Agriculture and Biotechnologies

Foundations of Technology (ITEA 15)

Outcomes

In this lesson you will learn:

- Agriculture includes a combination of businesses that use a wide array of products and systems to produce, process, and distribute food, fiber, fuel, chemical, and other useful products (ITEA 15-K)

- Biotechnology has applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering (ITEA 15-L)

- Conservation is the process of controlling soil erosion, reducing sediment in waterways, conserving water, and improving water quality. (ITEA 15-M)

- The engineering design and management of agriculture systems require knowledge of artificial ecosystems and the effects of technological development on flora and fauna. (ITEA 15-N)

Agribusiness

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Agriculture

When most people think of agriculture, they picture farmers in the field, producing animals and crops. Agriculture is often thought of as "cows, sows, and plows" or "weeds, seeds, and feeds." This may be a depiction of how agriculture used to be in the past, but times have changed. Today, most agriculture is seen as a technology based industry that includes production, agriscience, and agribusiness.

Agriculture is people using materials, information, and machines to produce food and natural fibers. It takes place on farms and ranches around the world.

Beautiful California Farmland.

Agriculture Industry

Agricultural literacy is important to everyone because it is very much a part of our daily lives. It is in the food we eat, the clothes we wear, and the houses of which we stay. These things come directly or indirectly (after further processing) from agriculture. It is a worldwide industry and the largest industry in the United States!

The Unites States uses more than 40 percent of its total land for farming activities. A total of about 350,000,000 acres are used for crop production. About half of this land is used for raising wheat and corn. Another billion acres is used for pastures, ranges, and forests.

The agribusiness industry accounts for nearly one-fifth of the US gross national product and employs close to one-fourth of the US labor force. There is a continuing strong demand by agribusiness firms, ranging from large multinational corporations to emerging food manufacturing and input supply firms, for more and better employees trained in both management and the agricultural sciences.

Agribusiness

Agribusiness encompasses the sum of all activities that occur in farm production, farm resource supply, manufacturing, processing, storage, distribution, wholesale and retail sales of plant and animal food, natural fiber, medicinal plants and animals, forestry, horticulture and aqua cultural products.

Agribusiness comes into play at every stage in the food chain, from primary production, to the packaging of your favorite snack food. It must respond to advances in technology, major changes in trade and policy and to an ever-changing, consumer-driven marketplace.

Crops (e.g., cotton, wheat, tobacco, and grains) and livestock (e.g., cattle, sheep, and poultry) are bought and sold by individuals, corporations, and financial institutions. Local, state, and federal governments regulate the marketing and safety of agriculture products and systems.

Agribusiness is large-scale industrial style farming, often carried out by multinational corporations; together with the industries that are related to large-scale farming.
For example, the corporations that manufacture pesticides and fertilizers — the agro-chemicals industry.

Science supports agriculture

Modern farming uses both scientific and technological knowledge. Two important branches of life sciences support agriculture. These areas are plant science and animal science. They are used in cross-pollinating plants to improve crops and in crossbreeding animals to improve livestock.

Other sciences help farms manage their operations. For example, the science of weather allows farmers to plan planting and harvesting activities. The sciences that describe the seasons allow farmers to select appropriate crops and livestock to raise. Knowledge of plant nutrients allows them to select appropriate fertilizers. These and other sciences have helped farmers become more efficient.

Technology and Agriculture

Technological advances have also caused many massive changes in farming. For example, they have caused changes in the size of farms and how farmers go about their work.

New and modern machines and equipment allow for greater production. Fewer are needed to grow more food on fewer acres. Technological advances have helped people work with greater ease and efficiency. These advances can be attributed to agricultural technology. This technology uses technical means (machines and equipment) to help plant, grow, and harvest crops and raise livestock.

Technological advancements have greatly changed agriculture.

Biotechnology

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Biotechnology

People have used scientific activities to improve plants and animals for hundreds of years. They have used selective breeding of livestock and cross-pollination of plants to create new or improved plants and animals. In recent history, technology has also been used for this goal. This technology is called ***biotechnology***.

Biotechnology is used in selective breeding of livestock and cross-pollination of plants to create new or improved plants and animals.

Biotechnology has applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering.

Biotechnology

But what is biotechnology? Biotechnology can be defined as using biological agents in processes to produce goods or services. The biological agents are generally microorganisms (very small living things), enzymes (a special group of proteins), or animal and plant cells.

They are used as a catalyst in the selected process. The word ***catalyst*** means they are used to cause a reaction. The catalyst, however, does not enter into the reaction itself.

Biotechnology throughout history

The term biotechnology is fairly new. The practice, however, can be traced back into distant history. Evidence suggests that the Babylonians used biotechnology to brew beer as early as 6000 B.C. As far back as 4000 B.C., the Egyptians used biotechnology to produce bread.

During World War I scientists used an additive to change the output of a yeast fermentation process. The result was glycerol instead of ethanol. The glycerol was a basic input to explosives manufacturing. During World War II, scientists used the fermentation process to produce ***antibiotics*** (anti-bodies).

