Biology Instructional Segment: Stability & Change in Ecosystems—Part 2 of 2

This 5E model of instruction may be useful in connecting human activity, organism interdependence, and ecosystem interactions.

Student Science Performance

Grade Level: Biology	**Title:**
Topic: Sickle Cell and Ecosystem Interactions	Can't We All Just Get Along?

Performance Expectation for GSE:

SB5. Obtain, evaluate, and communicate information to assess the interdependence of all organisms on one another and their environment.

c. Construct an argument to predict the impact of environmental change on the stability of an ecosystem.
d. Design a solution to reduce the impact of a human activity on the environment. (*Clarification statement:* Human activities may include chemical use, natural resources consumption, introduction of non-native species, greenhouse gas production.)
e. Construct explanations that predict an organism's ability to survive within changing environmental limits (e.g., temperature, pH, drought, fire).

Lesson Performance Expectations:

Group Performance:

1. Obtain, evaluate, and communicate information to assess the interdependence of all organisms on one another and their environment.
2. Students carry out an investigation to collect evidence regarding symbiotic interactions in ecosystems.
3. Students, in groups, develop a model for the interactions of Anopheles mosquito in the ecosystem in which it lives.

Individual Performance:

1. Individually, students construct an explanation for the various types of relationships in ecosystems and share with groups.
2. Students design a solution to minimize human impact on natural populations.
3. Individually, students construct an explanation for the various types of relationships in ecosystems and share with groups.
4. Students construct an argument for and/or against human involvement in the ecosystem of the Anopheles mosquito.

Group Discussion:

1. Student groups record and communicate findings with members of the class.
2. Students share models with the class.
3. Students share solutions as part of class discussion.
4. Students share ecosystem models with the class.
5. Students engage in a debate as part of a culminating project.

Additional notes on student supports

Materials:

- Computer with Internet access (at least one per group). (Alternatively, teacher may provide hard copies of maps and research documents.)
- Interactions in Ecosystems Cards (Cards should include per group: Plus (3), Minus (3), Zero(3) and at least one example of commensalism, parasitism, and mutualism on each)
- (per group of 3 students) -1 bowl of multicolored hard-shell candies -3 stacks of note cards (one per student) -3 empty cups (one per student) -student worksheet -3 plastic spoons (one per student)
- Chart Paper

Engaging Learners	**Phenomenon:** Some relationships between organisms are helpful to both organisms whereas others are harmful. ***Obtaining*** Obtain Information: Show video clip of parasitism with Anopheles mosquitoes and Plasmodium. *Teacher Notes:* *Students, in groups, are given cards of various interactions between organisms in an ecosystem. Students are also given plus, minus, and zero cards. Students must identify each organism interaction as beneficial for both (+, +), beneficial for one and no effect on the other (+,0), or beneficial for one and negative for the other (+,-)* ***Communicating*** Student groups record and communicate findings with members of the class. *Additional notes on topic, focus, and phenomena.*
Exploring Phenomena	**Phenomenon:** Groups of organisms change in response to positive and negative factors in the environment. ***Obtaining*** Show video clip of a variety of symbiotic processes: Population Interactions and Symbiosis. Carry out an investigation: Students carry out an investigation to collect evidence regarding symbiotic interactions in ecosystems. Teacher instructions Student instructions ***Evaluating*** Students evaluate interactions in ecosystems using evidence collected from the class activity. ***Communicating*** Individually, students construct an explanation for the various types of relationships in ecosystems and share with groups.

