THE CHECKS LAB

Teacher Notes

This exercise is designed to help students understand the idea that science is built on evidence that can be observed or deduced from the natural world. We gather evidence through the use of our senses. However, the evidence can be confusing, seemingly conflicting, and apparently random. Data is not always consistent nor even readable. Furthermore, all of the evidence may not be available. This is why scientific explanations are "tentative" explanations of natural phenomena.

In this simulation, there are several independent types of clues that may be used to develop a hypothesis. This illustrates the concept that scientists use a variety of criteria to compare explanations, selecting the better ones. Scientists may even have to connect seemingly unrelated lines of evidence to form tentative hypotheses.

Evidence in science, as in this simulation, is not of equal value. Scientists must learn to discern between useful and useless data. In this simulation, the value of each check is affected by the order in which it is selected, and by the relative importance placed upon it by the various group members. Individuals with strongly held opinions or with strong personalities may have a major effect on their group's opinions. This aspect of the game illustrates that human values, biases and experiences can deeply influence science.

This game is open ended. There is not enough information to say with certainty what the storyline is and each new check may create more questions than answers. This is a dynamic of both the game and science. In addition, the participants should recognize that not everyone reaches the same conclusion when observing the same data.

Finally, this simulation encourages participants to equate the solving of a mystery with the search for scientific explanations. At the same time, this simulation reinforces the collaborative nature of science: scientists work together to solve problems.

Procedure

1. Arrange students into groups (four works well). Each group is given an envelope containing checks written by fictitious characters in a fictitious scenario

2. After reading the Lab Introduction, each team draws **four** checks from the envelope at random. Using the information on the checks, each group attempts to determine the circumstances that surrounded the writing of the checks. In other words, each group tries to come up with a storyline for the fictitious character(s) based on the information on the checks. This leads them to formulate an original tentative "hypothesis" (=storyline).

3. After the teams appear to have exhausted their ideas with the first four checks, instruct them to select **four** more checks from the envelope. If you like, you can contrive a situation in which students are detectives using some checks found as partial evidence in some sort of crime; after a period of time, some more checks are found. Observe the groups for insights as to how the new information affects their old hypothesis. Once again, allow each group to work until it appears that most have exhausted their individual lines of thought.

4. Each team should draw **two** more checks and proceed as before. After a few minutes, suggest that the different groups collaborate by sharing their information. The groups should realize that others may have one or two different pieces of data. Unused checks must stay in envelope (in nature, we never have ALL of the desired info.)

5. At the conclusion of this "share time", ask each group to select its strongest hypothesis (likliest storyline).

6. After giving the groups time to formulate their hypotheses, ask the group spokesperson to stand and report the group-selected hypothesis (storyline) to the class, so that all may hear different conclusions from similar data.

7. Lead a follow-up discussion on the value of **collaboration**, **tentativeness** of scientific explanations, the effects of **limited data**, and the influence of personal **biases** and experience on their ideas and ultimate selection of a most likely hypothesis. Even if scientists have a strong hypothesis, or explanation of a natural phenomenon, they can never be absolutely sure that new data won't eventually appear and show the explanation to be wrong. You might also use this experience as a springboard to a close look at some of the criteria scientists use to determine which answer (hypothesis) is "best" (closest to reality).

Original idea from '92 ENSI; Revised Oct. '96 by J. Loundagin; Adapted for ENSIweb 2/00 by L. Flammer

THE CHECKS LAB

Introduction

This activity is designed to help you experience the true nature of science, that it is built on evidence that can be observed or deduced from the natural world. However, this evidence can sometimes be confusing, seemingly conflicting, and apparently random. Furthermore, each new bit of evidence often creates more questions than it answers. The activity illustrates that scientific explanations are only tentative explanations, because new discoveries may show that previous hypothesis were incorrect.

No scientist or scientific group works alone. This activity will demonstrate the value of collaboration within each group and with other groups in order to arrive at a reasonable explanation of the problem. There is at least one other characteristic of science which is not usually appreciated or realized by people in general. See if you can recognize it.

Directions (Your teacher may require only one worksheet to be completed by each group).

1. Each group will be given an envelope which contains a total of 16 checks written by fictional character(s). Do not look at the checks until instructed to do so. When directed, and without looking, remove **four** of the checks from the envelope and place them on the lab table.

2. Do not allow other groups to examine your data at this time.

2. Observe the information on the checks. Try to formulate a tentative hypothesis that explains the storyline represented by the checks. This is your **original hypothesis**. Record this on your worksheet.

3. When directed, remove **four** more checks from the envelope. Use this new information to formulate a **second tentative hypothesis** that explains the storyline. Record this on your worksheet.

4. When directed, remove **two** final checks from the envelope. Use this new information to formulate a **third tentative hypothesis** that explains the storyline. Record this on your worksheet. Do **NOT** remove any more checks. Scientists never have all the data they might need to reach the highest level of confidence in their explanations.

5. To simulate the expanded collaborative nature of science, each group will be given a few minutes to meet with other groups to compare data. Remember, since each group drew at random, all groups may have some different data. (This simulates the sharing of data and ideas by scientists by way of personal communications, email, etc.)

6. When instructed, each group will come back together to formulate a **final hypothesis** based upon all of the available data. This hypothesis should attempt to explain the events in the life of the character(s) who wrote the checks. Record this on your worksheet.

7. Choose a spokesperson to present the group's final hypothesis to the class. This simulates the sharing process of scientists at symposia and by publishing.

8. Keep in mind that scientific explanations are tentative because we can never be absolutely sure that all of the information about a problem is known and that new information may be discovered later.

9. Answer the questions asked on your worksheet. Your teacher may lead a class discussion before or after you answer these questions.

Original idea from '92 ENSI; Revised Oct. '96 by J. Loundagin; Adapted for ENSIweb 2/00 by L. Flammer

Name_____ Period____ Date_____ Score____

THE CHECKS LAB WORKSHEET

1. Original Hypothesis:

2. Tentative Hypothesis # 1:

3. Tentative Hypothesis # 3:

4. Final Hypothesis:

Questions:

1. What bits of information on the checks were valuable to your group in formulating a hypothesis?

2. What information was useless?

3. List any misleading information that was presented.

4. Why do we say that a hypothesis in science is "tentative?

5. How could your hypothesis become a theory?

6. Is your final hypothesis "correct"? Explain.