

UNIT 3

Nature via Nurture

How can we use environmental and genetic factors to explain changes in organisms?

SCALE

Stanford Center for Assessment,
Learning & Equity



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6th Grade Science Unit 3: Nature via Nurture

Culminating Project

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Challenge

In the Lift-Off Task, you saw the consequences of a lake experiencing a toxic algae bloom. Imagine a local lake is experiencing the same kind of toxic algae bloom this summer. Fish are dying, the lake is closed to swimming, and there are no dogs allowed on the trails around the lake because consuming the algae could cause serious illness! This isn't the first time this has happened to this lake, and the community wants to know—what is going on?!



Your task is to figure out exactly why this is happening and what can be done—is it an environmental issue or has the algae itself actually changed? As a group, create a news story update on the local lake situation, share any new evidence you have uncovered, and explain what this means. This can either be a video newscast or an article in the local newspaper. As individuals, you will then write a letter to the town's mayor explaining the problem and advocating for a potential solution given what you know.

Background Information

Location: The lake is located in the middle of a neighborhood of residential homes. It is fed by a small creek that travels through homes and a number of small farms on the outskirts of the neighborhood.

Description of Toxic Algae in Lake: The toxic algae is also known as blue-green algae, but is technically not an algae at all. They are bacteria that do photosynthesis like algae do, called *Cyanobacteria*. Water temperatures above 75° Fahrenheit are optimal for *Cyanobacteria*, or the blue-green algae. Most other types of algae, which are not toxic, grow best at temperatures between 53 and 59° Fahrenheit.

History of Algal Blooms

	Presence of Toxic Algal Bloom in Local Lake	Average Summer Temperature (° F)	Annual Rainfall (inches)
4 Years Ago	No	78° F	30 inches
3 Years Ago	Yes	80° F	37 inches
2 Years Ago	No	80° F	30 inches
1 Year Ago	Yes	84° F	31 inches
This Year	Yes	85° F	34 inches

**6th Grade Science Unit 3: Nature via Nurture
Culminating Project****Group Project Criteria for Success**

Your news update should include:

- ✓ A recap of the problem at the local lake
 - What is happening to the lake?
 - Why is it a problem?

- ✓ A claim for whether the lake's algal blooms are caused by genetic and/or environmental factors
 - Provide evidence to support your claim
 - Include an explanation of why algal blooms happen some years but not others

- ✓ A conclusion that encourages your audience to think about solutions now that they know this information

- ✓ Quality News Update Structure
 - Grabs the audience's attention
 - Is organized logically
 - Includes relevant visuals, when appropriate

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Culminating Project

Individual Project Criteria for Success

The letter to the mayor should include:

- ✓ A description of the problem at the local lake
 - What is happening to the lake?
 - Why is it a problem?

- ✓ Background on the Blue-Green Toxic Algae (*Cyanobacteria*), including:
 - A model that shows how they reproduce and what this means for variation in their species
 - A description of their optimal growing conditions

- ✓ Background on the relevant history of weather in the region, including:
 - An explanation of what likely caused these different weather conditions from year to year, supported by data from Task 1 as evidence

- ✓ An explanation for whether the toxic algal blooms are caused by genetic and/or environmental factors, including:
 - All the specific factors that cause the toxic algal blooms
 - Evidence from the tasks that supports the explanation for how environmental and genetic factors affect growth of organisms

- ✓ A potential solution for the local lake, including:
 - A description of how finding out the causes of toxic algal blooms helped you come up with the solution

6th Grade Science Unit 3: Nature via Nurture Culminating Project

Letter Peer Review Feedback

Complete after you have a full first draft of your letter to the mayor.

