

Teacher's Guide

Ag in the Classroom - Helping the Next Generation Understand Their Connection to Agriculture

Biotechnology

INTRODUCTION:

Biotechnology is being used to advance human health through improved crops and medicines.

In agriculture, advances in science have opened up new options for farmers responding to market needs and environmental challenges. Many new plant varieties being developed or grown by farmers have been produced using genetic engineering, which involves selecting the plant's genes through techniques of modern molecular biology often referred to as recombinant DNA technology. These techniques are included in what is often referred to as "biotechnology" or "modern biotechnology."

Three federal agencies are involved in ensuring that plants produced using biotechnology and the many products derived from them are safe for farmers to use, safe to consume as food or feed, and safe for the environment. These are USDA's Animal and Plant Health Inspection Service, the Department of Health and Human Services' Food and Drug Administration, and the United States Environmental Protection Agency. The three agencies regulate these products based on the characteristics of the actual products and their intended uses, and they operate under the existing laws passed by Congress to ensure the safety of plants used in agriculture, the safety of pesticides used in agriculture, and

the safety of foods we eat and feeds given to animals. Many other USDA agencies have roles in the development, use, and marketing of these products as well.

Since the first successful commercialization of a biotechnology-derived crop in the 1990s, many new crop varieties have been developed and made available to U.S. farmers and farmers worldwide. U.S. farmers have rapidly adopted many of these new GE varieties, so that in 2012, 88 percent of the corn, 94 percent of the cotton, and 93 percent of the soybeans planted in the U.S. were varieties produced through genetic engineering. A large proportion of the production of other crops, such as alfalfa, and papaya, and sugar beet, is also biotech-derived.

So why would a farmer decide to use GMO crops?

They make it easier for the farmers to control weeds and use less herbicides on their fields.

Some GMO crops can withstand drought conditions, which means farmers can use less water and still get a harvest at the end of the year.

Some GMO soybeans produce more oil, which means the farmers can get more money for their crop.

Some GMO crops can fight off insects, viruses and other diseases. This means the farmers don't have to spray chemicals to fight these pests.

Of course, some GMO crops just produce more, meaning more efficient use of land and water resources while producing more.

Additional Resources

Useful Websites

http://www.biology4kids.com/files/cell_main.html

<http://bio100.class.uic.edu/lectures-f04am/lect06.htm>

http://www.agfoundation.org/images/uploads/EG_Biotech_Final.pdf

<http://www.factsaboutgmos.org/>

<http://www.coloradocorn.com/education-outreach>

Biotech Lessons

http://agclassroom.org/colorado/matrix/lessonplan.cfm?lpid=197&search_term_lp=biotechnology

<http://agclassroom.org/colorado/matrix/lessonplan.cfm?lpid=330>

<http://agclassroom.org/colorado/matrix/lessonplan.cfm?lpid=332>

http://agclassroom.org/colorado/matrix/lessonplan.cfm?lpid=381&search_term_lp=biotechnology

Government Agencies

USDA nutritional information:

<http://www.usda.gov/wps/portal/usda/usdahome?navid=BIOTECH>

Other Resources

agclassroom.org

This is the national website for Agriculture in the Classroom programs from across the nation. A site search will bring up a variety of lessons, books, videos and links.

growingyourfuture.com - connects you to Colorado's Agriculture in the Classroom program. A variety of resources are available at this site including past Colorado Readers. Be sure to check out the new Matrix of agriculture and natural resource lessons.

Comments, questions, suggestions and feedback about the Colorado Reader are welcome.

