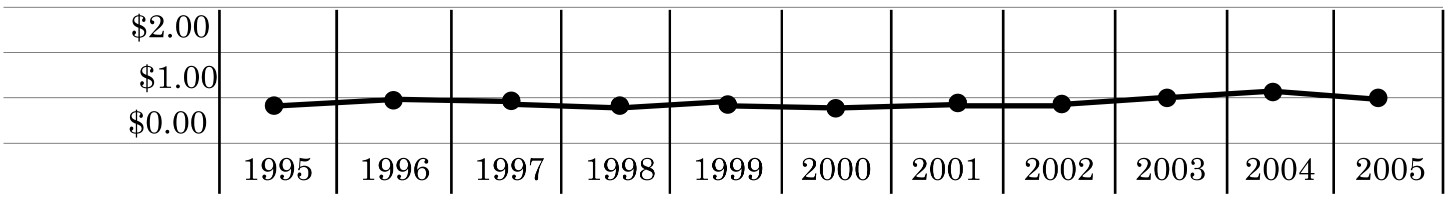
PROGRESSION OF TIME GRAPHS

Graphs can show a progression of change over time. The most widely used graphs are line graphs, multiple-line graph, and time lines.

Single-Line Graph: Time measurement, like minutes, days, or years, are on the horizontal (x) axis. The vertical (y) axis will have some other measurement (people, cars, animals, etc.) Increases, decreases, or flat lines are easy to distinguish by looking at this type of graph.

- Title the graph.
- Draw and label the axes.
- Label the years on the horizontal axis.
- Choose increments for the scale on the vertical axis.
- Estimate where each amount would fall on the vertical axis and place a dot at that point.
- Connect the dots.

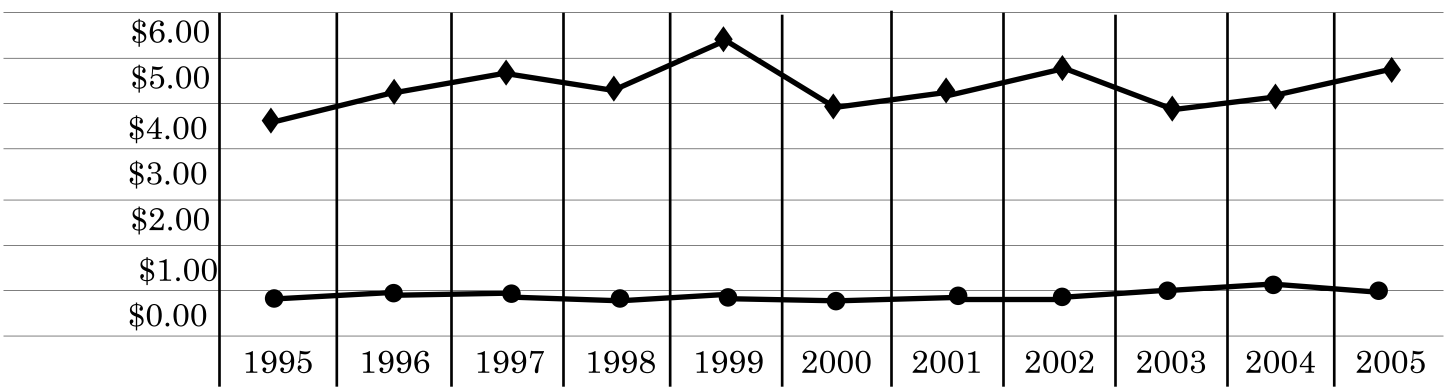
Single Line Graph: Price per Dozen Eggs, Oklahoma, 1995-2005



Multiple-Line Graph: A multiple-line graph compares two or more quantities that are increasing or decreasing over time. Each line shows one set of data.

- Follow all instructions for a single-line graph.
- After plotting and connecting the dots for the first set of data, continue with the next set/s, remembering to use a different color to connect the dots for each set.
- Include a "key" with the graph to explain the colors of the lines.

