Asking Scientific Questions

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Activity
Student Handout

INTRODUCTION

Nobody likes being told what to do. Indeed, the opposite of being told what to do is making your own choices. It can sometimes feel like a lot of science learning comes from the top down. However, one underappreciated aspect of doing science is that, with a little creativity, you can be free to pursue questions that interest you. What do you want to figure out?

Asking questions and determining the cause for phenomena are at the heart of what many scientists do. In this activity, you will learn how good scientific questions are constructed and engage in these exciting, essential practices as you ask and answer your own scientific questions.

PART 1: Scientific Questions

1. Use the space below to record your observations of the phenomena provided by your instructor. If you are using organisms, spend at least 5–10 minutes observing your organisms and record at least 10 observations.

2. Write down as many questions as you can about your phenomena/organisms in the space below. Be creative!

3. Complete the following tasks.
   a. Mark the questions you wrote for Step 2 that could be answered using the processes of science.
   b. Reflect on the criteria or "rules" you used to decide whether the questions were scientific. Record the rules you used below.

4. Your instructor will provide a Venn diagram summarizing aspects of questions that can and cannot be addressed using the methods of science. Explain how the criteria you described in Step 3 are similar and different from the criteria on the Venn diagram.

One class of questions that are especially valuable in science are comparative questions. Comparative questions ask how some variable differs among a set of groups. For example, "Are male crickets longer than females?" is a comparative question. The variable measured is length, and the groups that are compared are males and females.

Comparative research questions are often useful when designing experiments. Counting the number of deer that visit a field is a somewhat interesting observation. But comparing the number of deer in a field with a large number of shrubs to the number of deer in a field with a small number of shrubs is more interesting and useful.

5. With this in mind, choose one of the questions you asked in Step 2 and revise it to be a comparative research question that you think is interesting. Record your question below.

6. Make an outline or sketch of the methods you would use to answer your research question from Step 5, including the data you would collect and how it would be analyzed. Describe the variable(s) you would change, the variable(s) you would measure, and the variable(s) you would keep similar across groups. Revisit and revise your research question as needed.

PART 2: Cause and Effect

It is valuable to describe and find patterns in nature. Many scientific questions are asked in order to find patterns, develop models, or develop scientific tools or processes. Some of the most important, useful, and exciting questions in science seek an understanding of the causes underlying patterns in nature. These questions focus on causes and effects.

7. To help you reflect on the value of studying cause and effect, in the table below, list as many synonyms as you can for both the terms "cause" and "effect." Ignore the middle column for now.

Synonyms for Cause		**Synonyms for Effect**

When writing a sentence that includes a cause and an effect, these terms serve as the subject and the object. Verbs link subjects and objects.

8. Label the middle column of the table as "Verbs." Then, for the next two minutes, list as many verbs as you can that link the synonyms for cause and effect. (**Note:** Order is not important. You are not trying to link the left and right columns directly, just create a list of verbs that link cause and effect.)

9. Your instructor will assign you or your group an organism. Your challenge is to write a research question that includes your organism and also includes a cause, effect, and verb. Write your question in the space below.

10. Describe what would happen to your experiment if you switched the order of the cause, effect, or verb in your question from Step 9.

PART 3: Practice Analyzing Questions

11. Examine the titles of journal articles provided by your instructor. For each title, decide if you think the goal of the research is to:
    a. describe a cause-and-effect relationship
    b. describe a pattern, measurement, or observation in nature
    c. describe a scientific model
    d. describe a tool or process for scientific research
    e. something else

    If the title is describing a cause-and-effect relationship (a), highlight the potential causal agent(s) in yellow (or underline once) and highlight the effect(s) in green (or underline twice).

12. To further practice your scientific questioning skills, examine a scientific figure provided by your instructor. Write a testable, comparative question that you think drove the research.

13. Describe how asking questions in science allows you to express your creativity.

14. What is one major question in science that you find interesting or inspiring?