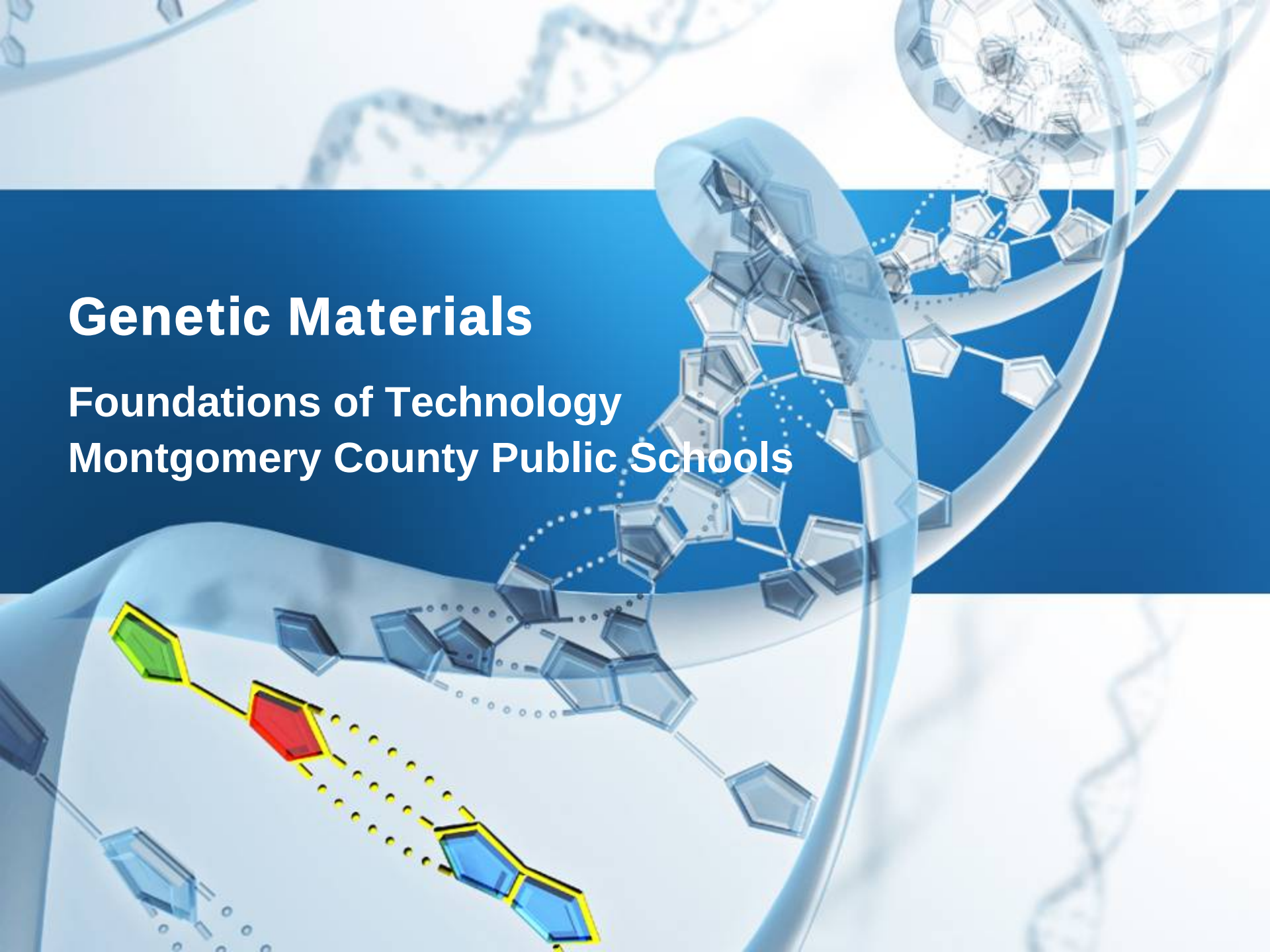


Genetic Materials

Foundations of Technology
Montgomery County Public Schools

Objectives

In this lesson, you will learn…

- The science of biochemistry and molecular biology have made it possible to manipulate the genetic information found in living creatures (ITEA 14-M)

Genetic Materials

This presentation will explore genetic materials and how plants and animal species are altered using genetic engineering.