Multiple Line Graph: Price per Dozen Eggs vs. Value of Bird, Oklahoma, 1995-2005



● = price of a dozen eggs
♦ = value of bird

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History of Farm Machinery and Technology in America: 1790s-1870s

1790s	1800s	1810s	1820s	1830s	1840s	1850s	1860s	1870s
Invention of cotton gin (1793) Thomas Jefferson's plow with moldboard of least resistance (1794) Charles Newbold patents first cast-iron plow (1797)			Jethro Wood patents iron plow with interchangeabl e parts (1819) US food canning industry established (1819-25)	McCormick reaper patented (1834) John Deere and Leonard Andrus begin manufacturing steel plows Practical threshing machine patented. (1837)	First grain elevator (1842) Sir John Lawes founds the commercial fertilizer industry by developing a process for making superphosphate (1843)	Self-governing windmill perfected (1854) Two-horse straddle-row cultivator patented (1856) Mason jars, used for home canning, were invented 1858	Change from hand power to horses characterizes the first American agricultural revolution (1862-75) Steam tractors are tried out (1868) Spring-tooth harrow for seedbed preparation appears (1869)	Silos and deep-well drilling come into use Glidden barbed wire patented; fencing of rangeland ends era of unrestricted, open-range grazing (1874)

Time Line

Source: A History of American Agriculture, 1607-2000, Economic Research Service, 2000, http://www.agclassroom.org/gan/timeline/index .htm

3. Time Lines: A time line is a graph. It includes a number line with numbers that are years or dates or times of day. Past and future events can be charted on a time line. Examples of future events are: a schedule for a day, week, or month.
   - Title the graph.
   - Draw a horizontal number line.
   - Mark the increments of times that are included in the data.
   - Place items where they belong on the time line.

GROUPED DATA GRAPHS

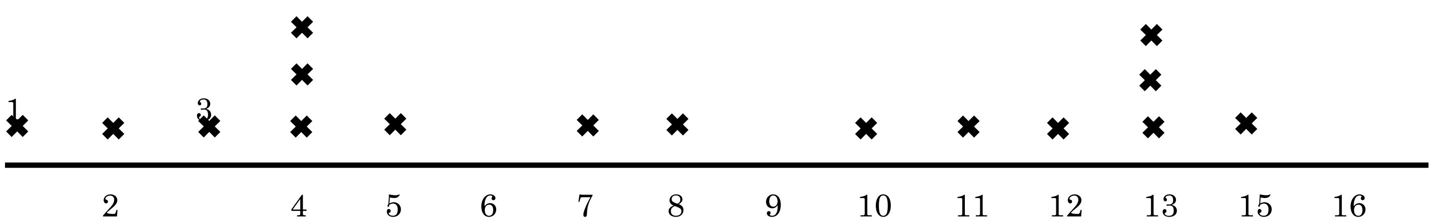
A Venn diagram shows which data belong together. The line plot shows whether the data is bunched or spread out. The graphs that show data groupings are often called plots. This is because there are no bars to draw or lines to connect. The information is plotted on the individual data points.

1. Line plots: Instead of comparing data or showing trends, the information shows the spread of the data. On a line plot, the range, mode, and any outliers can be quickly identified.
   - Title the plot.
   - Draw a number line on grid paper. The scale of numbers should include the greatest value and the least value in the set of data. (range)

Oklahoma's Rank in the US by Commodity

CROP	RANK IN THE US	LIVESTOCK	RANK IN THE US
winter wheat	2	beef cows	3
grain sorghum	4	hogs	8
rye	1	broiler production	10
peanuts	7	calf crop	4
watermelon	11	all cows	4
cottonseed	12	all cattle and calves	5
all cotton	13	sheep operations	15
all hay	13	milk operations	13

Source: Oklahoma Agricultural Statistics, 2006, USDA, Oklahoma Department of Agriculture, Food and Forestry, http://www.nass.usda.gov/ok/bulletin06/ok_annual_bulletin_2006.pdf



Line Plot: Oklahoma's Rank in the US by Commodity

   - For each piece of data, draw an "x" above the corresponding number.

<u>Histogram:</u> A histogram is a graph used to show the frequencies of a value or range of values within a single field (variable) of data. An example would be the duration (in minutes) for eruptions of the Old Faithful geyser in Yellowstone National Park. The mean, median, mean, and range of the set of data can be calculated since the data is related to one field only.

- Title the plot.
- Draw a number line on grid paper. The scale of numbers should include the greatest value and the least value in the set of data.
- For each piece of data, draw an "x" above the corresponding number.
- Draw bars to correct height, and show connection of data. May include a "y" axis.
- Calculate the mean (average), mode (most used number in the list of data), median (center number when the data is arranged from least to greatest), and range (difference between the least and greatest number).