	Student Science Performance
Explaining Phenomena	***Evaluating*** Students revise their explanations after group discussion. Teacher hint: Questions to further class discussion: ● What is symbiosis? ● What are examples of mutualism, commensalism, and parasitism? ● How can ecosystem interactions lead to an increase in the sickle cell trait in the human population? Finish watching this video starting at the 2 minute mark. Although students watched the video at the beginning of the course, students should be given direction as to what to look for during their review of the video. Have students watch the video through the lens of ecological interactions. Students should arrive at the conclusion that the sickle cell trait evolved in response to parasitism. ***Communicating*** Students reflect on their revised explanations in writing. Students reflections should include what they already knew about the topic, what they learned, and what they still do not understand.
Assessment of Student Learning *Instructor should give feedback on student reflections.*	
Elaborating Scientific Concepts and Abilities	**Student Science Performance** **Phenomenon:** Deforestation alters the ecosystem affecting where organisms can live. ***Obtaining*** *Show picture of deforestation in Africa* *Students should obtain information by researching in what type of habitats do Anopheles mosquitoes live and how does deforestation affect a food web?* *Suggested resource: CDC: Anopheles Mosquitoes* ***Evaluating*** Show map: Sickle Cell and Malaria Show map: Land Use in Africa ● What habitat does the Anopheles mosquito live in? ● What niche does the Anopheles mosquito fill? ● What would a food web look like that includes the Anopheles mosquito? ● How would deforestation affect the prevalence of the sickle cell trait? ● What human activities affect the abundance or decline of the Anopheles mosquito and sickle cell?

	• How can humans minimize their negative impact on the environment? ***Communicating*** Students, in groups, make a model for the interactions of Anopheles mosquito in the ecosystem in which it lives. Students share models with the class.

Assessment of Student Learning

Students share ecosystem models with the class. Students peer evaluate models and receive feedback from instructor.

	Student Science Performance
Evaluating Learners	***Evaluating*** Students design a solution to minimize human impact on natural populations. *Teacher Notes:* *Human impact may include cutting down trees and draining swampy areas that may affect the decline in mosquito population. (Ultimately, over time if the land area remains drier with less trees, the mosquito population may decline resulting in the decline in malaria infections, resulting in the sickle cell trait no longer having an environmental or evolutionary advantage. Over time sickle cell in the population may decline.) Other human impact to consider; deforestation may affect CO2 levels and greenhouse gases which may have an impact on the carbon cycle and climate change. Deforestation and draining swamps affect the organisms that can survive there affecting food webs and interactions between organisms.* ***Communicating*** Students share solutions as part of class discussion.

Assessment of Student Learning

Students construct an argument for and/or against human involvement in the ecosystem of the Anopheles mosquito. Students engage in a debate as part of a culminating project.

SEP, CCC, DCI	**Science Essentials**
Science Practices	• Engaging in argumentation from evidence • Constructing explanations • Designing solutions
Crosscutting Concepts	• Stability and Change • Cause and Effect • Systems and System Models
Disciplinary Core Ideas	From ***A Framework for K-12 Science Education:*** LS2.A: Interdependent Relationships in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS4.D: Biodiversity and Humans

Ecological Interactions Activity Teacher Guide

Adapted from The Young Scientists Program

Module Overview

Students will be introduced to basic vocabulary about ecological relationships (symbiosis, mutualism, competition, parasitism, commensalism, generalists, and specialists). Then, students will be split up into groups of three to do an activity that simulates these different relationships. Each student will represent a different species competing for limited food (Hard-shell candies). Between rounds, students will count how many hard-shell candies they collected and answer questions. Through this activity they will learn why no two species can occupy the same niche in a community and be able to predict what would happen if an invasive species was introduced into the ecosystem.

Goals

1. To describe the difference between mutualism, parasitism, and competition.
2. To explain why no two species can occupy the same niche in a community.
3. To predict what could happen if an invasive species is introduced into an ecosystem.

Timing

This activity takes about 60 minutes to complete.

Materials

Provided by the Young Scientist Program (per group of 3 students)

-1 bowl of hard-shell multicolored candies -3 stacks of note cards (one per student) -3 empty cups (one per student) -student worksheet -3 plastic spoons (one per student)

Helpful Tips

Students may struggle to understand what a "niche" is, so it helps to walk them through a specific example. Name an animal (such as a honeybee) and give them examples of its niche (the time of day the bee is active, the type of flowers it gets nectar from, the temperature range it can survive, where it builds its hive, which other species it interacts with, and how it interacts with those other species, etc). Then ask a student to name another animal, and have the class come up with examples for the things that make up its niche.

Safety

It would be best if the students do not eat the candies since many people have handled them.