Biotechnology in Agriculture

Today biotechnology has a major impact on modern agriculture. Agricultural biotechnology is being used to create, improve, or modify plants, animals, and microorganisms. It is being used to produce new pest-resistant and chemical-tolerant crops. This is done through a process called ***genetic engineering***.

These new crops have helped combat disease. For example, golden rice was developed using genetic engineering. This new rice provides infants in developing countries with beta-carotene to fight blindness.

Biotechnology is a major factor in increasing crop yields. It has helped produce more food on the same number of acres. For example, biotechnology has been used to produce soybeans that are resistant to certain herbicides. Also, it has been used to develop a cotton plant that is resistant to major pests.

Rice field

Soybeans

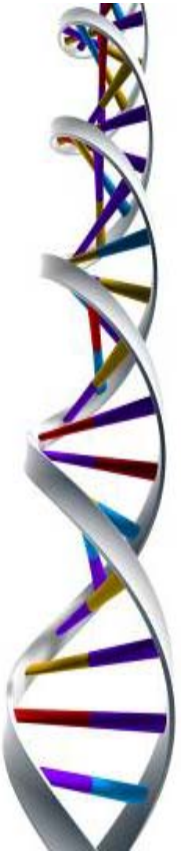
Gene Splicing

Genetic engineering is based on the fact that every living thing carries a genetic code (blueprint) that determines precisely the traits it will have.

The DNA molecule may be considered a set of plans for living organisms. It carries the genetic code that determines the traits of living organisms.

Scientists can use enzymes to cut the DNA chain cleanly at any point. The enzyme selected will determine where the chain is cut. Then two desirable parts can be spliced back together. This produces an organism with a new set of traits. The process is often called ***gene splicing***.

This process allows scientists to “engineer” plants that have specific characteristics. For example, resistance to specific diseases can be engineered into the plant. This could reduce the need for pesticides to control insect damage to crops.



DNA

Controversy

This activity has received many headlines in newspapers and magazines. It is controversial. Some people think it will make life better. Other think that we should not change the genetic structure of living things.

Friedrich Miescher isolated a substance called nuclein (now known as DNA) in 1896. In the 1970s, technology was developed that allowed researchers to isolate and alter individual genes. Later in the decade, researchers used recombinant DNA techniques to create insulin and interferon-producing bacteria.

In 1982, insulin produced by this technique became the first genetically engineered drug approved for human use. In 1986, the first U.S. patent for a genetically engineered plant was issued for a strain of corn that was engineered for increased nutritional value.

Conserving Our Environment

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Conservation

Conservation is the wise use of natural resources (nutrients, minerals, water, plants, animals, energy, etc.). Conservation is a planned action or non-action to preserve or protect living and non-living resources. Conservation is the process of controlling soil erosion, reducing sediment in waterways, conserving water, and improving water quality.

There is a continuing debate over land use in the United States. On one side are those who want land kept in a wilderness state. On the other side are people who want more land for lumber or agriculture production.

Conserving Our Environment

Open space, clean air, land for a home or farm, and safe drinking water were once viewed as a birthright for people in the United States. We simply expected them to be available. Today, we know better. We have discovered that unwise use of technology can threaten our quality of life.

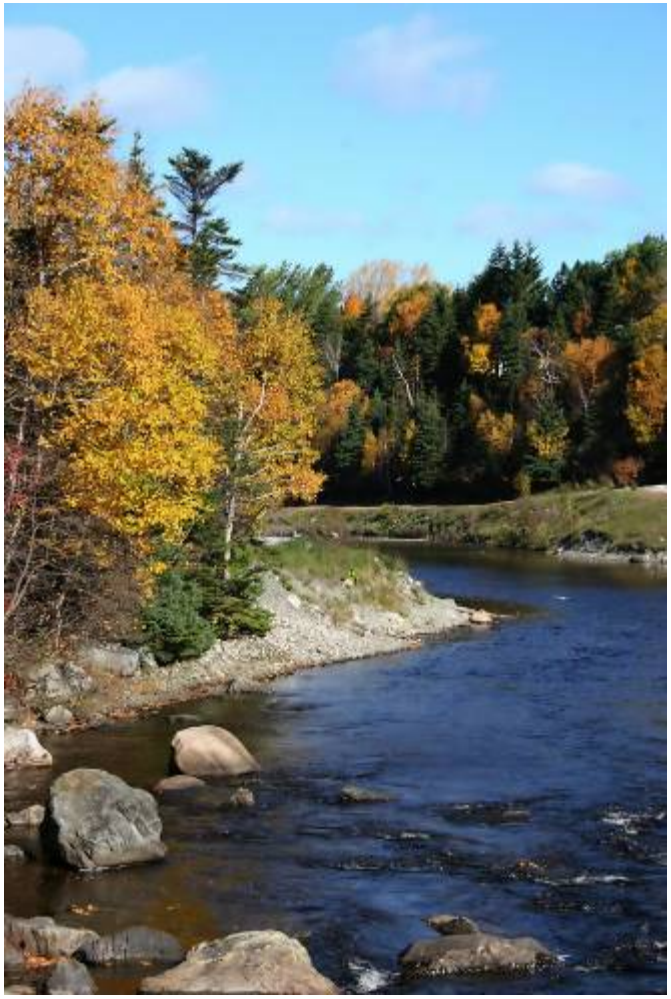
This understanding was slow to come. These issues have been brought into sharper focus in recent years. People have participated in what can be called an "environmental revolution." It has resulted in three basic principles:

1. The natural environment has a direct affect on the safety and health of people.
2. The long-term survival of any civilization is based on wisely managing natural resources.
3. A healthy natural environment is essential for human life.