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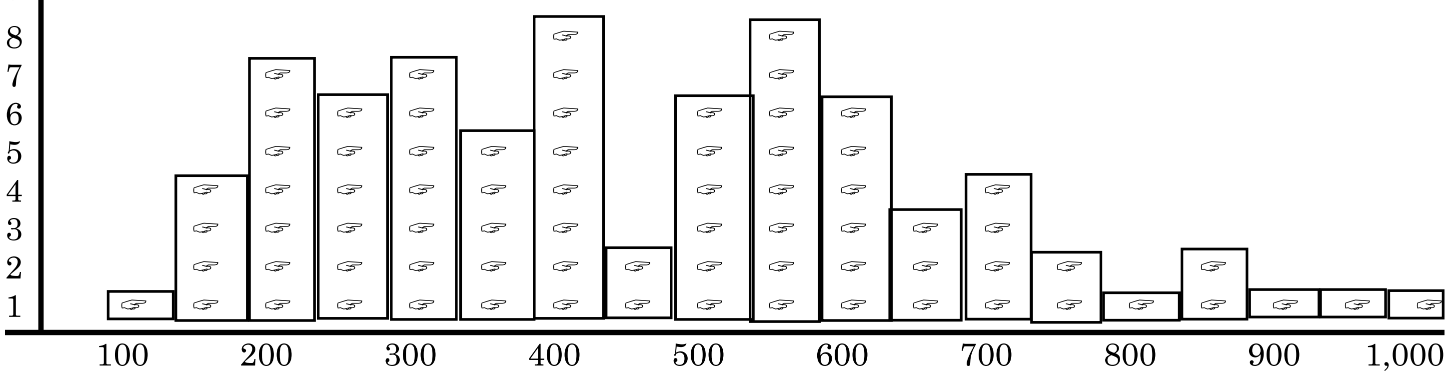
Oklahoma Women Farm Operators, by County, 2002

Adair, 471 • Alfalfa, 174 • Atoka, 552 • Beaver, 387 • Beckham, 378 • Blaine, 232 • Bryan, 674 • Caddo, 506
Canadian, 529 • Carter, 538 • Cherokee, 568 • Choctaw, 470 • Cimarron, 237 • Cleveland, 629 • Coal, 275
Comanche, 516 • Cotton, 160 • Craig, 611 • Creek, 859 • Custer, 201 • Delaware, 673 • Dewey, 281
Ellis, 281 • Garfield, 378 • Garvin, 653 • Grady, 745 • Grant, 224 • Greer, 194 • Harmon, 92 • Harper, 191
Haskell, 406 • Hughes, 400 • Jackson, 257 • Jefferson, 178 • Johnston, 290 • Kay, 390 • Kingfisher, 342
Kiowa, 206 • Latimer, 375 • LeFlore, 893 • Lincoln, 1,052 • Logan, 525 • Love, 297 • McClain, 474
McCurtain, 873 • McIntosh, 410 • Major, 264 • Marshall, 184 • Mayes, 686 • Murray, 247 • Muskogee, 800
McIntosh, 410 • Major, 264 • Marshall, 184 • Mayes, 686 • Murray, 247 • Muskogee, 800 • Noble, 306
Nowata, 387 • Okfuskee, 388 • Oklahoma, 631 • Okmulgee, 555 • Osage, 628 • Ottawa, 532 • Pawnee, 405
Payne, 677 • Pittsburg, 718 • Pontotoc, 605 • Pottawatomie, 778 • Pushmataha, 778 • Roger Mills, 289
Rogers, 888 • Seminole, 538 • Sequoyah, 489 • Stephens, 572 • Texas, 354 • Tillman, 167 • Tulsa, 563
Wagoner, 552 • Washington, 359 • Washita, 290 • Woods, 278 • Woodward, 321

