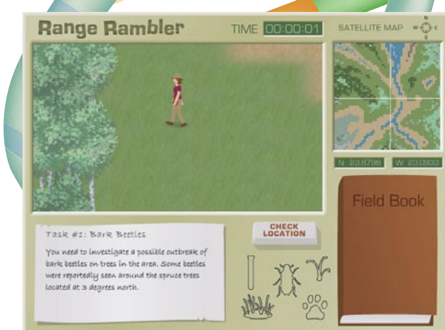
Agricultural & Natural Resources Careers

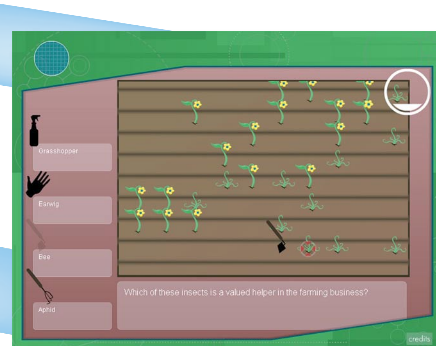
Instructional Unit and Interactive Software for Career & Technical Education, Introduction

- **Source Search Relay**
  - Explore the Source of Everyday Items from Agriculture and Natural Resources



- **Agricultural Career Concept Mapping**
  - Defining Agriculture & Natural Resources with the 5-Fs
- **Exploring Living Science Careers**
  - Explore Emerging Careers

- **Space Age Technology to Earth**
  - Featuring Range Rambler Interactive Software
- **From Milk to Cheese & Seed to Shelf**
  - Featuring From Seed to Shelf Interactive Software
- **Farming: It's a Fact!**
  - Use *Farm Facts* to Learn How Agriculture Counts



- **The Business of Agriculture**
  - Featuring Ag Overload Interactive Software
- **High-Tech Food**
  - Putting Science in Your Shopping Cart

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Utah Agriculture in the Classroom
Extension
UtahState University

Welcome to the "Career & Technical Education Introduction" *Agricultural & Natural Resources Careers* instructional unit. The following lesson plans have been designed to meet the Utah State Core Curriculum and enhance your instruction of agricultural career education. The activities are hands-on and user friendly.

Understanding the science of plants, animals, soils, and water in our environment has led to a very productive U.S. agricultural system. A miracle (that most of us take for granted) has taken place to produce, process, and market products to the American consumer and others around the world. As Americans we enjoy a quality of life where, for the most part, our needs are met and our dreams or wants are within our reach.

Agriculture affects our quality of life and our environment. We have the safest, most abundant, varied, least expensive food supply anywhere in the world. We don't worry about where our next meal is coming from. Our strong agricultural sector makes it easy for most of us to pursue our career goals. This is a unique situation when you look at other parts of the world. The American family spends about 10 percent of its total income on food, the lowest in the world! Less than 2 percent of our population produces our bountiful harvest, but nearly 20 percent of our total labor force is involved in our food and fabric processing, and marketing — or agribusiness industry. Considering that agriculture works with natural resources, it is easy to see why there are so many careers in these two areas! Yet many students have no idea where food and clothing comes from, the resources required, or how these products get to the store — the majority of students can't even define agriculture let alone think about a career in agriculture besides "farming."

We all partake of agriculture everyday. Whether it's the food we eat, the clothes we wear, the sheets we sleep on, the medicines we use, or the homes we live in, agriculture is our "link to life." Many of the products we use everyday are grown or raised on a farm. Agriculture is an important contributor to our economy and society, yet few young people today know of the industry's significance or the numerous career opportunities related to agriculture. Agriculture is everywhere!

Published, 2006
Revised, 2007

Ordering Classroom Materials
All items in this instructional unit that say "available from Utah Agriculture in the Classroom (AITC), may be ordered through the Utah AITC Website, www.agclassroom.org/ut.

Credits
This Instructional Unit was part of a cooperative agreement between the Utah State Office of Educaiton and Utah State University Extension - Agriculture in the Classroom.

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Agricultural & Natural Resources Careers

Standard 3: Agricultural & Natural Resources
Students will examine workplace tasks and concepts in agriculture.

Objective 1: Explore the relationship and impact of agriculture and natural resources on the economy.

Indicators:
- Explore career opportunities in agricultural production and processing (e.g., farm, food, fabrics), horticulture, and natural resources.
- Differentiate between facts and opinions concerning agricultural production and processing.
- Explain how supply and demand of agricultural products affects the market place and price (e.g., the supply, demand and price of major grains such as wheat, corn, and soybeans).
- Explore related career Pathways and related high school and middle school/junior high school course offerings.

Objective 2: Identify the relationship and impact of agriculture on the family and consumer.

Indicators:
- Recognize the sources of food, clothing and shelter and the processes that are used to deliver them to the consumer.
- Explain the values, benefits and issues concerning biotechnology and agriculture.
- Evaluate facts and opinion about food technologies (e.g., irradiation, e-coli, salmonella, hormones, and pesticide residues).
- Explore related career Pathways and related high school and middle school/junior high school course offerings.

Objective 3: Understand the relationship and impact of agriculture and natural resources on technology and engineering.

Indicators:
- Identify and demonstrate the uses of Global Positioning Systems (GPS) and satellite technology in agriculture.
- Understand the economic impact and value of wildlife and rangelands related to one's community, the nation, and the world.
- Explain the dependence and interaction between people and natural resources (e.g., rangeland, wildlife, wilderness, soil, water, and air).
- Explore related career Pathways and related high school and middle school/junior high school course offerings.

Source Search

Career & Technical Education, Introduction

Agricultural & Natural Resources Careers

Materials
- Four boxes labeled "Store," "Factory," "Farm," and "Natural Resources"
- Poster board (for mounting product pictures)
- Glue

Background

Many people have the misconception that farms simply provide us with raw produce and other foods. In reality, agriculture also provides us with a wide variety of raw materials from which we are able to make clothes, books, cosmetics, medicines, sports equipment, and much more.

Students may not realize that the items they use every day come from resources that are found in the environment. These resources are either extracted from the natural world through industries such as mining, or they are used in agricultural production. Most students don't recognize the origins of the products, and they think of the sources of these products as factories or stores. It is important for students to understand that before an item ever leaves a factory or enters a store, it began as a resource or product of the natural world.

Preparation

Cut out the attached pictures (40) of common products we see or use every day. Randomly divide the pictures into two groups. Use two colors of poster board (or card stock) and glue the pictures onto the poster board. Cut out the poster board around the pictures leaving a ¼ - ½ inch boarder. Laminate the pictures for future use.

If you prefer to get your students involved in the preparation stage (and have time), gather a variety of magazines or slick ads from the Sunday newspaper. Instruct your students to cut out pictures that represent items they use regularly (food, cars, soap, clothes, computer, etc.; avoid duplication). Glue these pictures onto poster board and laminate them.

Obtain four containers (boxes, plastic tubs or paper grocery bags) and label each with one of the following: "Store," "Factory," "Farms" and "Natural Resources." Identify a location for a relay race outside, wide hallway, or gymnasium.

Activity Procedures

Ask students what they did to get ready for school. Make a list of the common items used and foods eaten by the students. Discuss with students the types of items they use or eat everyday.

Time: 30 minutes

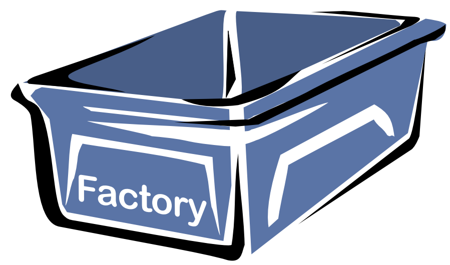
Grade Level: 7-9

CTE, Introduction: Standard 3
Students will examine workplace tasks and concepts in agriculture.

Objectives:
1. Explore the relationship and impact of agriculture and natural resources on the economy.
2. Identify the relationship and impact of agriculture on the family and consumer.
3. Understand the relationship and impact of agriculture and natural resources on technology and engineering.

Divide the class into two teams. Divide the laminated pictures by color. If you have used red and blue poster board, you have a red and blue team. Be sure you have the same number of pictures in each pile. This lesson comes with 40 pictures to accommodate large classes but you may not need them all. If you have 26 students you will only use 26 pictures, 13 in each pile. Each student will take only one turn in the relay. If you have 25 students, you will still need 13 pictures in each pile; it is just that someone will be taking two turns. This will keep the relay fair. Tell the students where they are going for the "relay race" and that they will need to line up behind one another. Their task will be to sort the pile of pictures placed in front of each team into one of the four tubs. Be sure to have all the pictures face down. Locate the tubs 20-50 feet away from the first person in each line.

Give students the following instructions: This is the source relay; your job is to place each picture in the tub that is the source for the items we use everyday. When you are in the front of the line, pick up a card, look at the picture, then run to and place the picture in the correct tub based on the product's "source"– either "Store," "Factory," "Natural Resources," or "Farm." You are looking at the product, not the packaging. The next person in line goes when the person in front of them returns, crossing over the start line or hand-tagging the person now in front of the line. The returning player should go to the end of the line. Continue the "relay race" until all of the pictures have been sorted. The first team done with the sort wins! Or do they? Now it is time to see if the pictures were sorted correctly.



Ask the students to gather around you as you go through the pictures in each box. As you hold up each picture, the students can show whether they agree or disagree with the sort. Begin with the "Farm" container. If the item contains ingredients or raw products from a farm, the item is in the correct box. Examples would be any food items such as cereal, cookies, and milk, or any clothing item made out of a natural fiber such as cotton (jeans) or wool (coat). Some items from a farm that are not eaten or worn would be paint (this contains linseed or soybean oil), or fuel such as ethanol. The "Farm" container will typically have only a few items in it. Next, look at the "Natural Resources" tub; it will only have a few items in it as well. Items in this tub should be products we get from the ocean, from plants or animals that occur naturally without management from humans, or from mining. Examples of items that should be in this box are: fish or shrimp (wild; however, fish and shrimp are also farmed), cars, salt, water, plastic (starts as oil, which is mined) synthetic fabrics (polyester, petroleum or oil products), computers, cell phones, any metallic items. Wood products may be in this box, but many wood products are from timber grown on farms. Let the class decide how to divide these. You might decide to "split the difference;" put one (the fish) into the "Farm" box and the wood into the "Natural Resources."

Remind your students that this is the "source" search. What is the "real" source of the things we use everyday? Nearly all are grown or mined – farmed or extracted from the natural world. With this concept in mind, you are ready to take a look at the "Factory" box. A factory is a place were raw ingredients are changed into the useful items we need or want; wood into furniture, ore into steel for cars, wheat into bread, and potatoes into chips. A factory assembles items for sale in a distribution center, a store. Everything in the "Factory" box should be sorted into either the "Farm" or "Natural Resources" container. After doing this, your students get it – products have been grown or mined. They realize that like the "Factory" container, nothing should be in the "Store" container; this is just where we purchase the items. Factories and stores rely on raw ingredients from the farm and natural world.

Every picture or product is now in either the "Farm" or "Natural Resources" container. At this point you'll want to remind students that farms need natural resources – soil, water, light, and air. The "Farm" container could actually be placed into the "Natural Resources" container!

Questions for Discussion

- Needs vs. Wants: Which of the products in the tubs do we need to survive? Which do we want for a variety of reasons?

- Considering all the things we use every day, how many careers do you think there might be in the area of farming or agriculture and natural resources? From production, processing (factory), to distribution what entry level and highly skilled jobs are there?

- Which items used in this activity are from renewable resources? What is a renewable resource? What is a recyclable resource? Which items are renewable/recyclable in the "Farms" container? Which are renewable/ recyclable from the "Natural Resources" container? Were there any items that were nonexhaustible?

- How does the proper management of farms and natural resources affect our quality of life?

Additional Activities, What's Next?

◆ Do the relay a second time using only two containers, "Farm" and "Natural Resources." This will help you to assess student understanding.

◆ Ask students to research some ways to conserve or manage our natural resources, including farms, and share their findings with the class.

◆ Ask your students to create a concept web (see Utah Agriculture in the Classroom lesson plan on the 5-Fs of Agriculture) with one of the pictures used in the "Source Search" activity. Each picture should be place in the center of a piece of large paper and the web drawn to identify associations or links to careers, natural resources or other products.

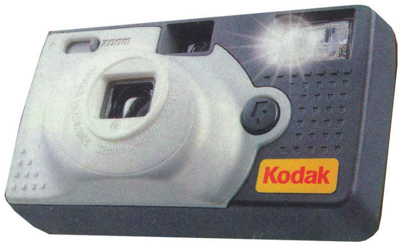
Vocabulary

Renewable Resources: Natural resources that can be replaced by human efforts are considered renewable. These resources can be used up without proper management. Examples: forests, fish, wildlife, agriculture, plants, animals.

Nonrenewable Resources: These are limited natural resources that cannot be replaced or reproduced (within a generation). We cannot manage them for renewal. Once they are gone they are gone – forever. Examples: oil, mineral resources (lead, iron, cobalt, zinc, etc.), soil (made so slowly, 1,000 - 500,000 years).

Nonexhaustible Resources: Natural resources that can last forever regardless of human activities. They renew themselves continuously. This does not mean that resources are not limited. Human misuse can damage these resources. Examples include surface water (little can be done to affect the total amount of water), air (we can damage the air with pollution, but we cannot use it up), and sunlight (pollution can limit this resource).

Activity adapted from Project Seasons


Kodak


ZIP PAK RESEALABLE PACKAGING TEAR OFF TOP
Pour Fresh Resealable Pour Spout
Malt-O-Meal
Golden Puffs
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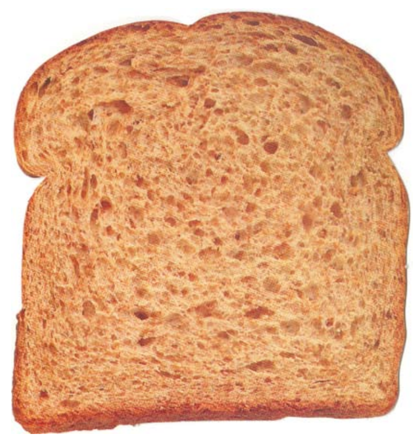

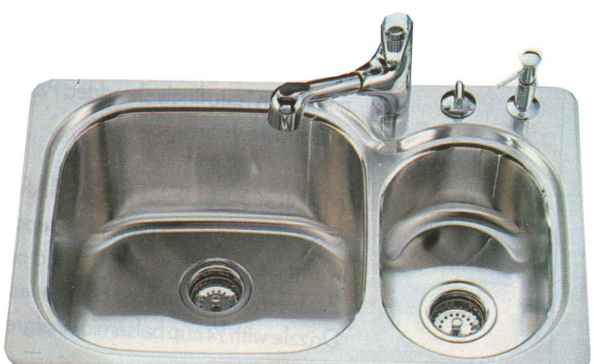

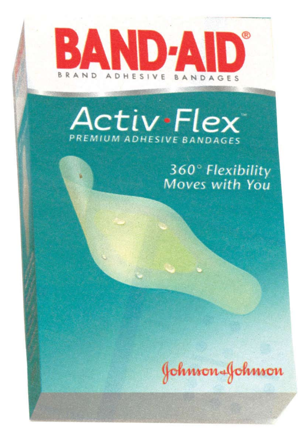
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BRAND ADHESIVE BANDAGES
Activ-Flex
PREMIUM ADHESIVE BANDAGES
360° Flexibility
Moves with You
Johnson & Johnson


Post
Healthy Classics
New!
RAISIN BRAN
Cereal Bar
cinnamon


GEVALIA
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PURINA
Cat Chow
COMPLETE FORMULA
FORMULATED FOR CATS OF
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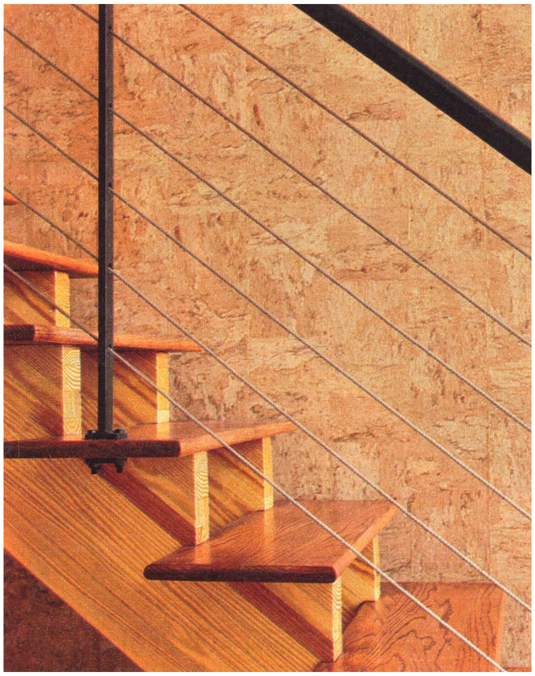


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Milk Chocolate


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Homogenized
Vitamin A & D
2% Milkfat
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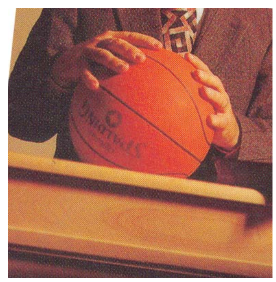
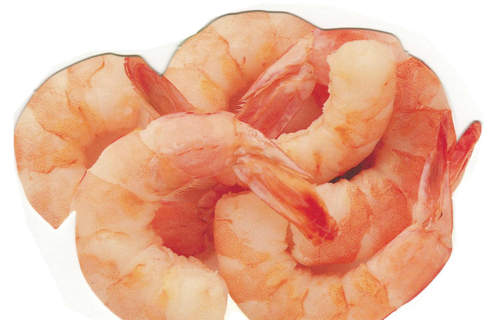
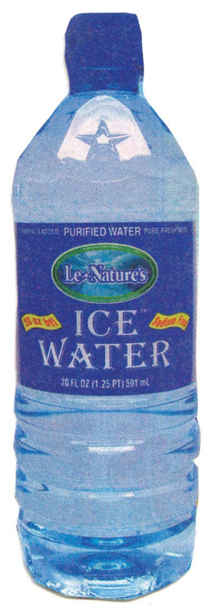
REAL
lowfat milk
8 fl. oz. (236 ml)






Three Full
Servings of
Vegetables
V8
100%
VEGETABLE JUICE


PURIFIED WATER
Le Nature's
ICE
WATER
20 FL OZ (1.25 PT) 591 mL

Agricultural Career Concept Map

Career & Technical Education, Introduction

Defining Agriculture & Natural Resources

Materials
- Bulletin Board Paper (5 pieces 2' x 3'), or Dry Erase (Chalk) Board, if you have enough board room for 5 groups of students
- Colored Pencils or Dry Markers or Chalk (5 sets with 5 different colors in each set)
- 5-Fs or Agriculture poster *(FREE)*
- *Connecting to Agriculture* Video/DVD (available from Utah AITC)

Time: 45 minutes

Grade Level: 7-9

CTE, Introduction: Standard 3
Students will examine workplace tasks and concepts in agriculture.