Letter Owner's Name	
Letter Reviewer's Name	

Review the following sections of the Letter to the Mayor:

- ✓ A description of the problem at the local lake
 - What is happening to the lake?
 - Why is it a problem?
 - Positive Comment:

 - Constructive Comment:

- ✓ Background on the Blue-Green Toxic Algae (*Cyanobacteria*), including:
 - A model that shows how they reproduce and what this means for variation in their species
 - A description of their optimal growing conditions
 - Positive Comment:

 - Constructive Comment:

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- ✓ Background on the relevant history of weather in the region, including:
 - An explanation of what likely caused these different weather conditions from year to year, supported by data from Task 1 as evidence
 - Positive Comment:

 - Constructive Comment:

- ✓ An explanation for whether the toxic algal blooms are caused by genetic and/or environmental factors, including:
 - All the specific factors that cause the toxic algal blooms
 - Evidence from the tasks that supports the explanation for how environmental and genetic factors affect growth of organisms
 - Positive Comment:

 - Constructive Comment:

- ✓ A potential solution for the local lake, including:
 - A description of how finding out the causes of toxic algal blooms helped you come up with the solution
 - Positive Comment:

 - Constructive Comment:

**6th Grade Science Unit 3: Nature via Nurture
3-Dimensional Individual Project Rubric**

Overview: The following rubrics can be used to assess the individual project: a letter to the mayor about the algal bloom problem. Each rubric is aligned to one section of the *Individual Project Criteria for Success*, located on your Culminating Project Student Instructions. Use these rubrics to see if you are doing your best work on your individual project.

Rubric 1: Student develops a model to describe how *Cyanobacteria* reproduce, which also describes the effect on genetic variation in offspring.

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student develops an inaccurate model to describe how <i>Cyanobacteria</i> reproduce.	Student develops a partial model to describe how <i>Cyanobacteria</i> reproduce.	Student develops a complete model to describe how <i>Cyanobacteria</i> reproduce, which also implicitly describes the effect on genetic variation in offspring.	Student develops a complete model to describe how <i>Cyanobacteria</i> reproduce, which also explicitly describes the effect on genetic variation in offspring.

Rubric 2: Student explains how the motions and interactions of air masses likely caused the changing weather conditions, describing Task 1 data* as evidence.

- *Examples of data are weather maps, diagrams, and visualizations (found in Task 1).

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student inaccurately explains how the motions and interactions of air masses likely caused the changing weather conditions, describing Task 1 data* as evidence with major errors .	Student generally explains how the motions and interactions of air masses likely caused the changing weather conditions, describing Task 1 data* as evidence with major omissions .	Student accurately explains how the motions and interactions of air masses likely caused the changing weather conditions, describing Task 1 data* as evidence with minor omissions or errors .	Student accurately explains how the motions and interactions of air masses likely caused the changing weather conditions, describing Task 1 data* as evidence in complete detail .

Rubric 3: Student explains whether the toxic algal blooms are caused by environmental and/or genetic factors, using evidence from the tasks.

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student inaccurately explains whether the toxic algal blooms are caused by environmental and/or genetic factors.	Student accurately explains whether the toxic algal blooms are caused by environmental and/or genetic factors, using no evidence from the tasks.	Student accurately explains whether the toxic algal blooms are caused by environmental and/or genetic factors, using at least one piece of evidence from the tasks.	Student accurately explains whether the toxic algal blooms are caused by environmental and/or genetic factors, using multiple pieces of evidence from the tasks.

**6th Grade Science Unit 3: Nature via Nurture
Project Organizer**

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

You have been asked to give a news story update on a local lake that is also suffering from a recurring toxic algal bloom. After each task, you will return to the table below to organize what you learn as you go through the unit. By the end of the four tasks, you will have all this information to use for your culminating project. For each activity, be sure to include answers to **ALL** the questions provided.

<p>Lift-Off Task: The Mystery of the Algal Bloom</p>	<p>Based on what you learned from the Lake Temescal news story and the background information about the local lake you are focusing on, answer the following questions:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Why are algal blooms a problem? <input type="checkbox"/> What do you think might be causing the algal bloom in the local lake?
<p>Task 1: Forecasting the Weather</p>	<p>In your Culminating Project document, you were given background information on the region where the lake is located. Review this information and answer the following questions:</p> <ul style="list-style-type: none"> <input type="checkbox"/> How has the weather changed from year to year? <input type="checkbox"/> Based on what you learned about air masses and weather fronts, what causes these different kinds of weather? <input type="checkbox"/> What role might weather play in algal blooms, based on the data?

