Using Technology to Influence Genetics

Lesson Overview

In this lesson, students will conduct online research on how technology can influence genetics. Students will work in small groups to become "experts" on a specified type of technology. They will later join a different group of students to share what they have learned. As each student shares his/or her evidence, other group members should record key details about what they learn from the "expert". The following day, students will participate in an agreement circle discussion and argue from evidence as to whether they agree or disagree with the statements being read by the teacher.

Alignment

Standard/Indicator Addressed

Standard 7.L.4 The student will demonstrate an understanding of how genetic information is transferred from parent to offspring and how environmental factors and the use of technologies influence the transfer of genetic information.

7. L.4A.6 Construct *scientific arguments using evidence to support claims* concerning the advantages and disadvantages of the use of technology (such as selective breeding, genetic engineering, or biomedical research) in influencing the transfer of genetic information. **(NEW)**

Science and Engineering Practices

7. S.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.

Students should also ask questions and define problems; analyze and interpret data; use mathematical and computational thinking; plan and carry out investigations; construct explanations; develop, use, and refine models; and obtain, evaluate, and communicate information.

Crosscutting Concepts:

Crosscutting Concepts: Cause and effect, Stability and change

ELA Inquiry Standards (as appropriate)

Standard 2: Transact with texts to formulate questions, propose explanations, and consider alternative views and multiple perspectives.
2.1 Formulate logical questions based on evidence, generate explanations, propose and present original conclusions, and consider multiple perspectives.
Standard 3: Construct knowledge, applying disciplinary concepts and tools, to build deeper understanding of the world through exploration, collaboration, and analysis.
3.1 Develop a plan of action by using appropriate discipline-specific strategies.
3.4 Organize and categorize important information, revise ideas, and report relevant findings.

Standard 4: Synthesize integrated information to share learning and/or take action.
4.1 Employ a critical stance to demonstrate that relationships and patterns of evidence lead to logical conclusions, while acknowledging alternative views.
4.2 Determine appropriate disciplinary tools and develop a plan to communicate findings and/or take informed action.
4.3 Reflect on findings and pose appropriate questions for further inquiry.
Standard 5: Reflect throughout the inquiry process to assess metacognition, broaden understanding, and guide actions, both individually and collaboratively.
5.1 Acknowledge and value individual and collective thinking; use feedback from peers and adults to guide the inquiry process.

ELA Writing

Standard 1: Write arguments to support claims with clear reasons and relevant evidence.
1.1 Write arguments that:
a. introduce claims, acknowledge alternate or opposing claims, and organize the reasons and evidence logically;
c. support claims with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text;
e. develop the claim providing credible evidence and data for each;
i. provide a concluding statement or section that follows from and supports the argument
Standard 6: Write independently, legibly, and routinely for a variety of tasks, purposes, and audiences over short and extended time frames.
6.1 Write routinely and persevere in writing tasks over short and extended time frames, for a range of domain specific tasks, and for a variety of purposes and audiences.

ELA Communication

Standard 1: Interact with others to explore ideas and concepts, communicate meaning, and develop logical interpretations through collaborative conversations; build upon the ideas of others to clearly express one's own views while respecting diverse perspectives.
1.2 Participate in discussions; ask probing questions and share evidence that supports and maintains the focus of the discussion.
1.5 Consider new ideas and diverse perspectives of others when forming opinions regarding a topic, text, or issue.