Source: Oklahoma Agricultural Statistics, 2006, USDA, Oklahoma Department of Agriculture, Food and Forestry, http://www.nass.usda.gov/ok/bulletin06/ok_annual_bulletin_2006.pdf

number of counties



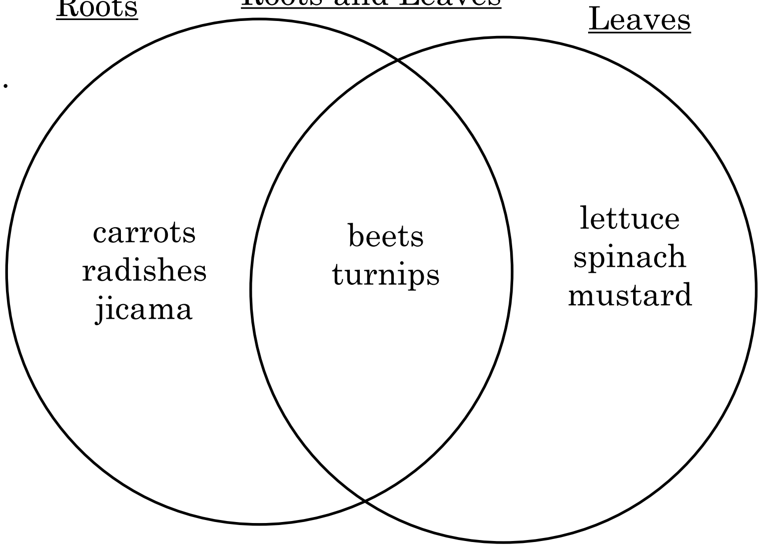
(number is approximate to the nearest 100)

Histogram of Oklahoma Women Farm Operators

Venn Diagram: A Venn diagram is a group of intersecting circles. It can have a few as 2 circles. Each circle is named for the data in it. Data that belong in more than one circle are placed where the circles overlap. Some information may fall outside the circles.

- Choose a title for the diagram.
- Decide how many groups of data were collected.
- Draw a circle for each group.
- Place each piece of data in the proper circle.
- If a piece fits in more than one circle, place it where the circles overlap.

Venn Diagram: Plant Parts We Eat



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Region	Field Worker dollars per hour	Livestock Worker dollars per hour	All Workers dollars per hour
Northeast I	10.10	9.59	10.77
Northeast II	10.34	8.56	10.55
Appalachian I	8.46	9.22	9.32
Appalachian II	8.64	9.07	9.77
Southeast	8.00	9.04	8.83
Florida	9.20	9.00	10.01
Lake	10.11	9.99	11.08
Cornbelt I	9.86	9.16	10.17
Cornbelt II	9.60	10.46	10.63
Delta	8.54	8.00	8.80
Northern Plains	10.04	9.75	10.63
Southern Plains	8.35	9.41	9.22
Mountain I	8.79	9.01	9.35
Mountain II	9.16	9.75	9.97
Mountain III	8.25	8.88	9.28
Pacific	9.39	9.70	10.24
California	9.62	10.90	10.63

Source: "Farm Labor, May 2007, Agricultural Statistics Board, NASS, USDA, http://usda.mannlib.cornell.edu/usda/current/FarmLabo/FarmLabo-05-18-2007.pdf

Stem-and-Leaf Plot: Stem-and-leaf plots allow for the organization of numbers so that the numbers themselves make the display. The stem-and-leaf plot summarizes the shape of a set of data (the distribution) and provides extra detail regarding individual values. The data is arranged by place value. The digits in the largest place are referred to as the stem and the digits in the smallest place are referred to as the leaf (leaves). The leaves are always displayed to the right of the stem. Stem-and-leaf plots are great organizers for large amounts of information such as test scores, scores on sports teams, and series of temperatures or rainfall over a period of time. A stem-and-leaf plot is similar to a histogram but shows more information.

- Choose a title for the plot.
- Write the data in order from least to greatest.
- Find the least and greatest values.
- Choose the stems. Each digit in the tens place in the data list is a stem.
- Write the stems by a vertical number line, least to greatest.
- The leaves are all the ones digits in your list. Write them next to the stems that match their tens digits.
- Write a key that explains how to read the stems and leaves.
- If needed, calculate the range, mean, median, and mode for the set of data.

Wages for Hired Farm Workers by Region

Dollars	Cents
8	80 83
9	22 28 32 35 77 97
10	01 17 24 55 63 63 77
11	08
12	85

Stem and Leaf

Double Stem-and-Leaf Plot: To compare two sets of data, use a back to back plot. A comparison is now possible for two sets of test scores, sport's teams or games, and possibly temperatures or rainfall.