**6th Grade Science Unit 3: Nature via Nurture
Project Organizer**

<p>Task 2: What Affects Plant Growth?</p>	<p>We have seen how environmental factors can play a role in the growth of organisms.</p> <ul style="list-style-type: none"> <input type="checkbox"/> What natural environmental factors do you think affect the growth of the toxic algae? <ul style="list-style-type: none"> ○ How does the data from the Culminating Project handout support this? <input type="checkbox"/> Do some research on what other environmental factors might also be affecting the growth of the toxic algae. What else might be causing algal blooms besides weather conditions?
<p>Task 3: Genetics or Environment?</p>	<p>In Task 2, we identified some environmental factors that cause toxic algae growth. Researchers have also identified the gene that leads to the toxic protein, but it is not found in all types of algae, just toxic ones like Blue-Green algae.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Based on the information you have, do you think the toxic algal bloom in the local lake is caused by genetics or environmental factors? Explain your reasoning.

**6th Grade Science Unit 3: Nature via Nurture
Project Organizer**



<p>Task 4: From Parent to Offspring</p>	<p>An algal bloom refers to a large growth of algae, so we need to know how they actually reproduce!</p> <ul style="list-style-type: none"><input type="checkbox"/> Refer back to your model: How do cyanobacteria (blue-green algae) reproduce?<input type="checkbox"/> Does this better support the case for algal blooms being caused by genetics or environmental factors? Explain.
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6th Grade Science Unit 3: Nature via Nurture

Lift-Off Task: The Mystery of the Algal Bloom

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Like many lakes around the country, Lake Temescal in Oakland, CA is suffering a serious toxic algal bloom! Watch the following news video to learn about the situation: <https://abc7news.com/health/toxic-algae-bloom-in-oaklands-lake-temescal-prompts-closure/2156561/> (Pause at 1:30).



Part A: If you wanted to know more about the toxic algal bloom in Lake Temescal, what questions would you ask? Individually record any questions you would need to ask to get a better understanding of algal blooms.

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Lift-Off Task: The Mystery of the Algal Bloom

Part B: As a group,

- ✓ Discuss what questions each member wrote on his or her list.
- ✓ On a large piece of poster paper:
 - Write the phrase “Lake Temescal Algal Bloom” in the middle of your poster and draw a circle around it.
 - Around the circle, record the questions that were similar across your group members.
 - Draw lines to link together questions that relate to each other.
 - Draft possible answers to the questions, using your prior knowledge. Connect these to the questions on your poster.
- ✓ Post your group poster on the wall.
- ✓ Walk around and look at each groups’ ideas.

Part C: As a whole class,

- ✓ Construct a class concept map with the phenomenon in the middle: “Lake Temescal Algal Bloom”.
 - Decide which key questions you want to have on the concept map.
 - Draw lines with arrows between two key questions to show that there is a relationship.
 - Make as many connections as you can between the questions on the concept map.
- ✓ It’s important for everyone to share their ideas and it’s okay if you don’t agree.
- ✓ You will revise and add new questions and information to this concept map as you learn more about the causes of algal blooms.

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Connecting to the Culminating Project

You have been asked to give a news story update on a local lake that is also suffering from a recurring toxic algal bloom. Based on what you learned from the Lake Temescal news story and the background information about the local lake you are focusing on, answer the following questions:

- ✓ Why are algal blooms a problem?
- ✓ What do you think might be causing the algal bloom in the local lake?

This should be completed individually in your Project Organizer.

6th Grade Science Unit 3: Nature via Nurture**Lift-Off Task: The Mystery of the Algal Bloom**

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Reflection

Individually reflect on the Lift-Off Task, using the questions provided:

1. At the beginning of this task, you made a list of all the questions you have about algal blooms. Look back at your list: think about the questions your peers asked that you did not initially write down. How are their questions different from the ones you originally asked?

