

SUGGESTED REFERENCES

- Website with information about careers in agriculture
<http://www.florida-agriculture.com/consumers/careers.htm>
- Sustainable Agriculture Research and Education
www.sare.org
- Union of Concerned Scientists – Food and Agriculture
http://www.ucsusa.org/food_and_agriculture/
- U.S. Food and Drug Administration
Genetic Engineering: The Future of Foods?
http://www.fda.gov/fdac/features/2003/603_food.html
- United States Department of Agriculture
www.usda.gov

NATIONAL SCIENCE EDUCATION STANDARDS

Grades K - 4, 5 - 8

Science & Technology

Abilities of technological design
Understandings about science & technology

Grades 5 - 8

Science in Personal & Social Perspectives

Populations, resources, & environments
Science & technology in society

*Source: National Science Education Standards, 1996, National Academy Press

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VOLUME 21 ISSUE 1

AGRICULTURE - Farming Today & Tomorrow

SYNOPSIS

Many technological advances have helped in the agricultural sciences since the industrial revolution. But these sciences will demand extensive growth as the global population increases.

Farmers rely on techniques such as crop rotation, cover crops, soil enrichment, and pest management to enhance their yields. Genetic engineering has provided us with crops that can endure less than perfect growing conditions. Some are engineered to withstand stress from harsh environments such as arid lands, cold temperatures, and low nutrient levels. A variety of fruits and vegetables are altered to contain more vitamins and nutrients.

Using geospatial technology, farmers are taking advantage of global positioning systems and related software to navigate field equipment and make herbicide application, fertilizer, and irrigation more efficient and accurate.



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www.abet.org



Presidential Awards
for Excellence in
Mathematics
and
Science Teaching



CILC
Center for Interactive
Learning and Collaboration
www.cilc.org



Junior Engineering
Technical Society
www.jets.org

CURRICULUM UNITS

- AGRICULTURE
- BIOLOGY
- BIOTECHNOLOGY
- ECOLOGY
- ENVIRONMENTAL SCIENCE
- GENETICS

RUNNING TIME

15 minutes

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BACKGROUND

Agricultural resources exist in all of our lives in some way – From the clothes we wear to the food we eat. It is a market that demands extensive growth as the world population is increasing rapidly. We must find ways to produce food to sustain healthy lives without degrading the life support system of our local ecosystems.

Crop rotation is customarily used by farmers in an attempt to limit colonies of pests by interrupting their reproductive cycles. Crop rotation can reduce the need for chemical fertilizers as it replenishes nutrients and deters weeds.

Cover crops are important because they prevent soil erosion, suppress weeds, and improve soil quality. Cover crops are able to increase organic matter levels with biomass over time. The use of leguminous cover crops between crop seasons adds nitrogen to the soil, which is a very important plant nutrient. They can also prevent wind and water erosion.

Soil enrichment techniques such as organic fertilizers can improve soil quality. Animal waste, living plants, and compost can improve soil quality by adding important nutrients like nitrogen and phosphorus. These techniques also increase water retention capabilities of the soil.

Genetic engineering is a complex process that transfers desirable genes into the genetic material of another organism. Genetic makeup is altered through a process called recombinant DNA or gene splicing. Genetically altered foods are commonly referred to as biotech or bioengineered. The first genetically modified whole product was a tomato in 1994. The new tomato was shipped vine ripened and would rot slower than the non-genetically altered counterparts. Since that first tomato, over 50 other genetically engineered foods have passed all safety requirements of the Food and Drug Administration.

In 2008 the United States led the world in genetically modified crops with 62.5 million hectares. The U.S. Department of Agriculture reports that 86 percent of the land used for cotton growing was planted with genetically modified varieties, along with 80 percent of corn and 92 percent of soybeans. Worldwide, over 2 billion acres are dedicated to all biotech crop land use.

We have reduced insecticide application by over 360,000 metric tons while reducing greenhouse gas emissions with reduced fuel usage by improving crop traits with biotechnology. There are over 13 million farmers in over 25 countries planting biotech crops.

