ACTIVITY 7

Evidence and Explanations

CARD-BASED INVESTIGATION

7: EVIDENCE AND EXPLANATIONS

GUIDING QUESTION

What is the role of evidence in evaluating scientific explanations?

INTRODUCTION

The Skipton scenario is built on a modern understanding of how contaminants can be transmitted from the environment to people. It was not until the 1830s and 1840s that the use of data collection and analysis began to show that there was a direct link between poor living conditions, disease, and life expectancy. Around the same time, Dr. John Snow was studying cholera outbreaks in London in an attempt to find out how it was being transmitted. Cholera is an infectious disease that can cause severe diarrhea and vomiting, sometimes resulting in death by dehydration. Some cases are mild or without symptoms. Today, there are an estimated 2.9 million cases and 95,000 deaths globally due to cholera. In this activity, you will take on the role of scientists investigating the cause of cholera transmission by looking at the available evidence, as John Snow did in the 1800s. You will consider how the evidence does or does not support each of the three main explanations of transmission considered possible by scientists at the time.

CONCEPTUAL TOOLS

A boy receives the oral cholera vaccine from a public health worker in Haiti, where cholera outbreaks are a significant health concern today.

PROCEDURE

1 Read the following scenario, which describes a cholera outbreak in London in the 1800s.

For most of August 1854, there were few cholera deaths in Soho, London. However, during the night of August 31st, 56 new cases were reported. The next day, there were 143 new cases and on September 2nd, 116 cases. Many of those infected died: 70 people on September 1st and 127 on September 2nd. Imagine you are a doctor during this cholera outbreak in London. Some people come to you asking for your help. They want to prevent the spread of the disease but they do not know how it is being transmitted.

A busy London street in the 1800s.

2 In your group, generate at least two possible explanations for how this sickness might be spreading in 19th-century London.

3 Your group will receive three Explanation cards. Compare these three explanations to your own two explanations and then discuss what evidence you would need to decide which explanation of cholera transmission is correct.

4 Your group will receive Evidence cards 1–4. Work with your group to read each card and determine whether the evidence supports one or more of the three explanations or is not relevant evidence. Record your responses on Student Sheet 7.1, "Evaluating Evidence."

MATERIALS LIST

FOR EACH GROUP OF FOUR STUDENTS

- 15 EVIDENCE CARDS
- 3 EXPLANATION CARDS

FOR EACH STUDENT

- STUDENT SHEET 7.1 "Evaluating Evidence"

5 Discuss with your group which explanation is most consistent with the evidence and why.

6 Additional evidence becomes available. Your group will receive more Evidence cards representing this evidence. Read each card, determine which explanation(s) the evidence supports, and add your responses to Student Sheet 7.1.

7 Discuss with your group which explanation is most consistent with the fuller set of evidence and why.

8 Based on your current explanation for how cholera spreads, work with your group to identify steps that could reduce the spread of cholera.

9 Consider what other evidence you would like to have. Work with your group to brainstorm questions and investigations that would help you answer them.

10 In your science notebook, record one investigation that you think would be most helpful in testing your explanation. Record how your investigation could provide evidence supporting your explanation and how your investigation might provide evidence refuting your explanation.

HINT: If exactly the same thing would happen whether your explanation is supported or not, it is likely not a good test of your explanation.

BUILD UNDERSTANDING

1. Cholera outbreaks in the 19th century occurred before many modern scientific tools were developed. What is one modern scientific tool that might have helped doctors of the time figure out the transmission of cholera more quickly? How could this tool have been used to investigate cholera?

2. The development of scientific knowledge is iterative and occurs through continual re-evaluation and iteration of ideas that are informed by:

   - new evidence
   - improved methods of data collection and experimentation
   - collaboration with others
   - trial and error

   Which of these were relevant to Dr. Snow's investigation of cholera? Provide examples that describe how these elements were represented in his work.

3. How was the cholera outbreak in 1800s London similar to the Skipton scenario? How was it different?

CONNECTIONS TO EVERYDAY LIFE

4. Evidence can be useful in making everyday decisions. Imagine that your family decides they want to eat more fruit and less cereal at breakfast. Your dad says he heard that having smaller package sizes of foods in the house reduces the amount people eat. He buys more fruit and smaller boxes of cereal and then claims that the family has met their goal.

   a. Did he support his claim?

   b. Identify the relevant evidence and explain your reasoning.

   c. Explain what additional evidence could support his claim.

5. How do you think scientists know when they have enough information to construct a scientific explanation?