



Plant Breeding Grade 6-8 Lesson Plan

Grade: 6-8

Time: 90-120 minutes

NGSS Standards:

MS-LS4-5. Gather and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms.

Objective:

- Students will be able to understand basic gene editing.
- Students will investigate innovative ways scientists use gene editing to solve challenges in modern day farming practices.

Vocabulary:

gene editing: changing an attribute to improve a plant

biotechnology: combining technology and biology to improve a product

innovation: new idea or method

agriculture: growing food and/or raising animals on a farm

Materials:

Chromebooks
Pencils
Paper
T-chart Graphic Organizer worksheet
Presentation Guide worksheet
Presentation Rubric worksheet
Fruits and Vegetables

Engage:

Begin the lesson by asking students to edit the following sentence:

Biotechnology Combines. technology and An Understanding OF biological systems TO improve a Productt.

Correct sentence:

Biotechnology combines technology and an understanding of biological systems to improve a product.

Explore:



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After revealing the correct sentence to the class, share the following paragraph.

Editing a sentence consists of subtle changes. These subtle changes create stronger sentences and robust understanding. We know that writers edit words. However, did you know scientists use editing to improve plant growth? Of course, they don't edit *words* to improve plant growth. Instead of editing words, scientists edit certain characteristics within the plant to fight disease or climate change. This is called gene editing. Gene editing acts like a pair of "molecular scissors" to improve a plant! Today, we will learn how biotechnology, such as gene editing, help scientists solve modern day agricultural challenges.

As students view the following videos, students record their observations and questions on a graphic organizer. (See Appendix 1)

Show the following gene editing videos:

[Plant Breeding Innovation](#)

[Saving the Orange](#)

After viewing the videos and completing the graphic organizer, students share their observations and questions either as a whole group or with a science buddy.

***Prior to the following activity: check for student allergies and school policies regarding food in the classroom. Otherwise, use fake fruits and vegetables.**

If possible, distribute fruits and vegetables that are well known within the community. Discuss how the fruits and vegetables are necessary for everyone around the globe. Ask students to discuss how plant breeding, plant scientists and gene editing can help food production now and in the future. If permissible, students can touch and taste the fruits and vegetables.

Explain:

Modern agricultural food production faces many challenges, such as disease and climate change. As the human population increases, scientists are working hard to ensure our food production keeps up. An innovative and promising technology called gene editing, is at the forefront of crop improvement.

Gene editing consists of deleting, replacing, or inserting a DNA sequence with the aim to improve a crop or animal. For example, bruised and browning produce, such as potatoes, are a top contributor to food waste in restaurants and grocery stores. Many consumers and restaurants throw away perfectly healthy vegetables merely because they don't look appealing. Potatoes prepped before the dinner rush often need to be thrown out at the end of the night because of their brown color. Using innovations like gene editing, scientists are unlocking the code to make potatoes more resistant to bruising and browning. The result is a potato that could cut potato waste almost in half! Scientists are also looking to reduce bruising and browning in avocados, apples, and mushrooms.

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Cutting food waste also benefits our climate. An analysis by the United Nations Food and Agriculture Organization found that food waste is responsible for an estimated 8% of all greenhouse gas emissions. If it were a country, food waste would be the third-leading emitter of greenhouse gases, behind China and the United States. Climate change and food waste are some modern-day challenges in agriculture. Innovative and cutting-edge technology, such as gene editing can help solve these food production challenges.



source: www.innovature.com

As a class, discuss the following questions:

1. What are current food production challenges?
2. What is gene editing?
3. What other foods could gene editing benefit besides potatoes?
4. How could gene editing benefit future generations?

Elaborate:

Next, show the photograph. Explain this photograph demonstrates gene editing in tomato plants. The plants on the top level have yellow patches on the leaves. These tomato plants are suffering from a bacterial disease called tomato mildew. After gene editing, scientists were able to protect the plants from being infected by the disease (bottom level).



An example of tomato mildew, one of the bacterial diseases that researchers are looking to eliminate in plants through the use of CRISPR/Cas9 technology.

Credit: S. Kamoun.

Next, students investigate the following resources.

Videos:

1. [Lettuce vs Climate Change](#)
2. [Repairing the Root of the Problem](#)

Articles:

1. [Disease Resistant Pigs](#)
2. [Human Benefits](#)

Students select one resource they investigated to create a 5-10 minute class presentation. Suggested presentation methods include Google slides, PowerPoint, sketchbook, storyboard, etc. To help students prepare their presentations, they can use the Presentation Guide worksheet. (See **Appendix 2**).

Evaluate:

Use the Class Presentation Rubric (See **Appendix 3**) to evaluate student understanding.

Enrichment

Discuss careers associated with modern day farming production. Explain that students can get involved in plant breeding careers. Students can learn about a plant scientist, Natalie Kaiser, by reading the Innovature article [“Meet Natalie Kaiser, A Scientists Harnessing the Power of Potatoes Through Plant Breeding.”](#)

Natalie Kaiser



Source: www.innovature.com

Appendix 1

Gene Editing T-Chart

Name: _____ Class: _____

Directions: Record your observations and questions.

Observations	Questions
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Appendix 2

Class Presentation Guide

Name: _____ Class: _____

Directions: Answer the following questions. Include your answers within the presentation.

1. What is the name of the video or article you selected?



2. Describe the problem that scientists are trying to solve? Include specific details.

3. Why is it important to solve the problem?

4. What technology are scientists using to solve the problem?

5. Explain gene editing? Include how could it benefit future food production?

6. Write a strong conclusion about your investigation. Restate the problem and solution.

Appendix 3

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Class Presentation Rubric

Name: _____ Class: _____

	4-Excellent	3-Good	2-Fair	1-Needs Improvement
Delivery	Emphasizes all key points, direct eye contact towards audience, holds attention of audience most of the time	Emphasizes some key points, direct eye contact towards audience, holds attention of audience frequently	Emphasizes at least one key point, direct eye contact some of the time, holds attention of audience some of the time	Does not mention key points, no direct eye contact, does not hold audience attention
Content	Demonstrates and elaborates full knowledge of the subject, specific examples, provides data	Demonstrates understanding without elaboration, some specific examples	Basic knowledge about subject, provides at least one example	Unclear about the subject, does not provide examples,
Organization	Sequence of thoughts flows well, on topic, easy to follow, clear purpose, strong conclusion	Sequence of thoughts flows well, on topic, includes a purpose and supportive conclusion	Some thoughts are out of place, unclear purpose, confusing conclusion	Not on topic, confusing to follow does not include a purpose, no conclusion
Comments				

Adapted from www.readwritethink.org

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Resources

<https://innovature.com/article/how-agricultural-innovation-can-fight-food-waste>

<https://agsci.psu.edu/magazine/articles/2016/fall-winter/a-crispr-mushroom>

<https://innovature.com/article/meet-natalie-kaiser-scientist-harnessing-power-potatoes-through-plant-breeding-innovation>

https://www.readwritethink.org/sites/default/files/resources/printouts/30700_rubric.pdf

www.betterseed.org

