Symbiosis and Other Relationships – Peterson, et al.

Appendix. Evaluation Instruments.

Note: *All assessments and surveys were administered via Qualtrics survey software. The supplemental materials below present the content and logic of these instruments; however, the actual appearance and formatting in Qualtrics differs from what is shown here.*

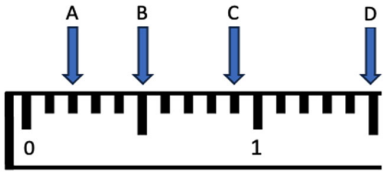
Symbiosis and Other Relationships: **Student Assessment**

Final 34-Item Assessment (Post-Validation)

Learning Objective 1: Species Interdependence

Students will recognize that within ecosystems, organisms of different species depend on one another

LO1.1 (pre-requisite) Look at the ruler picture above. This ruler measures length in centimeters (cm) and millimeters (mm). Some arrows are pointing to different marks on the ruler. Which arrow is pointing to the 5-millimeter mark?



A. Arrow A
B. Arrow B
C. Arrow C
D. Arrow D
E. None of the above

LO1.2 Ticks can carry bacteria that cause Lyme disease. The ticks don't get sick from the bacteria, but they can pass it to humans through bites. Humans can then get Lyme disease. Which statement best shows the relationship between the bacteria, ticks, and humans?

A. The relationship between the bacteria and the ticks is competition, and the relationship between the ticks and the humans is predation.
B. The relationship between the bacteria and the ticks is competition, and the relationship between the ticks and the humans is parasitism.
C. The relationship between the bacteria and the ticks is commensalism, and the relationship between the ticks and the humans is parasitism.
D. The relationship between the bacteria and the ticks is commensalism, and the relationship between the ticks and the humans is predation.

LO1.3 A protozoan (a microscopic, single-celled organism) lives inside a rat and feeds off its body. The protozoan harms the rat's brain, so that the rat loses its fear of cats. Later, a cat eats the infected rat and the protozoan transfers into the cat's body to complete its life cycle. Which best describes the relationship between the protozoan and the rat?

A. Mutualism
B. Commensalism
C. Parasitism
D. Competition

LO1.4 Many clover plants have tiny structures on their roots that are full of bacteria. The clover plants give food and shelter to the bacteria. The bacteria then give a nutrient back to the clover plants that makes the plants healthier. What type of relationship is this between the clover plants with the root structures and the bacteria inside the structures?

A. Mutualism
B. Commensalism
C. Parasitism
D. Competition

Learning Objective 2: Predatory Interactions

Students will identify and describe predatory interactions involving two or more species, including the roles and relationships among all participating organisms

LO2.1 A student counted the number of butterflies seen in a field over 8 weeks. Here are the numbers counted:

Based on the data, make a reasonable prediction about how many butterflies will be counted in week 9. Explain your prediction using details from the data table.

Week	Number of Butterflies
1	5 butterflies
2	7 butterflies
3	12 butterflies
4	11 butterflies
5	9 butterflies
6	15 butterflies
7	16 butterflies
8	14 butterflies

A. Week 9 is most likely to have less than 9 butterflies because the numbers are going down each week.
B. Week 9 is most likely to have around 18 butterflies because except for week 4, the numbers increase each week.
C. Week 9 is most likely to have about 20 butterflies because the numbers double each week.
D. Week 9 is most likely to have around 18 butterflies because the number has risen steadily over time.
E. All of the above are reasonable predictions.

LO2.2 Which of the following will most likely happen to a predator population if its prey population increases?

A. There will be no change in the predator population.
B. There will be a decrease in the predator population over time.
C. There will be an increase in the predator population over time.
D. There will be an immediate extinction of the prey population.
E. None of the above

LO2.3 Aphids are tiny insects that feed on fluids from the stems of plants. The aphids then release a sweet liquid called honeydew. Ladybugs eat aphids to get protein. Which of these terms best describes the relationship between the ladybugs and the aphids?

A. Mutualism

B. Commensalism
C. Predation
D. Competition
E. None of the above are correct

LO2.2b If prey numbers increase in an area, what will likely happen to the predator population in that same area?

A. No change
B. Decrease
C. Increase
D. Prey extinction
E. None of the above are correct

LO2.3b Green lacewing insects eat soft-bodied insects. What is the relationship between green lacewings and the insects they eat?

