Engorgio!

Subject Area(s) biology, chemistry, life science

Associated Unit

Lesson Title Engorgio!

Header Insert Image 1 here, centered

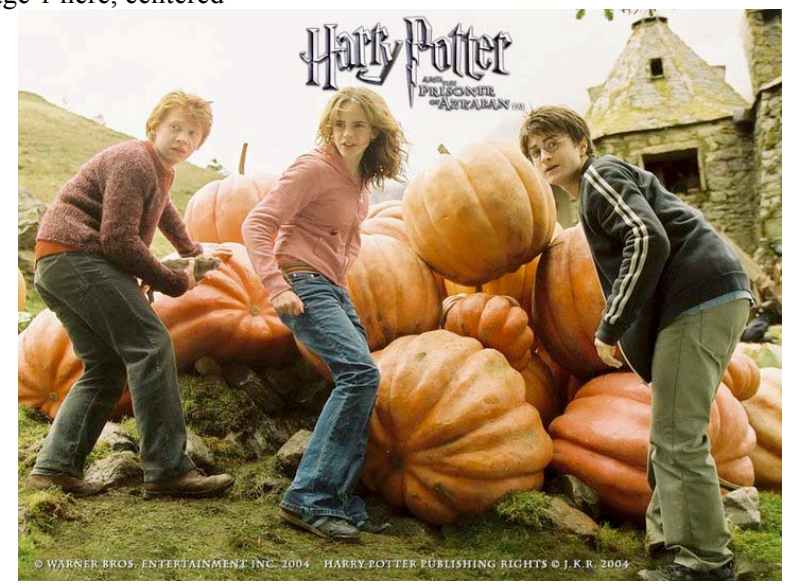

Image 1

ADA Description: Photograph of Harry, Hermione, and Ron with giant pumpkins

Caption: Bigger is better right?

Image file: large_pumpkins.jpg

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Grade Level 11 (9-12)

Lesson # 1 of 1

Lesson Dependency

Time Required **50 min**

Summary

The magic of the Harry Potter engorgement charm is explained by use of genetic engineering and modern fertilization and farming methods to enhance crop performance. The appeal and drawbacks of "organic" produce is described to allow students to make more informed decisions. The benefit of the advances in agricultural sciences and some of the consequences are explained.

Engineering Connection

Food engineering is vital to the performance of both animal and plant crops around the world. Without genetic manipulation and careful scientific study the population would not be able to be supported by the limited resources of the land.

Engineering Category = #1

Choose the category that best describes this lesson's amount/depth of engineering content:
1. Relating science and/or math concept(s) to engineering

Keywords
Crops, food engineering, genetics

Educational Standards
Choose from http://www.jesandco.org/asn/viewer/default.aspx.
ITEEA (provide standard number, grade band, benchmark letter and text):
State/national science/math/technology (provide source, year, number[s] and text):

Chapter 112. Texas Essential Knowledge and Skills for Science, Amended 2009 Subchapter C. High School 3 Biology (6) Science concepts. The student knows the mechanisms of genetics, including the role of nucleic acids and the principles of Mendelian Genetics. The student is expected to: (D) recognize that gene expression is a regulated process
ITEEA, Standard 15, Grades 9-12 L. Biotechnology has applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering.

Pre-Requisite Knowledge
None

Learning Objectives
After this lesson, students should be able to:
- Identify genetic traits that have been selected by humans for different crops
- List the benefits of genetic engineering in crops
- Compare and contrast "organic" products and genetically enhanced products

Introduction / Motivation
(Display a variety of organic foods, labeled "A", as well as non-organic foods, labeled "B", for students to see grouped separately). What can you tell me about the items you see in front of you? (possible answers: food, two groups) And what is the difference between the two separate groups of food? (answers will vary greatly depending upon the items for display) So which group looks better to you? What would you want in your lunchbox? (students should choose the non-organic food, but if not just ask why and lead them to the observations of the enhanced appearance of the non-organic food.) So we have decided we like the way group "B" looks better. Why do we choose food based on appearance? Isn't taste what really matters? (answers: size matters, if it looks bad it tastes bad) So what do you think causes these foods to look different? Are there any differences besides their looks? Could they have come off the same plant? If they come off different plants how would you make sure you got more "B" later? (students should be led to answer plant seeds from "B" plant) You have come up with the same ideas that the first human farmers came up with! We call the changing of animals or plants behaviors or appearance to suit our needs, domestication. The process of domesticating crops to get modern day fruits, vegetables, and grains was an experiment in genetics thousands of years in the works. This work still continues today not only by simply planting the seeds of desirable plants and discarding the unwanted, but also through genetic manipulation. Certain plants, like apples, are not grown from seed but by a process called grafting where a cutting from one tree is attached to the seedling of another causing the fruit to be identical to that of the original tree. Other modifications are done on the cellular level where the genes of one organism are incorporated into that of another. Genes are the way organisms pass down traits to their offspring. So what traits do we look for in a food item at the store? (write students' answers on the board: color, size, texture, taste, price) What is cheaper: a plant with or without all that genetic modification? All that work has to cost money right? But what traits do farmers look for in a crop? (answers: pest/disease resistance, drought tolerance, per acre yield) Can those traits be modified as well? Sure, we