- Follow the same procedure for the stem-and-leaf plot.
- Insert the second set of data to the left of the stem. The tens column is now in the middle and the ones column is to the right and left of the stem.
- Give each (leaf) column a title.

Double Stem and Leaf: Wages for Hired Farm Workers by Region

Field Workers		Livestock Workers
cents	dollars	cents
00 25 35 46 54 64 79	8	00 56 88
16 20 39 60 62 86	9	00 04 07 16 22 59 70 75 99
04 10 11 34	10	46 90

Sources: *A Mathematics Handbook: Math at Hand*, Great Source Education Group, A Houghton Mifflin Company, 1999.

"About: Mathematics," http;//www.math.about.com; "Math in Sight," www.mathinsight.ctl.sri.com; Landwehr, James M., and Ann E. Watkins, *Exploring Data*, Dale Seymour Publications, 1986; National Agricultural Statistics Service, USDA

How to Write a Research Paper

1. Select a topic for research.
   — Gather ideas through class discussion, reading, thinking, free writing, brainstorming, etc.
   — Choose a topic which interests and challenges you.
   — Narrow the topic down. Select a subject you can manage. Avoid subjects that are too complicated or for which there are not enough source materials available.
   — Get your teacher's approval for your topic.
   — If you are not sure what is expected, reread your assignment sheet or ask your teacher.

2. Find information.
   — Use search engines to find sources online. Make sure your sources are reliable.
   — Use a card catalog to find books in the library that relate to your subject.
   — Look at other print materials available from the library — encyclopedias, magazines, newspapers, etc.
   — Use note cards or a journal to write down important information along with full bibliographical information (author, title, place of publication, publisher, date of publication, page numbers, URLs, creation or modification dates on Web pages and your date of access to the Web page).

3. Create an outline.
   The purpose of the outline is to help you think through your topic carefully and organize it logically. Check your outline to make sure the points covered flow logically from one to the other. Include the following:
   I. Introduction: State your thesis and the purpose of your research paper. Explain briefly the major points you plan to cover and why readers should be interested.
   II. Body
      A. Supporting Details (three or more)
   II. Conclusion: Restate or reword your thesis. Summarize what you have learned. Explain why you have reached this conclusion.

4. Organize your notes according to your outline.
   — Choose the best of your sources.
   — Make sure your information is up-to-date and factual. (Is it backed up by at least one other source?)
   — Do not include information that is not related to your topic.
   — Do not include information that you do not understand.
   — Make sure the information you have noted is carefully recorded and properly credited.

5. Write your first draft.
   — Explore your topic without worrying about grammar, spelling or punctuation.
   — Start with the first topic in your outline. Read all the notes that relate to that topic. Summarize, paraphrase or quote directly for each idea you plan to use.
   — Make sure you are using your own words. Give credit for ideas your are borrowing or quoting.

6. Revise your outline and draft. Be your own critic.
   — Add, delete, or rearrange the material to follow your outline. Reorganize your outline if necessary, but always keep the purpose of your paper in mind.
   — Locate and correct errors in punctuation, capitalization, spelling, usage, and sentence structure.
   — Share your writing with peers for proofreading.

8. Type your final paper.
   — Read the assignment sheet again to make sure your paper meets the requirements.
   — Proofread again for spelling, punctuation, missing words or duplicated words.
   — Make sure your final paper is clean, tidy, neat and attractive.

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Suggested Research Topics

Agricultural Technology in America From Colonial Time Through Reconstruction

American Farm Labor From Colonial Times Through Today

Biosecurity: How Our Food is Protected

The Census of Agriculture and Fair Prices for Farmers

Cotton and the Civil War

Cotton Farming Around the World

Crops Grown in the US From Colonial Times Through Today

The Disappearance of Honeybees

The Effects of Drought on Subsistence Agriculture

The Effects of Ethanol Demand on the Food Supply

Farming on the Homestead

The Future of Switchgrass as a Biofuel Source

The History of Fire: How Fire is Used to Keeps the Land Healthy

How to Prevent the Spread of Disease

The Importance of Fiber in a Healthy Diet

George Washington and Agriculture in America

How to Stay Fit and Healthy

The Importance of Pollinators to Our Food Supply

Loss of Farm Land and Growth of Urban Areas Worldwide

Prevention of Farm Animal Disease

The Many Uses for Soybeans (Corn, Wheat, etc.)