Protocol

1. Fill out the introduction portion of the handout as a class.
2. Candy Activity
    a. Put students in groups of 3. Each student is a different species (Species A, B and C).

    b. Each group gets a bowl of candies. Each student gets a spoon, cup, and set of note cards.

    c. For each round, have students read the instructions on their note card about how they can survive the winter. Students should keep their instructions hidden from other group members.
    d. With the bowl of candies in the center of each group. Students will use a spoon to collect candies and place them into their cups. No stealing from other student's cups unless your instructions tell you to do so.

    Each round lasts 1 minute (or less). At the end of the round, students should record how many candies each species collected, then return the candies to the community bowl and answer questions.

Have students answer the elaboration questions at the end of the handout, then discuss as a class.

Round 1 **Species A**	**Round 1** **Species B**	**Round 1** **Species C**
Round 2 **Species A**	**Round 2** **Species B**	**Round 2** **Species C**
Round 3 **Species A**	**Round 3** **Species B**	**Round 3** **Species C**
Round 4 **Species A**	**Round 4** **Species B**	**Round 4** **Species C**

Round 1—Species C **What you need to do to survive:** You can only eat yellow candies. All other candies will make you sick. You must collect at least 6 yellow candies to survive.	**Round 1—Species B** **What you need to do to survive:** You can only eat green candies. All other candies will make you sick. You must collect at least 6 green candies to survive.	**Round 1—Species A** **What you need to do to survive:** You can only eat green candies. All other candies will make you sick. You must collect at least 6 green candies to survive.
Round 2—Species C **What you need to do to survive:** You can only eat any color candies, but you can only eat those that Species A or B have put into their cups (take them gently please). You need at least 6 candies to survive.	**Round 2—Species B** **What you need to do to survive:** You can eat green and orange candies. You need at least 6 candies to survive the winter. If another species tries to take your candies, you cannot stop them. No cup guarding.	**Round 2—Species A** **What you need to do to survive:** You can eat red and blue candies. You need at least 6 candies to survive the winter. If another species tries to take your candies, you cannot stop them. No cup guarding.
Round 3—Species C **What you need to do to survive:** You need 2 blue, 2 orange, and 2 red candies to survive winter. Unfortunately, you can only pick up orange candies. Species A and B will have to help you out for the blue and red candies. After picking up your 2 orange candies, put 2 orange candies in both Species A and B's cups.	**Round 3—Species B** **What you need to do to survive:** You need 2 blue, 2 orange, and 2 red candies to survive winter. Unfortunately, you can only pick up red candies. Species A and C will have to help you out for the blue and orange candies. After picking up your 2 red candies, put 2 red candies in both Species A and C's cups.	**Round 3—Species A** **What you need to do to survive:** You need 2 blue, 2 orange, and 2 red candies to survive winter. Unfortunately, you can only pick up blue candies. Species B and C will have to help you out for the orange and red candies. After picking up your 2 blue candies, put 2 blue candies in both Species B and C's cups.
Round 4—Species C **What you need to do to survive:** You can eat blue and green candies. Red candies are dangerous to your children, so you should remove them from the bowl before collecting the blue and green candies. Put red candies in Species A's cup. You must collect at least 6 candies to survive the winter.	**Round 4—Species B** **What you need to do to survive:** You can eat blue and green candies. Red candies are dangerous to your children, so you should remove them from the bowl before collecting the blue and green candies. Put red candies in Species A's cup. You must collect at least 6 candies to survive the winter.	**Round 4—Species A** **What you need to do to survive:** You can eat red and orange candies. You must collect at least 6 candies to survive the winter.

Return to Instructional Segment

Ecological Interactions Activity: Student Handout

Adapted from The Young Scientist Program

Background

A **niche** is the way of life of a species, or its role in an ecological community (what it eats, where it lives, how it interacts with other species, etc). For example, the niche of a honey bee is the time of day it is active, the type of flowers it gets nectar from, the temperature range it can survive, where it builds its hive, which other species it interacts with, and how it interacts with those other species (mutualism, parasitism, commensalism, etc). Another way of thinking about a niche is that it is the sum of the **biotic** (living) and **abiotic** (nonliving) resources that a species uses.