Connections

Active Learning Strategies
- Give Me Five
- Jigsaw
- Agreement Circles

Computational Thinking:
- Formulating problems in a way that enables us to use a computer and other tools to help solve them.
- Logically organizing and analyzing data

- Representing data through abstractions such as models and simulations
- Tolerance for ambiguity & the ability to deal with open ended problems
- The ability to communicate and work with others to achieve a common goal or solution

Content Connections

- Science
- Computational Thinking
- English Language Arts

Content area literacy: Students should *analyze data from a variety of sources, including informational text, argue based on evidence, obtain data from various sources, and evaluate and communicate evidence.*

Lesson Plan

Time Required – Two 60 minute class periods
Disciplinary Vocabulary –selective breeding, genetic engineering, biomedical research

Materials Needed:
  o http://kidshealth.org/en/kids/what-is-gene.html **Gene therapy** part of article from beginning of unit
  o Video: Genetic Disorders and Diseases- https://www.youtube.com/watch?v=8s4he3wLgkM&feature=youtu.be (Begin at 4:54)
  o Agreement Circle Statements (attached)

Formative Assessment Strategies: Students will be assessed by sharing of computer research during the Science Café, the notes taken during group dialogue, and by their agreement circle responses.

Computational Thinking: This lesson addresses computational thinking by allowing students to interact with authentic data to organize and analyze data about technology, represent the data in a graph, use evidence, apply logic, and construct arguments for their proposed explanations, and evaluate and communicate the information scientifically.

Misconceptions:
Some common misconceptions about genetics from
http://knowgenetics.org/common_misconceptions/
  1. All genetic tests are equally reliable and precise.
  2. Only certain people have "disease genes".
  3. If a couple has a "one-in-four" risk of having a child with a disease, and their firstborn has the disease, the next three children will have a reduced risk.
  4. Only genetically modified food crops have genes.

Engage
  o Begin class with the short paragraph on **gene therapy** http://kidshealth.org/en/kids/what-is-gene.html
  o Have students read about gene therapy (last section on the page).

- o Remind students that they have learned about genes and mutations in previous lessons.
- o Today students will learn about the advantages and disadvantages of the use of technology in influencing the transfer of genetic information.
- o Complete the following activity on Environmental Influences and Cancer with the whole class.

    1) Ask students to count off in sets of 6. Have students write down their numbers so they do not forget.

    2) Ask students who are numbered 2, 4, 5, and 6 to stand. This represents the percentage of the U.S. population that will have children (60%).

    3) Ask students who are numbers 1 and 3 to stand. This represents the percentage of the U.S. population that will develop cancer during their life (33%).

    4) Ask one-fourth of the standing students to sit. This represents the percentage of the U.S. population who will die of cancer (25%).

    5) All students should sit.

    6) Ask the class if it is possible to determine who will develop cancer and who will not.

    7) List answers such as genetics, diet, toxic exposure, and lifestyle choices on the board.

    8) Ask the class if anybody knows of any technology regarding cancer.

- o Use the **Give Me Five** Strategy to collect five responses from random students who wish to share. This will give the teacher a way to formally assess student prior knowledge and allow students to make personal connections.

Explore

- o Start video at 4:54 today to finish the previous lesson's video(Genetic Disorders and Diseases) https://www.youtube.com/watch?v=8s4he3wLgkM&feature=youtu.be
- o After the video, explain to students that they are going to be assigned one topic to research on the internet and they will have a chance to research before sharing with classmates who were also assigned the same topic before sharing with other classmates who had a different topic. Complete the following **Jigsaw** activity.
    - Divide students into heterogeneous groups of six members. This original group is considered the home group.
    - Have students count off from 1-6. Each group member is charged with becoming an "expert" on one "piece" of the assigned material. So all the ones, twos, threes, fours, fives, and sixes will form a new "expert" group.
    - Research topics are as follows: Group 1=Genetic Engineering, Group 2= Selective Breeding, Group 3 = Genetically Modified Organisms, Group 4= Biomedical Research, Group 5= Gene therapy, Group 6= Stem Cells. **Students should focus on what it is and what are the advantages and disadvantages of this technology.**
    - After **independently** researching the assigned topic online for a set amount of time (20 minutes), students assigned the same topic come together in a group to discuss the information they collected and identify the most important information or key details.
    - Give students who are researching the same technology 20- 30 minutes to share their individual research findings and to summarize what or how the

technology is used and the advantages and disadvantages of the technology. They decide how they will "teach" the information about their assigned technology to the rest of their original group.