Contact: Colorado Foundation for Agriculture

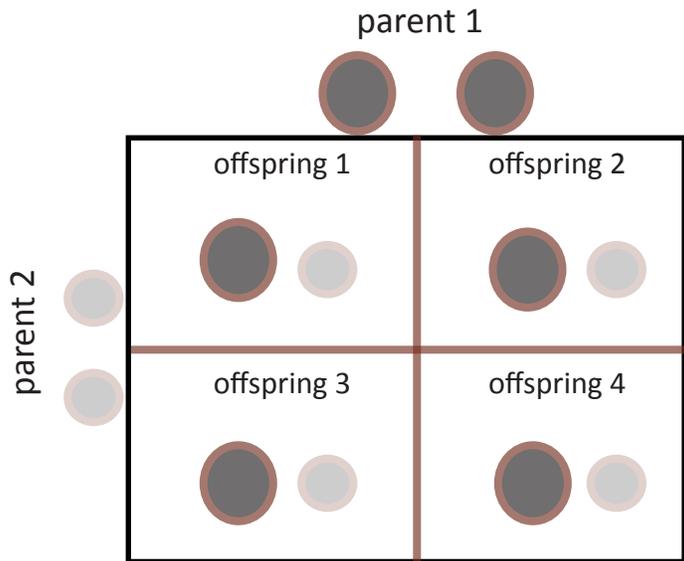
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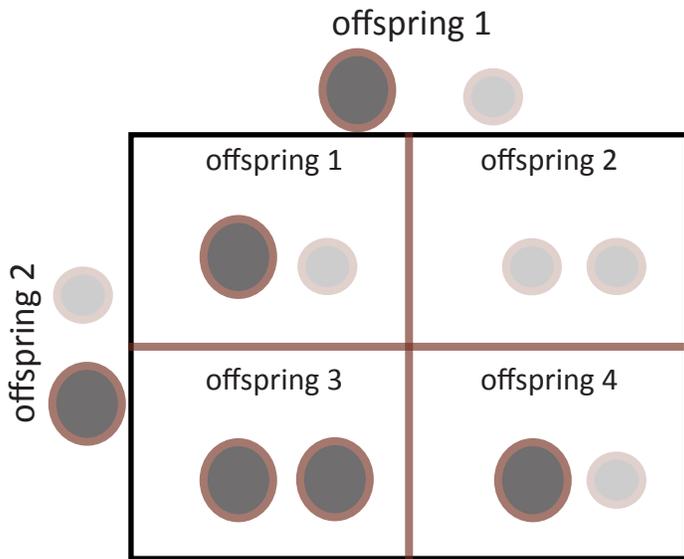
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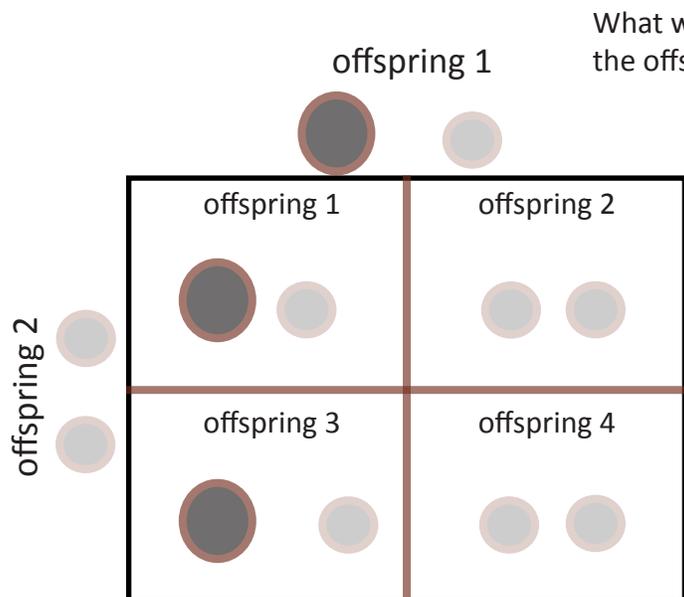
What will be the color of the offspring's seeds?

- offspring 1
 yellow
 green
- offspring 2
 yellow
 green
- offspring 3
 yellow
 green
- offspring 4
 yellow
 green



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Content Standards:

National Agricultural Literacy Outcomes (NALO):
 Science, Technology, Engineering & Mathematics Outcomes
 Science (3-5): Describe how technology helps farmers/ranchers increase their outputs (crop and livestock yields) with fewer inputs (less water, fertilizer, and land) while using the same amount of space; Identify examples of how the knowledge of inherited traits is applied to farmed plants and animals in order to meet specific objectives (i.e., increased yields, better nutrition, etc.); Provide examples of science being applied in farming for food, clothing, and shelter products.

Social Studies (6-8): Describe the process of development from hunting and gathering to farming; Identify specific technologies that have reduced labor in agriculture; Discuss how technology has changed over time to help farmers/ranchers provide more food to more people; Compare and contrast historical and current food processing and systems; Explain how and why agricultural innovation influenced modern economic systems.

Science (6-8): Provide examples of science and technology used in agricultural systems (e.g., GPS, artificial insemination, biotechnology, soil testing, ethanol production, etc.); explain how they meet our basic needs; and detail their social, economic, and environmental impacts; Explain the harmful and beneficial impacts of various organisms related to agricultural production and processing (e.g., harmful bacteria/beneficial bacteria, harmful/beneficial insects) and the technology developed to influence these organisms; Describe how biological processes influence and are leveraged in agricultural production and processing (e.g., photosynthesis, fermentation, cell division, heredity/genetics, nitrogen fixation)

Colorado Academic Standards: GLE.4.2010 / CCSS ELA-Literacy

Mathematics Standard 1. Number Sense, Properties and Operations

1. Different models and representations can be used to compare fractional parts.

CCSS.ELA-Literacy.CCRA.L.4: Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.

CCSS.ELA-Literacy.CCRA.R.1: Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

CCSS.ELA-Literacy.CCRI.R.1: Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.

CCSS.ELA-Literacy.CCRI.R.3: Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

CCSS.ELA-Literacy.CCRF.R3a: 3. Know and apply grade-level phonics and word analysis skills in decoding words. a. Use combined knowledge of all letter-sound correspondences, syllabication patterns, and morphology (e.g., roots and affixes) to read accurately unfamiliar multisyllabic words in context and out of context.

CCSS.ELA-Literacy.CCRF.R4: Read with sufficient accuracy and fluency to support comprehension

National Science Education Standards

Life Science Standards Level K-4; 5-8

Characteristics of organisms; Reproduction and heredity; Regulation and behavior; Populations and ecosystems; Diversity and adaptations of organisms.