2. In this unit, we will be focusing on one crosscutting concept:
 - **Cause and Effect:** Cause and effect relationships can be used to predict phenomena, and phenomena may have more than one cause.

Looking at your class concept map, give one example of how this crosscutting concept came up in today's task.

3. Now that you understand what project you'll be working on over the course of this unit, what else do you need to know? What additional questions do you have?

6th Grade Science Unit 3: Nature via Nurture

Task 1: Forecasting the Weather

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Engage

In the Lift-Off task, you learned that algal blooms are causing big problems in many lakes and ponds, like Lake Temescal. But what causes algal blooms? Why do algal blooms only happen some years but not others? In this task, we will be investigating one possible cause of algal blooms.

First, think back to Unit 2 when you learned about climate. Climate refers to the average weather conditions in a region over a long period of time, like 30 years. However, within a region's climate, weather varies depending on the conditions within a year. In this task, we are going to be focusing on weather.



1. Watch the following weather forecast from the area where Lake Temescal is located:
<https://abc7news.com/weather/accuweather-forecast-atmospheric-river-arrives-today/39468/>.
2. In pairs, discuss:
 - a. What weather conditions were forecasted?
 - b. Now go/look outside: what are the weather conditions like in your region today?
 - c. What are some other examples of weather conditions not seen in the video or your region?

6th Grade Science Unit 3: Nature via Nurture

Task 1: Forecasting the Weather



Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Explore

In the most recent year that Lake Temescal had a toxic algal bloom, the region experienced a lot of storms during winter, followed by an unusually warm summer. What causes these kinds of weather conditions?

Planning and Carrying Out Investigations: Today, you will collect data in groups to make sense of why regions, like Oakland, experience the kinds of weather they do. Use the resources cards provided by your teacher to learn more about the causes of weather and record your data analysis in the chart below:

	What information does the resource tell you? Include new terms and definitions.	Draw labeled diagrams to summarize what you learned from the resource
Resource 1: What is An Air Mass?		
Resource 2: How Do Air Masses Move?		

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Task 1: Forecasting the Weather



<p>Resource 3: Weather Fronts</p>		
<p>Resource 4: Weather Maps</p>		

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Explain

Cause and Effect: Now that you have collected all this data, let’s return to our original question: What are some possible causes for Oakland’s storms in winter and high temperatures in summer?

Individually, write and/or draw labeled diagrams to explain Oakland’s storms in winter and unusually high temperatures in summer.

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Task 1: Forecasting the Weather



Stormy Weather	Hot Weather

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Elaborate

Explaining weather is incredibly complex! Use the *Stronger/Clearer* method to improve your explanation of Oakland’s weather conditions.

1. **Individual Think Time:** Take a minute to think about how you will explain each type of weather to a first partner. When you are ready, fold your paper so you can’t read from your explanation/diagram.

2. **Partner Discussions 1:** You will work in pairs with another student. One of you will be Student A and the other Student B. Student A will start first:
 - **Student A:** Without reading what you wrote, describe and support the thinking you used in your explanation/diagram.
 - **Student B:** Listen and ask clarifying questions. Ask questions to help Student A add detail to their explanation. For example, you might ask, “How were air masses involved?” or “If a weather front was the cause, what kind?”
 - **Both Student A and Student B:** Write down any notes, thoughts, or questions that came up in this discussion.

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Task 1: Forecasting the Weather



Now switch roles and repeat the steps above.

- 3. **Partner Discussion 2:** Repeat the partnering process with another student. Remember to try to strengthen and clarify your explanation/diagram. Write down new notes, insights, and questions.

- 4. **Partner Discussion 3:** Repeat the partnering process with another student. Remember to try to strengthen and clarify your explanation/diagram. Write down new notes, insights, and questions.

- 5. **Final Explanation:** After you have worked with partners to clarify your thinking, review your notes. Revise your explanation/diagram in the *Explain*.