Objectives:
1. Explore the relationship and impact of agriculture and natural resources on the economy.
2. Identify the relationship and impact of agriculture on the family and consumer.
3. Understand the relationship and impact of agriculture and natural resources on technology and engineering.

Background

How do you define the word agriculture? Merriam-Webster's Dictionary states that it is the science, art, or practice of cultivating the soil, producing crops, and raising livestock and in varying degrees the preparation and marketing of the resulting products. An accurate definition, but students may find it difficult to link the importance of agriculture to his or her life.

Graphic organizers are research-based techniques that help students understand new concepts. They are particularly beneficial for visual learners. They are effective because learners are able to relate new concepts to their preexisting understandings and recognize new relationships among concepts. These associations help students to retain what they have learned; in addition, a concept map may help to identify student misconceptions.

Agriculture is a big "umbrella" term that includes so many concepts from farm-to-fork and field-to-fabric – not to mention all the other industrial uses of agricultural products such as linseed oil for paint and corn for fuel. A concept map is a good way to visually define and relate agriculture and its effects on our lives.

Preparation

Using the bulletin board paper you have cut approximately 2' x 3', write one of the following words on each piece: "FARM," "FOOD," "FABRIC," "FORESTRY," and "FLOWERS." Or, draw five 2' x 3' rectangles on the dry erase boards, amply spaced around the room for the groups to gather around. To learn more about concept mapping, read about them at http://library.usu.edu/instruct/tutorials/cm/CMinstruction1.htm; also use the attached transparencies as examples.

Activity Procedures

1. Divide your students into five groups. Give each group one of the sheets of paper with their word (coincidently they all start with F, easy to remember later), or send them to their word "space"

on the dry erase board. If they are using paper, give each group a set of colored pencils. If they are using the dry erase board give each group a set of colored dry erase markers. If you have a different color pencil/marker for each student in each group, you'll be able to determine if every student participated in the activity.

2. Ask the students to examine the word and consider the following: What do they know about that word? Do they have a direct or indirect relationship to that word?
3. Ask students to create a concept map around their group's word by thinking about products they can associate with the word. Give them about 5 minutes.
4. Next, ask them to identify careers with the new word links they have created. For example, if they have listed the word "yogurt" on "FOOD," they should now link the word to milk processing plant worker, and then to dairy farmers, and then to dairy computer programmers, and milk hauling truckers, etc. Again give the students 5 minutes to see if they can get 20 new career links. Or, make it a contest to see which group can link and list the greatest number of careers. Yes, they can add new words that help to make the new career link.
5. When the students have completed their maps, ask each group to share their map, explaining their connections (paper maps should be posted on the wall). Encourage other groups to help add to each other's maps as each group presents. It's important to add words showing the relationship between linked concepts if a step or stage is missing. Other words that could be added on the line linking the words are simple words or phrases, such as "are," "can be," or "are part of." Finally, cross-link other relevant relationships—often drawing lines going across to other group maps.
6. Conclude the instruction by announcing that the students have visually created a definition of agriculture.
7. Show the video *Connecting to Agriculture* and then ask students to make additions to their concept webs.

<u>Additional Activities, What's Next?</u>

◆ Add to the concept map by linking natural resources used.

◆ Keep the concept webs up for a few days, allowing students to add to them.

<u>Vocabulary</u>

Farming: The production of food and fiber derived from plants and animals. Farmers must understand economics, business, mathematics, and the science involved in getting their crops and animals to market. The science involved in agriculture includes the knowledge of ecosystems, soil, water, weather, chemistry, and plant and animal biology.

Food: Made from the raw products taken from the farm. Some products, like corn, may be consumed in their "raw" state or processed into an entirely different product like corn chips, soda, peanut butter, detergents, or medicines. Some of our farm "raw" food products need to be processed into a more palatable and digestible form before they can be eaten. Wheat, for example, is the most important grain in the U.S. We would have to eat hundreds of "raw" or whole-wheat seeds to get the same nutrition we can get more easily from processing the wheat into flour and then baking bread. Bread is a more palatable able way to eat wheat. Flour, of course, is used in hundreds of other products: tortillas, pastas, doughnuts, muffins, pancakes, cookies, pie crusts, and pretzels, just to name a few. The food industry is the processing and distribution of food.

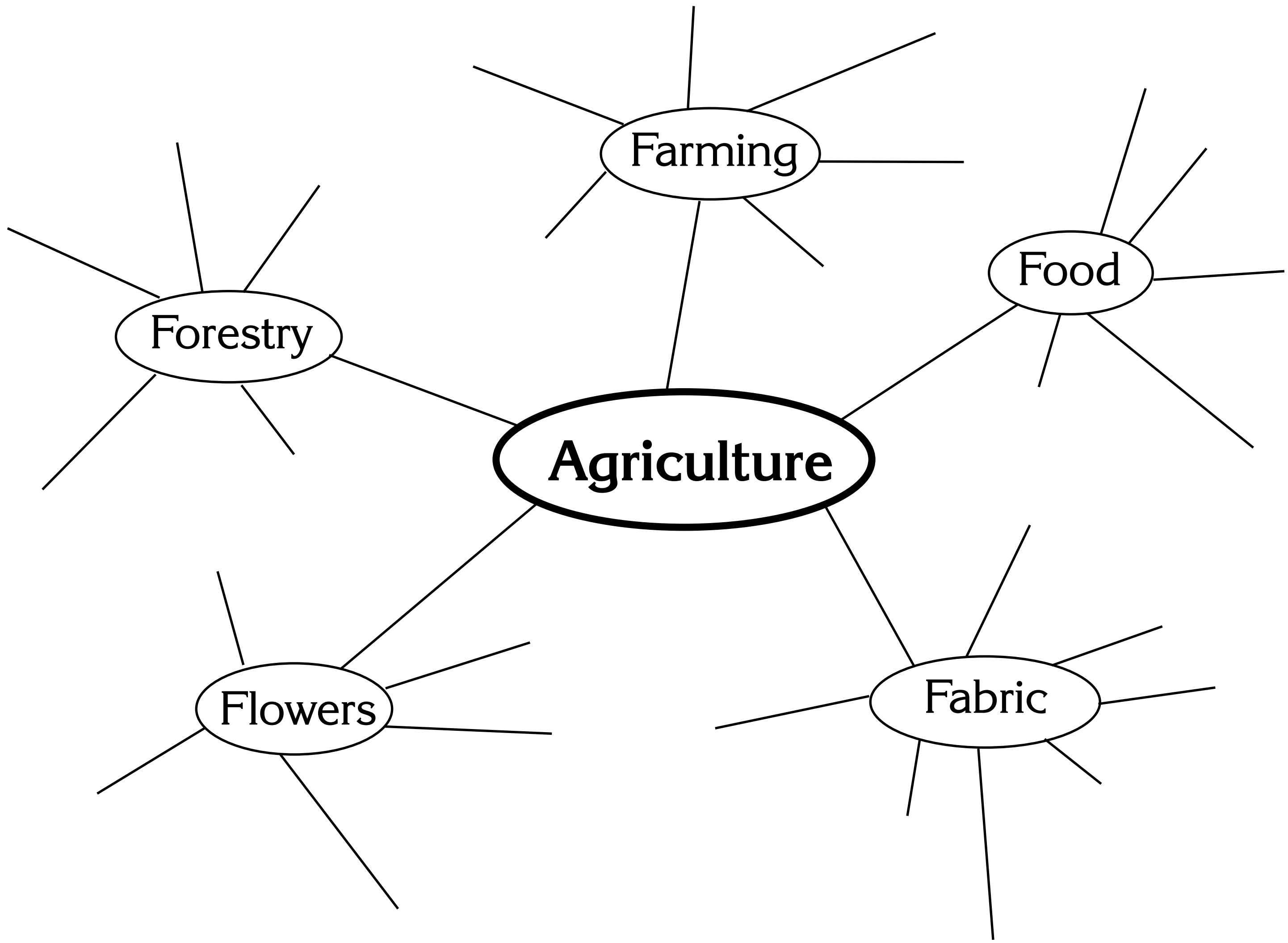
Fabric: Natural fibers are produced on the farm; the two most important fibers are wool and cotton. These fibers are made into thread or yarn and then knitted or woven into fabric or cloth, then finally made into gloves, socks, suits, coats, and other products including blankets, carpets, and curtains.

Forestry: Many forests are cultivated. Agriculturally, many private forests are grown to provide paper and other wood products.

Flowers: Flower and nursery crop production are part of the "green industry" which includes turf. The primary use of these "crops" is for aesthetics or beauty.

Agriculture Concept Map

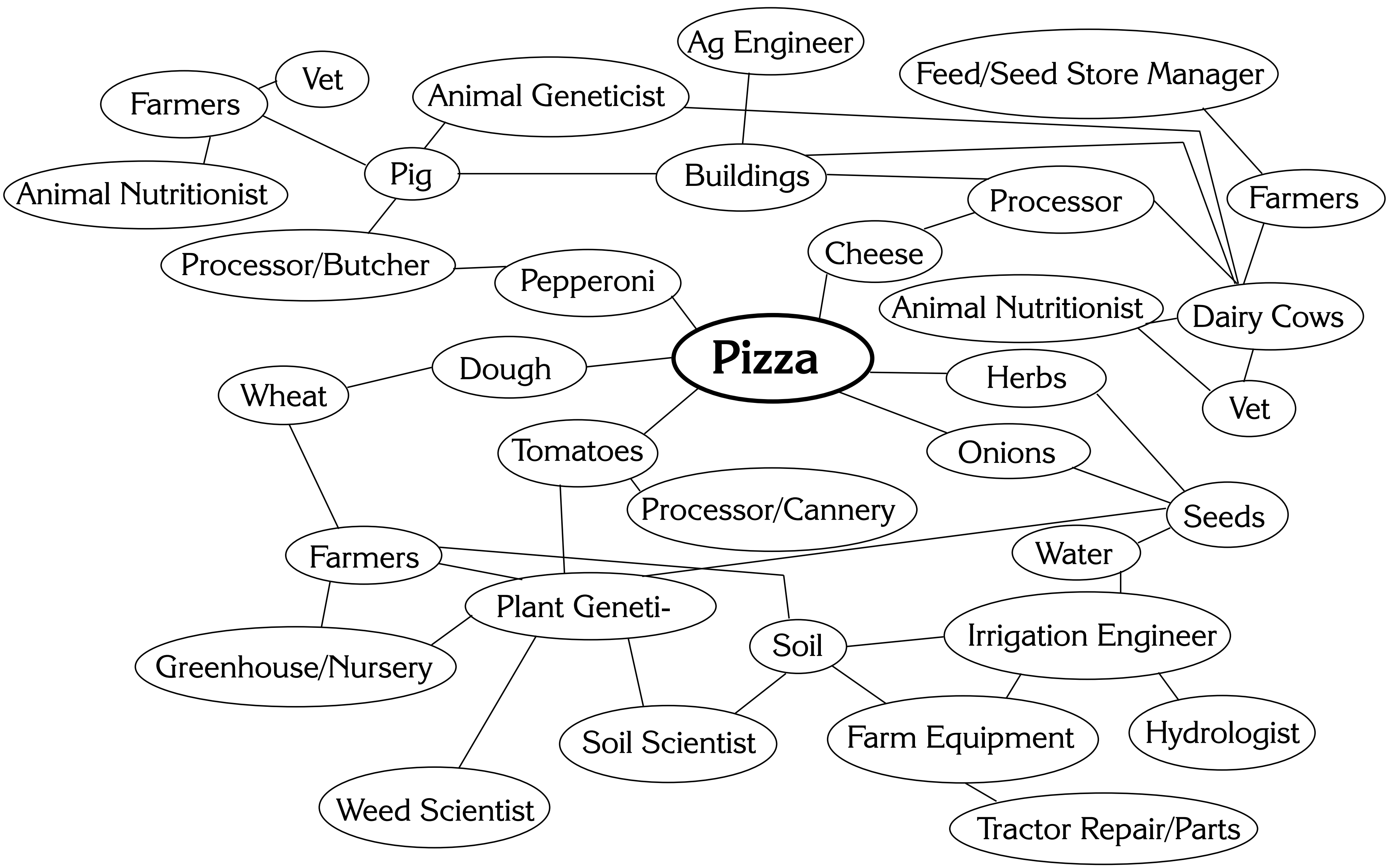
Much more needs to be added!



Take the 5-Fs: Farming, Food, Fabric, Flowers, & Forestry and create your own concept web.

Pizza Concept Map

Much more could be added!



Exploring Living Science Careers

Career & Technical Education, Introduction

Agricultural & Natural Resources Careers

Materials
- Living Science Career Cards
- Source Search Lesson Plan *(optional)*
- Agricultural Career Concept Map Lesson Plan *(optional)*
- 5-Fs or Agriculture poster *(FREE, Utah AITC)*
- *Employment Opportunities for College Grads in the U.S. Food, Agricultural, & Natural Resource Systems (FREE, Utah AITC)*
- Career Cluster Investigation Worksheet
- Career Matching Activity *(optional)*

Time: Two 45-minute sessions

Grade Level: 7-9

CTE, Introduction: Standard 3
Students will examine workplace tasks and concepts in agriculture.

Objectives:
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Background

Explore agricultural and natural resources careers that go beyond the stereotypical farmer and rancher occupations. These careers focus on food, land, and people and significantly affect our quality of life and our environment. To assess student knowledge about agriculture and its impact on their lives, do the "Source Search" activity (this can be found on the Agriculture in the Classroom Website, www.agclassroom.org/ut), prior to this lesson. After the students complete this activity, it becomes obvious to them that there must be numerous careers in agriculture and natural resources because they learn that the things we use everyday (with the exception of services) are either grown or extracted from the natural world.

The careers highlighted in this lesson require post high school training; many require Bachelor of Science degrees. The most important point to make with students concerning career education is that every industry or occupational endeavor has entry level positions, mid-level positions, and highly skilled/educated positions. For example, most students can relate to cars. In the automotive industry you can be a car detailer (entry level), sales person, auto plant worker, or mechanic (mid-level), or an automotive engineer who designs cars. What is the difference between these positions? Salary, yes, but what is the main factor that contributes to the differences in salary? Education! For the most part, you are paid for what you know. This isn't always the case, but training or education usually pays off. The other part of your salary may be determined by how much or how hard you work. Here is a table to compare entry-level wages with higher paying wages:

$7/hour	$14,560 per year
$10/hour	$20,800
$12/hour	$24,960
$18,810	current poverty level in America

Average US household (could be two wage earners) $43,318

Average in Utah is $48,537

US Department of Commerce (2005)

Your students are probably unaware of the career opportunities that make American agricultural and natural resources management systems work. Farmers and ranchers account for less than 2% of America's workforce, but the professionals supporting industry increase that number to about 9% and, if you count transportation and distribution, the number employed as a result of agriculture is about 20%. Think about a career in agriculture and natural resources.

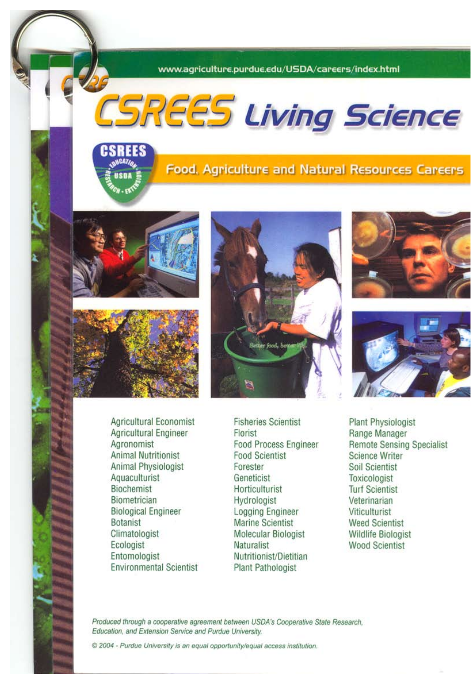
The agricultural industry is made up of four employment areas:

Agricultural and Forestry Production - 16%
Education, Communication & Governmental Services - 13%
Management & Business - 46%
Science & Engineering - 25%

Preparation

Obtain the ***Living Science Career Cards*** (if you are a Utah teacher, these career cards can be ordered from the Utah Agriculture in the Classroom Website; others should contact USDA Higher Education Programs, 202-720-1973). Laminate the cards, punch a hole in the upper left corner, and group them into 14 groups. Not all the cards will be used in this activity. Use a small book ring to keep the following groups together:

Group 1: Soil Scientist; Hydrologist
Group 2: Science Writer; Forester; Biological Engineer
Group 3: Geneticist; Environmental Scientist
Group 4: Agricultural Economist; Fisheries Scientist
Group 5: Climatologist; Logging Engineer; Plant Physiologist
Group 6: Entomologist; Wildlife Biologist
Group 7: Agricultural Engineer; Naturalist
Group 8: Weed Scientist; Animal Physiologist
Group 9: Plant Physiologist, Aquaculturist
Group 10: Remote Sensing Specialist, Horticulturist, Range Manager
Group 11: Food Scientist; Turf Scientist
Group 12: Nutritionist/Dietitian; Florist
Group 13: Animal Nutritionist; Botanist
Group 14: Veterinarian; Agronomist



Activity Procedures

1. Ask students to define "agriculture" and "natural resources." The concept web created in the previous lesson may be used with this activity.
2. Ask students to help you create a list of agricultural and or natural resource careers on the board or add them to the previously created concept webs.
3. After your students have made their list on the board or on the concept webs, add the careers cited on the career cards or use the attached transparency to display the science-related careers in agriculture and natural resources you will be discussing. The careers are integral to productive agriculture and well-maintained natural resources, yet most students will not be familiar with the job titles.