Geospatial technology has revolutionized agricultural practices. Farmers are finding good use for global positioning systems, or GPS devices. They are able to map their fields with precision and detail, track harvest records, and direct field equipment easier. With the ability to guide application vehicles, GPS devices working closely with agricultural software applications reduce overlap and improve accuracy of herbicide application, fertilizer, and irrigation.

CRITICAL THINKING EXERCISES

1. Examine the traditional method of agriculture, and how geospatial technology has changed the industry. Predict what changes may occur in the future.
2. List the most important factors in agricultural sustainability. Judge which factors are more important depending on specific environments?
3. Support the continued study of genetically engineered plant products, including a plan for the future of genetic engineering in agriculture.
4. Research the history of agriculture in regard to regions that previously flourished and are now deserts. Examine the current sustainability practices as a method to prevent the loss of agricultural land.

CAREER POSSIBILITIES

- BIOLOGIST
- ENVIRONMENTALIST
- ENGINEER
- FARMER
- GENETICIST
- PLANT PATHOLOGIST
- SOIL SCIENTIST

ADVANCED ORGANIZERS

Prior to viewing this program, students should have some understanding of the following Benchmarks for Science Literacy, Oxford University Press which are excerpted and, in some cases, abbreviated below. Refer to the Benchmarks for more information.

Benchmark 3. The Nature of Technology Section A: Technology & Science, Grades 3-5

- Throughout all of history, people everywhere have invented and used tools. Most tools of today are different from those of the past but many are modifications of very ancient tools.

Section C: Issues in Technology, Grades 3-5

- Factors such as cost, safety, appearance, environmental impact, and what will happen if the solution fails must be considered in technological design.

Grades 6-8

- Technology is largely responsible for the great revolutions in agriculture, manufacturing, sanitation and medicine, warfare, transportation, information processing, and communications that have radically changed how people live and work

Benchmark 5. The Living Environment Section D: Interdependence of Life, Grades 3-5

- For any particular environment, some kinds of plants and animals thrive, some do not live as well, and some do not survive at all.
- Insects and various other organisms depend on dead plant and animal material for food.
- Many plants depend on animals for carrying their pollen to other plants or for dispersing their seeds.
- Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful.
- Most microorganisms do not cause disease, and many are beneficial.

**Benchmarks can be found at www.project2061.org/tools/benchol/bolintro.htm*

VOCABULARY

- Biomass** The amount of living matter in a given habitat.
- Compost** A variety of decaying organic substances, such as dead leaves or manure, used for fertilizing soil.
- Cover Crops** A crop, usually a legume, planted to keep nutrients from leaching, soil from eroding, and land from weeding over, as during particular seasons.
- Crop Rotation** The system of alternating successive crops in a definite order on the same ground, especially to avoid depleting the soil and to control weeds, diseases, and pests.
- Gene Silencing** Interruption or suppression of the expression of a gene at transcriptional or translational levels.
- Genetic Engineering** The development and application of scientific methods, procedures, and technologies that directly manipulate genetic material in order to alter the hereditary traits of a cell, organism, or population.
- Geospatial Technology** . . . Systems used for visualization, measurement, and analysis of specific features that occur on the earth.
- Global Positioning System** A system of navigational satellites that provide precise positional and velocity data and global time synchronization for air, sea, and land travel.
- Hybrids** The offspring of two plants of different breeds, varieties, species, or genera, especially as produced through human manipulation for specific genetic characteristics.
- Leguminous** Any of a large number of eudicot plants belonging to the family Leguminosae with the characteristic fruit of a seed pod. Legumes live in a symbiotic relationship with bacteria in structures called nodules on their roots. These bacteria take nitrogen from the air and convert it into compounds that the plants can use. Many legumes are cultivated for improving the nitrogen content of soils.
- Nanotechnology** The branch of technology devoted to producing devices on an atomic scale. The working part of a typical nanotechnology device might be only a few thousand atoms in width.