



pets in the  
classroom

## Debate: Using DNA Technology

Adapted from	<a href="https://petsintheclassroom.org/wp-content/uploads/2018/08/6ARAllen.pdf">https://petsintheclassroom.org/wp-content/uploads/2018/08/6ARAllen.pdf</a>	
Pet: GloFish	Class:	6-9

<p><b>Brief Overview:</b> In this engaging project, students will dive deep into the world of DNA technology, exploring its potential and perils through the lens of debate. Partnered with a classmate, each student will research a specific example of DNA technology, delve into its applications and implications, and then advocate for or against its widespread use in a head-to-head debate against another pair. <i>The lesson assumes the students have an understanding of DNA, RNA, Protein Synthesis, and Inheritance.</i> Easily adapted to higher grades</p>	<p><b>Lesson Breakdown</b> Lesson 1: Introduction to GloFish and Genetic Modification Lesson 2: Preparing for the Debate Lesson 3: Time to Debate!</p>
<p><b>Essential Question</b> Should specific DNA technologies like gene editing be embraced or restricted? Why or why not?</p>	

<p><b>Subjects</b></p> <ul style="list-style-type: none"><li><input checked="" type="checkbox"/> Science</li><li><input checked="" type="checkbox"/> ELA</li><li><input checked="" type="checkbox"/> Math</li><li><input checked="" type="checkbox"/> STEM</li><li><input type="checkbox"/> Art</li><li><input type="checkbox"/> Other</li></ul>	<p><b>Stem Connections</b></p> <p>Science: DNA, RNA, Protein Synthesis, and Inheritance Technology: DNA Technology Engineering: Evaluate the potential benefits and possible risks of new technologies. Math: interpretation of data</p>
--	--

### **Performance Expectations/ Standards**

#### **NGSS Standards:**

**NGSS.MS-LS3-1.** Develop and use models to illustrate the principles of inheritance.

**NGSS.MS-LS4-5.** Analyze and interpret data to provide evidence for biological adaptations.

**NGSS.HS-ETS1-3.** Evaluate the potential benefits and possible risks of new technologies.

#### **CCSS Standards**

**CCSS.MATH.8.SP.2.** Analyze and interpret data to determine relationships and draw conclusions.

#### **English:**

**CCSS.ELA-LITERACY.CCRA.R.1.** Read closely and analytically to make inferences and draw conclusions.

**CCSS.ELA-LITERACY.W.8.1.** Write arguments to support claims with evidence and reasoning.

**CCSS.ELA-LITERACY.SL.8.1.** Engage effectively in a collaborative discussion, building on the ideas of others.

### **I CAN statements**

- research and explain a specific example of DNA technology.
- identify and analyze the potential benefits and risks of using this technology.
- form an informed opinion on the ethical implications of its use.
- organize my arguments logically and persuasively.
- effectively communicate my ideas and counter opposing arguments in a debate.

### **Materials**

[GloFish GMO DNA Technologies](#)

[Debate: Using DNA Technology Worksheet](#)

Coloring supplies

Research supplies: computers, books, etc.

## Teacher Background

### Decoding DNA: Genetic Modification and GloFish

Have you ever wondered how scientists can change the traits of plants, animals, and even fish? The answer lies in the microscopic world of DNA, the blueprint of life. By manipulating this code, scientists can create genetically modified organisms (GMOs) with specific desired characteristics. Let's unravel the mysteries of DNA technology and how it gave birth to the glowing wonders known as GloFish.

**DNA 101:** Imagine DNA as a long, twisted ladder. Each rung on this ladder is made up of pairs of molecules called nucleotides. The sequence of these nucleotides determines the genetic code, which instructs cells on how to build and function. Just like changing the letters in a sentence can alter its meaning, changing the sequence of DNA can change the traits of an organism.

**Genetic Modification Techniques:** Scientists have developed various tools to edit and manipulate DNA. Some common techniques include:

**Gene insertion:** Introducing a new gene into an organism's DNA, like adding a gene for pest resistance to a plant.

**Gene silencing:** Deactivating a gene, like turning off a gene that makes a plant produce allergens.

**Gene editing:** Precisely altering the DNA sequence to change a specific trait, like modifying a gene to make fish glow fluorescent.

**GMOs:** When scientists use genetic modification to create new organisms, we call them GMO (Genetically Modified Organisms). These modified organisms can have various benefits, including:

**Increased food production:** GMO crops can be more resistant to pests and diseases, leading to higher yields and feeding more people.