4. Divide the class into 14 groups; give each a set of the ringed career cards. Ask the students to take five minutes to read the back of the cards they have received to familiarize themselves with the careers, what roles they play in the agricultural community, and what education is necessary for each profession. The education required for each career is listed on the back of the cards and the explanation emphasizes that students should study science, math and English in high school in order to prepare themselves for similar subjects at the university level. Remind students that there will be entry- and mid-level occupations that support the highly skilled occupations.
5. Read the ***Career Activity Scenario*** and ask students to raise their hand if they think they have the career that correctly fills the blank. After each profession is answered correctly ask, "What other cards are in your group? What courses do they need to complete to get their degrees?"
6. Share with students the ***Emerging Agricultural Technologies*** noted on the transparency.

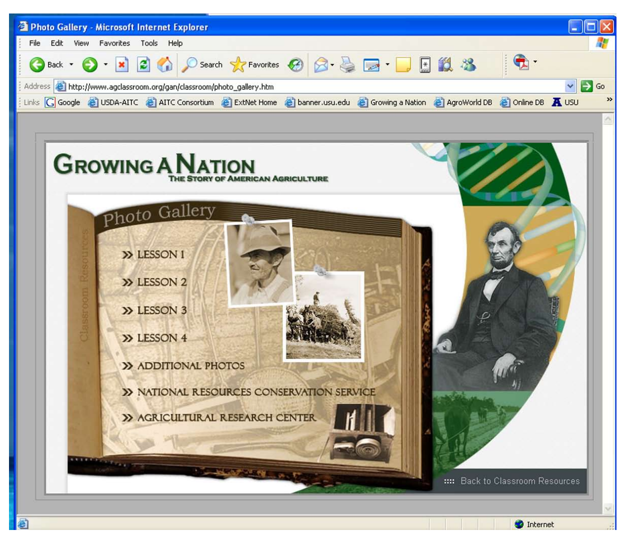
Additional Activities, What's Next?

◆ Use the ***Career Matching Activity*** to check student understanding.

KEY:	2	3	6	8
	31	10	11	15
	14	17	18	26
	22	27	4	28
	30	9	5	16
	7	13	12	20
	1	24	19	29
	21	23	25	

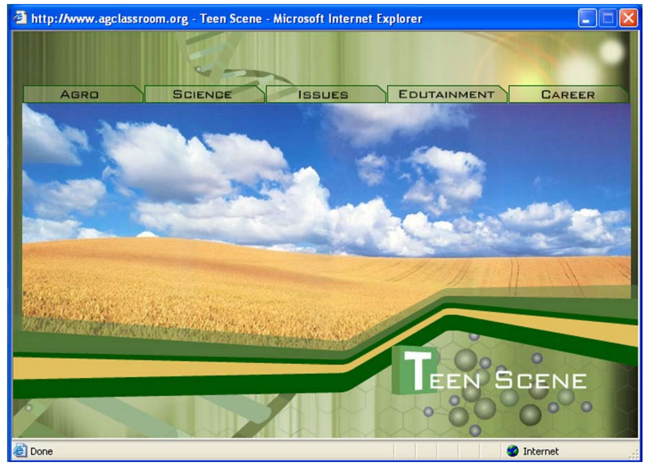
◆ Ask students to create PowerPoint slide presentations that show how agriculture has changed overtime by using pictures from the Growing a Nation photo gallery, http://www.agclassroom.org/gan/classroom/photo_gallery.htm.

◆ Using the FFA Career Explorer (http://www.ffa.org/index.cfm?method=c_job.CareerSearch) ask students to select a career cluster and then complete the ***Agricultural Career Cluster Investigation*** worksheet.



◆ Create your own "Career Activity Scenario" using the natural resource career cards (the story attached to this lesson focuses on agricultural careers).

◆ Ask the students to brainstorm other agricultural careers that have been left out of the activity. Popular ones include mid-level jobs in processing, marketing, and distribution. Ask each student to create their own agricultural or natural resource career card. Information to create these career cards can be found on the following websites:



Teen Scene – Career Opportunities
www.agclassroom.org/teen

Careers in Agricultural Science
www.florida-agriculture.com/consumers/careers.htm

Employment Opportunities for College Graduates
http://extension.usu.edu/aitc/teachers/secondary/pdf/employment_opp.pdf

FFA Career Explorer
http://www.ffa.org/index.cfm?method=c_job.CareerSearch

USDA Living Science
http://www.agriculture.purdue.edu/USDA/careers/

Agriculture Education Tech Prep
http://www.agedtechprep.com/content/volume1/targeted.html

Lesson Plan adapted from New Mexico AITC

Consider this:

$7/hour	=	$14,560 per year
$10/hour	=	$20,800
$12/hour	=	$24,960
$22.50	=	$45,000

$18,810 is considered the poverty level in America

Average U.S. household is $43,318

Average in Utah is $48,537

U.S. Department of Commerce (Online: 2005)

Career Activity Scenario

1. A family goes to the grocery store to pick up some groceries. The food in the grocery store exists because of well-managed natural resources such as soil and water, and the farmers and ranchers who grow the raw ingredients to fill the grocery stores. At the beginning of the season a farmer (also known as a grower or producer) needs to test soil to check for nutrients and to determine which fertilizers are necessary. The farmer needs the services of a ________________ (Soil Scientist).

2. As the farmer tries to decide which seed variety to plant, he or she will read agricultural publications written by ____________ (Science Writers).

3. A new seed hybrid that is better suited for the farmer's climate or soil has been developed, who developed that seed? ______________ (Geneticist).

4. The farmer has chosen the seed variety and determined what soil amendments are necessary. It's time to go to the bank for a loan. The local farm lender is an ____________ (Agricultural Economist).

5. The farmer is ready to plant, but wants to wait until there are favorable weather conditions. The farmer watches the weather to make sure the area is not expecting wind gusts or rain which would blow or wash away the seeds. Who develops the weather report? ______________ (Climatologist).

6. A couple of months after planting, the plants are growing, but the farmer notices holes in the leaves. They may be the result of an insect. Who can help identify the problem? ____________ (Entomologist).

7. The farmer is considering a new tractor. The tractor dealerships have a variety to choose from. Who is responsible for the design work? ________________ (Agricultural Engineer).

8. The insects have been identified and sprayed, but now there are weeds threatening to take over the field. Why are weeds harmful? Who can help him with this problem? __________________ (Weed Scientist).

9. The weeds are gone, but the plants aren't growing well. The farmer calls the University Extension office in the county. The Extension Educator referred the farmer to a __________________ (Plant Physiologist).

10. The Plant Physiologist says that the plants are stressed by either too little water or high soil salinity. Who can help the producer determine where irrigation is not reaching the plants? ___________ (Remote Sensing Specialist).

11. The crop is ready to harvest, and the farmer delivers it to the processing plant. The processor will turn the wheat, corn, cherries, etc. into bread, cookies, chips, pies, and so many other products. Who develops the food products? ___________ (Food Scientist).

12. Who determines the nutritional values of food? ______________ (Nutritionist/Dietitian).

13. What if the corn is bound for animal consumption rather than human consumption? Who helps determine feed rations (Animal Nutritionist)?

14. If an animal gets sick, who will a rancher call? ______________ (Veterinarian).

Career Matching Activity

Name ____________________________

Match the agricultural or natural resource career with the correct description.

_____ Agricultural Engineer	_____ Agronomist	_____ Aquaculturist	_____ Botanist
_____ Wildlife Biologist	_____ Entomologist	_____ Environmental Scientist	_____ Food Scientist
_____ Forester	_____ Horticulturist	_____ Hydrologist	_____ Science Writer
_____ Plant Pathologist	_____ Soil Scientist	_____ Animal Nutritionist	_____ Turf Scientist
_____ Weed Scientist	_____ Climatologist	_____ Animal Physiology	_____ Geneticist
_____ Biological Engineer	_____ Florist	_____ Fisheries Scientist	_____ Naturalist
_____ Agricultural Economist	_____ Range Manager	_____ Logging Engineer	_____ Veterinarian
_____ Nutritionist/Dietitian	_____ Plant Physiologist	_____ Remote Sensing Specialist	

1. Business skills to find success in sales, marketing, management, and finance careers.
2. Designs agricultural machinery and facilities such as tractors, implements, animal facilities, & irrigation systems.
3. Researches ways to produce crops and turf, to managing soils in the most environmentally friendly way.
4. Creates diets that must be nutritionally sound, good-tasting, and economical for the ages and types of animals that will use them.
5. Studies how animals interact with things outside them, such as temperature or air, plus things inside them, such as disease, poisons, or diet.
6. Raises a diverse array of aquatic plants and animals in controlled or semi-controlled settings for food or the stocking of public bodies of water.
7. Uses scientific principles and engineering involving the life sciences to create products and processes to meet human needs.
8. Studies all plant life.
9. Studies climate change, climate variability, and the effects of climate on the biosphere.
10. Helps farmers and ranchers produce crops and livestock more efficiently by using sound pest management strategies.
11. Protects the environment by working with hazardous waste management, land use, and air or water quality.
12. Dedicated to effective management, use, and conservation of aquatic plants and animals.
13. Designs floral arrangements, works with customers, and delivers flowers.
14. Spends time managing the "timberland."
15. Preserves our food supply by assuring its flavor, color, texture, nutritional quality, and safety.
16. Works with all species (plants and animals) at a "genetic" level.
17. Works primarily with nursery and greenhouse crops.
18. Assesses and protects our water supplies and quality.
19. Designs timber transportation and harvesting systems.
20. Studies the natural environment and enjoys sharing what they learn with other people.
21. Helps people look and feel well by making the connection between food, nutrition, and health.
22. Deals with the symptoms, causes, damage, spread, and control of plant diseases.
23. Studies the physical, chemical, and biological functions of living plants.
24. Cares for our country's vast rangelands.
25. Interprets and analyze many types of aerial photographs and satellite images.
26. Writes news stories, manuals, and press releases.
27. Maps and classifies soils and provide interpretations for land planners and managers.
28. Works to improve golf greens, park lawns, athletic fields, or other public or private grounds.
29. Diagnoses, treats, and helps prevent diseases and disabilities in animals.
30. Researches enforcing weed laws and developing regulations for biological and chemical control agents.
31. Researches animals in their natural environments.

Name ______________________________

Agricultural Career Cluster Investigation

Start your Internet search at the Teen Scene, www.agclassroom.org/teen/index.htm.

1. What is the name of this occupation?

2. What duties or responsibilities go along with this job?

3. What skills are needed for this job?

4. What type of personality is needed for this job?

5. What physical requirements or limitations are associated with this job?

6. What educational background is required?

7. What courses, especially in science, should be taken in high school and in college?

8. What is the best type of school to attend to attain the necessary skills?

9. What high school course should be taken to prepare for this position?

10. What are some positive aspects of this job?

11. What are some negative aspects of this job?

12. How does this profession help to better society?

13. What is today's demand for people in this?

14. What is the future outlook for this job?

Emerging Agricultural Technologies

Animal Technology

- Genetic Engineering in Animal Agriculture
- Reproduction and Embryo Transfer
- Transgenic Poultry
- Transgenic Fish
- Transgenic Swine
- Transgenic Ruminants
- Animal Health
- Steroid-Like Growth Promotants

Plant Technology

- Genetic Engineering in Crop Agriculture
- Genetic Technology for Resistance to Insect Pests
- Genetic Modification for Weed Control
- Genetic Modification for Disease Resistance
- Biocontrol for Weeds
- Pathogens for Insect Control
- Use of Parasites and Predators to Control Insect and Mite Pests in Agriculture
- Microbial Biocontrol of Plant Diseases
- Temperature and Water Stress
- Evolution of Resistance by Weeds and Pests to Herbicides and Pesticides
- Exchange of genetic material between genetically engineered crops and close relatives

Emerging Computer Technology

- Knowledge-based Systems for Agriculture
- Use of Expert Systems in Animal Agriculture
- Sensor Technology
- Robotics and Intelligent Machines

Food Safety and Quality

- Biotechnology in Food Processing
- Scientific information and methods for assessing the safety of genetically engineered foods and feeds

Space Age Technology Comes to Earth

Career & Technical Education, Introduction

Precision Agriculture, GPS and GIS

Materials

- ◆ Computer Lab or Computer & Projector for Presentation
- ◆ Computer Speakers or Headphones
- ◆ Computer Internet Access or Agricultural Technologies and Edutainment Software (available from Utah AITC)
- ◆ 5 - GPS Receivers *(optional)*
- ◆ Geocaching Bags *(optional)*

Background

Technology has changed all facets of our lives and had a dramatic effect on agriculture. Agriculture has been around for over 10,000 years. Several agricultural revolutions have occurred that today enable U.S. farmers to feed themselves and 129 other people here or around the world.

From simple stick scratching to make a furrow in the ground to planting a few seeds with a complicated combine with several different sensors, the applications of technology in agriculture are almost too numerous to count! Two hundred years ago, 98 percent of the population worked on farms. Today in the United States, technology and other scientific discoveries have left less than 2 percent of our population working on the farm to produce the raw food and fibers that we use every day. Advancements in plant and animal science, food storage techniques and machines, fertilizers and crop protection chemicals, numerous computer applications and modern machines have transformed American agriculture into the most productive food and fiber producing system the world has ever known, and kept the price of food the lowest of any nation.

Farmers rely on science and technology to produce and market their products. Creaky-bone predictions of rain may still be felt by older farmers, but farmers of the 21st Century will utilize precision farming techniques. Precision farming includes the use of the Global Positioning Systems (GPS), precise soil maps, yield monitors, and computer sensor applications.

Today's high-tech farmer needs to know as much about computers and satellites as he or she does about agronomy and phases of the moon. Modern precision farming allows farmers to work more efficiently, while obtaining increased yields from their crops. Theoretically, precision farming means using information technologies such as GPS and geographic information system (GIS) software to gather, store, view, and analyze vast amounts of data—which can then be converted into usable knowledge to make better farm management decisions for crop production.

Time: One or two 45-minute sessions (depending on optional GPS Receiver training time)

Grade Level: 7-9

CTE, Introduction: Standard 3
Students will examine workplace tasks and concepts in agriculture.

Objectives:

1. Explore the relationship and impact of agriculture and natural resources on the economy.
2. Identify the relationship and impact of agriculture on the family and consumer.
3. Understand the relationship and impact of agriculture and natural resources on technology and engineering.

Practically, precision farming means that farmers can visualize, identify and control crop patterns from a central computerized location. The goal is to improve profitability and reduce risk. For example, an increased number of tractors are linked to GPS, so their position can be tracked from a distant office. Land management information in office computers then tells tractors where to go, stop, turn or activate cutting or fertilizing equipment. Through a tractor-based GPS, a farmhand is told when and where to turn to begin tilling each row of a field. This can greatly reduce overlap, which on a large farm saves hours of work.

The use of GPS in farming has grown beyond the early practice of grid soil sampling and variable rate fertilizer applications to a new, more useful focus on yield monitoring. In precision farming, growers break fields down into regions, or cells, analyzing growth characteristics of each cell and improving crop health and yield by applying precise amounts of seed, fertilizers and pesticides as needed. Many associate precision farming with combine yield monitors, equipped with GPS. Some farmers now use multi-spectral imaging to produce gray scale values that are converted to color images showing poor to good vegetation conditions.

Yield monitors can forecast yield as bushels per acre, total pounds, acres per hour worked and grain moisture content. This is all done while the combine is in use, and can be recorded on a memory card for later analysis. Sensors monitor, calculate and record, in real time, each field's yield as the combine harvests the crop. This eliminates having to wait until the entire harvest is complete before projecting yields and making important decisions on how much to store or sell.

Field scouting uses a portable geographic information system unit that allows farmers to identify and record the location of problems or events that will affect production—including soil differences, insect infestations, fertility deficiencies and weed problems. Remote sensing and satellite and infrared images also can be employed while scouting fields. Satellites that capture infrared images can look at moisture content and quickly assess the health of a crop before visible damage appears. Soil testing, however, still requires farmers to walk across their fields to take samples. Once a farmer has this information, he or she can make accurate applications of water, chemicals, fertilizer or any other management tool to a particular part of the field in a specific amount or during a specific time.

The GPS is also used to map very large farms and ranches that may cover several square miles. Utilizing a handheld GPS unit, a farmer or rancher can locate pumps, irrigation standpipes, wet and dry areas, cattle, and the location of fences that need mending, etc. The usefulness in locating and mapping with GPS in agriculture is only limited by one's imagination.