Species do not live by themselves—they live in ecological communities and are constantly interacting with other species. Something that affects one species will impact all the other species it interacts with. For example, if a frog species goes extinct in a community, then the snakes that usually eat it will have to find another food source or they will go extinct as well. And since there are no more frogs left to eat the moths, the moth population might increase so dramatically that it becomes out of control and eats all of the plants in the community, leaving no food for other plant eaters.

Species can have many different types of interactions with each other, some interactions help both species, some help just one of the species, and some can be negative for one or both of the species. All of these interactions are needed to maintain balance in an ecosystem. **Symbiosis** means "to live together," and happens when two species have a close relationship with each other. Interactions that fall under the category of symbiosis are *mutualism*, *parasitism*, and *commensalism*.

Parasitism is an interaction that harms one species and benefits the other species. A parasite lives on or in a host organism. For example, tarantula wasps lay eggs in tarantulas. This benefits the wasps because the larvae eat the tarantula's tissues, killing the tarantula. Other types of interactions that harm one species and benefit the other are **predation** (where a predator eats its prey) and **herbivory** (where the consumer eats a plant species).

Competition is an interaction that harms both species. Two species are competing for a limited resource. This reduces the fitness of one or both of the species. For example, hyenas chase away vultures that are trying to eat the remains of the same zebra.

Mutualism is a type of interaction where both species benefit each other. For example, bees and flowers have a mutualistic relationship. The flowers need to bees to pollinate them so their seeds can be fertilized. Bees need flowers to make honey for their hives.

Commensalism is an interaction that benefits one species and does not affect the other species at all. For example, while cattle graze in fields they unintentionally stir up insects that were resting in the grass. Cattle egrets follow the cows' paths and eat these insects. The egrets benefit because cows help them find food. The cows are not benefitted or harmed by the egrets.

Interaction	**Species 1**	**Species 2**
Mutualism	+	+
Competition	-	-
Parasitism, Predation, and Herbivory	+	-
Commensalism	+	neutral

Some species are **generalists**, meaning they can eat many different types of foods. Raccoons are generalists, since they can eat many different foods such as eggs, bugs, nuts, birds, and berries. Other species are **specialists**, meaning they eat only a certain type of food. Koalas are specialists, since almost their entire diet is eucalyptus leaves.

Protocol

1. Fill out the introduction portion of the handout as a class.
2. Candy Activity
    a. Put students in groups of 3. Each student is a different species (Species A, B and C).

    b. Each group gets a bowl of hard-shell candies. Each student gets a spoon, cup, and set of note cards.

    c. For each round, have students read the instructions on their note card about how they can survive the winter. Students should keep their instructions hidden from other group members.

e. With the bowl of hard-shell candies in the center of each group. Students will use a spoon to collect hard-shell candies and place them into their cups. No stealing from other student's cups unless your instructions tell you to do so.

    a. Each round lasts 1 minute (or less). At the end of the round, students should record how many hard-shell candies each species collected, then return the hard-shell candies to the community bowl and answer questions.

2. Have students answer the elaboration questions at the end of the handout, then discuss as a class.

Introduction

A **niche** is: _____

Symbiosis means _____ and happens when two species have

_____.

Interaction	Species 1	Species 2	Definition	Example
1. **Parasitism** (parasitism lives on or inside of a host) 2. **Predation** (predator eats prey) 3. **Herbivory** (organism eats a plant species)				 Tarantula wasps lay eggs inside of tarantulas while they're still alive.
Mutualism				 Bees pollinate flowers.
Competition				 Hyenas and lions both try to eat the same prey.
Commensalism				 Egret birds eat insects that cows & horses disturb.

A **specialist** is a species that eats only a certain type of food.

For example, koalas only eat eucalyptus plants.

List another example:

Activity Instructions:

Each person in your group represents a different species (Species A, Species B, and Species C), so each person gets a different stack of cards. Don't let anyone else see the instructions on your card, or they'll have a better chance of beating you!

