

LESSON

Agricultural Revolution

Project Details

COURSE

Life Science, Biology, Anatomy and Physiology

GRADE SPAN

9–12

DURATION

Three forty-five to sixty-minute session

CONCEPT

Global agricultural gene editing

OVERVIEW

Students will participate in a simulation in which they have been appointed United Nations representatives who are being convened to decide if funding should be allocated to promote widescale use of agricultural gene editing. Students will first investigate the intersection of gene editing and agriculture through watching a video, reading an article, and participating in a jigsaw discussion. Once students have an understanding of the principals of agricultural gene editing, they will research the state of agriculture in “their” country and will determine if and how gene editing could improve their country’s food sources. The UN committee will then convene, and students will present their opinions, briefly debate their findings, and arrive at a final decision.

THIS LESSON FOCUSES ON:

Engineering Design Process

- Defining the problem
- Designing Solutions
- Creating or Prototyping
- Refine or Improve
- Communicating Results

21st Century Skills

- Collaboration
- Communication
- Critical thinking
- Creativity

OBJECTIVES

Students will be able to:

- Summarize the concept of gene editing.
- Analyze the potential effects of agricultural gene editing on world hunger.
- Perform research using multiple sources in order to evaluate if/how agricultural gene editing could affect a nation's food sources and hunger issues.
- Consider the arguments presented by peers in order to develop their own opinion on allocating funding for agricultural gene editing

MATERIALS

- Computer or device with the ability to project, one
- Computers or devices with internet access, one per student for the second-class period only
- Jigsaw articles, enough of each of the following for one-quarter of the class:
 - [Jigsaw Article 1](#): "Can Gene Editing Provide a Solution to Global Hunger?"
 - [Jigsaw Article 2](#): "These CRISPR-Modified Crops Don't Count as GMOs"
 - [Jigsaw Article 3](#): "These Foods Aren't Genetically Modified, but They Are 'Edited'"
 - [Jigsaw Article 4](#): "GMO Scientists Could Save the World from Hunger, If We Let Them"
- Article Discussion handout (two pages), one per student
- Article Analysis handout, enough for one-quarter of the class
- United Nations Notes Sheet, one per student
- United Nations Special Session Handout, one per student

HAVE YOU EVER WONDERED...

What is the United Nations?

The United Nations (UN) is an international organization that was founded in 1945. It is made up of representatives from 193 countries. The members of the UN work together to take action on current issues facing humanity, such as security, sustainable development, human rights, climate change, health emergencies, food production, governance and more. Members are able to share their viewpoints during the UN's General Assembly. Other bodies, committees and councils also meet regularly around specific subject areas. Through the UN, governments from around the world are able to discuss and solve problems together.¹

What factors contribute to global hunger?

The United Nations' World Food Programme attributes world hunger to six main factors:

- Poverty trap, in which poverty results in a cycle of hunger from which people cannot escape
- Lack of investment in agriculture
- Climate and weather
- War and displacement
- Unstable markets
- Food waste

While investment and focus in all areas will be needed to fully stop world hunger, research by the UN Food and Agricultural Organization has shown that investment in agriculture has the ability to reduce poverty and hunger up to five times more effectively than investment in any other area.²

Sources:

1 – “Overview.” United Nations. un.org/en/sections/about-un/overview/.

2 – “What Causes Hunger?” World Food Programme. wfp.org/stories/what-causes-hunger.

