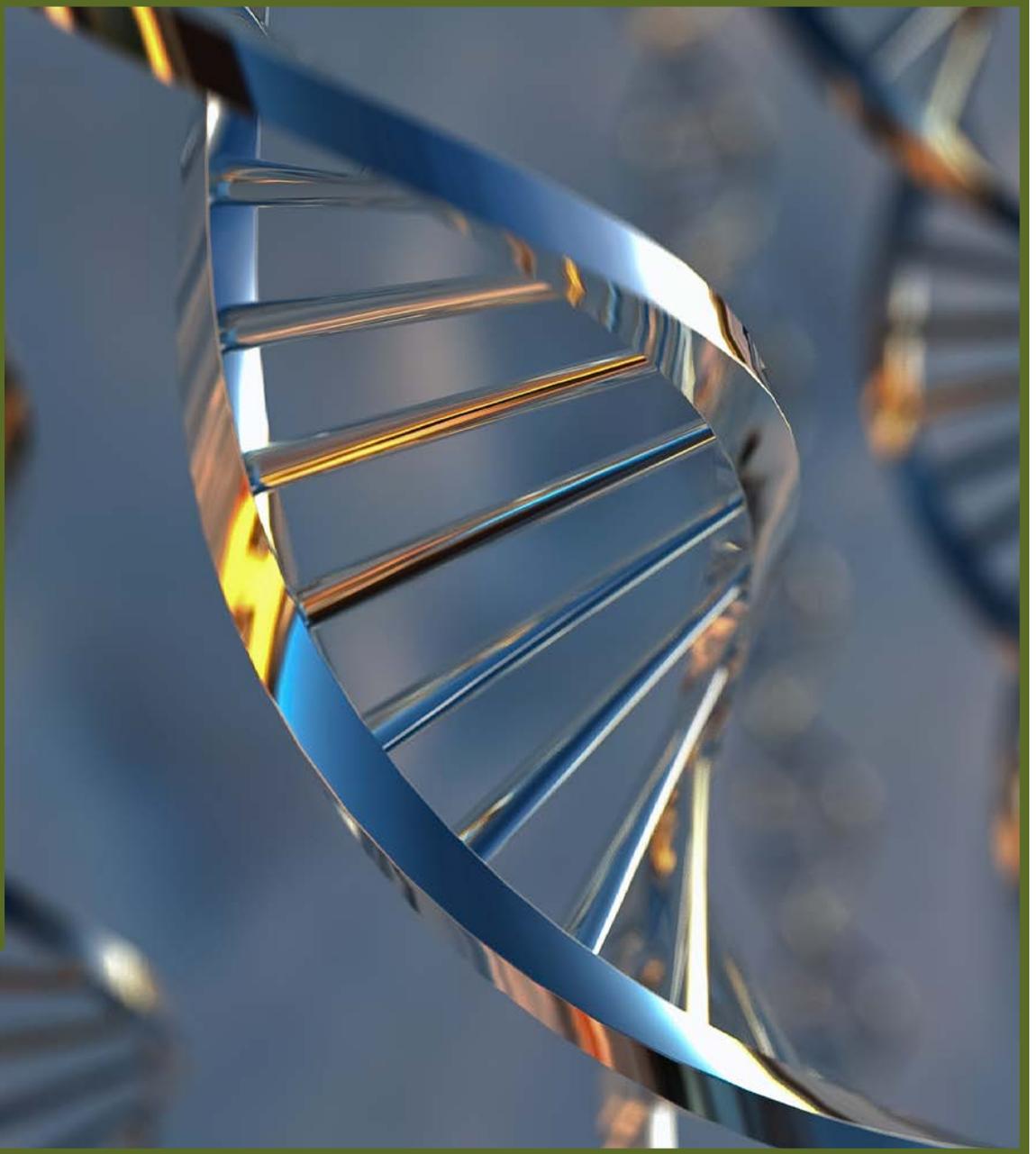


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High-Tech Harvest: Genetic Engineering and the Environment

California Education and the Environment Initiative

Approved by the California State Board of Education, 2010

The Education and the Environment Initiative Curriculum is a cooperative endeavor of the following entities:

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California Natural Resources Agency
California State Board of Education
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Key Partners:

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Key Unit Vocabulary

Lesson 1

Biofuel: An energy source derived from biomass, such as plants, or from metabolic byproducts, such as animal manure.

Biological diversity (biodiversity): A measure of the number of different species of organisms in a specific area, it is also used as a general description of species richness, ecosystem complexity, and genetic variation.

Biomedical: Referring to biological, medical, and physical sciences and related activities.

Bt gene: A gene inside bacterium, responsible for producing a toxin that kills common corn pests.

Components: The parts of something, such as a system.

Composition: The makeup of a system including the mixture of components and relative numbers of those components.

Cross-pollination: The transfer of pollen from the flower of one plant to flowers of a different plant.

Genetic contamination: The unintended transfer of genes from one population to another, in the case of genetic engineering (GE), from GE organisms to non-GE organisms.