Manure: It's Not Just Waste

Some Ways to Prevent NonPoint Source Water Pollution

What is Subsistence Agriculture?

What Will Fuel My First Car?

Where are the Subsistence Farmers?

What Was Life Like for the Children of Homesteaders?

Which is Better for the Environment? Organic Food or Locally Grown Food?

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How Reliable Are Your Sources?

When conducting research, make sure you use reliable information from legitimate sources. Reliable information is well-researched from sources that are well-respected and as objective, or neutral, as possible. The best way to find legitimate sources is to go to the library and use scholarly journals, reference books and other well-researched sources.

Another place to find information is the Internet. Conducting research on the Internet is convenient, but it can also be tricky. There are many thousands of Web pages that have little actual content and are mainly links to other pages, which may be links to other pages, and so on. Anyone can post anything to the Internet. To make sure you have found a reliable source of information, ask yourself these questions:

1. Who is responsible for the Web site? Is the Web page associated with a reliable organization, such as a university or a government agency? What interest does the organization responsible have in the information presented. For example, will the organization profit from the information presented?

2. Who wrote the information? If the author is not listed or has no credentials, it may not be a credible source. Pay attention to the author's credentials or experience. Is the source really an authority on this particular matter or someone with an impressive title that has no connection to the subject matter?

3. When was the information written? Is it current? Is it still relevant?

4. Are there other sources that agree with statements made on the site, or do other sources contradict this source? In that case you may need to search further. It's always a good idea to gather more than one source.

5. Are any sources cited? If the author does not document anything, then the information may simply be someone's opinion. If statistics used come from a survey, how was the data gathered? Who conducted the survey or poll? Was the sample representative of the population? How many were surveyed? What percent of the population?

When choosing between the library and the Internet keep in mind that up to 90 percent of the contents of college library collections are not on the Internet. Because of copyright laws it is too expensive to put all scholarly work on the Internet. This means that the most comprehensive source of information is still the library.

Name ___________________________________

How Reliable Are Your Sources?

Web site name	What organization is responsible for the site?	When was it written?	Who is the writer?	What are the sources cited?	How did you find the site?	Legitimate site or questionable?

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Name ____________________________________

Scientific Method Format

Title of Experiment or Study:

I. Stating the Problem:
What do you want to learn or find out?

II. Forming the Hypothesis:
What is known about the subject or problem, and what is a prediction for what will happen?

III. Experimenting: (Set up procedures)
This should include: materials used; dates of the experimental study; variables, both dependent and independent (constant and experimental); how and what was done to set up the experiment; fair testing procedures.

IV. Observations:
Includes the records, graphs, data collected during the study.

V. Interpreting the Data:
Does the data support/defend the hypothesis?

VI. Drawing Conclusions:
Justify the data collected with concluding statements about what has been learned. Discuss any problems or concerns. Use other studies to support the conclusion. Give alternative ideas for testing the hypothesis.