6th Grade Science Unit 3: Nature via Nurture**Task 1: Forecasting the Weather**

3. Now that you have learned more about the causes of weather that may play a role in algal blooms, what questions do you still have?

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Task 2: What Affects Plant Growth?

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Engage

In the last task, you investigated the causes of different weather conditions. Weather causes environmental changes for all kinds of plants and animals living in the region. How might this kind of change in environment affect plants?

Use any prior knowledge you have to answer the following questions in partners:



1. What do plants need to grow?
2. Hypothesize: How do you think changing these environmental conditions would affect the growth of plants?

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Explore

Cause and Effect: To figure out if environmental conditions affect plant growth, we can conduct an investigation! In groups, follow the procedure below and record your data in the data table below. Your data may consist of descriptive observations, measurements, and diagrams.

1. Label your baggies with the following labels:
 - Bag 1: Water, Sunlight
 - Bag 2: Water, No Sunlight
 - Bag 3: No Water, Sunlight
 - Bag 4: No Water, No Sunlight
2. Poke a few small holes near the top of each baggie with your pen or pencil.

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Task 2: What Affects Plant Growth?

3. For the two baggies that require water (Bag 1 and Bag 2), dip 5 cotton balls in water and place them in the bottom of the baggie.
4. For the two baggies that don't require water (Bag 3 and Bag 4), put 5 dry cotton balls along the bottom of the baggie.
5. Add 3 or 4 lima beans to each baggie. Seal the baggies.
6. Tape Bag 1 and Bag 3 to the window or place under a Sun Lamp.
7. Place Bag 2 and Bag 4 in a dark place like a cupboard or closed box.

	Bag 1: Water, Sunlight	Bag 2: Water, No Sunlight	Bag 3: No Water, Sunlight	Bag 4: No Water, No Sunlight
Date: _____				
Date: _____				
Date: _____				
Date: _____				

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Task 2: What Affects Plant Growth?



Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Explain

Constructing Explanations: Remember from the last task that weather conditions can change the environment for plants. What if Oakland had more rainy days one winter? What if Oakland had more sunny days one summer? How might these kinds of environmental factors affect plant growth? Individually, construct an explanation to answer this question, using evidence from your investigation to support your claim.

Claim	
Evidence and Reasoning	

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Elaborate

Cause and Effect: You decide to repeat your investigation using a different type of plant—lentils. You give them the same amount of water and sunlight as your other plant in Baggie #1, but it grows much less! How can you explain this? Discuss and make a hypothesis with a partner.

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Task 2: What Affects Plant Growth?

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Evaluate: Connecting to the Culminating Project

You have been asked to give a news story update on a local lake that is suffering from a recurring toxic algal bloom. We have seen how environmental factors can play a role in the growth of organisms.

- ✓ What natural environmental factors do you think affect the growth of the toxic algae?
 - How does the data from the Culminating Project handout support this?
- ✓ Do some research on what other environmental factors might also be affecting the growth of the toxic algae. What else might be causing algal blooms besides weather conditions?

This should be individually in your Project Organizer.

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Reflection

Individually reflect on Task 2, using the questions provided:

1. At the beginning of this task, you were asked to hypothesize how you thought changing environmental conditions might affect the growth of plants. Based on what you learned today, was your hypothesis correct? How could you revise or add to your response?

2. In this task, we focused on the crosscutting concept of:
 - **Cause and Effect:** Cause and effect relationships can be used to predict phenomena, and phenomena may have more than one cause.

Where do you see examples of **Cause and Effect** in this task?

6th Grade Science Unit 3: Nature via Nurture**Task 2: What Affects Plant Growth?**

-
3. Now that you have learned more about environmental causes of algal blooms, what questions do you still have?

6th Grade Science Unit 3: Nature via Nurture

Task 3: Genetics or Environment?

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Engage

In Task 2, you gathered evidence for some environmental factors that affect the growth of plants. However, at the end of the task, you also considered two kinds of plants growing in the same environmental conditions, but yielding very different results! Is it just environment or do genetics also play a role in the growth of organisms?