Websites

TerraServer-USA
http://terraserver.microsoft.com

Google Earth
http://earth.google.com

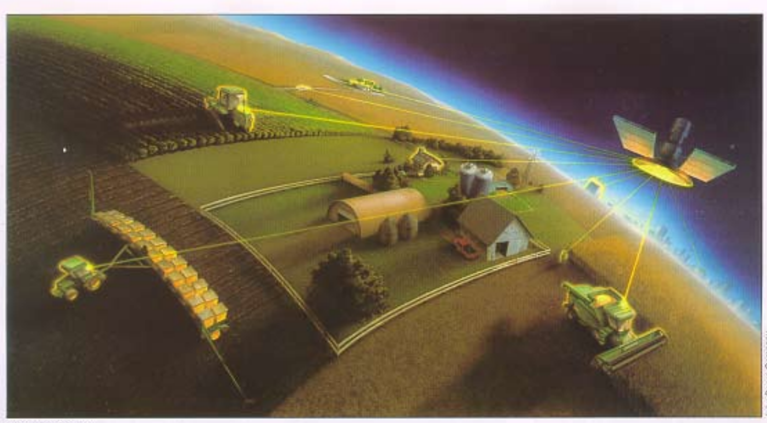
Wikipedia Geocaching
http://en.wikipedia.org/wiki/geocaching

ESRI GIS for Agriculture
http://www.esri.com/industries/agriculture/index.html

All about GPS
http://www.trimble.com/gps/

Remote Sensing
http://www.agclassroom.org/teen/ars_pdf/tech/2005/03remote.pdf

Tracking Cattle with Satellites
http://www.agclassroom.org/teen/ars_pdf/tech/2002/08tracking.pdf



The wired farm.

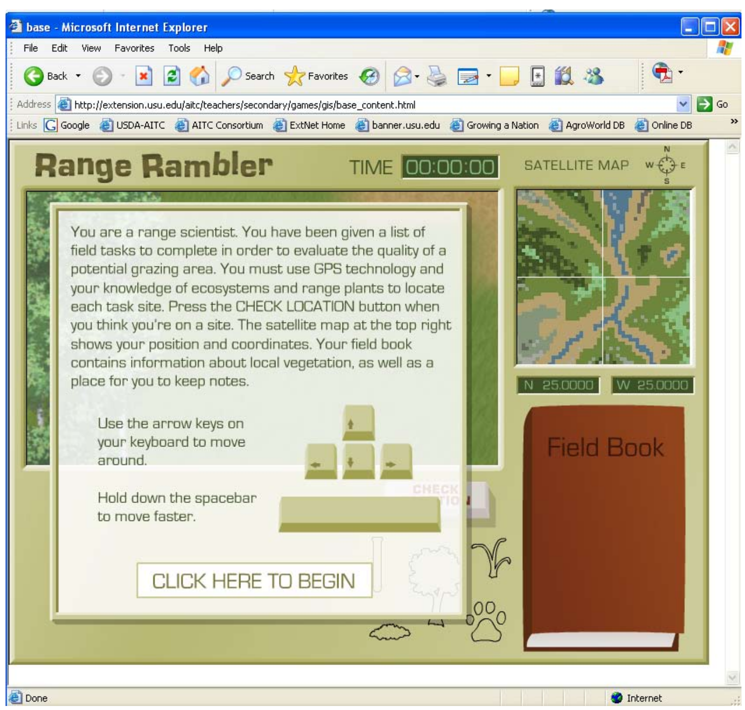
Preparation

Review with students the segment about precision agriculture and global positioning they watched previously in the video/DVD ***Connecting to Agriculture***. How does this technology help farmers and ranchers? How does the technology affect the price of food and clothing? Does GIS/GPS help the environment? Try out the following GPS/GIS activity with your students.

Activity Procedures: Range Rambler GIS, Software Simulation

Access the "Range Rambler" computer program either online (streaming from the web) at http://extension.usu.edu/aitc/teachers/secondary/enter_games.cfm or by purchasing the media from the same site and installing the program on your lab computers. Utah teachers will receive a password for free access. Request this password 24 hours prior to accessing the site. Demonstrate how to use the "Range Rambler" program by completing one field task, preferably using an LCD projector. Speakers are also required. If only one computer is available for the activity, invite a student to complete each new task and then complete the worksheet, as outlined below, as a class. If you have a computer lab, proceed with the following activity.

Provide each student or group of 2-3 students with a computer that allows access to the "Range Rambler" program (web or CD). There are five tasks each student or group of students needs to complete. (The tasks are the same for each group, however, the locations are randomly assigned, so each time students access the activity they will get different locations for each task.) The time it takes to complete the tasks is also calculated. Knowing how to use the Field Book will increase the student's ability to complete a task in a shorter amount of time. For example, knowing the color of a plant species you are looking for is very beneficial as you look at the map to find the location for completing tasks. Before students begin the tasks, demonstrate how the Field Book is used and how it will save them time. The Field Book is organized like a notebook a range scientist or rancher might keep and includes the legend for the map in the upper right corner of the screen. Students will need to complete the Field Book on the screen, i.e. the blue is water and students can type the word "water" by the side of the blue block.



Provide each student or group with the ***Range Rambler Worksheet***. They should complete their Field Book on the computer first and then on their worksheet, before they begin the five tasks. At the beginning of each task, students record their beginning time and ending time. They should find that each task takes less and less time as they advance through each task and learn to use the Field Book.

The following instructions are read aloud to students when they launch the program:

"You are a range scientist. You have been given a list of field tasks to complete in order to evaluate the quality of a potential grazing area. You must use GPS technology and your knowledge of ecosystems and range plants to locate each task site. Press CHECK LOCATION button when you think you're on a site. The satellite map at the top right shows your position and coordinates. Your Field Book contains information about local vegetation, as well as a place for you to keep your notes. Use the arrow keys on your keyboard to move around. Hold down the spacebar to move faster."

When students complete the activity, review the questions asked in the **Preparation** section. Have their answers changed? Where else could GPS and GIS be used?

Optional

If you have GPS receivers, teach students how they work and how to use them. Next do a "geocaching" activity or scavenger hunt where students use the GPS receivers to find caches (or items in Ziploc® bags) and complete the agricultural tasks found inside. These tasks will familiarize them with various agricultural careers.

Corn Starch Plastic Formula

1- pint or quart Ziploc® bag

1-T of water
1-T of corn starch
2 drops of corn oil
2 drops of food coloring

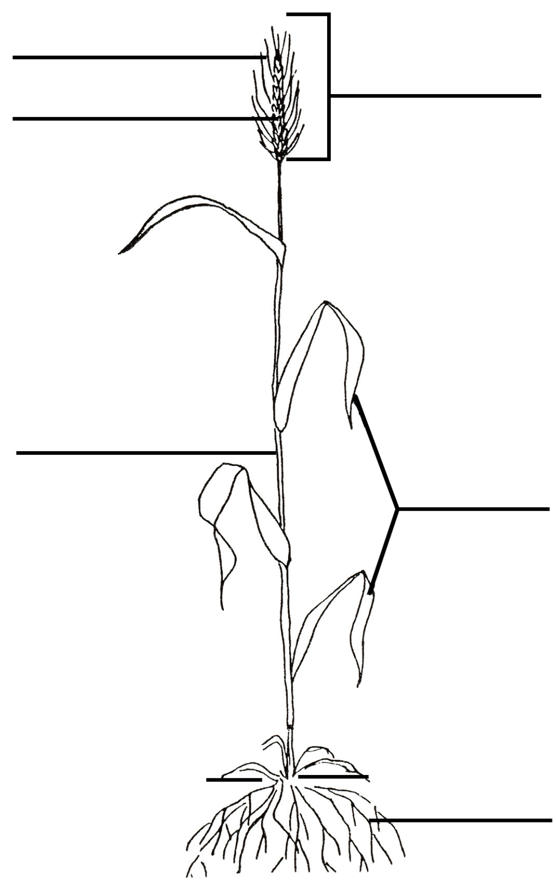
Additional Activities, What's Next?

Geocache Ag Bags:

1. You are a farmer and want to know the current price for potatoes. Go to the USDA Market News page at http://www.ams.usda.gov/foodserv/index.htm and find out the price for a 100 lb. sack (1-cwt).
2. Sound waves are used to determine the amount of back fat on a hog. Find out how this technology works and how much this unit will cost. (www.rencocorp.com/leanmeater.htm)
3. You are a vegetable farmer. Go to a commodities market and find out the price for lettuce. (http://www.ams.usda.gov/foodserv)
4. There is a bumper crop of corn this year and the government has asked you to experiment with corn starch to make plastic. If you are successful, there will be a larger market and higher price for this year's crop. You have come up with a formula that creates a plastic-like substance. Test your formula. Place the ingredients into the Ziploc® bag and mix well. Seal the bag most of the way; leave 1 inch open for the escape of steam. Keep the mixture agitated until you place it into a microwave. Cook on high for 25 seconds. When you remove the mixture, wave the bag around in the air until it is cool enough to handle. You may take the plastic out of the bag and form it however you like or, you may want to leave it flat so it will dry quickly and you can see how brittle it gets. How might this "corn plastic" be used? If you have time, leave the "plastic" flat/thin and allow it to dry. How has the "dried" substance changed?

5. Aquaculture or fish production is on the increase because consumers are seeing the benefits of fish protein and are demanding more fish at grocery stores. Your trout are not growing well. Research the temperature requirements for trout at http://aquanic.org/publicat/state/il-in/as-502.htm. What is their preferred temperature?
6. Forestry is one of the “5-Fs of Agriculture.” Which universities in your state offers a Bachelor’s Degree in forestry? What is the web address for that university? Find one other university in the United States that offers a degree in forestry. Note its website.
7. Soil less vegetable farming is called hydroponics. Visit a hydroponics website www.hydroponics.com/gardens/mixmatch.html, and list the types of hydroponic systems.
8. To explain a disease problem you are having with your wheat, you need to know the parts of the plant. Read the following and then identify the parts of the wheat plant:

    The top of the wheat plant, is called the head. The head contains the seeds or kernels and the hairy part is called the beard. The stem supports the head and in ancient times was used to weave baskets and other household items. Today the stem is used primarily as bedding for animals, as organic matter for the soil, and sometimes as a building material (strawboard or straw bales for walls). The leaves are where the food is made for the plant to grow. The roots anchor the plant, absorb water and minerals, and store the food the plant has made through photosynthesis as sugar.



Name ______________________________

Range Rambler Worksheet

1. List in order the types of vegetation you have mapped.
   Colored pencils for the legend boxes, optional.

   ☐ ____
   ☐ ____
   ☐ ____
   ☐ ____
   ☐ ____
   ☐ ____
   ☐ ____
   ☐ ____
   ☐ ____
   ☐ ____

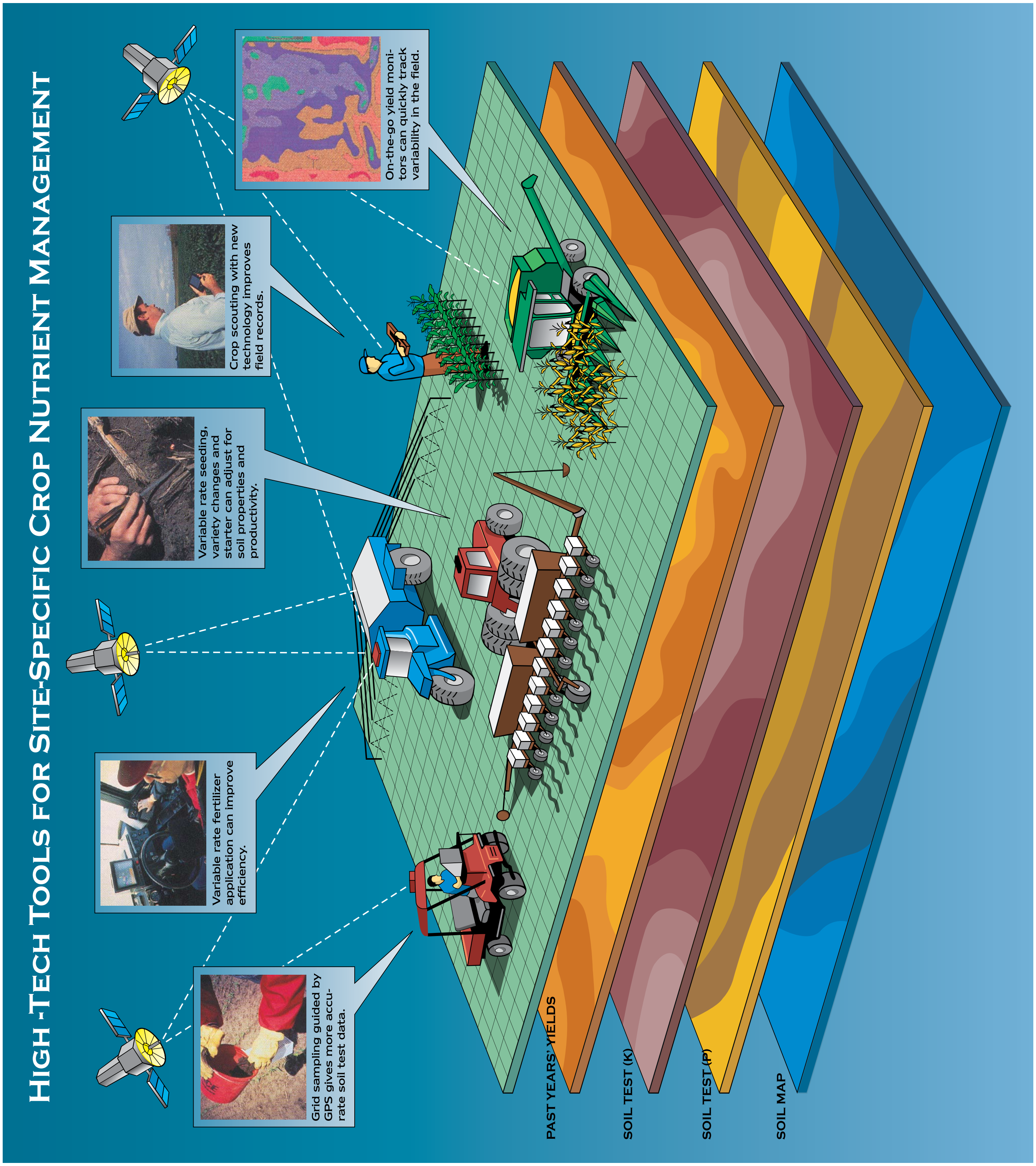
2. Note the time you start and complete each task, then calculate the time it took to do each task (time elapsed).

	Start Time	Time Completed	Time Elapsed
Task 1: Bark Beetles	________	________	________
Task 2: Water Sample	________	________	________
Task 3: Poisonous Plant	________	________	________
Task 4: Plant Density	________	________	________
Task 5: Predator Check	________	________	________

3. Did you get faster at finding the locations?

4. What did you learn about geographical coordinates and direction?

5. If the task site locations were marked as a location on a GPS receiver unit, could the sites be found more quickly? Why or why not?


High-Tech Tools for Site-Specific Crop Nutrient Management
Grid sampling guided by GPS gives more accurate soil test data.
Variable rate fertilizer application can improve efficiency.
Variable rate seeding, variety changes and starter can adjust for soil properties and productivity.
Crop scouting with new technology improves field records.
On-the-go yield monitors can quickly track variability in the field.
PAST YEARS' YIELDS
SOIL TEST (K)
SOIL TEST (P)
SOIL MAP

From Milk to Cheese & Seed to Shelf

Career & Technical Education, Introduction

Agricultural Science in Your Shopping Cart

Materials

Activity 1: Making Cheese, Old and New

- Computer Lab or Computer & Projector for Presentation
- Computer Speakers or Headphones
- Computer Internet Access or Agricultural Technologies and Edutainment Software (available from Utah AITC)
- Biotech Cheese Kit
- 2 Crockpots
- Rennet
- Thermometer
- Large Spoon
- Large Knife
- Colander
- 8 Cups Powdered Milk
- 2 Quarts Buttermilk
- Salt
- 2 Small Bowls
- Crackers
- Herbs *(optional)*
- ***Understanding Biotechnology*** CD available from Utah AITC *(optional)*
- ***What is Biotechnology*** Bulletin Board and Lesson Plan, and Worksheet available from Utah AITC *(optional)*
- ***Bringing Biotechnology to Life*** available from Utah AITC *(optional)*

Activity 2: From Seed to Shelf

- Computer Lab or Computer & Projector for Presentation
- Computer Speakers or Headphones
- Computer Internet Access or Agricultural Technologies and Edutainment Software (available from Utah AITC)

Activity 3: No Fear Food Safety First

- Science in Your Shopping Cart Booklet & DVD (available from Utah AITC)
- 5 Sets of Specialist Fact Cards
- 5 Sets of Specialist Matching Cards
- 5 Consumer Facts Information Boards

Time: Two or three 45-minute sessions

Grade Level: 7-9

CTE, Introduction: Standard 3
Students will examine workplace tasks and concepts in agriculture.

Objectives:

1. Explore the relationship and impact of agriculture and natural resources on the economy.
2. Identify the relationship and impact of agriculture on the family and consumer.
3. Understand the relationship and impact of agriculture and natural resources on technology and engineering.

Background

Food production, processing, and preservation techniques have changed drastically in the United States over the last 200 years. This lesson looks at three major agricultural changes – science of biotechnology, science of food preservation, and business of processing and distribution – through three classroom activities.

Activity Procedures

Activity 1: Making Cheese, Old and New

Biotechnology is a relatively new term that is defined as "techniques that use living organisms or parts of organisms to produce a variety of products (from medicines to industrial enzymes) to improve plants or animals or to develop microorganisms to remove toxins from bodies of water, or act as pesticides." With this definition, humans have been practicing "biotechnology" since the dawn of civilization. Over time, humans have wanted access to more high quality food and have sought out methods or techniques to improve agricultural production and food preservation. Today, we also want quantity and quality, but we also want food to be inexpensive.

As science has advanced, the ability to modify organisms through the tool of biotechnology has resulted in "genetically modified organisms" or GMOs. Some of these GMOs are controversial, especially if the GMO has caused or has the potential to cause a change in the environment.

A positive example of biotechnology and the resulting GMO can be found in cheese making. According to legend, cheese was "discovered" thousands of years ago by a traveler who placed milk into a pouch made from a sheep stomach. During the journey, the sun's heat and the enzymes in the lining of the stomach pouch changed the milk into curds and cheese whey.