A. Mutualism
B. Commensalism
C. Predation
D. Competition
E. None of the above are correct

Learning Objective 3: Relationship Classification

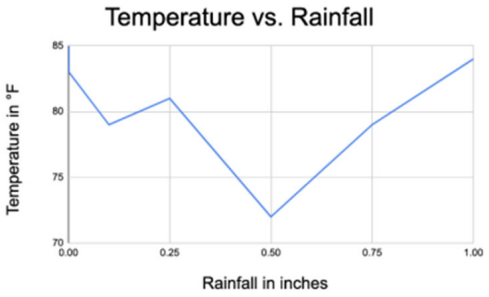
Students will identify and differentiate among ecological relationships by analyzing the effects of interactions on participating species

LO3.1 (pre-requisite) Makenna recorded observations about the weather at 12:00 P.M. each day for a week for her science class. Her data is summarized in the table below.

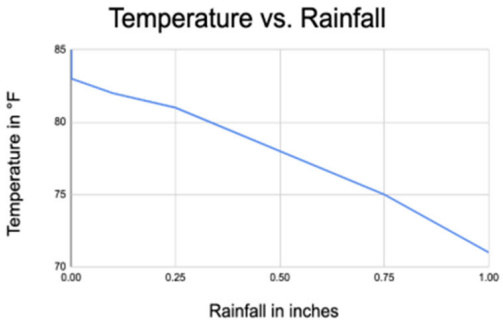
Day of the Week	Temperature	Rainfall amount
Monday	82°F	0 inches
Tuesday	78°F	.5 inches
Wednesday	71°F	1 inch
Thursday	75°F	.75 inches
Friday	81°F	.25 inches
Saturday	85°F	0 inches
Sunday	83°F	0 inches

Which of the following line graphs most closely represents the relationship between temperature and amount of rainfall?

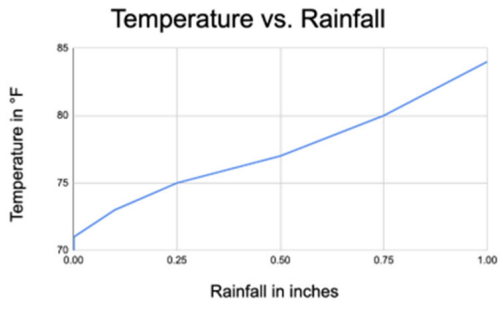
A.



B.



C.



D. All of the graphs represent the relationship between temperature and rainfall.

LO3.2 Flies and ticks bite horses. The cattle egret is a bird that sometimes eats the ticks and flies from the horses. This relationship between the horse and the egret helps:

A. Only the horse
B. The flies and the ticks
C. Only the cattle egret
D. The horse and the cattle egret

LO3.3 Black walnut trees make a chemical called juglone. Juglone acts as a mild poison. It can move into the dirt around the trees, killing some nearby plants. Some scientists studied how close other plants can grow next to black walnut trees before the juglone hurts them. Their observations are recorded in the table below.

	# of Black Walnut Trees	# of Onion plants in the vicinity	# of Asparagus plants in the vicinity
Area 1	23	26	4
Area 2	2	24	45
Area 3	8	25	26
Area 4	11	25	19

Identify the relationship the black walnut trees have with the plants around it.

A. The relationship between Black Walnut trees and Onion plants is parasitic while the relationship between Black Walnut trees and Asparagus is neutral.
B. The relationship between Black Walnut trees and Onion plants is neutral while the relationship between Black Walnut trees and Asparagus is parasitic.
C. The relationships between Black Walnut trees, Onion plants, and Asparagus are all neutral.
D. The relationships between Black Walnut trees, Onion plants, and Asparagus are all parasitic.
E. None of the above

LO3.4 The Phainopepla is a desert bird found in the southwestern U.S. and Mexico. These birds mainly eat mistletoe berries. After the Phainopepla birds digest the berries, they pass out the seeds onto trees. New mistletoe plants can then sprout where the birds left the seeds. What type of relationship is best shown between the Phainopepla bird and mistletoe plants?

A. Mutualism
B. Commensalism
C. Parasitism
D. Competition

LO3.4b A bird eats berries from a plant and spreads the plant's seeds in its droppings. What kind of relationship is this?

A. Mutualism
B. Commensalism

C. Parasitism
D. Competition
E. None of the above

Learning Objective 4: Adaptive Behaviors

Students will evaluate how organisms engage in behaviors that increase their odds of survival and reproduction

LO4.1 Some cuckoo birds lay their eggs in the nests of reed warbler birds. The reed warblers sit on the cuckoo eggs along with their own eggs and take care of the chicks when they hatch. What is the main benefit to cuckoos who lay eggs in reed warbler nests?