You may have heard of the “nature vs. nurture” argument to describe how humans grow up to be the way they are. “Nature” refers to the **genetics**, or the characteristics you inherit from your parents. “Nurture” refers to the **environmental** factors around you. Individually, decide on your own opinion using the questions below:

1. What do you think makes you who you are today? Nature or nurture? Give reasoning to support your claim.
2. Watch the following video introducing Mo and Jasper, two long-lost twin brothers, who are having the same argument: <https://www.youtube.com/watch?v=udCtpMZ95r0> (Stop at 2:15). Make a hypothesis: What do you think made them the way they are—genetics or environment?

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Explore

Cause and Effect: To answer this question of nature vs. nurture for Mo and Jasper, we need to collect some evidence. In groups, visit the research stations to learn more about the role of genetics and environment in different contexts. Record your analysis in the evidence chart below:

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Task 3: Genetics or Environment?



Station	<p>Circle whether this station gives evidence for genetics or environment, or both.</p> <p>Predict the probability that this is the cause.</p>	Describe the evidence.
<p>Plant Growth: Strawberry Plants</p>	<p>Environment Genetics Both</p> <p>Probability: _____%</p>	
<p>Plant Growth: Corn</p>	<p>Environment Genetics Both</p> <p>Probability: _____%</p>	
<p>Human Height</p>	<p>Environment Genetics Both</p> <p>Probability: _____%</p>	
<p>Twin Studies</p>	<p>Environment Genetics Both</p> <p>Probability: _____%</p>	
<p>Body Fat and Obesity</p>	<p>Environment Genetics Both</p> <p>Probability: _____%</p>	

6th Grade Science Unit 3: Nature via Nurture

Task 3: Genetics or Environment?

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Explain

Now that we have more evidence, let's get back to our twins, Mo and Jasper.

1. Watch the rest of the *Engage* video to gather more information on Mo's and Jasper's question. Take notes on any new information in the box below, which you may want to use in your own explanation.

2. Mo says it was environment that made them who they are; Jasper says it was because of genetics. Which is it? **Constructing Explanations:** *Individually*, construct an explanation to answer Mo's and Jasper's question, using multiple pieces of evidence from your Task 2 investigation, the *Explore* stations, and the video to support your claim.

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Task 3: Genetics or Environment?



Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Elaborate

Cause and Effect: Now that you have all this new evidence, return to the scenario from Task 2. When you placed lentils and lima beans in the same environmental conditions, you got much different results. How can you and your partner explain this? Use at least one piece of evidence from this task to support your explanation.

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Evaluate: Connecting to the Culminating Project

You have been asked to give a news story update on a local lake that is suffering from a recurring toxic algal bloom. In Task 2, we identified some environmental factors that cause toxic algae growth. Researchers have also identified the gene that leads to the toxic protein, but it is not found in all types of algae, just toxic ones like Blue-Green algae.

- ✓ Based on the information you have, do you think the toxic algal bloom in the local lake is caused by genetics or environmental factors? Explain your reasoning.

This should be individually in your Project Organizer.

6th Grade Science Unit 3: Nature via Nurture**Task 3: Genetics or Environment?**

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Reflection

Individually reflect on Task 3, using the questions provided:

1. At the beginning of this task, you were asked to make a hypothesis about what made Jasper and Mo the way they are—genetics or environment. Considering what you learned throughout the task, do you think your hypothesis was correct? How would you revise your response based on what you know now?
2. In this task, we focused on the crosscutting concept of:
 - **Cause and Effect:** Cause and effect relationships can be used to predict phenomena. Sometimes phenomena may have more than one cause and can only be described using probability.
Where do you see examples of **Cause and Effect** in this task?
3. Now that you have learned more about the role of genetics and environment in toxic algal blooms, what questions do you still have?

6th Grade Science Unit 3: Nature via Nurture

Task 4: From Parent to Offspring

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Engage

We have seen the evidence that genetics plays a role in the growth of different organisms, but how does genetic inheritance actually work? How do traits get passed from parent to offspring?



