# Reflection Section Possible Answers

The following section provides a guide to possible answers to the reflection questions found in each section of the articles. Reflection Sections are meant to stimulate critical thinking about the article, not to test knowledge. Use the answers below as a guide to stimulate critical thinking and discussion in your classroom.

***Moving Spore-adically***

## Introduction

- **What is the problem the scientists wanted to study?** The problem is that sudden oak death, a disease that can damage or kill trees, is spread from tree to tree within a forest. The scientists wanted to know how sudden oak death is spread from tree to tree in order to try to stop it.
- **Which type of tree would you guess is most often killed by the organism that causes sudden oak death?** Oak.

## Method

- **What would the scientists learn by comparing the number of spores found after a rain in buckets placed in increasing distances from infected bay laurel trees?** They would learn about how far the spores travel from affected trees across open spaces during a rain.
- **What is the difference between the spores found in the rainwater traps and in the buckets?** The rainwater traps would tell the scientists how many spores can travel from infected trees in the forest through rain to the ground. The bucket traps would tell the scientists how far spores can travel from infected trees across open spaces during a rain.
- **What would the scientists learn from floating leaves in the stream?** The floating leaves would become infected with sudden oak death if spores were in the stream. This part of the experiment would tell the scientists if spores were in the stream within the forest and, if so, if the spores could survive in the water 1 kilometer downstream of the forest.
- **What would the scientists learn from the students' hike?** The scientists would learn whether spores from infected trees would get in the soil and then onto the students' shoes. They would learn whether the spores would remain on the shoes after a 2.4-kilometer walk. This finding would tell the scientists whether hikers can transport sudden oak death if they walk through a forest with infected trees.

## Findings

- **Basing your answer on the findings, would you say sudden oak death can be transported by water? Why or why not?** Yes. The evidence indicates that the spores that cause sudden oak death are transported by rainwater and down streams.
- **Basing your response on the findings, would you say that people can transport the spores that cause sudden oak death? Why or why not?** Yes. The student hiking experiment showed that spores are in the soil and can be transported after the soil gets onto hikers' shoes.
- **Basing your answer on the findings, under what weather conditions would you say the transportation of spores is more likely to occur?** During the rainy season, or when it rains.

## Discussion

- **Do oak trees live in your area? What do you think would happen if sudden oak death began to kill those trees?** These questions are for individuals and each

student should come up with his or her own ideas. Some potential answers include: (1) Animals that use oak trees for food and habitat would no longer have a place to live, (2) the beauty of oak trees, including what they contribute to the area, would be lost, and (3) the ecology of forests with a lot of oak trees would be changed.

- **Do you think research should be done on sudden oak death outside California? Why or why not?** Yes. Because sudden oak death can kill oak trees and is easily transported from tree to tree in California, it would be best to know how it might be transported in areas outside California and which trees might be affected.

### *And Then There Were Nun*

## Introduction

- **In your own words, state the question the scientist wanted to answer.** Which tree species in the United States are most likely to be the preferred habitat of the nun moth?
- **What is the advantage of knowing in advance which tree species might be the preferred habitat of the nun moth?** If the nun moth were found in the United States, people would already know which tree species the moths prefer as habitat. People could stop the spread of the nun moth by cutting down those trees within the area where the moths were found, or by otherwise controlling the moths before they spread.
- **The scientist did this study in the Northeastern United States. Do you think she studied the moths inside or outside a laboratory? Explain your answer.** The scientist had to do her study inside a laboratory because she did not want any eggs, larvae, or moths to escape into the outside environment.

## Method

- **What did this experiment enable the scientist to discover?** The scientist discovered which species of foliage kept larvae alive and which species of foliage supported the development of larvae into pupae.
- **When the scientist placed fresh foliage in each container, do you think she used the same species of foliage that she had removed from that container? Why or why not?** Yes. If she used foliage from a different tree species, she would have no way of knowing which species of foliage supported the larvae's development.
- **Why do you think the scientist wanted to discover what percentage of larvae became pupae?** If the scientist had stopped the entire experiment at 14 days, she might have overestimated the percentage of healthy larvae. Some larvae may have lived but might never have become pupae.

## Findings

- **What species of trees do nun moth larvae prefer to eat?** Most conifer species and many oak species appear to be preferred by nun moth larvae.
- **Do you think these findings are good news or bad news for people worried about the invasion of nun moths into the United States? Why?** These findings would be bad news for people worried about a possible nun moth invasion because nun moth larvae appear to survive on a wide variety of tree species that are found in the United States.