A. This allows the cuckoo to conserve resources for laying more of its own eggs, while the reed warbler bird does the work of raising the chicks.
B. This gives the reed warbler chicks a better chance of survival to grow to adulthood because of companionship of the cuckoo chicks.
C. This allows the cuckoo to avoid having to build a nest so that it can migrate more easily.
D. This allows the cuckoo bird to more efficiently distribute food resources among many chicks, increasing the cuckoo's ability to gather food effectively.
E. There is no benefit to the cuckoos.

LO4.2 Gray wolves hunt deer as their primary food source. Deer often wander into open meadows to feed on tender green grass that helps females produce nutritious milk for fawns. Wolves have learned to lurk around meadow edges to ambush feeding deer. How might lingering around meadow edges benefit future reproductive success for wolves?

A. It provides softer grass for wolves to build more protective dens for their offspring
B. It reduces fighting among rival wolf packs in the region
C. It keeps the deer population smaller, so more food is available for wolf cubs
D. It allows wolves to expend less energy hunting, so they have better health for reproduction
E. None of the above

LO4.3 Brine shrimp hatch from dormant eggs only when triggered by specific environmental cues that signal that favorable habitat conditions have returned. What is the most likely reason brine shrimp eggs require these very specific cues before hatching?

A. To ensure that brine shrimp are not hatching too late in the season
B. To conserve the dormant eggs' stored energy
C. To ensure hatching only when the habitat can support brine shrimp growth and survival

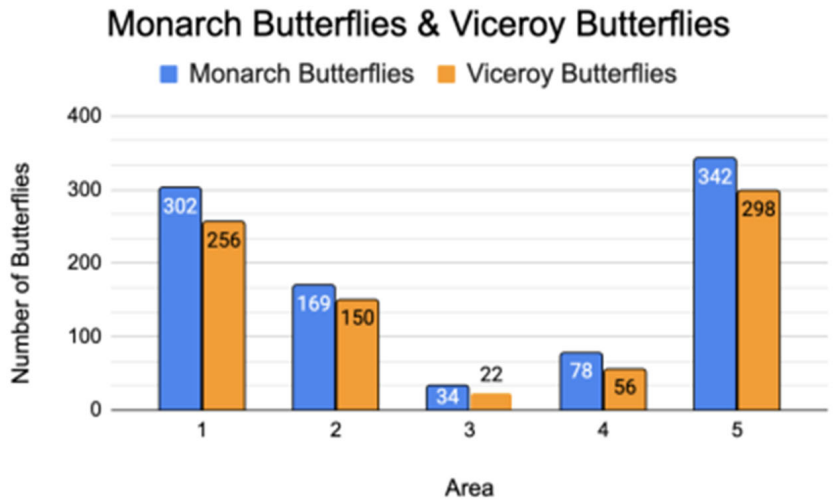
D. To help spread populations of brine shrimp to new locations
E. None of the above

Learning Objective 5: Species Dependency

Students will understand that some species completely depend on others for survival

LO5.1 (pre-requisite) Monarch butterflies are poisonous if eaten. Viceroy butterflies are not poisonous but look very similar to Monarch butterflies. A group of scientists recorded the number of both Monarch and Viceroy butterflies from five areas where their habitats overlap. The graph below shows their findings.

What type of relationship between the Monarch and Viceroy butterflies best accounts for the pattern seen in the graph?



A. In the presence of Monarch butterflies, Viceroy butterflies are not eaten by predators. But, Monarch butterflies do not benefit from the Viceroy butterflies.
B. In the presence of Viceroy butterflies, Monarch butterflies are not eaten by predators. But, Viceroy butterflies do not benefit from the Monarch butterflies.
C. Viceroy butterflies are dependent on Monarch butterflies for their food, so they live in the same areas.
D. Monarch butterflies hunt Viceroy butterflies to reduce competition for resources.
E. None of the above

LO5.2 Many species of trees rely on animals to spread their seeds away from the parent tree. Researchers studied palm trees called Attalea phalerata. Its large seeds are an important food source for agoutis - small forest animals. Data showed that over 75% of new Attalea palm seedlings grew from seeds that had passed through the digestive system of agoutis. If agoutis disappeared from the forest, what would most likely happen to Attalea palms over time?