Remember that offspring are the young born of living organism(s). Look at the following examples of parent(s) and their offspring.

Dog Parents



Dog Offspring



Bacterium Parent



Bacteria Offspring



With a partner, make observations:

1. Do the puppies look identical or different from their dog parents? Why do you think that is?

2. Do the bacteria look identical or different from their bacterium parent? Why do you think that is?

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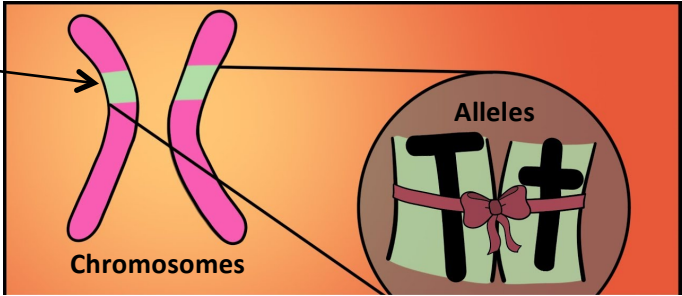
Task 4: From Parent to Offspring

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Explore

Developing and Using Models: You saw that some organisms, like puppies, can have variation in traits that is slightly different from their parents. Why does this happen? We can model the process of how organisms like these reproduce to better understand why this results in offspring with variation (difference) in traits. In pairs, create your own monster babies!

First, remember from the Task 3 video that a **gene** is a specific section of our **DNA** that codes for a specific **trait**. Look at the picture on the right: Because organisms have two of each **chromosome**, there are two **alleles** for each gene, which are shown as letters (Ex: Tt).



- Get a “Genes Card” from your teacher, which has the alleles (letters) for each of your main three monster traits:
 - Head shape (circular vs. square)
 - Mouth features (tongue out vs. teeth)
 - Number of eyes (one eye vs. four eyes)
- Individually, use your “Genes Card” and the Genetic Codebreaker below to figure out what traits your monster has. Record your alleles and traits in the data table on the next page.

Genetic Codebreaker

	At Least One Capital Letter	Both Lowercase Letters
Head Shape (H)	Circular (HH or Hh)	Square (hh)
Mouth Features (T)	Tongue Out (TT or Tt)	Teeth (tt)
Number of Eyes (E)	One Eye (EE or Ee)	Four Eyes (ee)

- Explain to a partner how you were able to figure out your monster traits. Get feedback and revise your data table, as needed.
- Find a mate to make a monster baby! Record your mate’s alleles and traits in the data table on the next page.

6th Grade Science Unit 3: Nature via Nurture

Task 4: From Parent to Offspring

5. To decide what traits your monster offspring will have, you will use pipe cleaners to represent your genes and your mate’s genes: Long pipe cleaner = Capital allele (letter) and short pipe cleaner = Lowercase allele (letter). Follow the process below for each of the three traits:
 1. Place two of your color pipe cleaners into the paper bag to represent your alleles.
 2. Place two of your mate’s color pipe cleaners into the paper bag to represent their alleles.
 3. There should be 4 pipe cleaner alleles in the paper bag. Without looking, pull out one pipe cleaner allele of each color (because half the DNA comes from each of you, as the parents!). This is your monster offspring’s allele combination for that trait. Record your offspring’s alleles and trait in the data table below.
 4. Repeat this process for the other two traits.

Data Tables

Parent 1: My Monster Genes

	Head Shape	Mouth Features	Number of Eyes
Alleles (Letters)			
Trait			

Parent 2: My Mate’s Monster Genes

	Head Shape	Mouth Features	Number of Eyes
Alleles (Letters)			
Trait			

Our Offspring’s Monster Genes

	Head Shape	Mouth Features	Number of Eyes
Alleles (Letters)			
Trait			

Notice: Does your monster offspring have the exact same traits as you? The same as your mate?