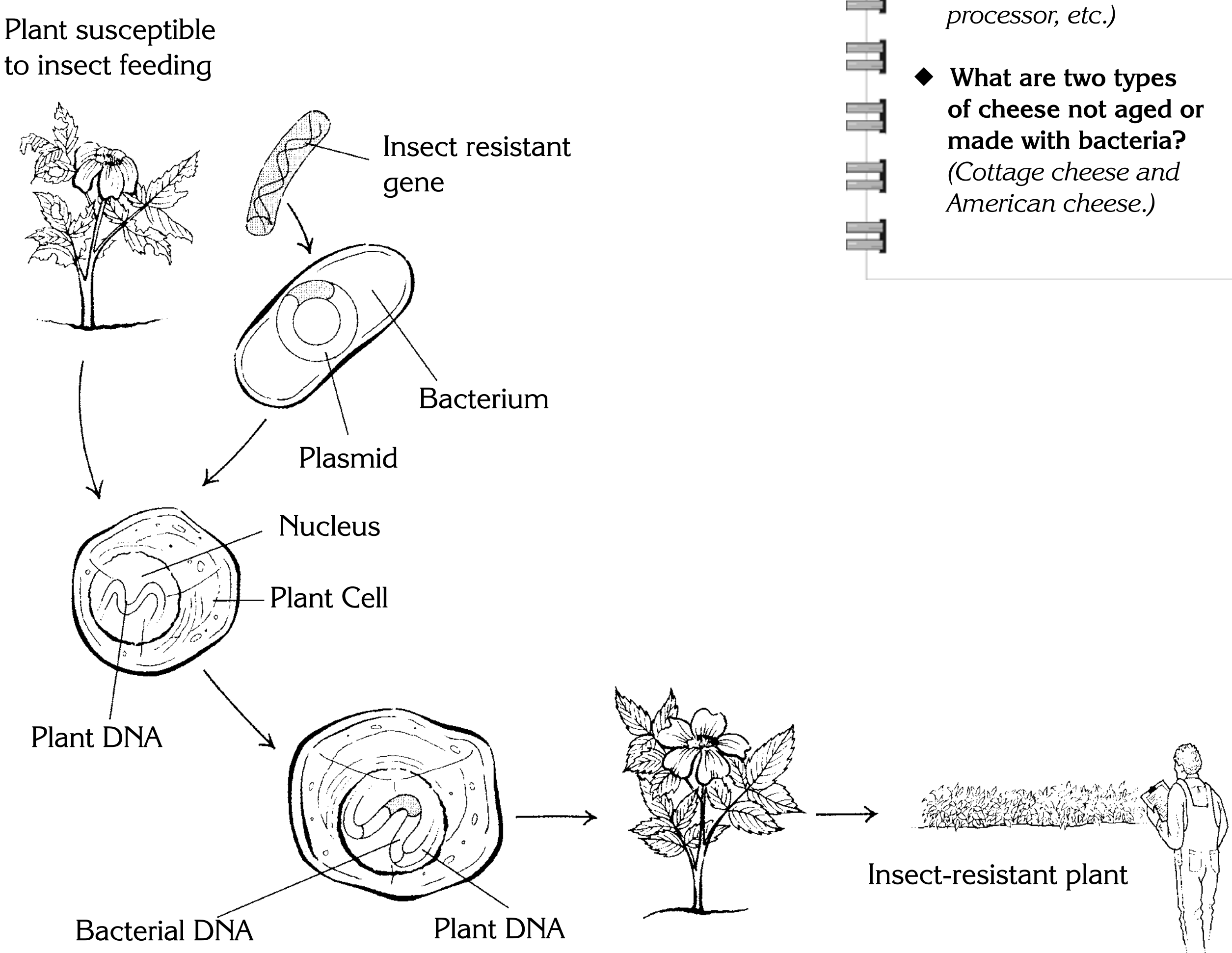
Scientists later discovered that the enzyme rennin (produced in calf stomach lining cells) would coagulate the protein (casein) in milk, forming curds and whey. Because the enzyme reacts with a protein, the enzyme is called a protease. Commercial rennin products, available in most grocery stores sold as "Junket" or "Rennet," are made from the enzymes found in the fourth stomach of calves. Through biotechnology, the gene from the calf stomach cell which makes the cell produce the enzyme, rennin, is removed and inserted into a bacteria or yeast cell. This causes the organism (bacteria or yeast) to produce the enzyme. Yeast replicate and grow rapidly, so yeast is often used to duplicate the enzyme. In the past, a large number of milk fed calves have been slaughtered to use their stomachs as a supply of rennin for cheese manufacturing. Through biotechnology, the enzyme-producing gene can be extracted, purified and concentrated – no calves necessary. This creates an endless supply of the human-made enzyme with the commercial name of "Chymosin." Today in the United States, about 80 percent of cottage cheese and 50 percent of all other cheeses are made with the enzyme Chymosin which has been isolated from a microorganism which has been genetically engineered through biotechnology.

Cheese making is really the removal of water from milk; milk is

87% water and 13% solids. This is done by coagulating the protein in the milk. Coagulation changes the chemical makeup of protein so it is no longer water-soluble.

Cheese making can be divided into two stages: coagulation and aging. The rennin enzyme splits kappa-casein, a major milk protein, causing the milk to coagulate or curdle. Chymosin and rennin work best at 90°F and in an acidic environment. The resulting curds and whey (milk liquid) are separated. The curd is used to make cheese. Some cheeses are used without much further processing and no aging. Cottage cheese is an example of a cheese that isn't aged. For proper aging, the action of specific bacteria and fungi are needed. Different strains of microbes are used for each type of cheese, e.g., Swiss, cheddar, and blue cheese.

In the ***Biotech Cheese Making Kit***, available from Utah AITC, buttermilk is added to the experiments to help with the flavor and increase acidity. The kit does not contain bacteria. Bacteria is not required for making cottage cheese, and using bacteria for making cheese requires more time in preparation and aging to see and taste the results. To compare a non-aged cheese like cottage cheese to cheese from rennin and Chymosin, obtain a ***Biotech Cheese Kit*** from Utah AITC and ask your students if they can see and taste the difference between "old" (rennin) and "new" (Chymosin) cheese. (Instructions are included with the kit.)



Discussion Questions:

- **List the various careers associated with dairy farming and dairy processing.** *(Dairy farmer, veterinarian, feed specialist, machinery operator, feed store manager, agricultural engineer, implement dealer, milk truck driver, milk plant manager, manufacturing engineer, graphic artist, marketing manager, food scientist, etc.)*
- **List the various careers associated with food science.** *(Nutritionist, food scientist, food manufacturing engineer, food chemist, food inspector, food marketer, graphic artist, dietician, processor, etc.)*
- **What are two types of cheese not aged or made with bacteria?** *(Cottage cheese and American cheese.)*

Activity 2: From Seed to Shelf

Access the "From Seed to Shelf" computer program either online (streaming from the web) at http://extension.usu.edu/aitc/teachers/secondary/enter_games.cfm or by purchasing the media from the same site and installing the program on your lab computers. Utah teachers will receive a password for free access. Request this password 24 hours prior to accessing the site. The game is easy to play but you may want to demonstrate how to use the "Seed to Shelf" program in front of the entire class using an LCD projector. Speakers are also required. If only one computer is available for the activity, divide the class into teams and play the game as an entire class. Ask each team to complete the worksheet. If you have a computer lab, proceed with the following activity.

Provide each group of 2-4 students with a computer that allows access to the "From Seed to Shelf" program (web or CD). There are two parts to the game, processing and marketing. (The tasks are the same for each group, however, the number dial spins randomly.) The player who produces the greatest number of cracker boxes and sells at a profit wins! The following questions and instructions are read aloud to students when they launch the program:

> "Where do all the crackers on the grocery store shelves come from? What occurred between the time the farmer planted the seeds and you bought the box of crackers? In this activity you will try your hand at producing boxes of crackers and distributing them to grocery stores across the country. As in real life you will encounter problems and surprises during the manufacturing process. Once you reach distribution, you will need to decide how quickly you can get the crackers to the stores. If you tell the distributors a time faster than you can deliver, you will lose some of your profit. However, if you take too long to deliver, they will not pay as much for your product. Carefully weigh your options before you decide. Good luck!"

Discussion Questions:

- **What are the advantages of being able to produce chymosin?** *(It is faster and the cheese production does not require calf stomachs.)*
- **If you have watched the first segment of Bringing *Biotechnology to Life* do you think biotechnology and genetically modified organisms will be part of the 21st Century?** *(Answers will vary, however the most probable answer is probably. GMOs that have direct environmental implications will be the most regulated and scrutinized.)*

Activity 3: No Fear Food Safety First

Most consumers have little understanding of production agriculture and the process of getting food from the farm to the fork. They often question whether advances in technology such as pesticides, chemicals, and biotechnology are really necessary to feed our country and others around the world.

Consumers can be assured that we have a safe food supply. It is estimated that over $3 billion is spent by 12 federal agencies to ensure food safety and quality inspection. In addition, it is estimated that private and state agencies spend an additional $6 billion annually. These educational, regulatory, and monitoring efforts help ensure the food we eat is safe.

Consumers often are confused by production practices used by farmers. Many questions and fears arise about the use of chemicals and pesticides. Studies reviewed by the FDA each year continue to show that the levels of pesticides in the U.S. food supply are low. According to Food and Drug Administration, about 75% of our foods contain no human-made pesticide residues. The human-made pesticide residues detected in 24% of FDA samples are well within the Environmental Protection Agency's very strict tolerance levels. In the remaining 1%, where human-made residues are outside legal limits, most often it's because the chemical product isn't registered for use on that particular crop. For example, a product may be registered for use on bell peppers, but not on chili peppers. This is a legal violation, not necessarily a health hazard. Pesticides in the environment are of greater concern than crop residues.

Consumers often ask, why must agriculture use chemicals and other technologies at all? Additionally, it is questioned whether the foods brought home from the supermarket would be safer to eat if farmers didn't use crop protection chemicals. Pesticides used in production agriculture help assure fungus-free grain, worm-free apples, leafy vegetables without aphids, and berries and fruits without mites or disease. Plants also generate substantial quantities of natural pesticides to ward off enemies such as insects, molds and fungi. Scientists believe that the vast majority of the pesticide residues we eat are naturally occurring.

Farmers face some great challenges in putting food on the consumer's table. Two of the biggest pests, which a farmer has to combat, are insects and weeds. For example, the average acre of land contains approximately a million weed seeds. If that does not boggle your mind, it is also estimated that farmers nationwide lose 33 percent of their harvest to insects. Without agricultural chemicals, pesticides, or other biological controls, farmers would be hard pressed to maintain our abundant and economical food supply. In other words, the supply would probably decrease and prices for food would increase. A question for discussion here might be, "What are you willing to pay for organic food?" "Will a large number Americans be willing or able to pay?"

With such an abundant food supply here in America, it is hard to imagine a food shortage. By the year 2050, it is estimated that the world population will be about 9 billion people. To feed this immense population, farmers will be asked to produce nearly as much food as it has produced in the entire 12,000-year history of agriculture.

Many people do not know exactly how vulnerable our food supply is. Our nation actually has only a surplus of a few commodities, such as corn and wheat. But this excess could be quickly diminished if bad weather or devastating crop failures occur. In fact, the USDA Economic Research Service estimates that our reserves could only last a mere two years.

Advances in biotechnology will continue to play a major role in helping farmers to control operating costs and produce a more bountiful and reliable harvest—if consumers will accept that science and biotech crop production doesn't adversely affect the environ-

Discussion Questions:

- Create a bar graph depicting the percentage of disposable income (dollars) spent on food by the following countries.

  10% United States
  16% Finland
  26% Japan
  26% Israel
  33% Mexico
  51% India

- Locate these countries on a world map.
- Why is food in the U.S. so inexpensive? *(Free market system, plant, soil, animal science increasing production and efficiency.)*

ment. Agricultural science and production efficiency is largely responsible for the relatively low cost that consumers in the U.S. pay for food. In fact, statistics show that only about 10 percent of a family's disposable (U.S. average) income is spent on food. This compares to consumers in Japan, Mexico, and India who spend about 26, 33, and 51 percent, respectively, on food.

Indeed our food system is complex and many times misunderstood. Today's food supply is not only abundant but also very safe. The key to our agricultural success in the future will center on our ability as producers and consumers to work together to keep our food system ecologically sound, sustainable, and safe, and delivering high quality, varied, and inexpensive food.

As a result of participating in the activities, students learn about food preservation techniques and some of the associated illnesses. Students will be able to sort out the facts concerning irradiation, *e-coli*, *Salmonella*, hormones, and pesticide residues.

1. Divide your students into groups of five.
2. Distribute to each group a plastic Ziploc® bag with the cut apart Specialist Fact Cards, Specialist Matching Cards, and Consumer Facts Information Board.
3. Students should take one of the Specialist Fact Cards. This will designate them as a "Food Science Specialist" in the area of irradiation, *e-coli, Salmonella*, hormones, and pesticide residues. (Option 1 - Each student reads their Specialist Fact Card before they begin matching or Option 2 - the matching begins and if the student player needs a clue to complete a match, one Specialist may read their card until a match can be made.)
4. Students should mix up or shuffle the Specialist Matching Cards and then place them upside down in a pile.
5. Each student takes a turn picking a Specialist Matching Card and trying to match the card to the appropriate place on the Consumer Facts Information Board. If they do not know where to match the card, the "Specialist" reads their Specialist Fact Card down to the place where the student says stop, because they have determined a match on the Consumer Facts Information Board.
6. The activity is finished when the Consumer Facts Information Board is complete. Answers can be posted on the overhead at the end of the activity.

More Activities, What's Next?

- While you wait for your cheese to set, show the students the CD ROM program titled *Understanding Biotechnology* (FREE download from Utah AITC website).

- Watch the first segment (21 minutes) of the video *Bringing Biotechnology to Life*. Invite discussion and questions.

- After the matching activity has been completed once, take away the Specialist Fact Cards and see which group can correctly match the items in the fastest time.

- Utilizing the booklet and DVD *Science in Your Shopping Cart*, bring in a bag of grocery items mentioned in the booklet. Ask the students to pair up. Pass one item to each team. Ask each team to guess and write down what "science" has been used in the production of their food item. Ask them to draw a line under their guesses. Next, view the *Science in Your Shopping Cart* DVD and ask the students to add any additional "science" techniques/processes that went into the production of the item. After they view the DVD, ask each team to share their "before and after" list. This is a good time for class discussions about new technologies and careers.

Name ______________________________

Seed to Shelf Worksheet

1. There are 14 steps noted in the game for the production of crackers. List 10 careers or jobs that would be necessary for getting the seeds from the farm into the cracker box.

2. How many (total) boxes of crackers did you produce?

3. What was the selling price of your crackers? Did you take a loss?

Seed to Shelf Worksheet

Name ______________________________

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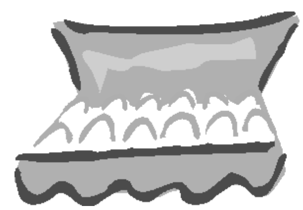
Specialist Fact Cards

Dr. Just Kookem

Irradiation is a process that "pasteurizes" food by using energy, just like milk is pasteurized using heat. Irradiation DOES NOT make food radioactive. The food never touches a radioactive substance. During irradiation, energy passes through food much like a ray of light passes through a window. Irradiation destroys insects, fungi, and bacteria. Fewer nutrients are lost during irradiation than in cooking and freezing. Food irradiation has been approved in 37 countries for more than 40 products including fruits, vegetables, spices, grains, poultry, pork, and beef. Irradiation is effective in destroying *e-coli*. Researchers have found that *e-coli* is among the most sensitive to irradiation, exceeded in sensitivity only by *Campylobacter jejunl*, which causes acute gastroenteritis. Other bacteria killed at low doses of irradiation are *Salmonella*, *Listeria*, and *Staphylococcus*. Hospitals use irradiation to sterilize food for immunocompromised patients, and astronauts have eaten irradiated foods for years. The public has not demanded irradiation yet—opting instead to cook their chicken and turkey thoroughly.

Dr. Will Hatch Cramp



Eggs quickly lose quality at room temperature. More importantly, refrigeration plays a role in preventing poisoning from the bacteria *Salmonella*. Eggs and their shells were once thought to contain natural barriers to contamination from bacteria. But in 1986, government experts linked food-borne illness to *Salmonella* contaminated eggs. It's still unclear how this contamination occurs. *Salmonella* is found naturally in the intestinal tracts of animals, including birds and reptiles, and in people. Food becomes contaminated through contact with feces. Symptoms of *Salmonella* poisoning include abdominal cramps, fever, headache, nausea, vomiting and diarrhea. Attacks are most serious for infants, pregnant women, older people, and people who are already sick or have immune system disorders.

Salmonella bacteria can double in number every 20 minutes — a single organism can replicate into more than 1 million in just 24 hours! *Salmonella enteritidis* doesn't grow at temperatures below 40°F, but this temperature range doesn't kill the bacteria.

What does kill *Salmonella* in eggs is cooking them until firm (160°F). Pasteurized eggs are also now available. These eggs have been heat-treated to 140°F for 3.5 minutes. This is enough to kill bacteria but not cook the egg. Pasteurized eggs can be used safely in lightly cooked egg-based creams, sauces or "sunny side up" breakfasts.

Beef, fruits, vegetables, and spices are all susceptible to *e-coli* which produces similar symptoms to *Salmonella* poisoning. Simply cooking ground beef and other meats to 160°F, well-done, juices running clear, destroys *e-coli* and other microbes. Only meat, like ground beef, that has been exposed to the air by grinding machinery needs to be cooked well-done. Steaks and other cuts may still be safely served "pink" in the middle.

Specialist Fact Cards

Dr. B. Bugbee

About one-third of the crops grown every year in the U.S. are destroyed by pests. Insecticides help control insect pests, and herbicides help control weed pests. Pesticides don't kill all the pests but they do keep them at a manageable level. Without pesticides, it would take 40 percent more farmland to produce the same amount of food farmers produce today. Pesticide products must go through several years of testing and research before farmers can use them. Once the product passes the lab tests it is ready to be tested in the fields of a research farm. Field testing helps researchers see what effect the product has on the environment. Researchers also use field-testing to find out how long the product stays in the environment and how it breaks down in soil and water.