A. Other animals would begin dispersing Attalea seeds.
B. Attalea palm seeds would evolve to be lighter and travel farther.
C. Fewer Attalea seeds would sprout into new palm trees.
D. Attalea palm forests would remain mostly unaffected.
E. None of the above

LO5.1b There are two types of butterflies that look alike. Type A is poisonous, but Type B is not. Scientists counted both types of butterflies in several areas where they live together. They found that the numbers of both types are similar in each area. Which statement best explains their findings?

A. Type B benefits by not being eaten since it looks like Type A, but Type A does not benefit.
B. Type A benefits by not being eaten since it looks like Type B, but Type B does not benefit.
C. Type B relies on Type A for food, so they live in the same places.
D. Type A preys on Type B to reduce competition for resources.
E. None of the above are correct

LO5.3 In Yellowstone National Park, grizzly bears feed on roots, berries, fish, and elk calves. Elk graze on Aspen tree saplings. Wolves hunt elk. Which best explains what would happen if wolves disappeared from Yellowstone National Park?

A. Aspen trees would decrease, and the number of grizzly bears would increase.
B. With more elk eating them, Aspen trees would decline but berry bushes would thrive.
C. Aspen trees and berry bushes would be unchanged, only the elk and bear populations would be impacted.
D. The elk population increase would drive down Aspens but not alter any other populations.

LO5.2b A type of pine tree relies on a small forest animal to spread its seeds. Research shows that most pine seedlings grow from seeds that have passed through this animal's digestive system. What would likely happen to the pine tree population if the animal disappeared from the forest?

A. Other animals would start spreading the pine tree seeds.
B. The pine tree seeds would evolve to be lighter and spread more easily by wind.
C. Fewer pine tree seeds would grow into new trees.
D. The pine tree population would stay about the same.
E. None of the above are correct

LO5.3b In a forest, bears eat plants and deer. Deer eat young trees. Wolves hunt deer. What would likely happen to the forest if wolves disappeared?

A. The number of bears would increase and the number of young trees would decrease.
B. With more deer eating them, young trees would decline but other plants would thrive.
C. With more deer eating them, young trees would decline but other plants would thrive.
D. The deer population would increase and eat more young trees, but other populations would not change.

Learning Objective 6: Three-way Relationships

Students will describe how each species is helped, harmed, or not affected in ecological relationships that involve three or more species

NOTE: LO6.1 was removed due to negative item-total correlation (r = -.262)

LO6.2 Sparrows and field mice often feed in grassy fields. When red-tailed hawks, which prey on both sparrows and mice, disappeared from an area, the sparrow population decreased a small amount while the field mouse population tripled in size over 5 years. What most likely caused these population changes?

A. Reduced pressure from predators allowed the mouse numbers to rapidly grow through more reproduction
B. With fewer hawks preying on insects, more damaging insect pests decreased grass seeds needed by sparrows
C. The larger mouse population took over nesting sites previously used by the sparrows
D. Diseases transmitted by mice spread more rapidly with more mice hosts, harming the sparrows

LO6.3 Dragonfly nymph populations in a pond declined following the introduction of sunfish. Shortly after, aquatic algae and plants grew at an accelerated rate. Which statement best explains the algal bloom following the nymph drop?

A. The sunfish stirred up and revived dormant algal spores as they swam
B. Without dragonfly nymphs feeding on them, the algae was able to grow rapidly
C. Plants were not impacted by the loss of nutrients caused by the sunfish in the pond
D. The dead dragonfly nymphs fertilized the pond water, making algae thrive

LO6.1b In an ocean ecosystem, scientists noticed that as sea urchin populations increased, kelp forests decreased. A few years later, sea otters arrived in the area, and kelp forests began to grow back. How are sea otters most likely affecting the kelp forests?

A. Sea otters are eating the kelp, reducing its population.
B. Sea otters are helping sea urchins grow, which leads to less kelp.

C. Sea otters are keeping sea urchin numbers in check, allowing kelp to thrive.
D. Sea otters are not having a significant impact on kelp growth.

LO6.2b In a desert, snakes and mice are eaten by hawks. Mice have a very high reproductive rate and eat seeds and insects. Snakes have a low reproductive rate and eat mice and insects. When the hawks left the area, the mouse population increased substantially, while the snake population increased only slightly over several years. What likely caused these changes?

A. With fewer predators, the mice reproduced more, and their population grew quickly.
B. Hawks ate fewer insects, so bugs ate more grass seeds that snakes need.
C. More mice took over the snakes' nesting spots.
D. Diseases from mice spread more easily and affected the snakes.