Complex Relationship

The American people have had a complex relationship with nature. On the one hand, we have exploited the nation's natural resources with devastating speed -- clearing forests, damming rivers, killing wildlife, fouling the air and water with pollutants.

On the other hand, we have taken pride in the extraordinary beauty of our country. For more than a century, many Americans also have fought to protect the environment.



Conservation Methods

1. **By law -** Giving protection to animals and plant species or special areas of land or water
2. **Restoration** - To restore countryside areas of unsightly junk and other debris
3. **Alternative Energy -** A need to find alternative resources to replace coal and oil and other natural resources
4. **Nature Reserves and Zoos -** Of special value in preserving rare animal species
5. **Recycling -** Reprocessing of unwanted products such as newspapers, scrap metals, glass and plastic
6. **Education -** Making more people aware of the need to protect and preserve the environment through school environmental programs, youth organizations, and the media

Artificial Ecosystems

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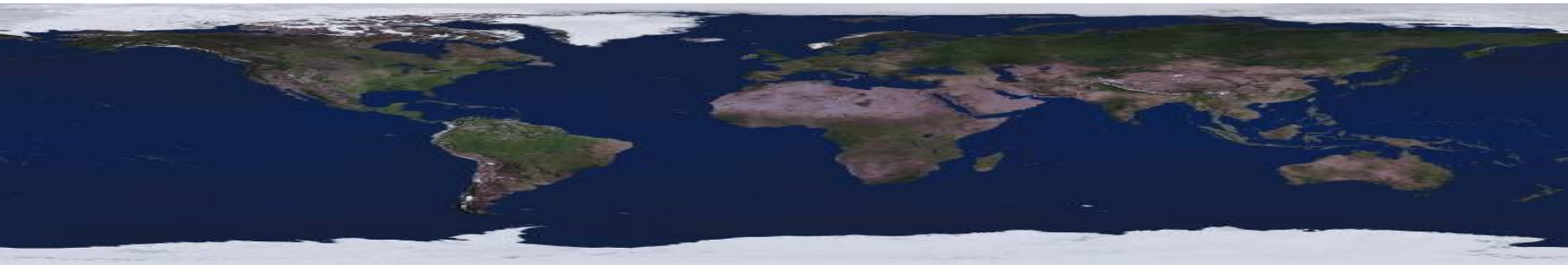
Natural Ecosystems

The whole earth's surface can be described by a series of interconnected ecosystems. All living beings form and are part of ecosystems.

Everything in the natural world is connected. An **ecosystem** is a community of living and non-living things that work together. Ecosystems have no particular size. An ecosystem can be as large as a desert or a lake or as small as a tree or a puddle.



Artificial Ecosystems

Artificial ecosystems are human-made complexes reproducing some facets of the natural environment. They can be used to study agricultural processes and systems as they would be useful to biological ecosystems.

Some examples of artificial ecosystems are terrariums and hydroponics. They function as part of a larger closed system supporting living organisms. A terrarium is used to nurture plant and or animal life in an enclosed environment. It acts as a complete habitat using all the systems of life, such as food, water, shelter, and space.

Terrariums can be used for decoration and enjoyment, but they can also be used to study the ways in which the elements of an ecosystem depend on one another.

Some greenhouses can be considered large-scale terrariums, and they can be used to grow plants and animals in areas differing from their natural habitats.

Hydroponics

- A hydroponics station is used to grow plants without soil. Similar to terrariums, these stations are controlled environments supplying the light, humidity, food, and water the plants needs for growth.
- Hydroponics is an alternative to traditional agriculture for farmers in areas with poor soil. Using hydroponics stations, farmers can grow vegetables and other plants in the middle of a desert or in an alley in a crowded city.

Managing the Ecosystem

Managing an artificial ecosystem entails collecting facts to plan, organize, and control processes, products, and systems. Operating such a system necessitates absolute control and cultivation.

Temperature, nutrients, light, water, air, circulation, waste recycling, and monitoring of insects all require management in order for the hydroponics system to function well.

Summary

- Agribusiness encompasses the sum of all activities that occur in farm production
- Agriculture is a major user of biotechnology processes
- Biotechnology is used to produce new strains of crops and drugs
- Biotechnology is being used to create, improve, or modify plants, animals, and microorganisms, to produce new pest-resistant and chemical-tolerant crops
- Conservation is a planned action or non-action to preserve or protect living and non-living resources
- The natural environment has a direct affect on the safety and health of people
- Protecting the environment involves studying the relationship between human population and the use of technology
- Natural agriculture environments can be recreated artificially
- Artificial ecosystems may be used for enjoyment or for educational purposes
- Terrariums and hydroponics stations are the most common types of these artificial ecosystem