After researchers have finished the first stage of testing, the company wishing to sell the product must complete more research to satisfy standards set by the Environmental Protection Agency. All products must be registered with the EPA before they can be used. It takes a minimum of seven years for a pesticide to go through all the tests necessary for EPA approval. Once a pesticide has been approved for sale, the EPA regulates how the product can be used. Failure to follow the instructions that come with the pesticides is a violation of federal law. These laws keep people from using dangerous levels of pesticides. If an unacceptable level of pesticide residue is found, the crop will be destroyed and the grower may have to pay fines.

Pesticide residues naturally wear off as time passes. Cooking will remove even more traces of residues. The FDA recommends fresh fruits and vegetables be washed with clean, running tap water before eating. Washing also helps to remove dirt that has collected on the food. Usually, by the time food is on the table, tests are unable to detect pesticide residues.

Dr. Angus Muscle

Some beef animals are given hormones (steroids) to increase muscle mass and thus produce more meat. The hormones are administered early before processing so that only a small amount of estrogen (hormone) can be detected in the final cuts of meat. The amount of hormones ingested by eating beef is miniscule when compared to the amount of hormones produced in the human body daily. For example, a 3 ounce serving of "hormone-free" beef contains 1.3 ng (nanogram, a billionth of a gram), a 3 ounce serving of "hormone implanted" beef contains 1.9 ng. Other food products with higher hormone levels include an 8 ounce serving of milk at 34.0 ng, one egg at 993 ng, and 4 ounces of cabbage at 2,700 ng. Women produce 480,000 ng of estrogen daily!

Hormone implants also increase the efficiency of beef production, thus alleviating energy, feed usage, and environmental impacts, and improve overall quality and healthfulness of beef by reducing the amount of fat.

Specialist Fact Cards

Dr. Kan Spoil

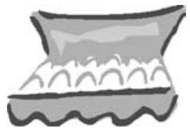
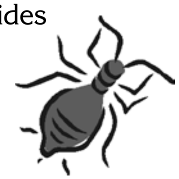
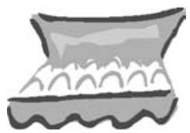
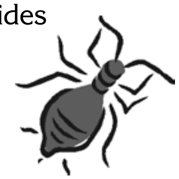
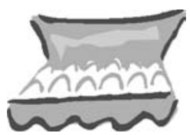
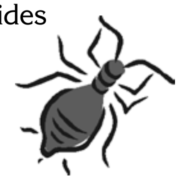
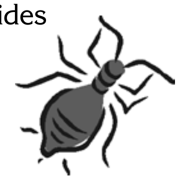
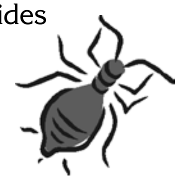
Food Preservation Techniques include: Canning, which first destroys bacteria through heating, and then the food is placed in a sterilized container and sealed. Drying removes water from the food that's required by spoilage bacteria to grow and reproduce. Freezing slows down the spoilage process by changing some essential water into ice, a form that the bacteria cannot use. Pasteurization destroys most of the existing spoilage organisms by heating the food to a high temperature for a short duration. Pickling or fermentation (culturing) leaves the food with a higher level of acid, making it an inhospitable environment for spoilage bacteria. Vacuum packaging uses a vacuum-sealed, abrasion-resistant, moisture-impermeable film that inhibits molds, yeasts, and bacterial growth on the surface of foods such as meat. Since there is no air in the package, vacuum-packaged meat will have a darker, purple color before being opened. Once the meat is exposed to oxygen, it will turn the familiar bright red color, because of the natural reactions within the package. Fresh vacuum-packaged meat will give off a slight odor upon opening. The smell will dissipate within a few minutes—this should not be confused with spoilage. Smoking adds smoke-born chemicals to food that help destroy potential spoilage organisms. Chemical additives are designed to destroy spoilage organisms or inhibit their growth. Sugar and salt are examples of additives that have been in use for centuries. Both of these work by drawing water out of the spoilage organisms, thus preventing their growth. UHT (Ultra-High Temperature), heats the product to higher temperatures than pasteurization resulting in a sterile product. Food additives are any additives added to food. Sugar, salt, and corn syrup are the most commonly used food additives. Food additives keep foods fresh, slow microbial growth, give desired texture and appearance, and aid in processing and preparation.

Key to Consumer Facts Information Board

Salmonella	Pesticides	Food Preservation	Irradiation	Pesticides
Hormones	Irradiation	Hormones	Salmonella	Irradiation
Irradiation	Food Preservation	Salmonella	Hormones	Food Preservation
Food Preservation	Salmonella	Pesticides	Irradiation	Hormones
Pesticides	Hormones	Food Preservation	Pesticides	Salmonella

Specialist Matching Cards

(to be cut apart)

Irradiation 	 Salmonella	Pesticides 	 Hormones	Food Preservation 
Irradiation 	 Salmonella	Pesticides 	 Hormones	Food Preservation 
Irradiation 	 Salmonella	Pesticides 	 Hormones	Food Preservation 
Irradiation 	 Salmonella	Pesticides 	 Hormones	Food Preservation 
Irradiation 	 Salmonella	Pesticides 	 Hormones	Food Preservation 

Consumer Facts Information Board

(do not cut apart)

Cooking to 160°F will kill these organisms.	EPA regulates this.	Destroys bacteria through heating when sealed in a sterilized container.	Energy passes through food.	Tested for a minimum of seven years.
Cause quicker weight gain.	Astronauts have this done to their food.	Cabbage has more than beef.	Doubles its population every 20 minutes.	Few nutrients are lost during this process.
Kills other bacteria like *Listeria*.	Sugar and salt are used extensively for this.	Doesn't grow at temperatures below 40°F.	Help to reduce fat.	All the air is sucked out.
Food has a higher level of acid.	Sickness symptoms include cramps, fever and vomiting.	If this is found you might have to pay a fine.	Hospitals use this method to sterilize food.	This is a type of steroid.
Without this we would need 40% more farmland.	Increase muscle mass.	Removes water from food.	Used to control insects.	These are also pasteurized.

Farming: It's a Fact!

Career & Technical Education, Introduction

Where Does Your Food Dollar Go?

Time: Two to three 45-minute sessions

Grade Level: 7-9

CTE, Introduction: Standard 3
Students will examine workplace tasks and concepts in agriculture.

Objectives:

1. Explore the relationship and impact of agriculture and natural resources on the economy.
2. Identify the relationship and impact of agriculture on the family and consumer.
3. Understand the relationship and impact of agriculture and natural resources on technology and engineering.

Materials

- ◆ Computer Lab or Computer & Projector for Presentation
- ◆ Computer Speakers or Headphones
- ◆ Computer Internet Access or Agricultural Technologies and Edutainment Software (available from Utah AITC website)
- ◆ *Farm Facts* Booklets (1 for every two students, available from Utah AITC website)
- ◆ Software (such as MicroSoft PowerPoint and Excel) or Graph Paper that will allow students to create charts and graphs
- ◆ Copies of handouts and transparency masters
- ◆ Ten Grocery Items with Receipt
- ◆ Calculators (hand-held or computer accessory)
- ◆ Ag Overload Score Card for each player or team

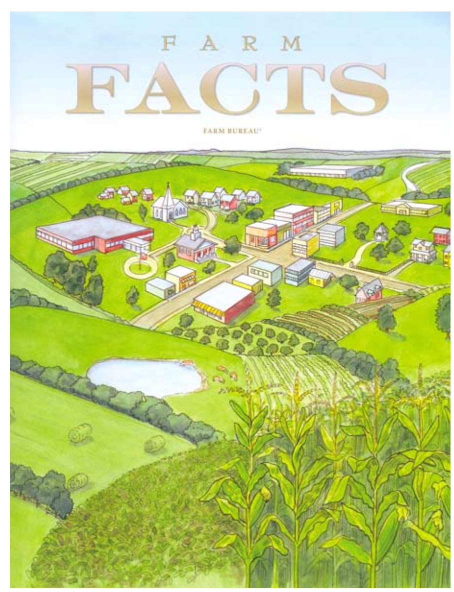
Background

The story of modern agriculture is highlighted by current facts. This lesson utilizes the current issue of *Farm Facts*, produced by the American Farm Bureau Federation. This publication is updated every two years (next revision, 2009, 2011, etc.). It is suggested that you purchase a classroom set of *Farm Facts* from Utah AITC website.

American agriculture is the story of American business. Agriculture has been around for over 10,000 years. Several agricultural revolutions have occurred that today enable each U.S. farmer to feed themselves and 144 other people here or around the world.

Two hundred years ago 98 percent of the population worked on farms. Today in the United States technology and other scientific discoveries have left less than 2 percent of our population working on the farm to produce the raw food and fibers that we use every day. Advancements in plant and animal science, food storage techniques and machines, fertilizers and crop protection chemicals, numerous computer applications and modern machines have transformed American agriculture into the most productive food and fiber producing system in the world, and kept the price of food the lowest of any nation.

The following activities are designed to give your students an introduction to the scope and importance of agriculture and some of the skills that are necessary for careers in agricultural business. Students will need to be somewhat familiar with MS Office programs such as PowerPoint and Excel.



Activity Procedures

Activity 1: Farm Facts or Opinion

1. Preview the *Farm Facts* booklet identifying with the students the different types of graphs used in the publication (bar graphs, pie charts, line graphs, etc.).
2. Pick a couple of pages in the *Farm Facts* booklet and ask students if the data on the pages could be displayed utilizing a different type of graph. Ask "What is the graph saying?" "What is it not saying?"
3. Ask students to complete the ***Farming: It's a Fact*** worksheet using the *Farm Facts* booklet. You may want to tell students the page numbers where they will find the requested information. *Farm Facts* is updated every two years (2009, 2011). Be sure you are using the most current booklet to have the most accurate data; this also means the page numbers may change in new booklets. This activity is great preparation for the "Ag Overload" game.

Activity 2: Who Gets Your Food Dollar?

1. Bring a bag of ten grocery items and a receipt that itemizes the cost of each item.
2. Using the receipt and a transparency pen, fill out the ***Itemized Grocery List*** transparency master, and share it with the students.
3. Review with the students the "Where Your Food Dollar Goes" graph in the *Farm Facts* booklet (page 14).
4. For each of the ten grocery items, ask students to compute how much each off-farm item (agribusiness) costs and how much was returned to the farmer or rancher for each item (***Where Does Your Food Dollar Go*** worksheet). You may want to demonstrate how to make the calculations for the first item.

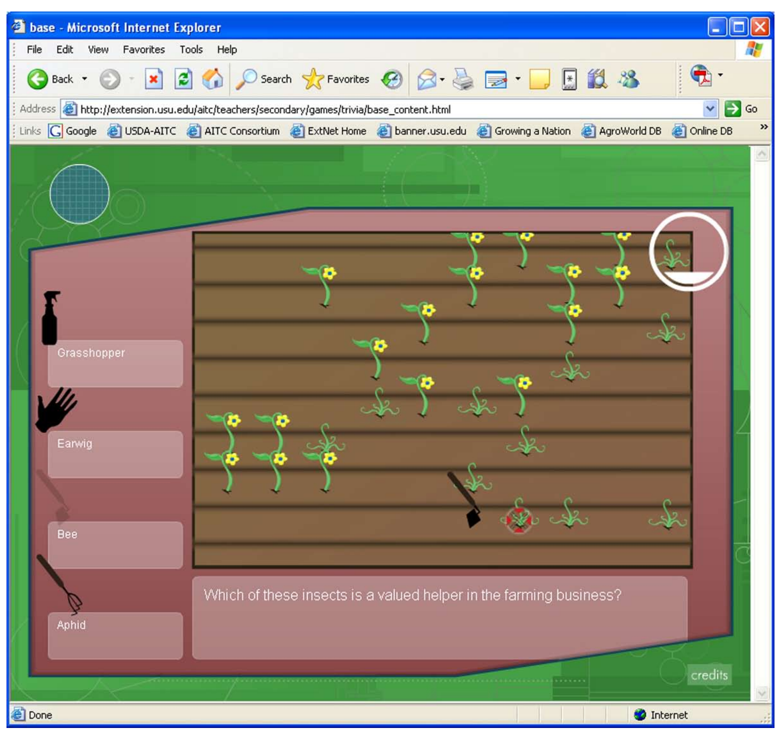
Activity 3: Ag Overload

Access the "Ag Overload" computer program either online (streaming from the web) at http://extension.usu.edu/aitc/teachers/secondary/enter_games.cfm or by purchasing the media from the same site and installing the program on your lab computers. Utah teachers will receive a password for free access. Request this password 24 hours prior to accessing the site. The game is easy to play but you may want to demonstrate how to use the "Ag Overload" program in front of the entire class using an LCD projector. Speakers are also required. If only one computer is available for the activity, divide the class into teams and play the game as an entire class. If you have a computer lab proceed with the following activity. The *Farm Facts* booklet should be used as the resource for this game.

Students may play the game individually, in pairs or as two teams. Provide each student, pair, or team of students with a computer that allows access to the "Ag Overload" program (web or CD). There are two parts to the game – quiz questions and two bonus round questions. Five questions are asked and then a bonus question, five more questions are asked and then a final bonus question. (All the questions are random from a database of 150 questions. If you are playing this game from the web, questions will be periodically updated.) Points are totaled from the quiz and bonus rounds. The following instructions are read aloud to students when they launch the program:

> "Welcome to Ag Overload! Agriculture is part of each of our lives, from the food we eat, to the clothes we wear. Check out some rare and fun facts about this amazing topic as you progress through this activity. In this activity, you are to choose the correct answer to each question or fact that appears. You can get help from the HINT BUTTON, but beware, you lose points by using it. After every 5 questions you will have a chance to play a BONUS ROUND. In the Bonus Round it is your job to control a noxious weed that is threatening to choke out a new crop. To do this, you have to choose the correct answer to a challenging question. Be prepared to save this crop with knowledge!"

Ask each team to play three games and complete the ***Ag Overload Score Card*** for each round. Did their score improve each game? What is at least one new fact they learned? Ask each individual or team to total all three rounds for a final score. Which team in the class did the best?



Name ________________________________

Farming: It's a Fact

Fact or Opinion: Read each sentence below and decide if it is based on fact or opinion by referring to the *Farm Facts* booklet. If the sentence is a fact, circle the letter in the fact column. If the sentence is an opinion, circle the letter in the opinion column.

	Fact	Opinion
1. Most Americans have earned enough money between January 1st and February 10th to pay for a year's worth of groceries.	**e**	**r**
2. Too much time is devoted to seeding trees on farmland each year.	**t**	**n**
3. Canada is the top customer for U.S. farm products.	**t**	**w**
4. A larger percentage of income is spent for food in Japan than in the United States.	**r**	**y**
5. More of the United States Department of Agriculture's (USDA's) budget should go for social programs.	**i**	**e**
6. The most important part of USDA's budget is spent on conservation programs.	**s**	**p**
7. Corn is used to fuel cars.	**r**	**b**
8. Corn is the best crop.	**v**	**e**
9. Technology makes American farmers more productive.	**n**	**c**
10. The invention of barbed wire in 1867 was the most important invention for all farmers.	**i**	**e**
11. Americans consume an average about 31 pounds of cheese each year.	**u**	**d**
12. The rate of soil erosion has decreased in the last 20 years.	**r**	**s**

Write the circled letters in the blanks to complete the following sentence:
Farming is still a family affair with individuals owning most of the farms in America. When a farmer takes a risk and organizes, manages, and assumes the risks of a farming business, the farmer is an

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___.

Itemized Grocery List

Grocery Item	Price

Name ______________________

Where Does Your Food Dollar Go?

Grocery Item	Price	Cents (fraction of a dollar shown in %, numbers from *Farm Facts* have been rounded up or down to equal $1.00)												
		Off-farm Labor 39¢ (.39)	Packaging 8¢ (.08)	Transportation 4¢ (.04)	Energy 4¢ (.04)	Profits 5¢ (.05)	Advertising 4¢ (.04)	Depre. 3¢ (.03)	Rent 4¢ (.04)	Interest 2¢ (.02)	Repairs 1¢ (.01)	Taxes 4¢ (.04)	Other 3¢ (.03)	Farm 19¢ (.19)
Total the cost for each item.														

Name ____________________________

Ag Overload Score Card

1. Report your score or your team's score for each game:

   Game 1: ________

   Game 2: ________

   Game 3: ________

   Total points for you or your team: ___________

2. Did your scores improve for each game? Why or why not?

3. What is at least one new fact you or your team learned?

Name ____________________________

Ag Overload Score Card

1. Report your score or your team's score for each game:

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   Game 3: ________

   Total points for you or your team: ___________

2. Did your scores improve for each game? Why or why not?

3. What is at least one new fact you or your team learned?

The Business of Agriculture

Career & Technical Education, Introduction

Farming: Seeds of Successful Marketing

Materials
- Seed samples of corn, rice, wheat, and soybeans (available from Utah AITC)
- Agronomy Specialist card sets and game boards for each group of four students
- Copies of map handout
- Marketing Integrated Lessons in Business for TLC, distributed by the Utah State Office of Education *(optional)*
- "Pit" game *(optional)*

Background

Without the grains grown on American farms, the cereal shelves would be empty (as would other shelves). Consumers and business owners alike need farmers to produce the raw ingredients to fill the factories, trucks and stores, and to provide jobs along the way (graphic designers for packaging, engineers in processing, food scientists, etc.). In fact the person who designs the box for Tony the Tiger's Frosted Flakes® owes his or her livelihood to the fact that someone grows corn.

About one out of five or 20% of Americans rely on agriculture for employment. It's hard to imagine an empty cereal aisle at your favorite grocery store, and easy to forget that all of the cereals came from a farmer's field. Grains are simply the seeds or fruits of grasses. They belong to a group of grasses called cereals or cereal grains and include wheat, corn, rice, oats, rye, buckwheat, millet, sorghum (milo), barley, quinoa, amaranth, and triticale (a high-yield grain developed by crossing wheat for its gluten and rye for its hardiness).