MAKE CONNECTIONS

How does this connect to students?	How does this connect to careers?	How does this connect to our world?
<p>More than 11% of the world is hungry on a daily basis—and this statistic is not just limited to other countries. In the United States, people in both rural and urban areas also face hunger every day. In fact, more than 13 million children in America (equivalent to about 1 in every 5 students) go to school hungry every day.³ While hunger can be more visible in urban areas, the vast majority of America’s most food-insecure counties are in rural communities.⁴ Hunger is a real issue across the United States and it important for students to come together, discuss this problem, and consider various possible solutions.</p>	<p>Geneticist in Agriculture Research: In general, geneticist are scientists who study genes, DNA, and heredity. Geneticists in agricultural research study how genetic variation can be used to develop crops that have valuable traits, such as those that can grow in atypical conditions.</p> <p>Biotechnology Lawyer Lawyers in the field of biotechnology are involved in decisions that involve using biology for environmental or human advancements. Biotechnology lawyers may work with a biotech project from the beginning stages of development all the way to making the idea a reality in order to ensure that the technologies adhere to ethical and legal regulations.</p> <p>Agricultural Policy Analyst: These analysts conduct research and analysis to inform and assist Congress on issues surrounding agricultural programs and policies. They use their research and analysis to help develop government policies, and they provide briefings and advice to senior government members based on their findings.</p>	<p>The United Nations reports that world hunger has been on the rise over the past three years. Sadly, it has returned to levels that it had at one point decreased from a decade ago. While the United Nations has set a sustainable development goal of zero hunger by 2030, a lot will need to be quickly accomplished to make this a reality.⁵</p> <p>At the same time, the field of genomics and the potentials of gene editing are expanding at a pace that has also never before existed. Students will therefore be entering college and the work force at a time when the world will have to make important decisions regarding the intersection of genomic developments and widescale world hunger.</p>

Sources:

3 – Seaton, Jaimie. “Reading, writing and hunger: More than 13 million kids in this country go to school hungry.” Washington Post. [washingtonpost.com/news/parenting/wp/2017/03/09/reading-writing-and-hunger-more-than-13-million-kids-in-this-country-go-to-school-hungry/?utm_term=.e2530daaa1e7](http://www.washingtonpost.com/news/parenting/wp/2017/03/09/reading-writing-and-hunger-more-than-13-million-kids-in-this-country-go-to-school-hungry/?utm_term=.e2530daaa1e7).

4 – Erbenraut, Joseph. “Hunger in Rural Areas is Less Visible but Just as Pressing.” HuffPost. [huffingtonpost.com/entry/rural-communities-hunger-rates_us_59148645e4b030d4f1f09941](http://www.huffingtonpost.com/entry/rural-communities-hunger-rates_us_59148645e4b030d4f1f09941).

5 – “Global Hunger Continues to Rise, New U.N. Report Says.” UNICEF. [unicef.org/press-releases/global-hunger-continues-rise-new-un-report-says](http://www.unicef.org/press-releases/global-hunger-continues-rise-new-un-report-says).

BLUEPRINT FOR DISCOVERY

DAY 1

Directions

- 1 Begin by projecting the United Nations' [website](#) and tell students that for the next several class periods, they are going to role-play United Nations representatives of countries around the world. They have been called to convene for a special session in which they will decide if funding should be allocated to promote widescale use of agricultural gene editing. It will be up to each student to take a stance on what is best for “their” country and the world at large.
- 2 Explain that before students find out which country they represent, they need to have a solid understanding of gene editing.
 - Guide individual students to use a scrap piece of paper and rip it into eight pieces. Ask them to write a vocabulary word on each piece: Gene, DNA, errors, gene editing, replace, change, health, ethics. Students should then be directed to mix them up.
 - In small groups of 3-4, have students discuss which words are familiar and share their understanding of the meanings.
 - As a whole group, briefly have students share and review the words and their meanings.
 - Next, ask small groups to predict what the video may be about.
 - Explain to students that as they watch the video clip, they should place the vocabulary words in order as they are heard in the segment.
 - Play the [video](#) (until 2 minutes 10 seconds).
 - After the video segment concludes, have students discuss the sequence of topics from the segment, using the order identified for the vocabulary words. Then, ask the students to hypothesize how gene editing could be used to help world hunger, based on the video they just watched. Give groups a few minutes to discuss their ideas and then call on several groups to share their thoughts.
- 3 Next, tell students that they will participate in a jigsaw discussion to further increase their understanding of agricultural gene editing. Distribute a jigsaw article to each student, and ensure that about one-quarter of the class is reading each article.
- 4 In addition, distribute one Article Discussion handout to each student. Review the instructions in the first square of the Article Discussion handout, and tell students that they will be responsible for completing this square for the article they have been assigned. Explain that they will then inform their peers about what they have read. Note: As a means of differentiation or for additional research for any students who finish early, this [optional video](#) may also be viewed.
- 5 Once students have read, annotated, and recorded notes, form jigsaw discussion groups around the

classroom. Each group should consist of at least four students, with one student representing each article. (If you have an odd number of students, it will be better to double up students, rather than have one group where all articles are not represented.)