**Enhanced nutrition:** Scientists can add genes to crops that increase their vitamin or protein content, improving dietary quality.

**Medical advancements:** Genetically modified bacteria can produce insulin for diabetics, and modified animals can help us develop new therapies for diseases.

**GloFish: The Glowing Guppies:** Now, let's dive into the colorful world of GloFish. These fluorescent zebrafish are not a result of radioactive spills or mutant breeding. They are, in fact, a prime example of successful genetic modification. Scientists inserted a gene from a jellyfish that codes for a fluorescent protein into the DNA of zebrafish embryos. This protein absorbs blue light and re-emits it as green, red, orange, or yellow, making GloFish glow in their mesmerizing hues.

**Beyond the Glow:** GloFish are more than just pretty pets. They serve as valuable tools in scientific research, helping scientists study how genes influence development, disease, and even aging. Moreover, their vibrant colors have made them educational ambassadors,

sparkling curiosity about genetics and the wonders of scientific discovery.

**The Future of DNA Technology:** Genetic modification is still evolving, and its potential is vast. While concerns about safety and ethics exist, ongoing research and open dialogue are crucial in ensuring responsible development and use of this powerful technology.

## Lesson 1: Introduction to GloFish and Genetic Modification

Time	Materials	Activity
15 mins	<a href="#">GloFish GMO DNA Technologies</a>	Introduce the topic with this slide presentation.
20 mins	Coloring supplies	<p>Divide students into small groups or pairs. Ask them to brainstorm their ideal genetically modified creature. Encourage them to think beyond existing animals and plants. Consider these prompts:</p> <p>What problem would your creature solve? (e.g., food security, pollution cleanup) What special abilities would it have? (e.g., bioluminescence, enhanced strength, communication with other species) What specific genes would you modify to achieve these abilities? (research online or use reference pictures) What ethical considerations would you have when creating this creature?</p> <p>Design Time: Encourage students to be creative and detailed. Draw their creature's appearance, including any unique features or modifications. Label the specific genes they modified and explain their function. Create a habitat or ecosystem for their creature. Write a short story or dialogue showcasing their creature's abilities and addressing any ethical concerns.</p>
10 mins		Presentation: Each group or pair presents their creature to the class.

## Lesson 2: Preparing for the Debate

Time	Materials	Activity
25 mins	<a href="#">Debate: Using DNA Technology Worksheet</a>	Guide the students to complete Part 1 of the worksheet, "Diving into the GloFish World"
2 -3 class periods	Research supplies: computers, books, etc.  <a href="#">Debate: Using DNA Technology Worksheet</a>	<p>Review the Requirements for the debate as described on the Student Worksheet.</p> <p>Allocate sufficient time for students to research their assigned stances. Provide credible resources like scientific articles, news reports, or documentaries. Consider offering research guides or graphic organizers for students who need support.</p> <p>Steps for the Project:</p> <ul style="list-style-type: none"><li>● Allow the students to partner up and select a specific example of DNA technology (e.g., gene editing, genetic testing, genetically modified organisms).<ul style="list-style-type: none"><li>○ Alternatively, students can be assigned a partner and a specific topic.</li></ul></li><li>● Research and analyze: Deep-dive into your chosen technology. Explore its applications, potential benefits, and possible risks. Gather data and evidence to support your perspective.</li><li>● Form your stance: have the students decide whether they will advocate for or against the widespread use of the technology.<ul style="list-style-type: none"><li>○ Alternatively, students can be assigned the side to research.</li></ul></li></ul>

## Lesson 3: Time to Debate!

Time	Materials	Activity
45 mins	<a href="#">Debate: Using</a>	Introduction: Briefly introduce the debate topic, provide

### Lesson 3: Time to Debate!

[DNA Technology Worksheet](#)

context, and state the learning objectives. Briefly explain the debate format and roles. Remind students of respectful communication and active listening. Assign a student not presenting to be in charge of the time)

Opening Statements: Each debater delivers a concise opening statement outlining their main arguments and stance on the issue. Encourage strong evidence and a confident tone. (2 mins)

Presentations: Each debater presents their arguments in detail. They should use evidence, reasoning, and persuasive language to support their claims. (5-7 mins)

Rebuttals and Cross-Examination: After each presentation, allow for respectful rebuttals and cross-examination. This is where students can challenge opposing arguments and clarify their own points. (5-7 mins)

Closing Statements: Each debater delivers a closing statement summarizing their key points and reiterating their stance. (2 mins)

Discussion and Reflection: Facilitate a class discussion where students can ask questions, share their opinions, and reflect on the arguments presented. Encourage them to analyze the effectiveness of different strategies and consider the complexity of the issue. (5-7 mins)

Evaluation and Feedback: Use the rubric to provide individual feedback to each participant. Highlight strengths, areas for improvement, and specific examples from their performance.