- The students then leave their "expert" group and join their original group.
- Each group member then takes turns teaching each other what they have learned about their research topic. **Each student listens and takes notes because each is accountable for the information shared.** (Allow 20 minutes for this productive dialogue to take place).
- Students should have notes on all six research topics by the end of the group discussion.

Explain

o Print a copy of the **Agreement Circle** statements attached to this lesson.
o Students begin by standing in a large circle.
o Read one of the statements to the students.
o The students who agree with the statement step to the center of the circle.
o Students who stepped to the center of the circle turn to face their peers still standing in the larger outer circle.
o They match themselves up in small groups of students who agree and disagree.
o The small groups engage in dialogue to defend their thinking.
o After dialogue, give students an opportunity to reposition themselves with those who now agree standing in the center of the circle.
o The idea is to get everyone either in the circle or on the circumference.
o Repeat with several rounds of questions related to the same topic, each time with students starting by standing along the circumference of a large circle.
o At the end of class, have students write a reflection on the advantages or disadvantages of technology to influence genetics.

Extend

o Additional research topics could include genetic engineering, cloning, DNA use in forensic science, the Human Genome Project, and careers that would require a background in genetic science.
o Suggested Resources: Careers in Human Genetics, The American Society of Human Genetics, http://www.ashg.org/education/careers.shtml) and The University of Kansas Medical Center's Genetics Education Center, http://www.kumc.edu/gec/.
o There are many Science 360 videos, radio shows, etc. about genetics.
    Go to https://science360.gov/files/ and search for genetics
o Here is a 360 video about diseases https://science360.gov/obj/video/08ddb887-5c77-44f0-bf91-5e9e5f51f5fd/examining-dna-understand-disease

Lesson adapted from
- Exploring Genetics. Across the Middle School. Science and Math Curricula. Dr. Jeffrey Batten. Carol Cutler White, Editor. 2nd Edition. July 2014. (n.d.). Retrieved April 25, 2017, from http://www.greenomes.org/ ("Genetic Disorders Mini Research Project-Science Activity 10)

Agreement Circle Statements

1) One of the oldest examples of selective breeding is the diversity within dogs. **True**

2) Corn is not one of the 3 crops that is currently being genetically modified in the United States. **False**

3) One advantage of modifying the genes in corn is that it makes it resistant to plant diseases. **True**

4) One possibility of genetic engineering in wheat plants is to alter its genome to make it grow insulin, which is the hormone needed to control blood sugar in the human body. **True**

5) Genetic Engineering does not produce any moral, ethical or religious issues. **False**

6) It is ok for scientists to genetically manipulate the DNA sequence of a rat to grow a human ear on its back. (For reproducing human organs for medical purposes- this has happened)

7) The advantages of cloning animals outweigh the disadvantages. **False**

(See List Below for Possible Connections Students May Make)

The following are the advantages of cloning animals:

1. The creation of identical copies of animals – through cloning, it is possible to create genetically identical animals for organ or tissue transplantation; and the creation of identical copies of only the best animal population
2. Repopulate the world with endangered or even extinct animals – with the modern technology nowadays, it is possible to address the problem of endangered species, or recreate the extinct species of animals.

The following are the disadvantages of cloning animals:

1. Mutations – in cloning, somatic cells play a significant role; when these cells contains mutations, the cloned animal can be weak or it could have lethal effects on the subject
2. Death – death can happen when the donor egg's mitochondria doesn't match with the somatic cell's mitochondria
3. Early death or premature aging – when somatic cells undergo telomeric shortening during cloning, the results can be early death of the animal or premature aging
4. Expensive – cloning is expensive because a great number of eggs are required for a single viable clone and this may seem wasteful since it is much easier to breed animals naturally
5. Genetic diversity is reduced – since it is possible to create identical copies of animals, this aspect is reduced greatly
6. Scientific limitation – until now, cloning is still experimental and it warrants further research

https://occupytheory.org/advantages-and-disadvantages-of-cloning-animals/