LO6.3b In a pond, the population of young Mayflies decreased after a new fish was introduced. Soon after, the amount of algae and plants in the pond increased quickly. What most likely caused the algae to grow so fast after the Mayfly numbers went down?

A. The fish swimming in the pond woke up dormant algae.
B. The algae grew quickly because the young Mayflies were no longer eating it.
C. The plants were not affected by the fish changing the nutrients in the pond.
D. The algae grew well because of nutrients from the dead Mayflies.

Learning Objective 7: Novel Applications

Students will apply understanding of ecological relationships to novel scenarios by determining how each species is affected and explaining survival strategies

LO7.1 Fairy prions are seabirds that come onto land only to nest. They like to build nests in burrows. Tuataras are medium-sized reptiles that are often found living together with fairy prions in their burrows. Tuataras eat things like beetles, insects, lizards, eggs, and even adult fairy prions or their chicks. But even with some prions eaten, the total fairy prion population is not meaningfully affected because of the tuataras. Recent research shows tuataras benefit significantly from sharing burrows with the fairy prions. The birds dig out the burrows that many tuataras then use. The waste of the birds makes the burrow good for beetles and insects to live there, which tuataras like to eat. The research also shows fairy prions make the burrow more humid, which tuataras prefer. But when tuataras are in the burrow, the adult fairy prions spend only about half as much time there nurturing their chicks. What is the best description of the relationship between fairy prions and tuatara?

A. Mutualism because the tuataras benefit from living in the burrows of the fairy prions, and the fairy prions benefit because the tuataras take care of their chicks.

B. Mutualism because the fairy prions are good at building burrows and the tuataras are good at hunting the beetles that live in the burrows.
C. Commensalism because the fairy prion population is not negatively affected by the tuataras, but the tuataras benefit from sharing burrows with the fairy prions.
D. Commensalism because the fairy prions benefit from having the tuataras to guard their chicks, and the tuataras benefit from living in the burrows of the fairy prions.

LO7.2 Attini tribe ants, also known as Fungus-growing ants, are known for cutting grasses and leaves and carrying them to their colonies' nests. They use the grasses and leaves to grow fungi that they eat. The ant larvae eat only one kind of fungus. The fungi cannot survive without the constant care of the ants. The ants provide the fungi with digested leaf material. They can also sense if a leaf species is harmful to the fungi, and they keep it free from pests. [What type of relationship is this?]

A. Parasitism because the fungi can't survive without the ants.
B. Parasitism because the ants grow the fungus to eat it.
C. Mutualism because the ants cut the grasses and leaves, and the fungus grows on the leaves
D. Mutualism because the ants eat the fungus they grow on the leaves, and the fungus can grow because the ants feed it and take care of it.

LO7.1b In a forest, there are two species of birds: Species X and Species Y. Species X is a large bird that builds nests high up in the trees. Species Y is a smaller bird that often builds its nests lower down in the same trees. Species X sometimes preys on the eggs and chicks of Species Y, but this doesn't significantly impact Species Y's overall population. The presence of Species X in the area scares away predators that would otherwise eat Species Y's eggs and chicks. Species Y has no noticeable effect on Species X's population or behavior. What best describes the relationship between Species X and Species Y?

A. Mutualism, because Species Y benefits from the protection provided by Species X, and Species X benefits from preying on Species Y's eggs and chicks.
B. Mutualism, because both species benefit from nesting in the same trees, as it confuses predators.
C. Commensalism, because Species Y's population is not significantly harmed by Species X, but Species Y benefits from the presence of Species X scaring away predators.
D. Commensalism, because Species X benefits from preying on Species Y's eggs and chicks, while Species Y is unaffected by the presence of Species X.

LO7.3 There are two species of oxpecker, the yellow-billed and the red-billed. The oxpeckers eat ticks and other external parasites that live on large mammals, as well as blood, mucus,

dandruff and ear wax. Parasites such as ticks can pass on deadly diseases as well as draining the blood of their mammal host. Oxpeckers spend their days clinging to large mammals, such as giraffes, buffalos, rhinos, hippos and antelope, feeding off the parasites they find infesting the animals' fur. Because a rhino's skin is very sensitive, ticks and parasites that live on it can be irritating to the rhino. The ticks and parasites are a delicious meal for the oxpeckers. While the oxpeckers keep their host animals well groomed, recent research suggests that the oxpecker does not significantly decrease the number of parasites on the animals. The oxpeckers also act as lookouts - watching for danger. When danger approaches, the oxpecker makes a sound that warns its host that there is a threat nearby. This gives the animal time to either fight or flee. Rhinos do not have good eyesight, so the oxpecker's warnings about danger are very beneficial to the rhinos. What kind of ecological interaction do rhinos and oxpeckers have?