## Discussion

- **Trees are important to people in forest industries, such as those using trees for wood products. Many industries that depend on forests might need the trees alive and healthy. What other forest-dependent industries could be affected by a nun moth invasion?** You may need to

encourage your students to think outside the box. One forest industry that encompasses many different businesses is the tourism industry. If many trees are damaged or die from a nun moth invasion, people may not want to visit the forest for recreational activities such as hiking, bird watching, camping, and boating. This lack of visitors could affect businesses such as hotels, stores, restaurants, and recreation guides. Your students may think of other industries that could be affected.

- **In addition to economic problems, what other kind of problems might be created by the damage or loss of a large number of trees in a forest?** It would cause a lot of environmental damage, which could include the loss of habitat for animals, increased erosion that results in loss of soil and in water siltation, and a loss of tree diversity.
- **What is one way we can protect trees in the United States from a possible nun moth invasion?** Your students may come up with a variety of suggestions. Some obvious ones include: (1) Carefully inspect wooden packing crates for nun moth larvae before allowing them into United States ports, and (2) teach people how to identify nun moths so that if they do come into the United States, they can be dealt with before they spread.

***Knocked Out by Trout***

## Introduction

- **Basing your response on the information presented in the "Introduction," state in your own words what the scientists expected to find out about the population of Pacific tree frogs in JMW compared with KCNP. Then, give the reason for your statement.** Your students may state it differently, but in essence, they should state that the scientists expected that the population of Pacific tree frogs would be lower in JMW than in KCNP. The reason for this expected answer is the higher population of nonnative trout found in JMW compared with KCNP.
- **You read about the concept of experimental control in "Thinking About Science." (If you need a reminder, reread that section.) Which variable did natural resource management control, enabling the scientists to study the effect of nonnative trout on Pacific tree frog populations?** The number of nonnative trout living in the lakes in JMW and KCNP was controlled by the natural resource managers.

## Method

- **Why did the scientists not include the presence of nonnative trout in their first calculations?** If the number of tree frogs was about the same between JMW and KCNP, then the number of nonnative trout did not affect the population of tree frogs, and the scientists would have no reason to count their presence or absence.
- **Basing your thoughts on previous scientific findings about the presence of nonnative trout and the population of mountain yellow-legged frogs, do you think the scientists found a difference in the populations of Pacific tree frogs in JMW and KCNP? Why or why not?** Yes. One would expect to find a difference based on the previous research. The previous research indicated that when nonnative trout are present, the population of frogs is lower than in areas where nonnative trout are not present.

## Findings

- **Why do you think the scientists considered things such as the size and depth of the lakes and how much silt was in them?** The scientists considered that these other things could also influence the presence and number of tree frogs in a lake. If they did not consider these things, they would not know for sure whether the number

of tree frogs in a lake was due to the lake's characteristics or whether it was due to the presence and number of nonnative trout.

- **After reading the "Findings" section above, would you conclude that the presence of nonnative trout had an effect on the number of tree frogs in a lake? Why or why not?** Yes. The evidence shows that after considering the characteristics of the lakes, the presence and number of nonnative trout had the strongest relationship with a lower number of tree frogs.

## Discussion

- **Garter snakes are a source of food for skunks found in the Sierra Nevada mountains. Basing your thoughts on what you know about food webs and the results of this research, do you think it is likely or unlikely that continued stocking of nonnative trout could affect the population of skunks in the Sierra Nevada mountains? Why?** It seems likely that a reduction in an animal population's food source would affect its numbers. If fewer tree frogs are available as food and the population of garter snakes is therefore reduced, it seems likely that the population of skunks could be affected as well. Your students might have different explanations, such as the skunks finding a new food source. Above all, the students should be able to support their answers.

***Shoot! Foiled Again!***

## Introduction

- **Explain in your own words how verbenone protects the beetle population but not the pine trees.** The verbenone is emitted from individual beetles as they reproduce, eat, and grow. When a large number of beetles is on a tree, the combined amount of verbenone tells other beetles that many beetles are already present. This message discourages more beetles from attacking the tree and, therefore, encourages them to find new trees. The number of beetles present at this point is already high enough to damage or kill the tree.
- **In your own words, ask one question the scientists wanted to answer.** (1) Can verbenone be used to discourage pine shoot beetles from attacking pine trees? (2) Can other volatiles, such as those from broadleaf trees, be used to discourage pine shoot beetles from attacking pine trees? Your students may state these questions a little differently.

## Method

- **Explain in your own words what the scientists might learn from each of the four sets of traps (from figure 6).** The first set of traps is a control. With no chemicals, it provided a way to equally compare each of the other traps. The second set contained the chemical that attracts pine shoot beetles to Scots pine. This set of traps told the scientists how many beetles would be attracted in the absence of any repelling chemical. The third set of traps contained the attractant and the broadleaf chemicals that might discourage beetles. This set of traps, when compared with the second set, told the scientists how many beetles might be discouraged from Scots pine trees when using chemicals from broadleaf trees. The fourth set of traps contained the attractant, the broadleaf chemicals for discouraging beetles, and the verbenone, which should also discourage beetles. This set of traps, when compared with the third set, told the scientists how many more beetles might be discouraged from Scots pine trees with the addition of verbenone to the broadleaf chemicals.
- **Why do you think the scientists repeated the experiment 10 times on each plantation?** The more traps that could be set and compared, the more confidence the

scientists could have in their results. If the traps set in different areas of the plantation showed different results, then the scientists might suspect that something more than the chemicals was affecting the behavior of the beetles. If the results were similar across all experiments, then the scientists could assume that the beetles' behavior was the result of the different chemicals in the traps.