All grains have basically the same makeup. Each kernel, or grain, has a tiny "germ," or seed, at its core. It represents from 2 to 3 percent of the seed's weight and is the embryo from which new plants develop. The germ is surrounded by the endosperm – a storage packet of starch (a complex carbohydrate) – encased in protein to nourish the young plant in its early growth if the seed sprouts. Gluten is an elastic protein within the endosperm that stretches like bubble gum when wet and expands to hold the gas that yeast generates. Protecting the germ and endosperm is the bran, or hull – a tough, fibrous, hard covering.

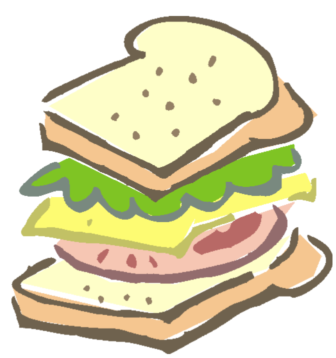
Grains are the primary raw material in bread. The kind of grain used largely determines the flavor, texture, and nutrition of the bread. Wheat, rye, oats, and barley were the primary grains in Europe during the Middle Ages. The principal grains grown in the world today are wheat, corn, and rice; these three provide more than half of the world's food from plants.

Time: One or two 45-minute sessions

Grade Level: 7-9

CTE, Introduction: Standard 3
Students will examine workplace tasks and concepts in agriculture.

Objectives:
1. Explore the relationship and impact of agriculture and natural resources on the economy.
2. Identify the relationship and impact of agriculture on the family and consumer.
3. Understand the relationship and impact of agriculture and natural resources on technology and engineering.



This activity exposes your students to the common grains used in cereal and shows where they are grown. If students are designing cereal boxes they might want to include pictures of the complete grain plant, e.g. if the cereal contains corn, a picture of the cob or plant could be part of the box design. Additionally, making the connection between actual cereal ingredients and what that cereal may taste like will help them to find words that better describe the cereal and assist them in product marketing i.e., words on the box that will sell.

NOTE: The activities in this lesson are designed to be integrated into the "Marketing Integrated Lessons in Business," Option #1 "Developing a New Cold Breakfast Cereal." The first two activities in this lesson plan could be inserted into or between the Product & Price section. This lesson can be downloaded at http://www.uen.org/Lessonplan/preview?LPid=228.

Activity Procedures: Seeds of Successful Marketing

1. Divide your students into groups of four.
2. Distribute to each group a plastic Ziploc® bag with the cut apart Specialist Fact Cards, Agronomy Specialist Matching Cards, and Grain Facts Information Board.
3. Each student should take one of the Specialist Fact Cards. This will designate him or her as an "Agronomy Specialist" in the areas of corn, rice, wheat, and soybeans. (Option 1 - Each student reads the Specialist Fact Card before he or she begins matching or Option 2 - the matching begins and if the student player needs a clue to complete a match, one Specialist may read his or her card until a match can be made.)
4. Students should mix up or shuffle the Specialist Matching Cards and then place them upside down in a pile.
5. Each student takes a turn picking a Specialist Matching Card and trying to match the card to the appropriate place on the Grain Facts Information Board. If they do not know where to match the card, the "Specialist" reads the Specialist Fact Card down to the place where the student says stop, because he or she has determined a match on the Grain Facts Information Board.
6. The activity is finished when the Grain Facts Information Board is complete. Answers can be posted on the overhead at the end of the activity.
7. Using the U.S. map provided and the Specialist Fact Cards, students should place a colored dot in each of the major grain producing states. (Instructions are on the map.)

More Activities, What's Next?

◆ The game "Pit" (commercial card game) could be used to demonstrate how agricultural commodities such as grains are traded. This game works best when played with 4-6 players and can be obtained in discount stores or online at websites including www.amazon.com.

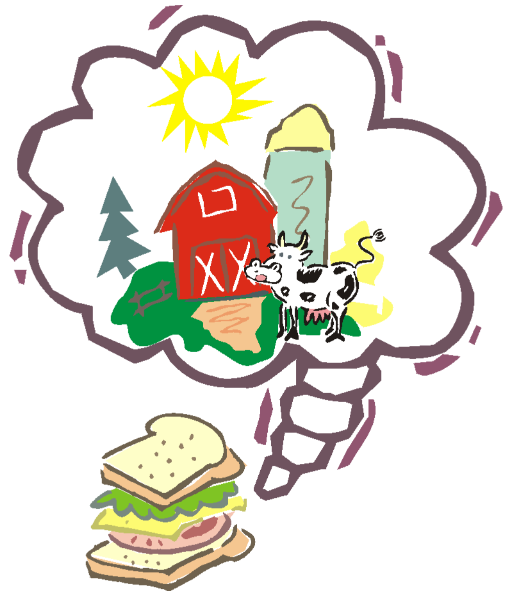
◆ After the matching activity has been completed once, take away the Specialist Fact Cards and see which group can correctly match the items in the fastest time.

◆ Students may want to include the Food Guide Pyramid as part of their cereal box design.

◆ Students should include an ingredients list on the cereal box they design.

◆ This cereal activity could be adapted to virtually any product, e.g., pickles, garden seeds, yogurt, etc.

◆ Design a menu (using classroom software) that conveys the theme "Farm Fresh to Your Table."



Specialist Fact Cards

Dr. Chris R. Patty

Rice, the world's third-leading grain, is the staple food of over half the people in the world today. For many it is their main source of protein, and for some it is their only protein. To most Americans, however, rice is casually treated as "filler food" to go along with meat, fish, or poultry. Rice is a native of Asia, where it was grown and used for food even before written records were kept. It arrived on the shores of North America in 1694.

Rice thrives in tropical areas because of the warm, wet climate that it requires. Rice fields are flooded to provide growing plants with moisture and to kill weeds and other pests. Rice can be grown where there is an annual rainfall of at least 40 inches or where water is available for irrigation. During the growing season rice needs an average temperature of at least 70°F.

Rice is inexpensive, easy to prepare, and easy to store, and it mixes well with lots of flavors. It can be made into breakfast cereals. Rice flour, both white and brown, is finely milled and useful in making noodles, pancakes, breads, cakes, and muffins, usually in combination with wheat flour. Rice is grown in more than 100 countries. China and India are the top rice-producing countries, growing more than 50 percent of the world's rice. The United States grows about 1 percent of the world's rice. Like wheat, rice is primarily used to feed people. Rice does have some industrial uses. For example, rice hulls have been used as an ingredient in fertilizer, insulation, cement, and a liquid chemical furfural (used as a solvent and in making plastics). Rice starch is the basis for most face powders. Many people in Asia use the dried stalks (straw) to thatch roofs and to weave items such as baskets, mats, sandals, hats, brooms, and rope. The major producing states are Arkansas, California, Louisiana, Mississippi, Missouri, and Texas.

Dr. Kim D. Legume

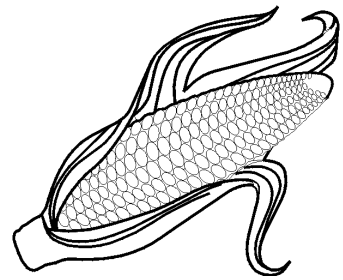
Soybeans are technically beans – dicots. Wheat, rice, and corn are grasses – monocots. The soybean probably originated in eastern China and is widely cultivated as a farm crop. The soybean was introduced into the United States in the early 1800s and was grown as a minor forage crop for many years. The development of a soybean – processing industry in the early 1920s gave soybean cultivation a great impetus, and today the soybean is a leading crop in the United States, ranking only behind corn and wheat.

The United States' produces about 50 percent of the world's soybeans. Leading soybean producing states include Iowa, Illinois, Indiana, Minnesota, Ohio, and Missouri. More than 30 percent of the United States production is exported. The soybean plant is 2 to 5 ft. in height, with large leaves, small white, pink, or purple flowers, and short pods with one to four seeds. On maturity, which is reached from 100 to 150 days after planting, depending on variety, location, and weather, the leaves turn yellow and drop, and the pods rapidly become brown and dry. The seeds, which are almost spherical in shape, are usually light yellow, but some rare varieties are black, brown, or green. They have a black, brown, or yellow hilum (seed scar) and contain about 20 percent oil and 40 percent protein. In the United States, soybeans are grown as a row crop, planted in May or June, and harvested with a grain combine in the fall.

The two basic products of the soybean are protein meal and oil. In the United States, more than 90 percent of the oil is consumed as margarine, shortening, mayonnaise, salad oils, and other edible products; the rest is used in industrial products such as paint, varnish, linoleum, and rubber fabrics. Soybean meal is the major source of the protein supplement used in livestock feeds, which utilize 98 percent of the total meal produced. Soybean use as a flour in cold cereals is limited. However, soybean oil is routinely added to cold cereals as a binding agent.

Specialist Fact Cards

Dr. Cornelius E. Kernel



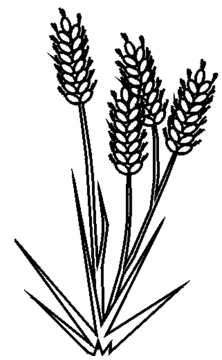
Corn is a grain that is tens of thousands of years old. Corn pollen grains dated as 80,000 years old were found in rocks about 200 feet below present day Mexico City. Most archaeo-botanists agree that corn migrated from Mesoamerica along sea and land routes to South America. It also migrated into North America and was cultivated by various Indian tribes such as the Mogollon, the Hohokam, and the Anasazi. In North America the American Indians were cultivating several different types of maize. Columbus took seeds from the grain back to Spain. Maize had two distinct advantages over wheat: it could be grown in three months and did not require oxen or plows to cultivate the soil. Within one generation it had spread through southern Europe, and within two generations, around the world.

Today, maize, or what we call corn, is one of our nation's top agricultural commodities. (The Pilgrims called maize "Indian corn" and Americans have called it corn ever since. Today corn is still correctly called maize.) Corn can be found in more than 4,000 food and non-food products. It is used to make bread, breakfast cereals, chips, and many other food products. Corn is the leading source of sweetener and is found in thousands of food items including sodas and candy. It is also used to make industrial products such as ceramics, pharmaceutical drugs (e.g., penicillin and other antibiotics), paints, paper goods, textiles, batteries, fireworks, biodegradable packing materials, and much more. In the United States, about 50 percent of the corn crop is fed to livestock (hogs, cattle, sheep, and poultry).

Corn can be grown in most mild and tropical regions of the world. It will grow wherever there is suitable soil, freedom from frost and cold nights, plenty of hot sun when maturing, and ample soil moisture during the hot season. It grows best in those parts of the Northern Hemisphere with daily July temperatures of 70°-80°F and a rainfall of at least 20 inches a year, with ample rain distributed throughout the growing season. The United States is the world's leading producer and exporter of corn, producing 36 percent of the world's supply. Corn is the chief food of most Mexicans, with the tortilla as the primary bread. No other crop is distributed over so large an area of the world, and corn is second (after wheat) in world grain production. The major corn-producing states are Iowa, Illinois, Nebraska, Indiana, Minnesota, and Ohio.

Specialist Fact Cards

Dr. Will G. Wheaton



Wheat has been cultivated and used for human food for many thousands of years. People have used wheat to make bread throughout recorded history. Wheat has been grown in Egypt since about 4000 B.C. and in China since at least 2800 B.C. The ancient Egyptians ground wheat into flour, combined it with liquid, and baked it into bread. They also "discovered" the property of wheat that has made wheat most popular grain for bread baking: the ability of wheat dough to rise and form a high loaf when yeast is added as a fermenting agent.

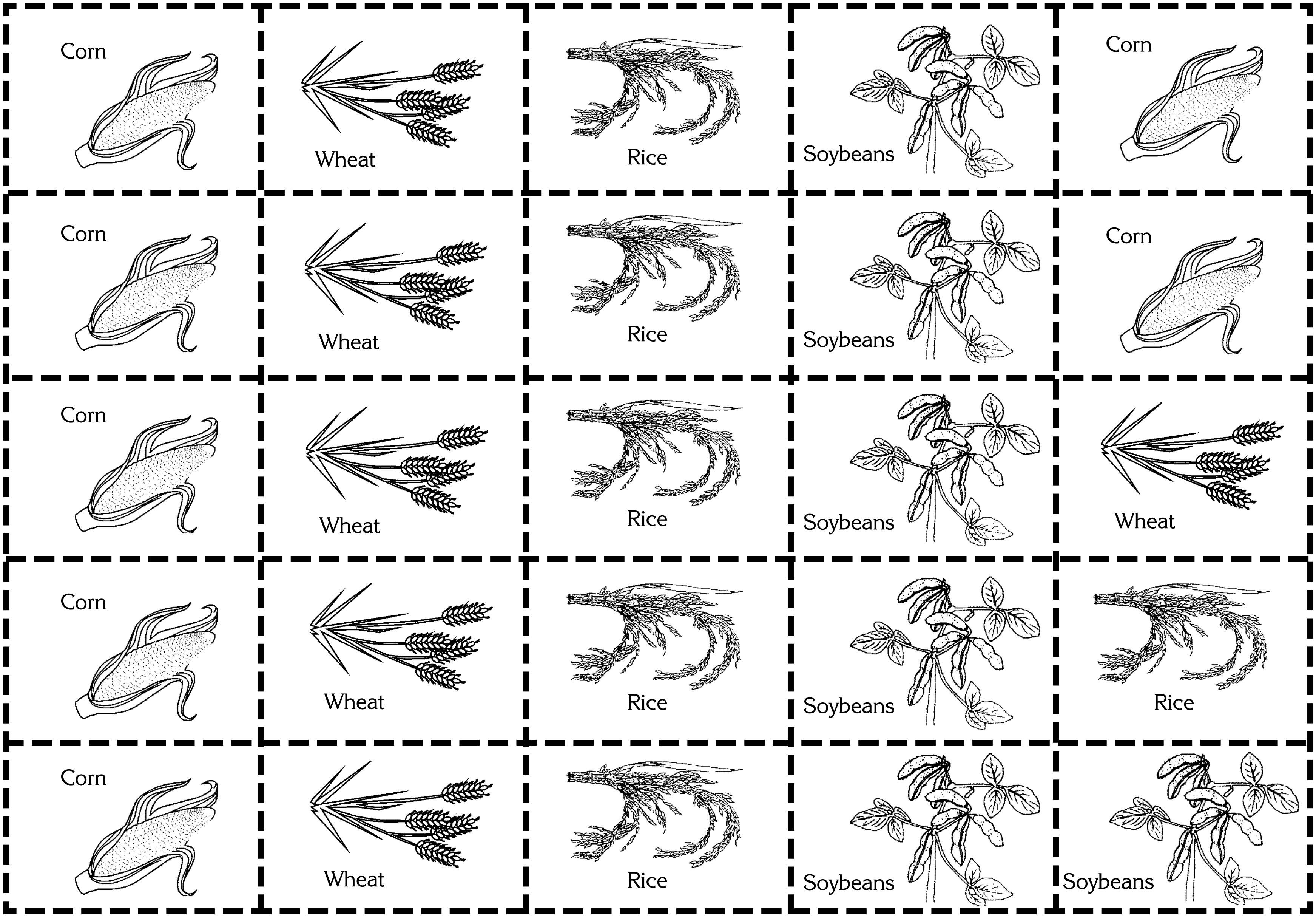
Today the United States is the world's largest producer of wheat, but it wasn't always so. Wheat did not become a major crop in America until after the French Revolution in the late 1700s. In addition to the war, Europe was experiencing large-scale urban growth, crop failures from drought, and potato blight. America responded to the need for grain in Europe by growing more wheat and exporting it to England and France.

Fairly dry and mild climates are the most favorable for growing wheat. In general, wheat needs lots of sunshine, 12-15 inches of water, and temperatures of 70-75°F. Winter wheat is planted in the fall and harvested the following spring or summer. It needs a period of cold weather with short days and long nights to flower. When the temperature drops below freezing, wheat becomes dormant. Spring wheat is planted in the spring and becomes fully ripe in the summer. Extreme heat or cold and very wet or very dry conditions will destroy both winter and spring wheat. Wheat is by far the world's largest and most widely cultivated food crop: one-seventh of all farmland around the world is used for growing it. Every moment of the year, some farmer, somewhere, is harvesting this grain as another is planting it. Today American wheat is exported and feeds millions of people all over the world, and new varieties of wheat have made it possible for the king of grains to be grown essentially worldwide. The top six wheat-producing states are Kansas, North Dakota, Montana, Washington, Oklahoma, and Idaho.