find which traits or genes make plants resist bugs, or grow more fruit with less water. So what does that mean for a farmer growing genetically engineered plants? Which is cheaper for him? While the cost of the seed may be more because more work has been put into it, the reduced cost in maintenance of the crops as well as the increased yield make genetically engineered crops much more valuable. These crops can also be made to last longer after they have been picked, so instead of rotting on the shelves you can buy them and eat them fresh in your home long after their organic food relatives have been tossed in the garbage.

Lesson Background & Concepts for Teachers

Crops are modified in several ways by humans to enhance their usefulness. Earliest modifications were through domestication starting earlier than 10,000 BC, which were achieved by early humans selecting the most desirable plants of a species to reproduce (selective breeding). Humans have also used chemical treatment through fertilizers as well as pesticides, herbicides, and fungicides to improve production. The most recent modifications to plants have been through genetic engineering, or incorporating the genes of one organism into that of a food crop. Genetic modification has been used to enhance herbicide tolerance, insect and virus resistance, nutritional content, and durability for transportation.

All of these types of modifications except for domestication have come under scrutiny because of safety or ethical concerns. Public opinion is the greatest factor in determining the success of a food product. The trend toward organic products has caused certain genetic modifications to be abandoned due to public outcry. The benefits of genetic engineering have given rise to cheaper food and more crops per acre. Without continuing research to improve usage of the resources we are given, we could not continue to support the growing population of the earth. Organic production is a popular trend, but without the use of engineering the cost and space of production is just too great.

Vocabulary / Definitions

Word	Definition
Domestication	The process of taming a population by selection to be controlled by humans for their use.
Grafting	The asexual propagation of a plant by fusing the tissue of one plant to another to produce a clone of the desired plant.
Gene	A unit of heredity in a living organism.
Genetic engineering	Modification of an organism's genetic material in a way that does not occur under natural conditions like selective breeding.
Organic Food	Food that is free of chemical inputs (e.g. fertilizer, pesticides, antibiotics, food additives, etc.), genetically modified organisms, irradiation, and sewage sludge.

Associated Activities

The Benefits of Biodiversity Students can be introduced to the lack of genetic variation when genetic engineering is employed.

How Fast Can a Carrot Rot? Students can compare the decomposition rate of organic carrots vs those that have been grown with antifungal modifications

Lesson Closure

So how do we modify our crops? (Answer: selective breeding, chemical treatment, genetic engineering)
Why do we use all these things? (Answer: to improve resistances, to increase production, etc)

Genetic engineering has given us the tools to modify plants to our liking. There are consequences and benefits to these alterations. It is important to consider the consequences of using genetically modified foods compared to the benefits of organic, but not all consequences are what you can see. How we impact our environment is not often immediately evident. And the economic consequences of organic farming are no less important that how the food looks on the shelf.

Assessment

Pre-Lesson Assessment

Display a picture of the enlarged pumpkins from Harry Potter large pumpkins.jpg

Discussion Questions: Students answer questions individually in a journal or piece of paper.

• In Harry Potter, Hagrid uses magic to enlarge his pumpkins. How could you make a real pumpkin grow larger?

• How else would you change a pumpkin to make it better?

• What is “organic” food?

Post-Introduction Assessment

Short Answer: Students define key words and give and example of each in their journal

• Domestication

• Grafting

• Genetic Engineering

• Organic Food

Lesson Summary Assessment

Organic / Non-Organic brochure: Students make a visual aid to compare and contrast benefits and consequences of genetic engineering

Homework

Short Paragraph: Students find an example of a genetically modified food and write a short paragraph describing:

• What the modification is

• How it is better than the organic version

• What is a possible consequence of this modification

• How long it has been in production, and what percentage of the market is genetically modified

Additional Multimedia Support

PBS Documentary: The Botany of Desire

References

Genetically Modified Foods and Organisms. November 5, 2008. US Department of Energy. Accessed December 1, 2010. (source of the teacher background information with links to articles for more information) http://www.ornl.gov/sci/techresources/Human_Genome/elsi/gmfood.shtml

Genetically Modified Food. Dec 1, 2010. Wikipedia. Accessed Dec 2, 2010. (source of useful links and figures) http://en.wikipedia.org/wiki/Genetically_modified_food

Supporting Program

GK-12 Program, University of Houston

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