Put the bowl of hard-shell candies in the center of your group, and give each group member a spoon. Use the spoon to collect hard-shell candies—*only one at a time*. Leave your cup on the table, not in your hand. No cup guarding! At the end of the round, count how many hard-shell candies you collected, fill out the table, and answer the related questions. Then, put all of your hard-shell candies back into the community bowl for the next round.

Round 1			
	Species A	Species B	Species C
Number of hard-shell candies in the cup			
Did this species collect enough food to survive the winter?			

2. Which two species occupied the same niche in this community? How do you know?

3. Which ecological relationship does…

   a) …Species A and Species B have?
   (mutualism / parasitism / competition / commensalism / none)

   b) …Species A and Species C have?
   (mutualism / parasitism / competition / commensalism / none)

   c) …Species B and Species C have?
   (mutualism / parasitism / competition / commensalism / none)

3. Why will two species not be able to occupy the same niche in a community for very long?

4. Was your species a generalist or a specialist? Why?

Round 2			
	Species A	Species B	Species C
Number of hard-shell candies in the cup			
Did this species collect enough food to survive the winter?			

5. Which ecological relationship does…

   b) …Species A and Species B have?
   (mutualism / parasitism / competition / commensalism / none)

   c) …Species A and Species C have?
   (mutualism / parasitism / competition / commensalism / none)

   d) …Species B and Species C have?
   (mutualism / parasitism / competition / commensalism / none)

6. Was your species a generalist or a specialist? Why?

Round 3			
	Species A	Species B	Species C
Number of hard-shell candies in the cup			
Did this species collect enough food to survive the winter?			

7. Which ecological relationship does…

c) …Species A and Species B have?
(mutualism / parasitism / competition / commensalism / none)

d) …Species A and Species C have?
(mutualism / parasitism / competition / commensalism / none)

e) …Species B and Species C have?
(mutualism / parasitism / competition / commensalism / none)

Round 4			
	Species A	Species B	Species C
Number of hard-shell candies the cup			
Did this species collect enough food to survive the winter?			

8. Which ecological relationship does…

d) …Species A and Species B have?
(mutualism / parasitism / competition / commensalism / none)

e) …Species A and Species C have?
(mutualism / parasitism / competition / commensalism / none)

f) …Species B and Species C have?
(mutualism / parasitism / competition / commensalism / none)

Elaboration Questions

9. If the environment changed suddenly, for example because of global warming, do you think generalist or specialist species would be better able to adapt and avoid going extinct? Why?

10. What would happen if a new invasive species came into your ecosystem that ate blue, red, and orange hard-shell candies and was better at collecting food than all three of your species?

11. Using what you have learned about ecological interactions, think an example of each interaction in which humans are involved:

    a. Competition:

    b. Parasitism:

    c. Mutualism:

    d. Commensalism:

12. "*All populations living together within a community interact with one another and with their environment in order to survive and maintain a balanced ecosystem*." Do you agree with this statement? Why or why not?

Return to Instructional Segment

Stability & Change in Ecosystems GSE: **SB1e, SB2c, SB5a, SB5b, SB5c, SB5d, SB5e, SB6a, SB6b**			
Anchoring Phenomenon: Human activities can cause major shifts in ecosystems. Desertification is causing global impacts.			
Topic	**Focus**	**Lesson Phenomenon**	**GSE/Notes/Language**
Ecosystems & Adaptations	Initial overview of how the latitude of the Earth affects ecosystems; introduction of plant and animal adaptations may be addressed here and revisited later in adapting to changing conditions.	Skin color is a trait that has a wide variation of phenotypes that tends to be concentrated in different ecosystems.	SB5c/SB3a/SB3b/SB6b Discussions on the evolution and inheritance of skin color are beneficial in connecting this instructional segment with Patterns in Heredity & Selection: Different Strokes for Different Folks. Make connections between the evolutionary benefits of having variations in DNA & fitness related to different regions of the Earth.
Human Population Growth	Human growth rate has been exponentially increasing since advancements in agriculture and medicine. The large human population uses a significant amount of limited natural resources and is exceeding our natural carrying capacity. Density-dependent and density-independent limiting factors regulate populations of organisms.	**Biotechnology Connection:** Deer in Georgia were almost eliminated but hunting regulations have successfully restored their population. Scientists are genetically modifying crops to contend with the increase in human population along with the shifting climate and reduction of resources.	SB2c/SB5a/SB5d It is beneficial to discuss carrying capacity and limiting factors in populations of other organisms (i.e. deer) before applying those concepts to human population growth.