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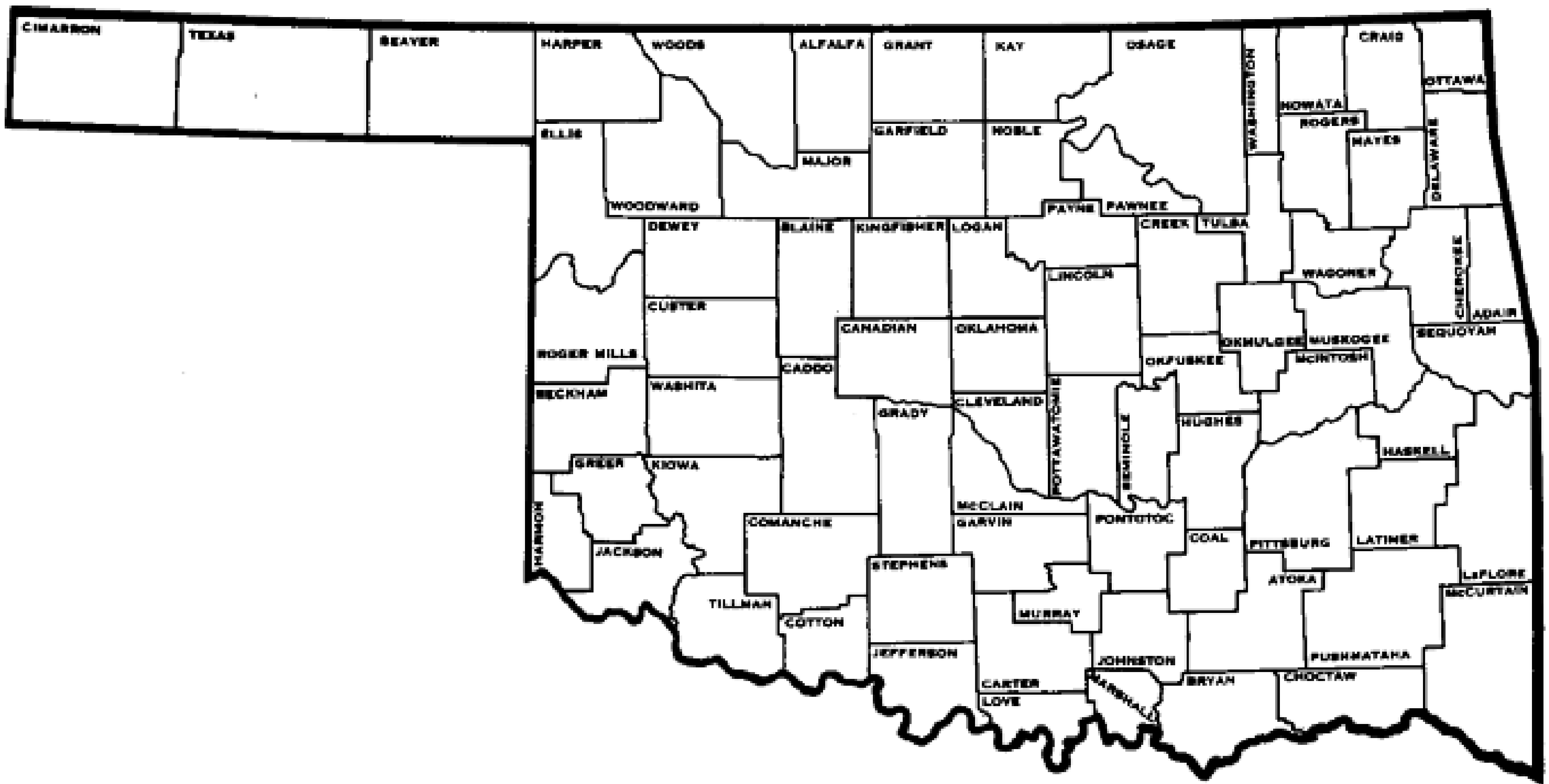
Name ________________________________

Name ________________________________

Oklahoma Map



Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Name ____________________

US Map (Contiguous 48 States)

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

Name ____________________

World Map

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2007.

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Notes:

Notes:

"The AITC lessons are aligned with P.A.S.S. The background information is interesting to the students and allows for engaging discussion."
Kassandra R. Tippey, teacher
Moore Schools

"The charts, graphs, surveys, background information and vocabulary are good for reflection and are historically important. The activities are interdisciplinary and allow for students to think outside the box."
Elizabeth Carver-Cyr, teacher
Stillwater Schools

"AITC lessons allow my students to question current topics they are hearing about in the news. The lessons lend themselves to inclusion in several science topics."
Debbie Catlett, teacher
Oktaha Schools

"My students love hands-on activities and they were able to relate well to the AITC lessons. The lessons show important aspects of agriculture and the value of protecting our earth."
Stephenie Everett, teacher
Vanoss School

Oklahoma Ag in the Classroom is a joint project of the Oklahoma Department of Agriculture, Food and Forestry, the Oklahoma State Department of Education and the Oklahoma Cooperative Extension Service. The goal of the Ag in the Classroom program is to help familiarize Oklahoma school children, both urban and rural, with the food and fiber industry.

Ag in the Classroom lessons use agriculture-related activities and research-based background material to teach Priority Academic Student Skills (P.A.S.S.) in language arts, math, science, reading, social studies and visual arts.

For more information,

visit our Web site at: www.agclassroom.org/ok

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