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## Science Research Summary Questions: Strategies and Sample Questions

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- Focus on the purpose of the study or experiment(s), their differences, similarities, and outcomes, and how many were completed.
- Consider possible hypotheses or generalizations that can be made from the results.
- Watch for the methods used and the design of each study or experiment.
- Notice what may be suggested by the evidence or outcome and how the data were obtained and kept.
- Understand how the data are displayed (table and/or figure).
- Reason from the information and draw conclusions.

### *Sample passage:*

Buckeye caterpillars take and store certain chemicals such as iridoid glycosides from their host plants. Wolf spiders prey upon buckeye caterpillars for food. Scientists have noted that these spiders prefer some buckeye caterpillars to others. They hypothesize that spiders have taste preferences that vary according to which plants the caterpillars eat.

In order to determine whether wolf spiders find buckeye caterpillars that store iridoid glycosides unpalatable (not pleasing to taste), two experiments were conducted—one in the field and one in the laboratory. For both experiments, two types of caterpillars were used—those reared on *Plantago lanceolata* (containing very high levels of iridoid glycosides) and those raised on *P. major* (containing very low levels of iridoid glycosides).

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### Experiment 1—In the Field

Spiders were located in the field at night by headlamp and were randomly offered either a buckeye caterpillar raised on *P. lanceolata* or a buckeye caterpillar raised on *P. major*. Figure 1 compares the acceptability of these two types of caterpillars to the spiders.

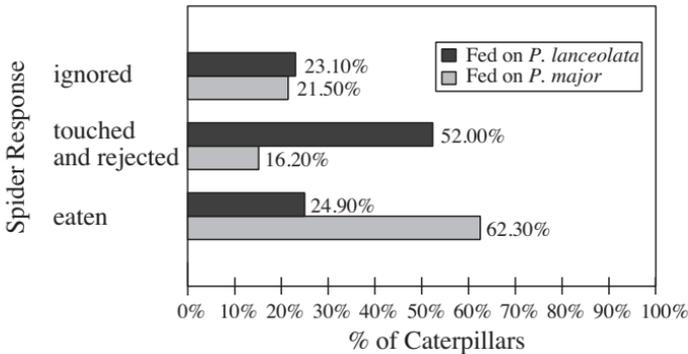


Figure 1

### Experiment 2—In the Lab

This experiment was conducted with 50 spiders collected in the field. Ten trials were conducted per spider. Every third day for approximately one month, two buckeye caterpillars were offered to each spider—one caterpillar raised on *P. lanceolata* and one raised on *P. major*—and spider responses were recorded. Figure 2 shows percentage of caterpillars eaten, and Figure 3 shows spider response, where higher values indicate greater acceptability of the caterpillar to the spider.

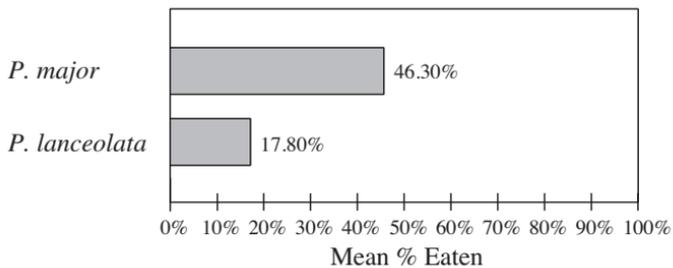


Figure 2

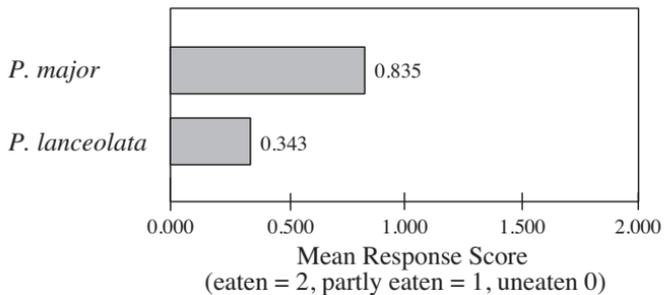


Figure 3

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**Focus on the purpose of the study or experiment(s), their differences, similarities, and outcomes, and how many were completed.** You may wish to underline or circle similarities and/or differences in the studies and outcomes.

*Sample:*

1. How is the design of Experiment 1 different from the design of Experiment 2?
  - F. In Experiment 1, trials give spiders no choice, whereas in Experiment 2, trials give spiders a choice.
  - G. In Experiment 1, trials give spiders a choice, whereas in Experiment 2, trials give spiders no choice.
  - H. In Experiment 1, spider responses are examined, whereas in Experiment 2 caterpillar responses are examined.
  - J. In Experiment 1, caterpillar fates are examined, whereas in Experiment 2, spider fates are examined.

As you focus on each experiment in this passage, you should notice or mark the differences. In Experiment 1, field spiders weren't given a choice when presented with caterpillars for food. In Experiment 2, lab spiders were presented with a choice between caterpillars fed on *P. major* and caterpillars fed on *P. lanceolata*. So choice **F** is correct.