Human Impact on Land Use	The increase in human population requires more land for living and agriculture; deforestation occurs. Emphasize ecological succession (primary and secondary). Relate deforestation to the impact on the carbon cycle by revisiting photosynthesis and cellular respiration.	Controlled burns and clear-cutting forests affect ecosystems differently. Atmospheric carbon levels are altered by increasing human population and clearing land.	SB5b/SB5c/SB5d Revisit cycling of carbon through photosynthesis and cellular respiration to make a connection between human impact on the carbon cycle and energy flow between producers and consumers.
Human Impact on Agriculture	Deforestation negatively affects the number of producers in an ecosystem that are the sole provider of energy to consumers. Energy flows from producers to consumers and is modeled using a food chain/food web. Farming practices include the use of fertilizers that are high in nitrogen that runoff into aquatic ecosystems and can cause eutrophication, upsetting the natural flow of matter and energy.	**Biotechnology Link:** Scientists are genetically modifying crops to contend with the increase in human population along with the shifting climate and reduction of resources. Minamata disease results from humans eating mercury contaminated seafood. Ponds that have a thick layer of algae tend to have a low population of fish.	SB1e/SB2c/SB5a/SB5b/SB5d Revisit cycling of carbon through photosynthesis and cellular respiration. Include deforestation and effect on runoff and water cycle. Emphasize human dependence on producers and other consumers. Biomagnification results from contaminants being passed through the food chain. Integrate necessity of genetically modified foods and mass farming of produce and meat to sustain the growing population to ethical concerns. Highlight the need for cycling of

	Ecological pyramids show the relationship of energy, population numbers and biomass among trophic levels.		nitrogen and phosphorus through discussion of farming practices.
Human Impact on Ecosystems & Biodiversity	Keystone species are a pivotal part of an ecosystem. If removed, all aspects of the ecosystem will be affected.	Urchin barrens significantly increased during a time of increased sea otter hunting. The wolves of Yellowstone were eliminated in the 1920s but have been reintroduced to the area in the 1990s, and it has had a widespread effect.	SB5a/SB5c/SB5d/SB5e/SB6a/SB6b Focus on community interactions and how humans have positively and/or negatively influenced these interactions. Discuss the positive and negative impacts that conservation efforts may have on an ecosystem.
	Introduction of non-native species may be detrimental to an ecosystem.	Kudzu has seemed to "take over" the south by growing uncontrollably.	
	Emphasize different community interactions (predation and competition) and symbiotic relationships (mutualism, parasitism, commensalism).	The population of arctic hares tend to be much larger than the population of snow leopards. Mosquitos steal nutrients from a host by sucking blood and can transmit diseases to host.	
	Plants and animals have specific adaptations that increase their fitness in specific ecosystems. Emphasize plant	Plants Vines "climb" trees to reach sunlight while leaves in the understory are very wide with pointed drip leaves.	The sickle cell trait evolved in response to parasitism. Instructional Segment: <u>Can't We All Just Get Along?</u>

	tropisms.		
	Humans are constantly impacting ecosystems, altering the biodiversity of plants and animals that can survive and withstand the different environment	Globally, deserts are expanding. There are large numbers of threatened, endangered, and extinct species.	
Natural Impact on Ecosystems & Biodiversity	Geological evidence of the history of the Earth shows it has changed drastically over time, altering the biodiversity of plants and animals that can survive and withstand the different environment.	Related species are sometimes found on separate continents.	SB6a/SB6b Revisit the evolutionary idea that organisms adapt to changing environments; the natural geologic history of the earth has impacted the processes of speciation and shifts in biodiversity. Revisit the evolutionary concepts of adaptive radiation and convergent evolution.

