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