You have learned that technology involves people designing and using tools and artifacts. This action extends human abilities to control or modify the environment. When no object or technical means exists, no technology is present.

All technological objects (human-made objects, called artifacts) are made of materials. The materials that each object is made from can be traced back to one or more natural resources. For example, plastic materials are made from plant fiber (cellulose) or natural gas.

Organic Materials

Many resources come from living things. These resources are called organic materials. Some organic materials are from organisms that have been dead for hundreds of years.

Genetic Materials

Other organic materials are obtained during the normal life cycle of plants and animals. These materials may be called genetic materials. We obtain genetic materials through three activities: farming, fishing, and forestry. Each of these activities works directly with nature as plants and animals move through the stages of life.

Typical genetic materials used in the production systems are grains (wheat, oats, barley, and corn, for example), vegetable fibers (wood, flax, and cotton, for example), and animals or fish (meat, hides, and wool, for example).

The origin of all genetic materials is in birth or germination. The appearance of animal life is called birth. Plant life generally starts with the germination of seeds or spores.

Finding Genetic Materials

Most genetic materials are easy to find. Trees and farm crops are on easily used plots of land. Domesticated animals and fish raised on fish farms are contained in specific locations. Only those who fish commercially must seek genetic resources that are sometimes hard to find.

The major challenge for people dealing with genetic resources is to harvest the plant or animal at the proper stage of growth. This stage will vary with the growth cycle and growing habits or organisms.

Genetic Generations

Improvements have been made in animals and plants over hundreds of years. For example, a farmer wants to increase his yield of soybeans. The farmer would crossbreed plants with the highest yield with another variety of the same species that had a resistance to a particular problem, such as drought.

This method, however, takes generations to produce results, and there is no guarantee of success. Today, hardier plants and animals are possible in a single generation through genetic engineering.

Genetic Materials

Genetic engineering is a technology used to alter the genetic material of living cells. Cells are the basic units of all living organisms. Inside a cell is a nucleus, which contains the hereditary information, or genetic material, of a cell.

This genetic material may determine whether a person is tall or short, whether a cow can produce more or less milk, and whether a plant can withstand drought.

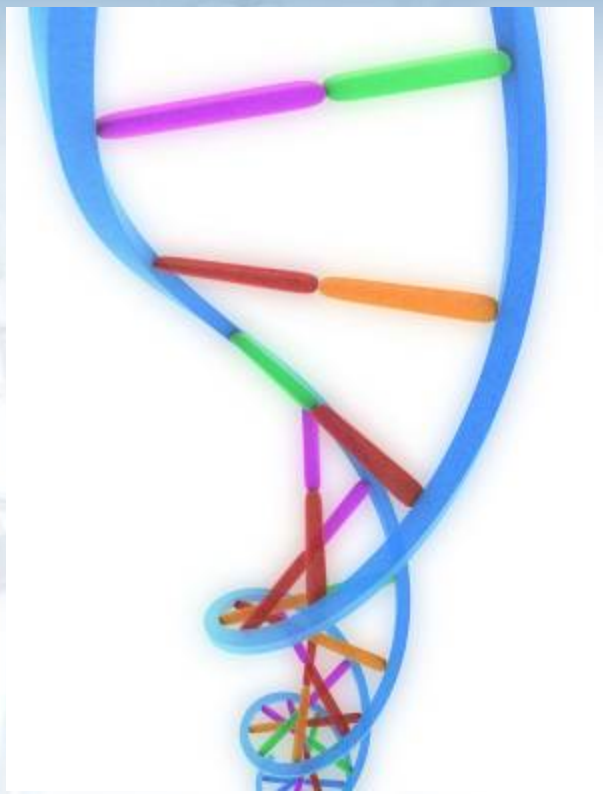
Genetic Resources

Steel and fossil fuels were the resources of the last century. Genes are the resource materials of the twenty-first century. Every living thing, from the smallest beetle to the tallest oak tree, has a set of genes, which we call a genetic code. This code determines precisely what traits it will have.

DNA

Strands of DNA are the basic building blocks of life. The discovery of DNA opened the way for a more precise understanding of how living things work.