Anchoring Phenomenon:

Human activities can cause major shifts in ecosystems. Desertification is causing global impacts.

Students should be able to explain the phenomenon using the following concepts:

- Plants and animals have different adaptations that increase fitness in different ecosystems.
- Increasing human populations requires the use of more limited resources.
- Misuse of these resources may result in an increase of carbon in the atmosphere, causing climate change.
- Improper farming practices in areas with high biodiversity may have drastic effects on the soil, plants, and water.
- These areas can experience desertification, affecting plants and animals native to the biome.
- Plants and animals must adapt to human induced or naturally changing ecosystems.
- Conservation efforts may help slow or reverse the negative effects of humans on ecosystems.

Return to Instructional Segment

Additional Supports for struggling learners:

The following supports are suggestions for this lesson and are not the only options to support students in the classroom. These supports target students that struggle with science material, this lesson or a previous lesson. These are generalized supports and do not take the place of IEP accommodations as required by each student's Individualized Education Program.

General supports for the following categories:

Reading:	Writing:	Math:
1. Provide reading support by reading aloud or doing partner reads 2. Have the teacher model what they are thinking when reading the text 3. Annotate the text with students so that they may refer to it as they work through the lab	1. The teacher can provide a sentence starter for the students. 2. The teacher can give students an audience to write to (i.e. Write a letter to your sibling explaining this topic). 3. The teacher can provide constructive feedback during the writing process to help students understand the expectations.	1. The teacher should model analyzing data for this activity.

Supports for this specific lesson if needed:

Performance expectations for instruction:

1. The teacher should provide multiple formats that the student can use to express their knowledge.
2. The teacher should be sure to remind students of the definition of a scientific argument. The teacher can, also, create guidelines of how to format a scientific argument to help students feel more confident in their ability to make a scientific argument.
3. At the end of the lesson the teacher should reflect on the following topics:

   -The teacher should reflect on grouping of students. Was it beneficial and were all students able to contribute? Why or Why not?

   -The teacher should reflect on supports for struggling learners. Were the supports enough for the student population? Why or why not? Then make a list of other supports that the teacher can try in the classroom.

Engaging Learners:

1. The students may need to view the video on parasitism more than once. Show the video as needed for students with processing issues to be able to recall the important facts.
2. Struggling readers may need assistance reading the scenarios. The teacher can provide support by leading a read aloud or by having the groups share responsibility for reading aloud within their group.

Exploring:

1. The activity contains a large reading portion. Struggling readers may need supports to read and process the information given. The teacher can provide these supports by assisting in annotating the text and modeling their thinking, as they read, aloud.
2. The teacher may, also, want to assist students but filling in the beginning of the activity as a class to ensure that everyone has the correct answers and no misconceptions are created.
3. The students may need to be reminded of the instructions multiple times.
4. The teacher should offer multiple formats for the students to express the explanation. Some options of formats are writing an explanation, drawing a picture or verbally explaining.

Explaining:

1. The students may require additional time to revise their models.
2. The teacher should provide the questions in advance to students that have processing issues. This way students can prepare for the discussion and may be more inclined to participate because they feel prepared.
3. The students should be given the opportunity to express their knowledge and reflections in various formats. This can include writing, drawing or explaining verbally.
4. The students may require additional time to complete their reflections.
5. The teacher should consider giving the students a rubric to guide their reflection writing process.

Elaborating:

1. The teacher may want to consider having the students generate some questions after viewing the video. Then the teacher can help students determine what questions go with this topic and the students can use those questions to guide their research.
2. The teacher should provide the questions in advance to students that have processing issues. This way students can prepare for the discussion and may be more inclined to participate because they feel prepared.
3. The students may require additional time to develop the models.
4. The teacher should consider giving the student a rubric to grade their models on and time to revise as needed prior to peer review.

Evaluating:

1. The students may require additional time to draft their solution.
2. The students should be given the opportunity to express their solution in various formats. This can include writing, drawing or explaining verbally.
3. The teacher should consider giving the student a rubric to grade their solutions on and time to revise as needed prior to sharing with the class.

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