A. Mutualism because the oxpecker gets food from the rhino and the rhino gets warned of danger by the oxpecker
B. Mutualism because the oxpecker gets food from the rhino and the rhino has fewer parasites because of the oxpecker
C. Commensalism because the oxpecker does not significantly decrease the number of parasites on the rhino, and the rhino does not affect the oxpecker.
D. Commensalism because the rhino benefits from the oxpecker's warning of danger, and the oxpecker benefits from eating parasites on the rhino.

LO7.2b In the ocean, there is a small fish called a cleaner wrasse. These fish have a special relationship with larger fish, like groupers. The cleaner wrasse eats parasites and dead skin off the grouper's body, keeping the grouper healthy. What type of relationship exists between the cleaner wrasse and the grouper?

A. Commensalism, because the cleaner wrasse benefits while the grouper is unaffected.
B. Commensalism, because the grouper benefits while the cleaner wrasse is unaffected.
C. Mutualism, because the cleaner wrasse gets food and the grouper gets cleaned.
D. Mutualism, because both fish are protected from predators while they interact.

LO7.3b In the tropical forests of South America, there is a species of ant called the Azteca ant that lives in a special relationship with a type of tree known as the Cecropia tree. The Azteca ants make their nests inside the hollow stems of the Cecropia tree. The tree provides the ants with a place to live and produces nutrient-rich food bodies for the ants to eat. In return, the Azteca ants fiercely defend the Cecropia tree from herbivorous insects and other plants that might try to grow on or around the tree, effectively protecting the tree from competition and damage. However, research has demonstrated that the presence of the Azteca ants does not significantly impact the insect population in the area. Considering the information provided,

what type of ecological relationship is most likely occurring between the Azteca ants and the Cecropia tree, and why?

A. Commensalism, because the ants benefit from living in the tree and eating the food bodies, while the tree is not significantly affected by the ants' presence.
B. Parasitism, because the tree expends energy to support the ants, but the ants do not provide a significant benefit to the tree in terms of reducing herbivore damage.
C. Mutualism, because even though the ants do not significantly reduce insect populations, the tree still benefits from the ants' presence, such as through protection from competition, while the ants receive shelter and food from the tree.
D. Neutralism, because the ants and the tree do not seem to have a significant effect on each other, as the ants do not greatly reduce herbivore damage and the tree continues to support the ants despite this.

***Symbiosis and Other Relationships*: Teacher End-of-Implementation Survey**

Instructions: Thank you for taking the time to participate in this pilot study. We appreciate and celebrate your commitment and efforts! The purpose of this survey is to learn about your experience implementing the activities and lessons on the basics of ecological relationships. The questions ask about your challenges using the module, your plans for future use, and your observation and impression of students' learning. We are also interested in how our module compares to others you have used in the past and your overall assessment of the module. We invite you to share your honest opinions with us and kindly ask you to be as detailed as possible. Our goal is to improve the module for future users; your feedback is invaluable to our work and will benefit teachers and students worldwide!

Background Information

1. **Name:** _____
2. **What grade level are your students who participated in the activities? (Select all that apply)**
    - 6th
    - 7th
    - 8th
    - 9th
3. **Which class type best describes the class(es) you teach?**

Class Period	General	Honors	AP	Not Applicable
Period 1	o	o	o	o
Period 2	o	o	o	o
Period 3	o	o	o	o
Period 4	o	o	o	o
Period 5	o	o	o	o
Period 6	o	o	o	o

Student Engagement

4. **On a scale of 0-5, with 0 being not applicable and 5 being the most engaged, please rate your students' engagement in the following activities:**

Activity	0 1 2 3 4 5
Meet the Soybean Looper (video)	o o o o o o
Caterpillars! (pdf)	o o o o o o
Meet the Parasitic Wasp (video)	o o o o o o
What's the Relationship? (pdf)	o o o o o o
Interwoven Life Cycles (explore)	o o o o o o
Examples of Symbiosis (video)	o o o o o o
EcoTrios & Symbiotic Strategies (pdf)	o o o o o o

5. **Meet the Soybean Looper (video) - Briefly describe the students' engagement. Include what went well and any challenges.**