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**Consider possible hypotheses or generalizations that can be made from the results.** Here you should consider important data and how the information relates to the results of each experiment.

*Sample:*

2. On the basis of the experimental results, one can generalize that which of the following is responsible for protecting buckeye caterpillars from being eaten by wolf spiders?
- A. Bitter-tasting chemicals in certain plants
  - B. Sour-tasting chemicals in certain plants
  - C. *P. major*
  - D. Iridoid glycosides in the caterpillars

Three of the answer choices are very similar, so you should take care to choose the answer that is the most specific and directly related to material in the passage. Since the data indicate that spiders ate significantly more *P. major*-reared caterpillars, choice C is incorrect. Of the remaining three possible answers, choice D is the only one that is supported by information in the passage and is therefore the correct answer.

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**Watch for the methods used and the design of each study or experiment.** In some cases, scientists make an assumption in setting up an experiment or study. Focusing on the methods and design will help you understand what is being assumed.

*Sample:*

3. All of the following are unstated assumptions of the experimental design EXCEPT:
- F. wolf spiders make distinctions between caterpillars based on taste.
  - G. wolf spiders avoid caterpillars that do not taste good to them.
  - H. iridoid glycosides are nontoxic (not poisonous) to wolf spiders.
  - J. iridoid glycosides are nontoxic (not poisonous) to buckeye caterpillars.

The experimental design does *not* assume that iridoid glycosides are nontoxic to wolf spiders, choice **H**. If it were so assumed, then the scientists would not have expected that spiders would consistently reject caterpillars raised on plants high in this chemical (which was the case).

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**Notice what may be suggested by the evidence or outcome and how the data were obtained and kept.** Carefully following what actually happened in the experiments will help you spot what this evidence suggests.

*Sample:*

4. During the course of this study, four spiders died in the laboratory. All four of these spiders had eaten only caterpillars reared on *P. lanceolata*. This evidence may suggest that:
- A. iridoid glycosides are poisonous to wolf spiders.
  - B. iridoid glycosides are poisonous to buckeye caterpillars.
  - C. *P. lanceolata* is eaten by wolf spiders.
  - D. *P. lanceolata* is poisonous to buckeye caterpillars.

Wolf spiders don't directly eat *P. lanceolata* (choice C). Instead, they eat caterpillars that store chemicals that are found in this plant. Four spiders that were fed *only* caterpillars high in iridoid glycosides died, which suggests that this chemical may be harmful, and even fatal, to wolf spiders. Choice A is the correct answer.

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**Understand how the data are displayed (table and/or figure).**

How well you understand the method of display can be a major factor in how well you understand the information and outcome. Make sure you understand what the graphically displayed material tells you.

*Sample:*

5. During the course of Experiment 1, some of the caterpillars offered to spiders in the field were released by the spiders after being touched but not yet bitten. This particular behavior may suggest that the spider's detection of a harmful chemical in its prey is:
- F.** restricted to tasting the chemical.
  - G.** not restricted to tasting the chemical.
  - H.** restricted to touching the chemical.
  - J.** not restricted to touching the chemical.

Notice how Figure 1 displays the information. This information (and the information in this question) indicates that spiders may, using the sense of touch, be sensitive to the presence of harmful chemicals in their prey (touch-and-reject). Spider responses of taste-and-reject (indicated by partly eaten caterpillars, as shown in Figure 3) may indicate detection of a harmful chemical by taste. So choices **F** and **H** are incorrect. While both choices **G** and **J** are suggested by the experiments, of the choices given, this *particular behavior* (caterpillars released after being touched but not yet bitten) suggests only choice **G**, which is the correct answer.

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**Reason from the information and draw conclusions.** You must sometimes be able to draw a logical conclusion from the information presented, a conclusion not provided for you in the data. But be sure that the conclusion is *logically based* on the data.

*Sample:*

6. Which of the following conclusions about the relationship between caterpillar diet and caterpillar interactions with wolf spiders would be consistent with the results of the two experiments?
- A. Wolf spiders prefer buckeye caterpillars that have been raised on a diet of *P. lanceolata*.
  - B. Wolf spiders prefer only large buckeye caterpillars that have been raised on a diet of *P. major*.
  - C. Buckeye caterpillars fed on plants low in iridoid glycosides were preferred by wolf spiders to those fed on plants high in iridoid glycosides.
  - D. Buckeye caterpillars fed on plants high in iridoid glycosides were preferred by wolf spiders to those fed on plants low in iridoid glycosides.

For this question, arriving at a logical conclusion based on the data may be best accomplished by a process of elimination. The data clearly indicate that spiders don't prefer caterpillars that have been raised on plants high in iridoid glycosides. So choices **A** and **D** are incorrect. There are two problems with choice **B**. The word *only* is too broad. It could not be determined from these experiments that the spiders have no *other* food preferences (in normal circumstances in the wild, for example). Also, nothing in the data concerns the size of the caterpillars preferred, and this choice indicates a preference for *large* caterpillars. Be careful you don't assume things not based on information given. The best choice here is **C**.