6th Grade Science Unit 3: Nature via Nurture

Task 4: From Parent to Offspring



Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Explain

Developing and Using Models: Your monster offspring wants to know where it came from! Individually, draw a model that shows the monster parents, the monster offspring, and the process that results in the offspring’s traits. Use the checklist below to make sure you include all the parts:

<p><u>Checklist</u></p> <ul style="list-style-type: none"> • A drawing of your monster, your mate’s monster, and your monster offspring <ul style="list-style-type: none"> ○ Labels all traits and alleles for each • Uses <u>arrows</u> and/or <u>color-coding</u> to clearly show where the monster offspring’s genes come from <ul style="list-style-type: none"> ○ Hint: Which alleles are passed from you to your offspring? Mate to your offspring? ○ Hint: How much of the offspring’s genes come from you? From your mate? 	Empty space for drawing
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Cause and Effect: This kind of reproduction is called sexual reproduction. Why does this kind of reproduction process create offspring with genetic variation (different genes between parents and siblings)?

6th Grade Science Unit 3: Nature via Nurture

Task 4: From Parent to Offspring



Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Elaborate

You just modeled the process of sexual reproduction. But what about organisms, like the cyanobacteria in Blue-Green Algae, that do asexual reproduction? Individually, follow the instructions below to model asexual reproduction:

1. Asexual reproduction involves only one parent organism, rather than two. The alleles for the gene we will focus on in this model are: Rr for round shape.
2. To decide what traits your bacteria offspring will have, you will again use pipe cleaners to represent your alleles. Long pipe cleaner = Capital allele (letter) and short pipe cleaner = Lowercase allele (letter).
 1. Place two of your pipe cleaners into the paper bag to represent your alleles.
 2. There should be 2 pipe cleaners in the paper bag. Without looking, pull out two pipe cleaner alleles. This is your bacteria offspring’s allele combination for that trait. Record your offspring’s alleles and trait in the data table below.

	Parent’s Trait	Baby’s Trait
Alleles (Letters)		
Trait		

Developing and Using Models: *With a partner*, draw a model of this process, using the checklist below.

<p><u>Checklist</u></p> <ul style="list-style-type: none"> • A drawing of your bacteria and your bacteria offspring <ul style="list-style-type: none"> ○ Label the trait and alleles for each • Uses <u>arrows</u> and/or <u>color-coding</u> to clearly show where the bacteria offspring’s genes come from <ul style="list-style-type: none"> ○ Hint: Which alleles are passed from you to your offspring? ○ Hint: How much of the offspring’s genes come from you? 	
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6th Grade Science Unit 3: Nature via Nurture

Task 4: From Parent to Offspring

Cause and Effect:

1. How does this process of asexual reproduction (bacteria) seem different from sexual reproduction (monsters)?
2. Does this process create genetic variation? Why or why not?

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Evaluate: Connecting to the Culminating Project

You have been asked to give a news story update on a local lake that is suffering from a recurring toxic algal bloom. An algal bloom refers to a large growth of algae, so we need to know how they actually reproduce!

- ✓ Refer back to your model: How do cyanobacteria (blue-green algae) reproduce?
- ✓ Does this better support the case for algal blooms being caused by genetics or environmental factors? Explain.

This should be individually in your Project Organizer.

Unit Essential Question: *How can we use environmental and genetic factors to explain changes in organisms?*

Reflection

Individually reflect on Task 4, using the questions provided:

1. At the beginning of this task, you were asked to think about why puppies look different than their dog parents, but bacteria look the same as their bacteria parent. Look back at your initial responses: Based on what you learned throughout this task, how could you better explain this?

6th Grade Science Unit 3: Nature via Nurture**Task 4: From Parent to Offspring**

2. In this task, we focused on the crosscutting concept of:
- **Cause and Effect:** Cause and effect relationships can be used to predict phenomena, and phenomena may have more than one cause.

Where do you see examples of **Cause and Effect** in this task?

3. Now that you have learned more about how different kinds of organisms reproduce, what questions do you still have?