## Findings

- **Look at table 1. Would you say the Scots pine volatiles attracted pine shoot beetles to the traps? Why or why not?** Yes. The average number of beetles caught was much higher than in the control, which contained no attractant.
- **If you were one of the scientists, what would you tell people who manage holiday tree plantations about the use of chemicals to discourage pine shoot beetle damage?** I would tell them they can discourage the pine shoot beetle by using broadleaf volatiles or a combination of broadleaf volatiles and verbenones.

## Discussion

- **Why do you think the broadleaf volatiles discourage the pine shoot beetle from attack?** Because the broadleaf volatiles smell like a broadleaf tree to the beetle. Broadleaf trees are not the preferred habitat of the beetle. The beetle is fooled into thinking the tree is a broadleaf, not a pine.
- **Do you think these findings are important to people who grow holiday pine trees for sale during the winter holiday season? Why or why not?** Yes. If the pine shoot beetle damages or kills too many holiday trees, the trees will not be available for sale. If the people who grow these trees cannot sell them, they will lose money.

***Tag, You're It!***

## Introduction

- **State in your own words the question the scientist wanted to answer through this research.** About how far do Asian long-horned beetles fly in a day's time?
- **If the Asian long-horned beetle were found again in the United States, how would forest managers use the scientist's information to help them destroy the insects?** They could determine approximately how far and how fast the insects would disperse. This information would help them determine how large an area they would need from which to remove and burn the trees.
- **If a different insect pest were found in the United States, should forest managers use this information about the Asian long-horned beetle to tell them how far the insect might fly? Explain.** If the insect pest were similar to the Asian long-horned beetle, the information learned in this study could be used as a guide, if no other information were available. Different insect species behave differently, however, and it could be disastrous to use information learned about one insect and apply it to the behavior of another.

## Method

- **Do you think the scientist should have done this study in the United States? Why or why not?** No. The Asian long-horned beetle is an insect pest in the United States. It might be disastrous to do this study in the United States. Beetles would likely escape from the study area and destroy trees.
- **What would have happened if the scientist had forgotten to paint a number on each beetle?** The scientist would have no idea how far each beetle had dispersed, because he would have no way of knowing which beetle was which.

## Findings

- **Why do you think the beetles moved only either east or west and did not move north or south? (Hint: Reread the second paragraph in the "Method" section.)** The study site was a row of willow trees growing along a highway with agricultural land on either side. Therefore, the beetles were most likely to fly from tree to tree, which were lined up east to west.
- **Do you think this study completely answers the question of how far Asian long-horned beetles travel? Why or why not?** The study does not completely answer the question because its findings were different from other findings. It gives a clue about the relationship between distance traveled and air temperature. It also provides a clue as to the relationship between the sexual maturity of females and whether and how far they will travel.

## Discussion

- **In what way could a few female beetles traveling 30 meters pose a threat to American trees?** If the females laid eggs, those eggs could hatch and the population of Asian long-horned beetles would increase. To control the beetle population, forest managers might have to cut down hundreds or thousands of trees.
- **From the results of this study, what might you conclude about the dispersal of Asian long-horned beetles?** You might conclude that higher air temperatures slow the dispersal of beetles. You might also conclude that after a beetle begins to move, he will most likely continue to move in the same direction. You might also conclude that female beetles that are ready to lay eggs will be less likely to travel than female beetles that are not yet ready to lay eggs.

*Hurry Up and Wait*

## Introduction

- **What human actions caused the problem we now have with Oriental bittersweet? What actions might be taken today to help solve the problem?** On the surface, the answer would be that we imported Oriental bittersweet as an ornamental plant, and this action certainly started the problem. You can challenge your students, however, to consider other actions that have expanded the current problem. Other actions include gardeners being careless with the plant and allowing it to escape from gardens. They also include using the plants for indoor arrangements, then discarding the plants outdoors along with their seeds. Actions that might help solve the problem include educating people about the danger posed by Oriental bittersweet and helping people identify the plant. People could also learn how to remove or destroy the plant when they find it.
- **If you were the scientist, how would you set up an experiment to compare the amount of seed germination and growth under different amounts of shade and sunlight?** You could take the seeds and plant them in containers. Then you could place them under different amounts of sunlight and shade and compare their germination and growth. You can ask your students to be as specific as possible as they think about how they would do this experiment.