- 6 Instruct group members to take turns using their notes to share the gist of their article and the points it made about agricultural gene editing. As one group member shares, the others should listen carefully and take notes on their Article Discussion handout. Questions should be asked only once a group member has finished speaking.
- 7 When groups have finished sharing, distribute one Article Analysis handout to every group. Each group should work together to synthesize their notes and develop an answer to each question. This will allow each group to consider the most important takeaways from the articles and can also serve as a mid-point assessment.

Day 2

- 1 Begin class by reminding students that as United Nations representatives, they have been called to convene to decide if funding should be allocated to promote widescale use of agricultural gene editing. Explain that they will spend this class period learning about “their” country and considering how agricultural editing could affect their country’s food sources.
- 2 Tell students that an organization called the Internal Food Policy Research Institute calculates the world’s progress, or lack of progress, in decreasing hunger on a yearly basis. This “global hunger index” is calculated based on 4 factors. Project this [infographic](#) and review it with your students.
- 3 Next, project and explore the Global Hunger Index’s [interactive map and chart](#). Click the “Order by 2018 GHI Score” button above the data list to order the countries according to the severity of their hunger. Allow a few moments for students to study the map and the corresponding data, make observations and ask questions.
- 4 Encourage students to select (or you may choose to assign) the country for which they will serve as the representative. Students should select a country that is ranked from about 80 and above on the GHI Score scale.
- 5 Once every student has selected a different country, distribute one United Nations Notes sheet to each student. Review the directions, as well as the three questions provided. Explain that the first two questions are designed as research questions, whereas the analysis required for the third question is what students should be prepared to share at the UN Special Session next class.
- 6 Instruct students to spend the rest of the class period using the internet to perform research and begin answering questions 1-3. The following websites may be a good starting point, but students should also research resources that are specific to their country.

Suggested Websites:

- Global Hunger Index: globalhungerindex.org/results
- USDA World Agricultural Production: apps.fas.usda.gov/psdonline/circulars/production.pdf
- United Nation's Zero Hunger Goal: un.org/sustainabledevelopment/hunger
- Food and Agriculture Organization of the United Nations: fao.org/home/en

- 7 When there are approximately 10 minutes left in the period, encourage students to begin working on the third question if they have not yet begun.

Day 3

- 1 Explain to students that the Special Session of the United Nations will begin shortly. Each student will be required to share their country's stance on agricultural gene editing – which is the response the students have been preparing in question #3 of their United Nations Notes sheet. Tell students that they will have 10 minutes to finalize their statement (it should be between 30 seconds and one minute long) and then the session will begin.
- 2 Assemble the desks and/or chairs into a circle. Explain that during today's class period, every student will share their statement without interruption. The floor will then be open to questions and comments, and the session will ultimately end with a vote.
- 3 Distribute one United Nations Special Session handout to each student. Explain that while the students will be responsible for carefully listening to each representative, they will only be responsible for taking notes on five of the presentations. They may select the presentations about which they have comments or questions, and should take notes on what these representatives say as well as the questions they would like to ask.
- 4 Begin the session by welcoming everyone to this Special Session of the United Nations. Tell students that from this moment until the end of the class period, they will be regarded as an esteemed country representative.
- 5 Explain that the session will begin with a round table. During this time, each representative should introduce him/herself and then share their country's stance on agricultural gene editing, including potential benefits and risks.
- 6 Select the first student to share, and then rotate clockwise until all students have had a chance to state their opinion.
- 7 Open the floor up to questioning. Encourage students to use their notes to ask questions or voice concerns. These comments may be pointed toward a particular representative or to the entire group.

As the Special Session spokesperson, you will call on students who wish to speak.