6. **Caterpillars! (pdf) - Briefly describe the students' engagement. Include what went well and any challenges.**

7. **Meet the Parasitic Wasp (video) - Briefly describe the students' engagement. Include what went well and any challenges.**

8. **What's the Relationship? (pdf) - Briefly describe the students' engagement. Include what went well and any challenges.**

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9. **Interwoven Life Cycles (explore) - Briefly describe the students' engagement. Include what went well and any challenges.**

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10. **Examples of Symbiosis (video) - Briefly describe the students' engagement. Include what went well and any challenges.**

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11. **EcoTrios & Symbiotic Strategies (pdf) - Briefly describe the students' engagement. Include what went well and any challenges.**

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12. **How do you know when your students understand a concept? Please give an example from the teaching of the current module.**

Teacher Practices

13. **Think about how often your students typically engaged in the following practices PRIOR to your use of the *Symbiosis and Other Relationships* module: Scale: 1 = Never, 2 = Sometimes, 3 = About half the time, 4 = Most of the time, 5 = Always**

Practice	1 2 3 4 5
Develop scientific questions which guide experimental design?	O O O O O
Use questions to critique experimental design or scientific models?	O O O O O
Develop models and use them to explain scientific concepts?	O O O O O
Develop and revise models based on evidence to make predictions about scientific phenomena?	O O O O O
Use the same set of steps to reach a conclusion in a project or experiment?	O O O O O
Plan and conduct their own investigations to answer their own questions?	O O O O O

Engage in analysis (statistical processing, graphing, etc.) to make sense of data?	O O O O O
Consider the limitations of data collection and analysis?	O O O O O
Use mathematical and/or computational models to identify relationships in data?	O O O O O
Use mathematical and/or computational models to make and test predictions?	O O O O O
Make explanations based on data and current scientific understanding?	O O O O O
Employ a claim, supporting evidence, and connecting reasoning when constructing explanations of their findings?	O O O O O
Construct written and/or oral arguments based on data and evidence?	O O O O O
Engage in critiquing one another's scientific arguments based on evidence?	O O O O O
Engage in reading and evaluating scientific information from multiple authoritative sources?	O O O O O
Communicate scientific ideas using multiple representations (oral, graphic, textual, mathematical)?	O O O O O

14. **How often did the CURRENT MODULE and its activities support your students to: Scale: 1 = Never, 2 = Sometimes, 3 = About half the time, 4 = Most of the time, 5 = Always**

Practice	**1 2 3 4 5**
Develop scientific questions which guide experimental design?	O O O O O
Use questions to critique experimental design or scientific models?	O O O O O
Develop models and use them to explain scientific concepts?	O O O O O
Develop and revise models based on evidence to make predictions about scientific phenomena?	O O O O O
Use the same set of steps to reach a conclusion in a project or experiment?	O O O O O
Plan and conduct their own investigations to answer their own questions?	O O O O O
Engage in analysis (statistical processing, graphing, etc.) to make sense of data?	O O O O O
Consider the limitations of data collection and analysis?	O O O O O
Use mathematical and/or computational models to identify relationships in data?	O O O O O

Use mathematical and/or computational models to make and test predictions?	○○○○○
Make explanations based on data and current scientific understanding?	○○○○○
Employ a claim, supporting evidence, and connecting reasoning when constructing explanations of their findings?	○○○○○
Construct written and/or oral arguments based on data and evidence?	○○○○○
Engage in critiquing one another's scientific arguments based on evidence?	○○○○○
Engage in reading and evaluating scientific information from multiple authoritative sources?	○○○○○
Communicate scientific ideas using multiple representations (oral, graphic, textual, mathematical)?	○○○○○

15. **Please rank the below practices (1-8) to indicate how important you feel they are in helping students fully understand science core ideas:**
    ___ Analyzing and Interpreting Data
    ___ Asking Questions
    ___ Constructing Explanations
    ___ Developing and Using Models
    ___ Engaging in Argument from Evidence
    ___ Obtaining, Evaluating, and Communicating Information
    ___ Planning and Carrying out Investigations
    ___ Using Mathematics and Computational Thinking
16. **Please rank the below practices (1-8) to indicate how the current module and its activities supported students to fully understand science core ideas:**
    ___ Analyzing and Interpreting Data
    ___ Asking Questions
    ___ Constructing Explanations
    ___ Developing and Using Models
    ___ Engaging in Argument from Evidence
    ___ Obtaining, Evaluating, and Communicating Information
    ___ Planning and Carrying out Investigations
    ___ Using Mathematics and Computational Thinking
17. **Which parts of this module and/or its activities supported the scientific practices you identified as the top 3 most important?**

