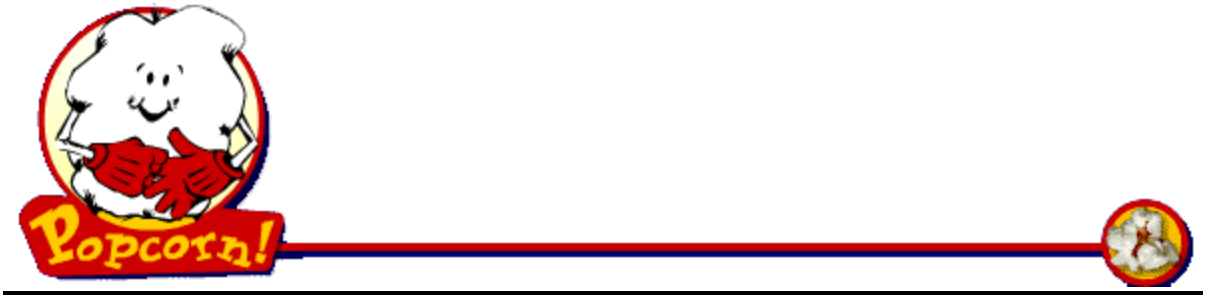

AGRICULTURAL SCIENCES

TITLE: Please Pass the Genes: How New Plants are Made, from Connecticut Agriculture in the Classroom (http://www.ctaitc.org)
SUBJECT: Science
GRADE LEVEL: 5-8. Various factors can be made more complicated for older students.
MATERIAL(S): Extension resource materials on cross-breeding and cross-pollination

OBJECTIVE(S): Students will understand how and why new varieties of plant and animal life are created. Cross-curricular Science and Language Arts opportunity.

OVERVIEW:
INTRODUCTION: Genetic engineering, while still controversial, offers possible solutions to food shortages and environmental problems. The applications are almost limitless. Research has been done to design plants that are resistant to disease, kill insects and debilitate certain weeds.

Plants may be engineered to be more nutritious, more responsive to fertilizers and easier to pack and transport.

BACKGROUND: Biotechnology is the development of products by manipulating natural biological processes. Intact organisms, such as yeast or bacteria, and natural substances from organisms, such as enzymes, may be used. Through biotechnology, living organisms are used to produce useful products. Scientific discoveries then are applied to new products to improve the quality of life.

Biotechnology may involve a technique called genetic engineering. Genetic engineering is a highly sophisticate method of cross-breeding and manipulation of plant and animal genes. Genes from one selected species are moved, with the help of a bacterial virus or plasmid, to another species. The selected traits are expressed in the offspring of the plant to which the genes were transferred.

For example, marigolds are naturally poisonous to some insects. By transferring to tomato plants the marigold genes which carry the codes for producing a substance poisonous to certain insects, scientists have eliminated the need to use certain insecticides on tomato plants.

The basics of cross-breeding were discovered by Gregor Mendel, an Austrian monk, in the 19th century. Mendel bred and crossbred thousands of garden pea plants, observing the characteristics of each successive generation. He was looking for a pattern in the inheritance of seven specific pairs of traits, including rounded or wrinkled seeds and tall or short plants. Mendel concluded that plant traits were handed down through hereditary elements we now call genes. If a plant inherited two different genes for one trait, one gene would be dominant and one recessive. Mendel published the results of his

research in 1886. Although scientists have some exceptions to his conclusions, most of Mendel's theories have been proven correct and now form the basis of our knowledge of genetics.

Some biotechnologists now use a process called tissue culture. In this technique, tiny slices of a given plant's tissue are grown in a sterile laboratory environment on a nutrient medium. This procedure allows the scientist to rapidly grow many genetically identical offspring from one plant.

Plant scientists at the Connecticut Agricultural Experiment Station pioneered work developing ornamental mountain laurel varieties using tissue culture. Mountain laurel, the Connecticut state flower, is an expensive, slow-growing plant which is difficult to propagate from seed, cuttings or other routine methods.

Tissue culture is currently being used most widely for propagating ornamental plants. Its advantages include time saved in growing a plant to market size, duplication of superior plants and economics.

There are many ways biotechnology is improving life and the standard of living for all people. Biotechnology is being used in the areas of human and animal health care, waste management, energy, chemicals and agriculture. Some current agricultural practices use inefficient technology. Biotechnology will result in improved, more efficient farming methods.

Agricultural use of biotechnology results in improved food production. Plant science developments have resulted in dramatic changes in farming practices. Some examples are:
· Disease resistant crops
· Plants that resist insect damage
· Crops that adapt to adverse conditions
· Plants that produce weed-controlling chemicals
· Plants that provide for their own fertilizer needs
· Food crops that are more nutritious
(For more information about the United States Department of Agriculture and biotechnology, visit http://www.usda.gov/agencies/biotech/)

Animal science developments will provide improved efficiency in the raising of livestock, including:
· Health care products that cure disease
· Products that improve the production of meat and milk
· Enhanced genetic potential of livestock through genetic engineering
· Managing animal wastes to reduce environmental ills

VOCABULARY: genes, genetics, DNA

PROCEDURE:
Students and teachers will discuss biotechnology—both the promise it holds for the future and some of the problems of manipulating natural processes. Students will begin this activity by writing a paragraph about their least favorite vegetable, called "What I Hate About _____." They will focus on texture, color, smell and appearance. They will follow with a paragraph on how they might genetically engineer the vegetable to make it more desirable, naming the new vegetable they create. Students then will design an ad for their new vegetable, introducing it to shoppers. The teacher will display the ads and essays on a bulletin board.

EXAMPLE: I hate spinach! It is slimy and blackish-green. It smells like grass and looks like seaweed. If I could change those green genes, I'd definitely go to work first on the taste. I'd want it to taste like a cross between peanuts and popcorn. Next, I'd change that slimy, gooshy texture. I'd give it the crunchy texture of lettuce. Then I'd change the color. A few beet genes would make it a nice red color. I'll call my new vegetable Scarlet Popach.