Key to Grain Facts Information Board

Wheat	**Soybeans**	**Corn**	**Wheat**	**Corn**
Soybeans	**Corn**	**Rice**	**Soybeans**	**Soybeans**
Corn	**Corn**	**Rice**	**Soybeans**	**Rice**
Rice	**Wheat**	**Wheat**	**Corn**	**Corn**
Wheat	**Rice**	**Rice**	**Wheat**	**Soybeans**

Agronomy Specialist Matching Cards
(to be cut apart)



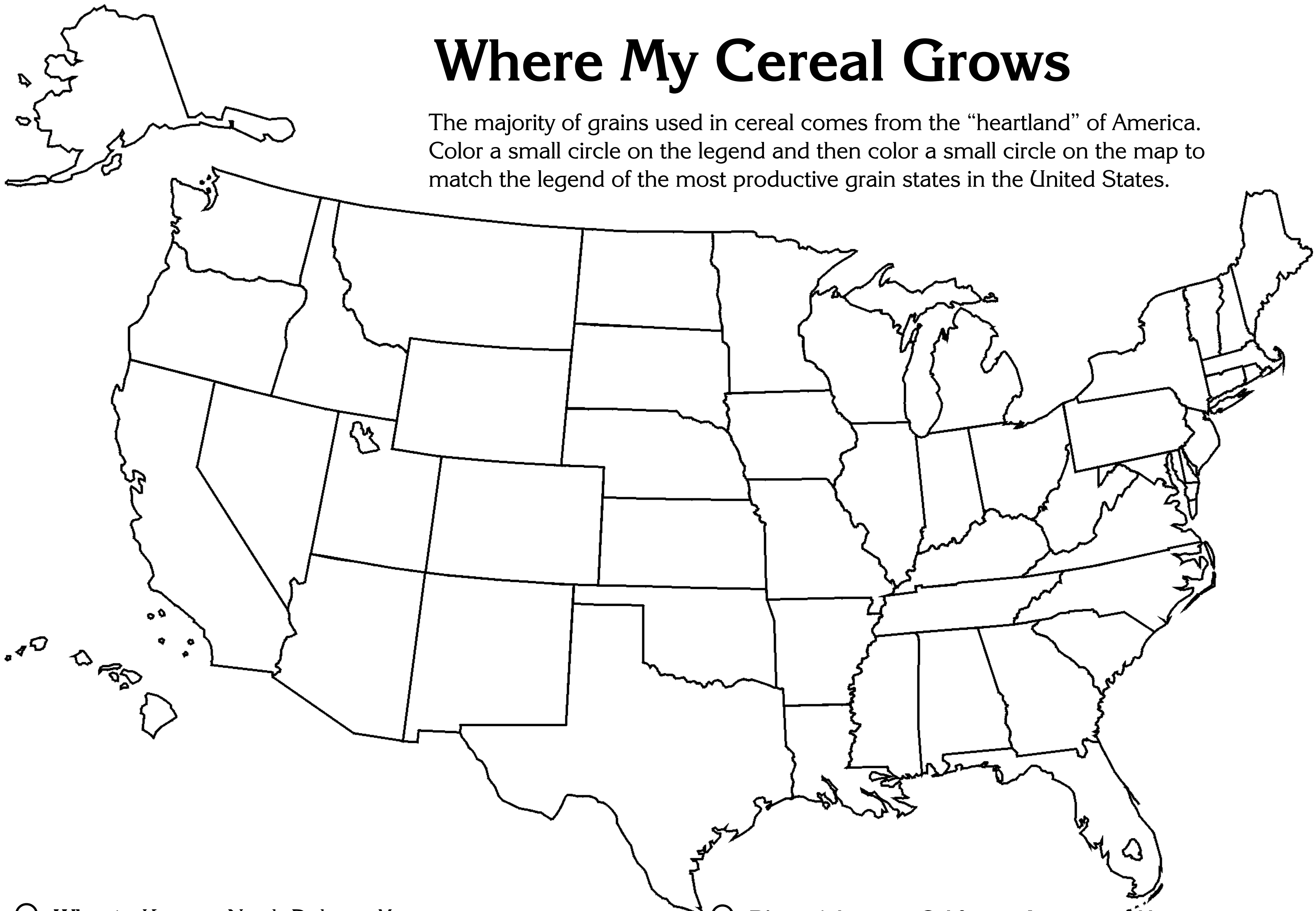
Grain Facts Information Board

(do not cut apart)

World's most widely grown grain.	Oil is the primary product of this crop.	U.S. produces 36 percent of the world's supply.	Grown by the Egyptians.	Second in world grain production.
The U.S. produces 50% of the world crop.	Native of Mexico.	Thrives in tropical climates.	Seeds are round and usually light yellow.	Plant is 2 - 5 feet tall.
Found in more than 4000 food products.	Used in batteries.	Needs an average temperature of 70° F.	Dicot.	Arrived in U.S. in 1694.
Fields are flooded.	King of grains.	Needs 12-15 inches of water.	Prefers 20 inches of rain per year.	Leading sweetener.
Planted in either spring of fall.	Native of Asia.	Used in face powders.	Remains dormant in the winter.	The seed is 40% protein.

Where My Cereal Grows

The majority of grains used in cereal comes from the "heartland" of America. Color a small circle on the legend and then color a small circle on the map to match the legend of the most productive grain states in the United States.



○ **Wheat:** Kansas, North Dakota, Montana, Washington, Oklahoma, and Idaho

○ **Rice:** Arkansas, California, Louisiana, Mississippi, Missouri, and Texas.

○ **Corn:** Iowa, Illinois, Nebraska, Indiana, Minnesota, and Ohio

○ **Soybeans:** Iowa, Illinois, Indiana, Minnesota, Ohio, Missouri

High-Tech Food

Career & Technical Education, Introduction

Science in Your Shopping Cart

Materials
The following materials are available on this website:
www.agclassroom.org/scienceinshopping.htm

- "Science in Your Shopping Cart" booklet (PDF)
- "Science in Your Shopping Cart" PowerPoint Presentation
- "Science in Your Shopping Cart" video (free download or purchase the DVD from the website, 14 min.)
- "Agricultural Science and Technology Worksheet," one for each student
- "Modern Marvels: Harvesting Technology" video/DVD (order online from the History Channel, www.historychannel.com)

Time: Two or three 45-minute sessions

Grade Level: 7-9

CTE, Introduction: Standard 3
Students will examine workplace tasks and concepts in Agriculture.

Objectives:

1. Explore the relationship and impact of agriculture and natural resources on the economy.
2. Identify the relationship and impact of agriculture on the family and consumer.
3. Understand the relationship and impact of agriculture and natural resources on technology and engineering.

Background

There really is science in your shopping cart! If we abide by the familiar saying "you are what you eat," it is understandable that people may be concerned with the incredible advances in food science technology and their possible impacts on human health. For example, in recent years high-tech scientific processes such as genetic modification, irradiation, and cloning have all been used to increase the safety of the food supply, create foods that are more appealing to eat and easier to produce, and increase crop yields. This article will summarize a few hot topics in food science, address what is currently known about the safety of these processes, and present resources on the subject to use with your students.

What are genetically modified foods? Genetically modified (also referred to as GM) foods are produced from sources whose genetic makeup has been altered through genetic engineering processes such as recombinant DNA or gene splicing. While this technology is relatively new, if viewed in a historical context, people have been selecting desirable plant and animal DNA through traditional selective breeding processes for centuries.

All plant and animal breeding that is selective—choosing particular parent stock, plant or animal, and cross-fertilizing (naturally or artificially) to produce offspring with desired traits of the parents—is, in actuality, low-tech "genetic engineering." While it is not normally thought of as scientific technology, it provides the foundation for how we have selected the desired traits for our food—color, taste, size, yield—for centuries. Even though humans did not have the capacity to isolate DNA until recently, by choosing certain individuals for breeding, they were in fact selecting the DNA that would be replicated.

In contrast, newer biotechnology in food production uses gene splicing, recombinant DNA, cloning, or other techniques to produce the desired plant or animal product. With gene splicing and recombinant DNA directly modifying only certain parts of the organisms'

DNA, it is possible to produce a more consistent product than would be possible using simpler forms of genetic manipulation or selective breeding. The first genetically modified whole food product, a tomato that could be shipped vine-ripened without rotting rapidly, went on the market in 1994. Today, the top three genetically modified crops in the United States are soybeans, corn, and cotton. Crops are modified not only for better taste and decreased spoilage, but also for resistance to disease and insects, and tolerance to certain herbicides or pesticides.

Manipulating DNA through genetic modification also allows genes from animals to be inserted into plant genomes— an example would be inserting the "antifreeze protein" gene from the Arctic flounder into a tomato's genome to produce a tomato that freezes and thaws better than the traditional tomato. What results is an example of a transgenic plant. Another successful example is the insertion of bacterial DNA that kills certain insects into a plant's genome, thus making the plants pest-resistant.

Genetic modification is not limited to the addition of DNA to an organism. Scientists are also genetically modifying the DNA of certain plants to remove or to silence parts of its DNA that cause allergic reactions or gastric distress to those who consume the plants. For example, through gene silencing, researchers were able to alter soybeans so they did not produce a protein called P34, which causes an allergic reaction in 75 percent of the people allergic to soybeans (Bren 2003). Work is continuing on this technique with soybeans, because there are up to 15 different proteins in soybeans that cause allergic reactions. To be totally effective, scientists will have to determine which of the additional 14 proteins cause allergic reactions and find ways to knock out those proteins as well; it is hoped that within a few years they will be successful.

It is estimated that between 70 and 75 percent of all processed foods now available in U.S. grocery stores may contain ingredients from genetically modified plants. Additionally, it must be remembered that genetic modification is not limited to whole foods—ingredients may also be engineered. Today, foods such as bread, cereal, hot dogs, pizza, and soda contain genetically engineered ingredients.

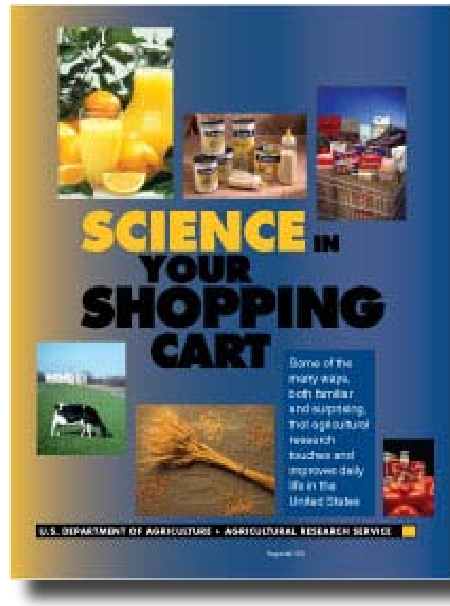
Genetically modified foods are not required in the United States to carry special labels, unless their content is significantly different from other products of the same type of food (such as decreased nutritional value, added allergen components, and so on). U.S. law requires foods to be labeled with information concerning their material and its processing, not the method by which a plant is developed by a breeder. For example, orange juice that is labeled as "fresh orange juice" cannot have been subjected to heat or chemical processing or processed into concentrate at any time before sale; the word fresh is considered to refer to the material (contents). Alternatively, if the oranges from which that same orange juice was made were the product of a hybrid cross-fertilization procedure, the orange juice is not required to be labeled "hybrid orange juice" because "hybrid" refers not to the contents of the orange juice, but to the method by which the oranges themselves were created. In actuality, almost every product we eat would require special labeling as to the method that was used to produce it if labeling laws extended beyond materials (contents) to include production methods.

There are several concerns raised about genetically modified foods. Transgenic plants have received much more attention than transgenic animals, partly because most transgenic animals are usually used for pharmaceutical or research purposes rather than for food. Concerns about genetically modified foods fall into several categories:

• Environmental—Pest-resistant crop plants may kill beneficial insects as well as pests. Another concern is whether the introduced genes will spread from the crop plants into plants growing nearby. For instance, it is proposed that soybeans modified to be resistant to herbicide might cross-pollinate with weeds growing in the fields, thus creating “super weeds” that would be herbicide-resistant.

• Economic—Transgenic plants are expensive to produce because it takes expensive technology to create them. The companies that produce them (primarily in countries such as the United States) want to make a profit because they put a lot of resources into making them. It is suggested that poor countries that might benefit most from the technology would not be able to afford the seeds.

• Human health—Despite the fact that package labeling for potential allergic reactions is required by law for genetically engineered foods, there is still a concern that allergenic compounds (such as peanuts or soy) may be present in a food eventually consumed by an unknowing allergic person. While a consumer can read labels to control which foods are eaten at home, such control is lost when dining out. For example, a person with a peanut allergy could unknowingly consume a genetically modified food product containing a peanut compound at a restaurant or someone else’s home. If the food being consumed normally would not contain peanuts, there would be no reasonable way for the diner to foresee that consuming it would produce a reaction, and that would place an allergic person at risk (Rajagopal 2001).



Activity 1: Procedures

1. Assign each pair or small group of students one of the products listed on the “Agricultural Science and Technology Worksheet.” You may want to provide each group with a picture of the product they have been assigned (located on pages 8-12 in this lesson). Alternatively, a “real” food or non-food product on the list may be used to add interest.
2. Review the “Science in Your Shopping Cart” PowerPoint presentation, slides 1-5, and discuss the scientific changes that are sometimes used to change particular crops, animals, and resulting foods.
3. Ask each pair/group to write down, on their “Agricultural Science and Technology Worksheet,” the scientific changes they think have been applied to the development of the product they have been given (there may be more than one).
4. View with your students the video “Science in Your Shopping Cart” (streams from the Internet or purchase the DVD). Ask students to write down the actual scientific changes *all* the products shown in the video have undergone to get that product to the consumer.
5. After viewing the video, ask students if they guessed the scientific changes correctly. Students will notice that not all the products were shown in the video. Provide each group with a copy of the “Science in Your Shopping Cart” booklet (order or view online) to complete the worksheet. (Utah teachers can order up to 15 free booklets, while they last, from www.agclassroom.org/ut, type “shopping cart” in the search box and add the item to your cart; be sure to update your quantity.)
6. Show students slides 6 and 7 in the PowerPoint presentation for a few other examples of food science.

Activity 2: Procedures

Technology is the application of science. To further demonstrate science and technology used in agriculture, view with students the video/DVD "Modern Marvels: Harvesting Technology" (order online from the History Channel, www.historychannel.com). Students can then complete the last column on the "Agricultural Science and Technology Worksheet." This video details harvesting technology for the following: GPS/GIS wheat, cotton, rice, sugar beets, tomatoes, walnuts, olives, lettuce, grapes, and oranges.

Activity 3: Procedures

Review with students the "Concerns About Food Science," the last five slides in the "Science in Your Shopping Cart" PowerPoint presentation. Here are some questions for discussion:

- Are the food products safe to eat?
- Do the benefits of GMO foods outweigh the risks?
- What is on the horizon in food science?
- What is left to invent?
- What are some career opportunities in the area of food science and food technology?
- How many people have really made a loaf of bread or a gallon of milk?
- From farm to fork: how much science is in your shopping cart?

Additional Resources

- "Understanding Biotechnology Multimedia Presentation" free download from this website: http://www.agclassroom.org/teacher/understand_biotech.htm
- "What is Biotechnology?" (Bulletin Board)
  What does GMO stand for? Why are people opposed to the use of biotechnology? Have you ever eaten a food that has been genetically modified? This bulletin board and accompanying lesson plan investigate the technology, history and concerns about biotechnology. Downloadable lesson plan (http://extension.usu.edu/aitc/teachers/pdf/lesson/biotech_bulletin.pdf) can be used with or without the bulletin board. https://extension.usu.edu/aitc/cart/details.cfm?ProdID=274&category=0
- "Agricultural Biotechnology Questions and Answers" pamphlet available from this website: http://extension.usu.edu/aitc/teachers/secondary/pdf/gmopamphlet.pdf
- "Science and Our Food Supply" curriculum and video: http://www.foodsafety.gov/~fsg/teach.html
- "Bringing Biotechnology to Life" teacher guide and video: www.ageducate.org
- Agricultural Research Magazine: www.ars.usda.gov/ar
- AgroWorld, E-zine and website: www.agclassroom.org

Background information written by Roxanne Greitz Miller, Ed.D., Chapman University (2007).

Key to Agricultural Science and Technology Worksheet

Agricultural Product	Actual scientific changes applied to the development product	Harvesting Technology
Apples	sweeter, crunchier, crisp, enzyme coating to deter browning	robotic pickers
Carrots	more vitamin A, new/old colors, enzyme to enhance color	
Tomatoes	colors, more beta-carotene, longer shelf life for processing	thicker-skinned fruit (plant breeding), mechanical harvesting machine that sees color
Peaches	new cold tolerant varieties	
Pears	pest resistance	
Watermelon	disease resistant, improved sweet taste	
Berries	extend the growing season, flavor, thornless varieties	
Peanuts	lower the fat, but maintain flavor	
Cayenne Pepper	increase the heat by 20%	
Bread/Wheat	changes in gluten, protein; ability to make sour dough anywhere with the identified bacteria; insect resistance	GPS/GIS technology, combine harvesting
Oranges/Citrus	higher yielding trees, increased disease resistance, better color, longer shelf life, freezing technology	picking machine, sensors for ripe fruit
Cheese	low-fat cheeses	
Milk	Lactose-free milk bacteria that produces an enzyme that breaks down milk sugar	
Grapes	seedless varieties, disease resistance, packaging technology	mechanized grape moving and picking
Potatoes	disease resistance, low-fat frying potato	
Rice	doubled the shelf life, rice flour to make bread and reduce oil absorption	GPS/GIS technology, combine harvesting
Poultry	turkeys bred to have more meat, disease resistance	
Beef	disease prevention, breeding programs for tender, low-fat, flavorful meat	
Oats	reduce cholesterol research	
Corn	enhance “corn flavor” in tortillas, corn starch, fat replacer,	
Soybeans	used as a substitute product in lipstick, plastics, flooring, paints, ink, cleaners, etc.	
Diapers	cornstarch-based moisture absorber, Super Slurper	
Cotton		cotton picking machine
Sugar Beets		lifter harvester
Walnuts	stronger trees developed through plant breeding	tree shaker
Olives	better canning methods	tree shaker
Lettuce		lettuce harvester for boxing, precision packing

Agricultural Science and Technology Worksheet

What scientific changes do we think have been applied to the development of the product we have been assigned?

Agricultural Product	**Actual scientific changes applied to the development of the product** *"Science in Your Shopping Cart" (video)*	**Harvesting Technology** *"Modern Marvels: Harvesting Technology" (video)*
Apples		
Carrots		
Tomatoes		
Peaches		
Pears		
Watermelon		
Berries		
Peanuts		
Cayenne Pepper		
Bread/Wheat		
Oranges/Citrus		
Cheese		

over...

Agricultural Product	**Actual scientific changes applied to the development of the product** *"Science in Your Shopping Cart" (video)*	**Harvesting Technology** *"Modern Marvels: Harvesting Technology" (video)*
Milk		
Grapes		
Potatoes		
Rice		
Poultry		
Beef		
Oats		
Corn		
Soybeans		
Diapers		
*		
*		
*		
*		
*		

** other food products shown in "Modern Marvels: Harvesting Technology"*