18. **How important is it that the science units you teach are based on the current work of scientists and use their actual lab data?**
    - ○ Not important at all
    - ○ Low importance
    - ○ Of neutral importance
    - ○ Generally important
    - ○ Extremely important
19. **Please expand on your thoughts about the relative importance or unimportance of using actual lab data in your instruction.**

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20. **To what degree did this module provide opportunities to engage in discussions with your students about how science is done within a research lab?**
    - ○ This module did not directly provide opportunities to talk about how science is done within a research lab
    - ○ This unit provided a few opportunities to talk about how science is done within a research lab
    - ○ This unit provided several opportunities to talk about how science is done within a research lab
21. **Did the current module and its activities support students' interests in science?**
    - ○ Yes
    - ○ No
    - ○ Maybe

Overall Impressions

22. **Overall, what did you like most about the activities?**

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23. **Overall, what did you like least about the activities?**

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24. **How would you describe these materials to other teachers?**

Future Use

25. **Do you plan to use these activities or parts of these activities in future years?**
    - ○ Yes → *Continue to Question 26*
    - ○ No → *Skip to Question 28*
    - ○ I'm not sure → *Continue to Question 30*
26. **[DISPLAY IF Q25 = Yes] How do you plan to use these activities in future years?**
    - ○ I plan to use the activities as-is (i.e., all lessons, in the specified order, with no outside resources) → *Continue to Question 30*
    - ○ I plan to use the activities with modifications → *Continue to Question 27*
    - ○ I plan to use only select activities from the list (i.e., I will cherry-pick from the list) → *Skip to Question 29*
27. **[DISPLAY IF Q26 = modifications] Which describes the modifications you plan to make? (Select all that apply)**
    - ○ Supplementing with additional materials
    - ○ Replacing some of the activities with materials from other sources
    - ○ Changing the sequence of the activities
    - ○ Other: _____

    Continue to Question 30

28. **[DISPLAY IF Q25 = No] Please explain why you do not plan to use some of these activities in the future.**

    _____

    Continue to Question 30

29. **[DISPLAY IF Q26 = cherry-pick] Which select activities from the list do you plan to use?**

    _____

    _____

Student Outcomes

30. **In terms of achieving student learning, how did the materials compare to other lessons you have used to teach similar content?**
    - ○ It was better than the other materials I've used in the past
    - ○ It was as good as the other materials I've used in the past
    - ○ It was not as good as the other materials I've used in the past

- ○ Some activities were as good as or better than other materials I've used in the past. Some parts were not as good
- ○ I have never taught this content to my students before this

31. **Please explain your answer above.**

32. **Which parts of the module were most effective for student learning?**

33. **Which parts of the module were least effective for student learning?**

Implementation Experience

34. **How prepared did you feel to introduce, wrap up, and transition between activities?**
    - ○ Very prepared
    - ○ Somewhat prepared
    - ○ Unprepared
    - ○ Hard to say/unsure
35. **Please comment if you would like to explain your answer.**

36. **How easy was it for you to find the information you needed when you needed it?**
    - ○ Very easy
    - ○ Somewhat easy
    - ○ Not easy
    - ○ Hard to say/unsure
37. **Please comment if you would like to explain your answer.**

38. **What was the average time that it took you to complete the following activities?**

Activity	Average Time (in Minutes)
Meet the Soybean Looper (video)	_____
Caterpillars! (pdf)	_____

Meet the Parasitic Wasp (video) _____
What's the Relationship? (pdf) _____
Interwoven Life Cycles (explore) _____
Examples of Symbiosis (video) _____
EcoTrios & Symbiotic Strategies (pdf) _____

39. **Were you able to complete all the components of the following activities?**

Activity	Yes	No	N/A
Meet the Soybean Looper (video)	o	o	o
Caterpillars! (pdf)	o	o	o
Meet the Parasitic Wasp (video)	o	o	o
What's the Relationship? (pdf)	o	o	o
Interwoven Life Cycles (explore)	o	o	o
Examples of Symbiosis (video)	o	o	o
EcoTrios & Symbiotic Strategies (pdf)	o	o	o

40. **If you answered "no" to any of the above, please provide details.**

Thank you so much for your feedback! We are grateful that you took the time to participate in this project and to provide your feedback on this survey. Your contributions will help make this module more successful for future teachers and students.