When we discuss the topic of genetics we are talking about biotechnology. Simply stated, biotechnology is the use of living organisms to develop and improve foods, medicines, and other products. The modern age of biotechnology started in 1953 when James Watson and Francis Crick announced the discovery of the structure DNA, which stands for deoxyribonucleic acid.



DNA Model

Transgenic Materials

Scientist and technologists started to take the basic blocks of living creatures apart and to put them back together in new and, possibly improved ways. In this way, thousands of these transgenic-plants, animals, bacteria, and viruses could become part of the earth’s ecosystem.

Transgenic engineering refers to plants and other organisms that have been changed by adding genetic material from another species. This is usually done to increase a plant's resistance to disease or to increase its productivity. Transgenic crops have been genetically engineered.

Example: Transgenic Engineering

For example, do a quick search on the Internet for the Enviropig™ to get an example of transgenic engineering of this animal. Manure from normal pigs can pollute rivers and lakes because of its high phosphorus content. Phosphorous increases the amount of algae in water.

Algae rob fish and other organisms of oxygen. That is why reducing pig pollution is very important. Using genes from other organisms, the Enviropig™ processes feed more efficiently. This reduces phosphorous in its manure, and water supplies are protected.

Example: Super Rice

A second example is genetically enhanced “super rice” being used in China. The project involves speeding up the growth of existing hybrid rice by inserting a gene from the corn plant.

A certain gene from the wing-bean is also added to the rice through transgenic engineering in order to improve resistance to stress resulting from severe weather conditions. Transgenic crops are also known as genetically modified crops (GMC).

Transgenic engineered crops or genetically modified crops are increasingly popular in Argentina, Canada, China, Mexico, and the United States, where over half the crops such as soybean, corn, and canola are GMC.

Genetic Controversy

Herbicide-resistant crops and insect-resistant, transgenic crops are also popular worldwide. Within the near future, we may see vitamin-enhanced fruits and vegetables, allergen-free nuts, low-calorie bread, genetically decaffeinated coffee, and vaccine-enriched bananas.

These products will be introduced with some controversy. However, one of the best arguments for the development and use of biotech crops is that they will reduce the amount of insecticides used. Fewer insecticides mean less wasted time and energy in spraying, less risk of exposure to people, and less fuel used.

Genetic Control

There is concern about who controls the industries responsible for new biotechnologies. For example, the ten top agrochemical companies control over 80% of the global market. This has an effect on costs. Genetically modified seeds are more expensive than standard seeds.

Often the places that need the genetically altered seeds most are the ones that cannot afford them. With such changes taking place, it is natural that many people have concerns. These people understand that the altered life forms may be restricted to one area.

Genetic Modified Crops

But at the same time, people know that GMC could migrate to another area where there is little control over them. People are also questioning whether it is a good idea to reprogram the genetic codes of life and artificially create new life forms.

The potential for misuse of this information should compel society to establish ethical mandates for regulating the incidence of testing and the use of test results.

As a minimum, people would like to know that GMC are labeled so they have a choice. Labeling of foods would help to prevent allergic reactions, respect personal values and religious dietary requirements, and address concerns about environmental practices.

Summary

- The modern age of biotechnology started with the discovery of the structure DNA, which stands for deoxyribonucleic acid
- An important property of DNA is that it can replicate, or make copies of itself
- The DNA molecule consists of two strands coiled around each other called a “double helix”
- DNA is composed of the following three parts: phosphate, a sugar called deoxyribose, and four compounds called bases. The bases are adenine, guanine, thymine, and cytosine
- Genetic engineering is a technology used to alter the genetic material of living cells
- Every living thing has a genetic code, which determines precisely what traits it will have
- Biotechnology is the use of living organisms to develop and improve foods, medicines, and other products
- Transgenic engineering refers to plants and other organisms that have been changed by adding genetic material from another species
- Cells are the basic units of all living organisms
- Harvesting is gathering genetic materials (living materials) from the earth or bodies of water at the proper stage of their life cycle
- Genetic materials are obtained through three activities: farming, fishing, and forestry
- Genetic, or biological, material is a classification of natural resources that includes all substances that are developed by plants or animals