## Method

- **What is the reason the scientists used shadecloth to cover the four groups of containers and a quantum sensor to measure the amount of sunlight reaching them?** By using shadecloth, the scientists could control the amount of sunlight reaching the containers. By using the quantum sensor,

they could know exactly what percentage of sunlight was reaching each group of containers.

- **Why did the scientists count the number of leaves and measure the roots and stems of each plant?** The scientists needed a way to compare the growth rate of the plants. By counting and measuring, the scientists could compare the plants' growth. Counting and measuring provided a way to compare the plants without introducing personal opinion or evaluation into the process.

## Findings

- **Basing your answer on what you know about plant germination, does it surprise you that Oriental bittersweet germinated and grew at about the same rate, regardless of the amount of sunlight? Why or why not?** Students should know that most plants will germinate better either in more sunlight or in less sunlight, depending on the unique needs of the plant. It is unusual for a plant to germinate and grow almost equally regardless of the amount of sunlight it receives. Students should be able to back up their answers with their own evidence or knowledge.
- **Reread the second paragraph in the "Introduction." What do you think would happen to the plants in the five groups if the scientists had let the plants grow for another 100 days before measuring them?** The Oriental bittersweet plants growing in 100 percent and 70 percent sunlight should grow much faster and have more leaves than the plants in the more shaded conditions.

## Discussion

- **Do you think Oriental bittersweet could become a bigger threat to native forests in the future? Why or why not?** Oriental bittersweet will likely become a bigger threat in the future. The reasons are that it can germinate and grow in shaded conditions, and it can sit and wait until an area is open to sunlight before it grows quickly and further reproduces. Regardless of the answers your students give, they should be able to back up their answers with observations, knowledge, or logic.

### *Goll-ly! Don't Take a Knapweed!*

## Introduction

- **In your own words, state how spotted knapweed and gall flies have changed some things for deer mice living in the arid grassland in this study.** The spotted knapweed has reproduced so much that native grasses and other native plants are overtaken and choked out. The addition of gall flies has caused the feeding cycle of deer mice to change. They now can eat as much as they want from September to May. Then in the summer, their food source is reduced. This situation is the opposite of their natural cycle. This change may also be causing the population of deer mice to increase because of the wide availability of food for much of the year.
- **What question did the scientists want to answer?** Is the population of deer mice higher in areas where spotted knapweed has overtaken native plants and gall flies have been released to control it?

## Method

- **Why did the scientists select two large areas to study—one ecosystem with nonnative knapweed and the other a native ecosystem without knapweed?** The question the scientists wanted to answer required them to compare a native ecosystem with a grassland area that had been overtaken by nonnative knapweed.
- **Why was each deer mouse given a different number?** Each deer mouse was

given a different number so the scientists could tell if they had trapped the same mouse twice. Also, when recording the weight and sex of each mouse, the number helped to identify it as an individual.

- **Why did the scientists collect information over 3 years?** The only way the scientists could compare fall and spring populations was to collect information over more than 1 year. In addition, the more times and the more different conditions under which the scientists were able to compare the numbers of mice, the more confidence they could have in their findings.

## Findings

- **Reread the last paragraph in the "Introduction" section. Was the scientists' prediction correct? What is the evidence?** Yes, the scientists' prediction of a larger population of deer mice in spotted knapweed sites was correct. The evidence is shown in figures 8 and 9, which indicates that, overall, larger numbers of deer mice were in spotted knapweed sites.
- **During the summer when gall fly larvae are not available, the population of deer mice living in areas with spotted knapweed eats more native seeds and insects than it normally would eat simply because the total number of individuals is higher. How might an overall increase in the number of deer mice affect the native seeds and insects?** As predators of insects and seed eaters, an increase in the number of deer mice, along with a decrease in other food, would cause the number of insects and seeds to be reduced.
- **Do you think the introduction of invasive species can upset the ecology of any area? Using this study as an example, explain your answer.** Yes. In this study two nonnative species have been introduced. The introduction of these two species has caused a change in the number of deer mice, which ultimately will have an impact on other plants and animals in the ecosystem.

## Discussion

- **Basing your response on the findings and implications of this study, what would you conclude about using nonnative species to control invasive ones?** You might conclude that before using nonnative species to control invasive species, you should give careful thought to the problem and do research to predict and protect against any harmful results that might happen to other plants and animals in the ecosystem.
- **Purple loostrife is an invasive plant. Scientists recently found that Galerucella beetles, native to Europe and Asia, help control purple loostrife by eating its leaves. How does this information change your answer to the question above?** If you concluded that nonnative species should not be used to control invasive species, this information will help you see that, in some cases, using nonnative species may be the best approach to controlling invasive species.