Genetic engineering: The manipulation of genes within a species or the transfer of genes from one species to another using recombinant DNA technology.

Genetic resource: Naturally occurring genetic materials that can be used to modify the genetic makeup of an organism.

Ligase: An enzyme that can be used to join DNA segments together.

Marker gene: A gene that is inserted in a host organism for the purpose of determining if other genetic material has been successfully incorporated into host cells.

Microdiesel: A type of fuel produced by bacteria.

Monoculture: The cultivation of the same crop in the same field each year without any crop rotation.

Natural system: The interacting components, processes, and cycles within an environment, as well as the interactions among organisms and their environment.

Pharm crop: An agricultural crop that is genetically engineered to produce a pharmaceutical product, such as a vaccine or drug.

Pharmaceutical: A medicinal drug.

Plasmid: A circular or linear strand of bacterial DNA often used by genetic engineers as a carrier of DNA.

Recombinant DNA technology (rDNA): The manipulation of DNA segments in the laboratory to form “new” (transgenic) organisms.

Restriction enzyme: An enzyme that is used to cut DNA.

Selective breeding: The process of breeding specific individual animals or plants to augment one or more desired traits.

Stakeholders: Individuals, groups, or organizations that have an interest in, or concern about, a particular action or decision.

System: A group of interacting components, processes, and cycles that form a complex whole, such as natural systems, political systems, and economic systems.

Transformation: The genetic alteration of a cell resulting from the introduction, uptake, and expression of foreign DNA.

Transgenic organism: An animal, plant, or bacterium that contains DNA from another species, based on rDNA technology.

Vaccine: A medical preparation given to produce or increase immunity to a particular disease.

Viable: Capable of living, developing, or germinating under favorable conditions.

California Rice Pharming

Lesson 1

Name: _____

Instructions: Write a brief response to each of the questions below. (10 points each)

1. How is the genetically engineered rice described in **California Connections: Rice Pharming in California, Part 1: Russ Greenwald and Ventria Bioscience** different from and similar to other rice?

Different: _____

Similar: _____

2. Why do scientists/farmers want to alter the genetic makeup of rice?

3. What advantages does this rice have over traditional rice? What disadvantages might it have?

Advantages: _____

Disadvantages: _____

Influences of Genetically Engineered Products

Lesson 3

Name: _____

Instructions: Read the articles on **Bt Corn** and **Malaria-Resistant Mosquitoes**. Then complete the appropriate rows on the chart below by describing how each genetically engineered product might influence: natural systems, biological diversity, and human health. (2 points per cell)

Human Health		
Biological Diversity		
Natural Systems		
Genetically Engineered Product	Bt corn	Malaria-resistant mosquitoes

Going Beyond the Field

Lesson 4 | page 1 of 3

Name: _____

Instructions: As you listen to the group reports, complete the following table with information about how each of the genetically engineered products discussed today might influence: natural systems, biological diversity, and human health. (1 point per cell)

Human Health		
Biological Diversity		
Natural Systems		
Genetically Engineered Product	Biofuels	Toxic-avenger trees

Going Beyond the Field

Lesson 4 | page 2 of 3

Name: _____

Human Health		
Biological Diversity		
Natural Systems		
Genetically Engineered Product	Vaccines in food	Anthrax vaccine from tobacco

Name: _____

Human Health		
Biological Diversity		
Natural Systems		
Genetically Engineered Product	Animals	Golden rice

Genetically Engineered Rice in California

Lesson 5 | page 1 of 2

Name: _____

Instructions: After reading *California Connections: Rice Pharming in California, Part 2: From the “Flavr Savr” to the 2007 Rice Crop* (Student Edition, pages 21–22), complete the following tasks in the spaces provided.

1. Describe the current status of genetically engineered rice in California. (3 points)

2. Why did Ventria Bioscience move its pharming operations to Kansas? (3 points)

3. In general, how can genetically engineered rice affect natural systems? (3 points)

Genetically Engineered Rice in California

Lesson 5 | page 2 of 2

Name: _____

4. Explain the beneficial and detrimental effects that genetically engineered rice had, or could have on natural systems and human health.

Beneficial (2 points):

Detrimental (2 points):

Pulling It All Together: Spectrum of Factors

Lesson 6 | page 1 of 2

Name: _____

Instructions: As you hear from each of the groups in class, fill in the table below describing relevant factors that may influence decisions about each GE product.

Genetically Engineered Product: Biofuels	
Decision-making factors	Stakeholders

Genetically Engineered Product: Toxic Avenger Trees	
Decision-making factors	Stakeholders

Genetically Engineered Product: Vaccines in Food	
Decision-making factors	Stakeholders

Name: _____

Genetically Engineered Product: Anthrax Vaccine from Tobacco

Decision-making factors	Stakeholders

Genetically Engineered Product: Animals

Decision-making factors	Stakeholders

Genetically Engineered Product: Golden Rice

Decision-making factors	Stakeholders



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