## Differentiation

### For students who need additional support

- Provide additional scaffolding or resources for students who need more support in research or debate preparation.
  - Pre-reading guides: Provide key definitions, diagrams, or background information on the debate topic to help them grasp the main points before diving into research.
  - Sentence starters for arguments: Offer a bank of sentence starters like "One reason to consider..." or "A potential risk of..." to help them structure their arguments.
  - Graphic organizers: Create templates with prompts for research notes, evidence analysis, and counter-argument responses to guide their thinking process.
- Offer alternative presentation formats like podcasts, infographics, or creative storytelling for students who prefer different communication styles.

### For advanced students

- Analyze opposing viewpoints: Challenge them to research and present the strongest arguments for the opposing side, anticipating and refuting them in their own debate.
- Develop ethical frameworks: Ask them to research and propose their own ethical guidelines for responsible development of the debated technology.
- Create a mock policy proposal: Have them research existing policies and draft their own proposal based on their stance and research findings.
- Connect to current events: Encourage them to research recent news or controversies related to the debated technology and integrate them into their arguments

Assessment				
Criteria	Exemplary (4 points)	Proficient (3 points)	Developing (2 points)	Needs Improvement (1 point)
Research and Evidence	Uses in-depth research and credible sources to support arguments. Demonstrates clear understanding of complex	Uses relevant research and cites sources. Demonstrates understanding of key concepts.	Uses limited research or unreliable sources. May misinterpret or oversimplify concepts.	Minimal or no research. Fails to grasp basic scientific concepts.

	concepts.			
<b>Argument Construction</b>	Presents clear, logical, and well-organized arguments. Anticipates and effectively addresses opposing counterpoints.	Presents well-structured arguments with supporting evidence. Addresses some counterpoints but may lack depth.	Presents arguments that are unclear, illogical, or lack evidence. Struggles to address counterpoints	Arguments are vague, disorganized, and unsupported. Fails to engage with opposing viewpoints.
<b>Persuasive Strategies</b>	Employs effective language and appeals to connect with the audience (e.g., logic, emotion, ethics). Uses powerful opening and closing statements.	Uses appropriate language and some persuasive techniques. Delivers a clear and engaging presentation.	Language is unclear or inappropriate. Limited use of persuasive techniques. Presentation lacks energy or focus.	Language is confusing or offensive. Fails to engage the audience. Presentation is weak and unorganized.
<b>Delivery and Demeanor</b>	Speaks confidently and clearly with appropriate body language. Demonstrates active listening and respect for opposing team.	Speaks with some confidence and clarity. Maintains eye contact and engages with the audience. Listens attentively and responds to counterpoints respectfully.	Speaks hesitantly or unclearly. Body language appears nervous or disengaged. May interrupt or show disrespect.	Speaks poorly and lacks confidence. Body language is unprofessional. Shows disinterest or disrespect.



<p><b>Overall Effectiveness</b></p>	<p>Delivers a persuasive debate that effectively advances their stance on genetic technologies. Contributes significantly to the intellectual exchange.</p>	<p>Delivers a well-organized and informative debate. Demonstrates understanding of the topic and contributes to the discussion.</p>	<p>Delivers a somewhat unclear or unconvincing debate. May struggle to grasp the complexity of the topic.</p>	<p>Delivers a poorly prepared and ineffective debate. Fails to understand the topic or contribute meaningfully.</p>
-------------------------------------	---	---	---	---

- Extension**
- Have students write a persuasive letter to a scientist or government official, advocating for or against GMOs
  - Design a public awareness campaign: Have them create posters, slogans, or social media posts promoting their stance on the issue.
  - Organize a mock press conference: Challenge them to answer questions from reporters and media representatives as experts on the debated technology.
  - Have the students answer the question: What role should public opinion and scientific consensus play in shaping policies around DNA technology?
  - Have the students answer the question: Is it ethical to alter the human genetic blueprint? Under what circumstances, if any?