- 8 When there are 5–10 minutes left in the period, wrap up the discussion and announce that it is time to ultimately decide if special UN funding should be allocated for agricultural gene editing. Encourage each representative to think about the future of their own country and the world at large, using what they learned during this session to guide their decision. Tell students they will have a couple minutes to think about their response, and then they will verbally share whether they are for or against this funding allocation.
- 9 Choose a student to begin the voting process, and direct each student declare “in favor” or “against” increased funding for agricultural gene editing. Keep a tally below of the votes:

In Favor Votes:	Against Votes:
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- 10 When every student has declared their viewpoint, quickly tally the votes and announce the decision. Thank the students for convening on such an important matter and for doing their part to consider solutions for world hunger.

EXTEND

Students may further consider the concept of agricultural gene editing through the lens of the United States and develop a stance that this country may have taken if it had been present at the UN Special Session.

Research questions to consider include:

- What role does agriculture play in the United States?
- What is the state of agriculture in America?
- Is U.S. agriculture affected by climate change? If so, where and how?
- What could agricultural gene editing look like in America?
- Could agricultural gene editing be beneficial? What may the risks be?

NATIONAL STANDARDS

Next Generation Science Standards

- HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
- HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
- HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

Common Core ELA Standards

Grades 9-10

- CCSS.ELA-LITERACY.RST.9-10.1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
- CCSS.ELA-LITERACY.RST.9-10.2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
- CCSS.ELA-LITERACY.SL.9-10.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
- CCSS.ELA-LITERACY.SL.9-10.4. Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

Grades 11-12

- CCSS.ELA-LITERACY.RST.11-12.1. Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- CCSS.ELA-LITERACY.RST.11-12.2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- CCSS.ELA-LITERACY.SL.11-12.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
- CSS.ELA-LITERACY.SL.11-12.4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.

Directions:

- 1 As you read the article you have been assigned, annotate for details about gene editing that you think may be important as you decide if/how agricultural gene editing could be used to help world hunger.
- 2 When you are done reading, use the square below to summarize your annotations. You will later use these notes as your guide when you share your findings with your group.

Article Title: _____

Article gist (brief summary):

Two or three specific details from the article about how gene editing may be used in agriculture

1.

2.

3.

- 3 Then use the remaining three boxes to take notes on your partners' articles during your jigsaw discussion. Remember: You will be asked to consider how agricultural gene editing could be used to help world hunger so make sure to take notes on relevant and important content.



Name _____ Date _____

Article #2 Title: _____

What information was shared that may help you determine if and/or how genetic editing may be used to help world hunger?

Article #3 Title: _____

What information was shared that may help you determine if and/or how genetic editing may be used to help world hunger?

Article #4 Title: _____

What information was shared that may help you determine if and/or how genetic editing may be used to help world hunger?

Directions: Based the information you have learned from your jigsaw discussion, discuss and answer the following questions together as a group. Try to incorporate information from each of the articles into your answers.

- 1 In one short paragraph, how would your group describe the process of gene editing?
- 2 Is there a difference between genetically-edited crops and genetically-modified organisms? Why may this distinction be important?
- 3 What are the potential benefits and possibilities of gene editing when it comes to agriculture? Consider factors such as the effects of environmental changes, adaptations and natural selection.
- 4 What are the potential risks of agricultural gene editing?



Name _____ Date _____

UNITED NATIONS NOTES SHEET

Representative of the Country of _____

1) Current state of agriculture in your country:

(Consider factors such as farming practices, percentage of land used for farming, primary crops, etc.)

2) Inhibitors and opportunities for agriculture as a food source in your country:

(Consider factors such as water and land availability, climate, environmental changes, available workforce, etc.)

Inhibitors	Opportunity

3) Analysis [to be used for United Nations Special Session]:

Could gene editing change the face of agriculture in your country and ease hunger? If so, how? If not, why not? Do you foresee any risks that must be taken into consideration?



Name _____ Date _____

UNITED NATIONS SPECIAL SESSION

Agricultural Gene Editing

Country name	For or against agricultural gene editing	Questions, comments, or concerns about this country's stance

Additional notes to take into consideration: