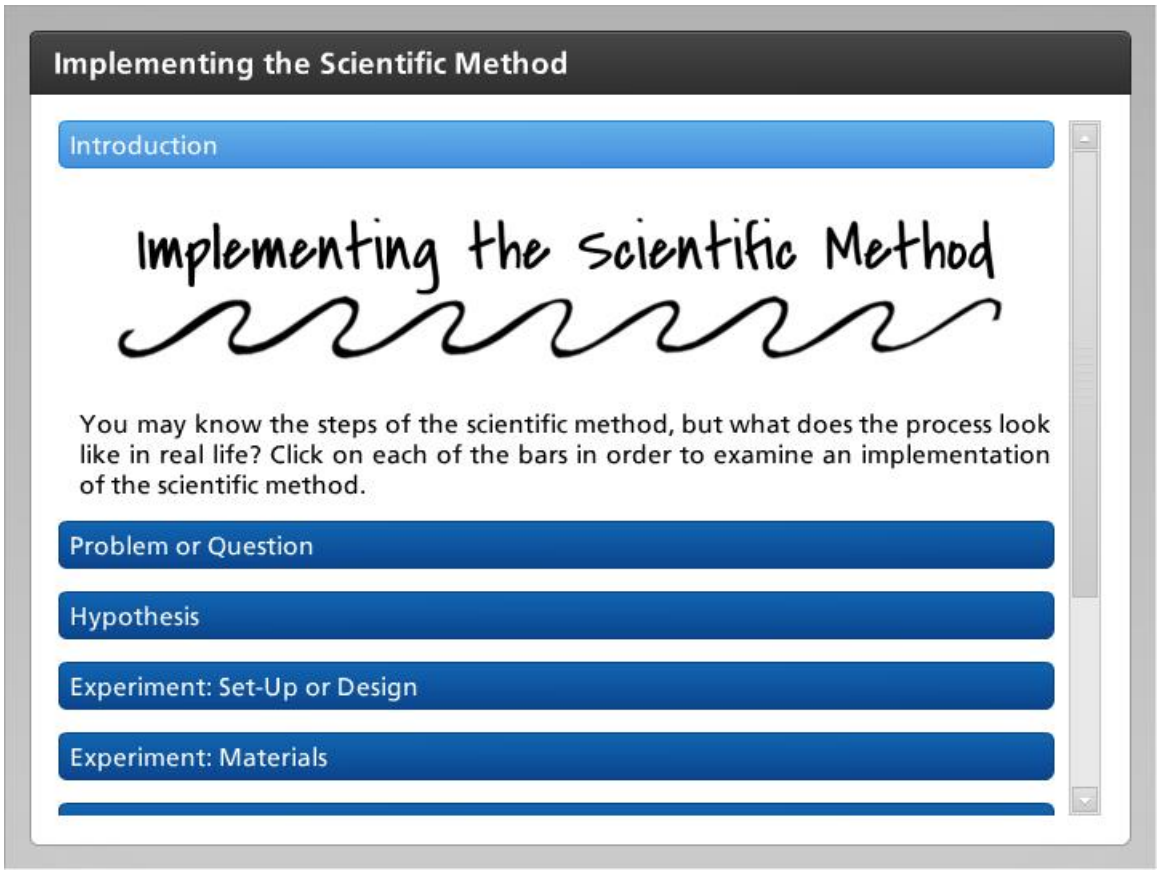
Introductory Module: Fundamentals of Science
Topic 1 Content: Implementing the Scientific Method Presentation Notes

Introduction



You may know the steps of the scientific method, but what does the process look like in real life? Click on each of the bars in order to examine an implementation of the scientific method.

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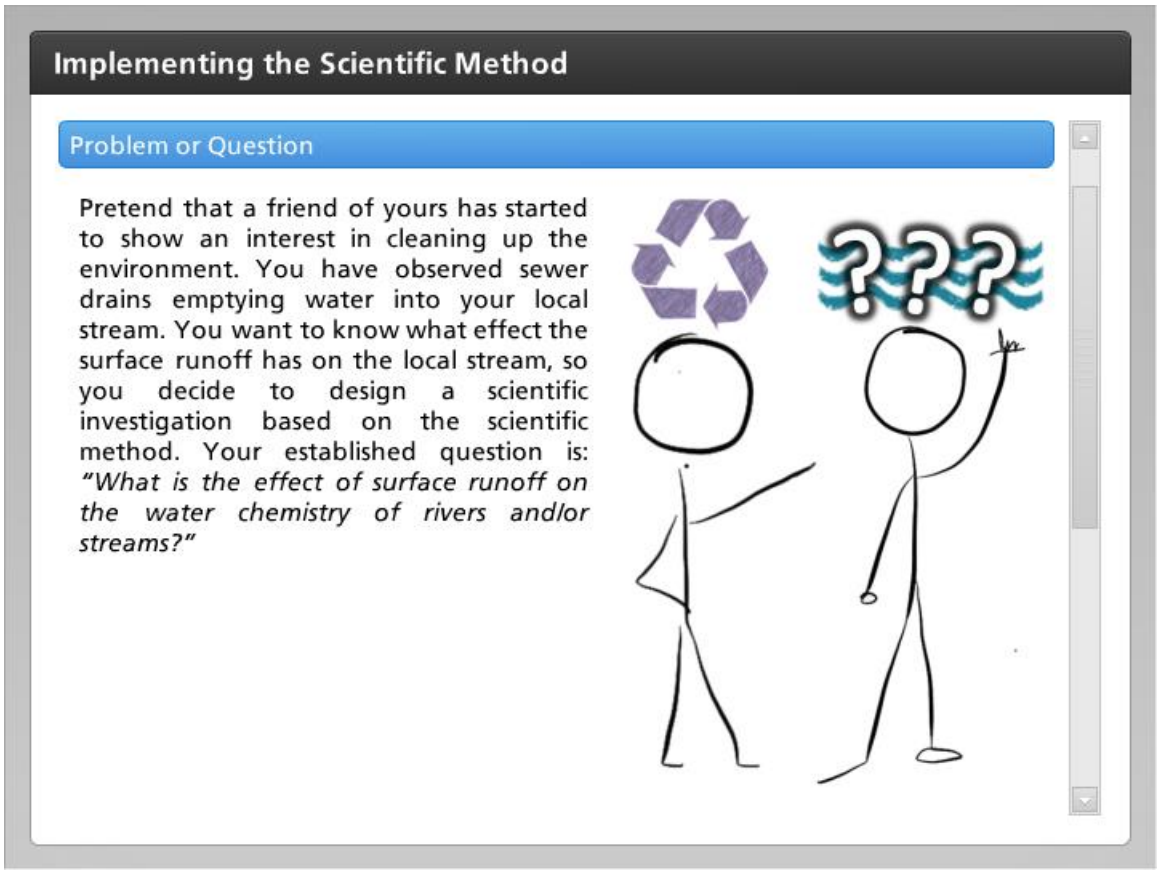
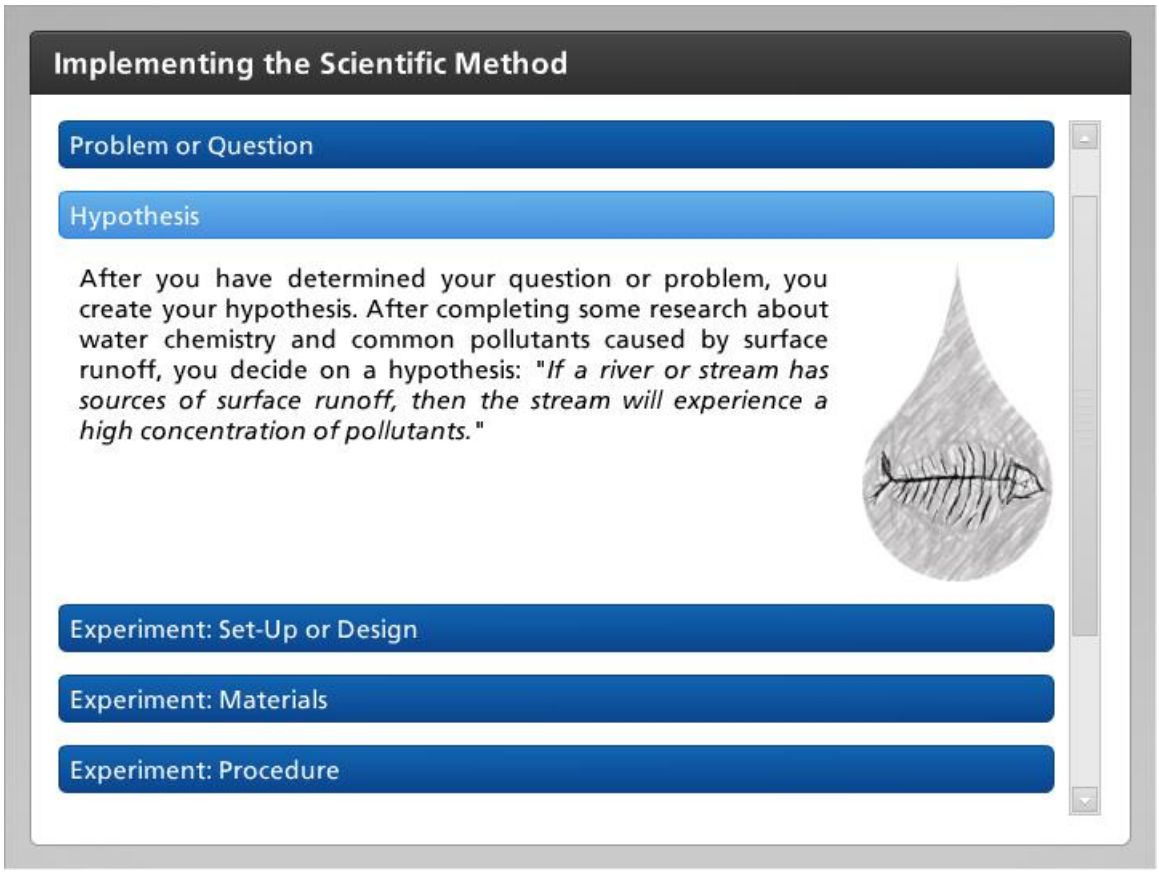
Problem or Question



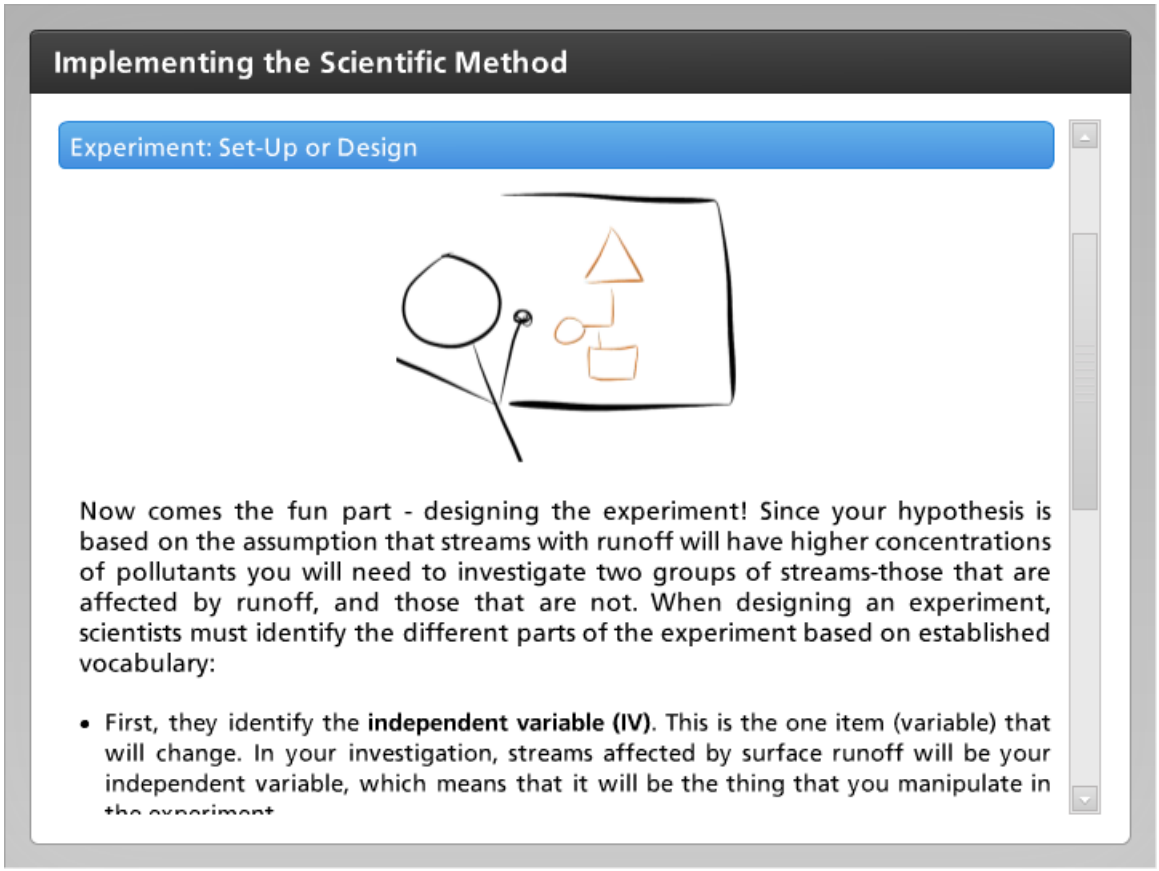
Pretend that a friend of yours has started to show an interest in cleaning up the environment. You have observed sewer drains emptying water into your local stream. You want to know what effect the surface runoff has on the local stream, so you decide to design a scientific investigation based on the scientific method. Your established question is: *"What is the effect of surface runoff on the water chemistry of rivers and/or streams?"*

Hypothesis



After you have determined your question or problem, you create your hypothesis. After completing some research about water chemistry and common pollutants caused by surface runoff, you decide on a hypothesis: *"If a river or stream has sources of surface runoff, then the stream will experience a high concentration of pollutants."*

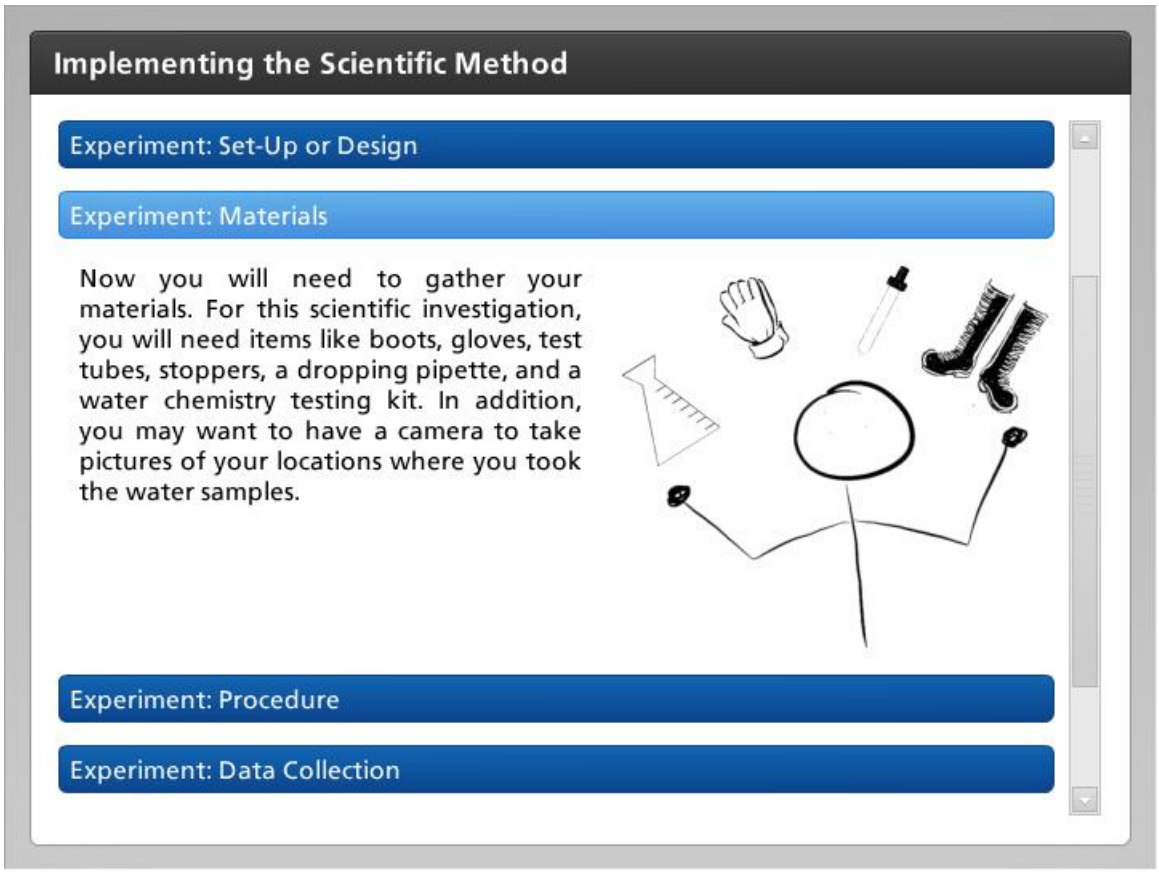
Experiment: Set-Up or Design



Now comes the fun part - designing the experiment! Since your hypothesis is based on the assumption that streams with runoff will have higher concentrations of pollutants you will need to investigate two groups of streams-those that are affected by runoff, and those that are not. When designing an experiment, scientists must identify the different parts of the experiment based on established vocabulary:

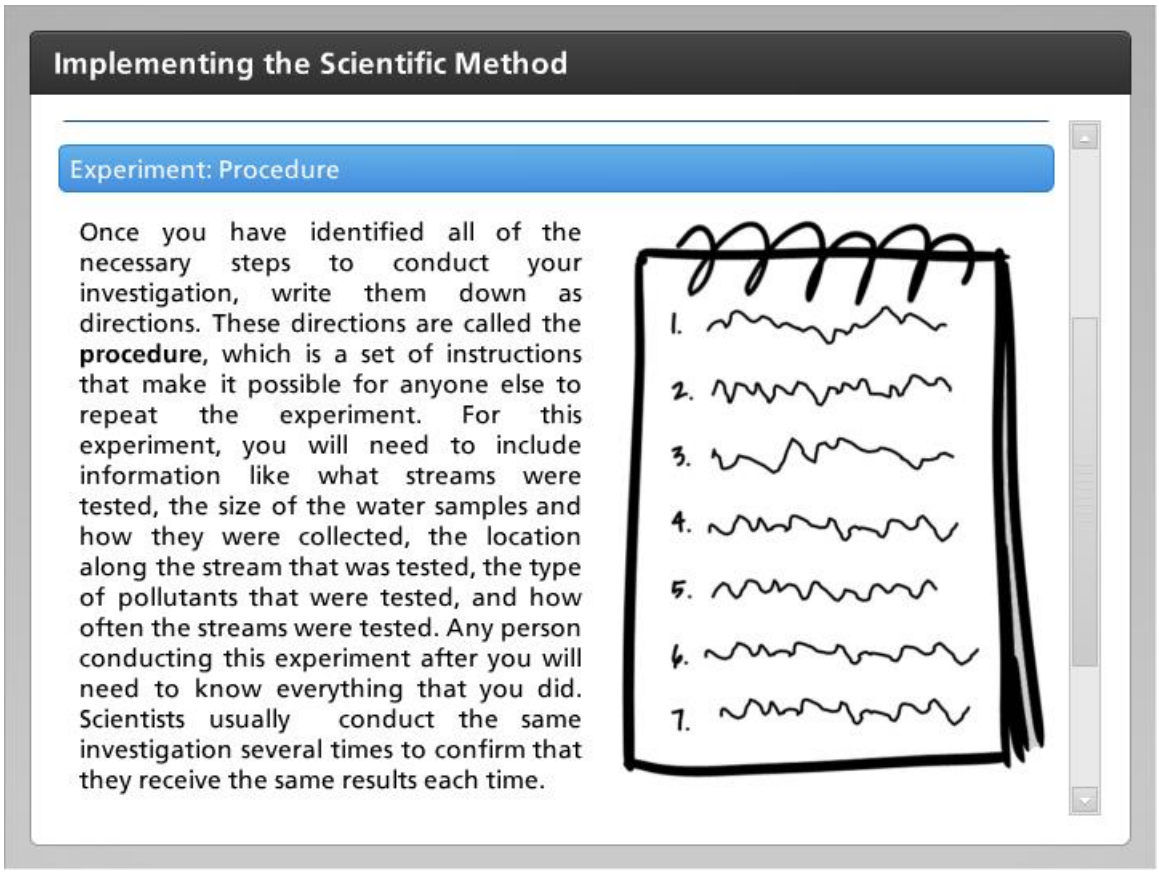
- First, they identify the **independent variable (IV)**. This is the one item (variable) that will change. In your investigation, streams affected by surface runoff will be your independent variable, which means that it will be the thing that you manipulate in the experiment.
- Next, they identify the **dependent variable (DV)**. This is the factor that changes because of what the experimenter did. In this case, the dependent variable is the amount of the pollutant(s).
- Each experiment must have a **control** group. This is the group that is used for comparison with those that include the independent variable. In your experiment, the control group is a group of streams surrounding your selected areas of testing.
- Everything in your experiment must be treated the same. You should take your measurements the same way and at similar times. These are examples of **constants**, which are factors that are the same in both groups.

Experiment: Materials



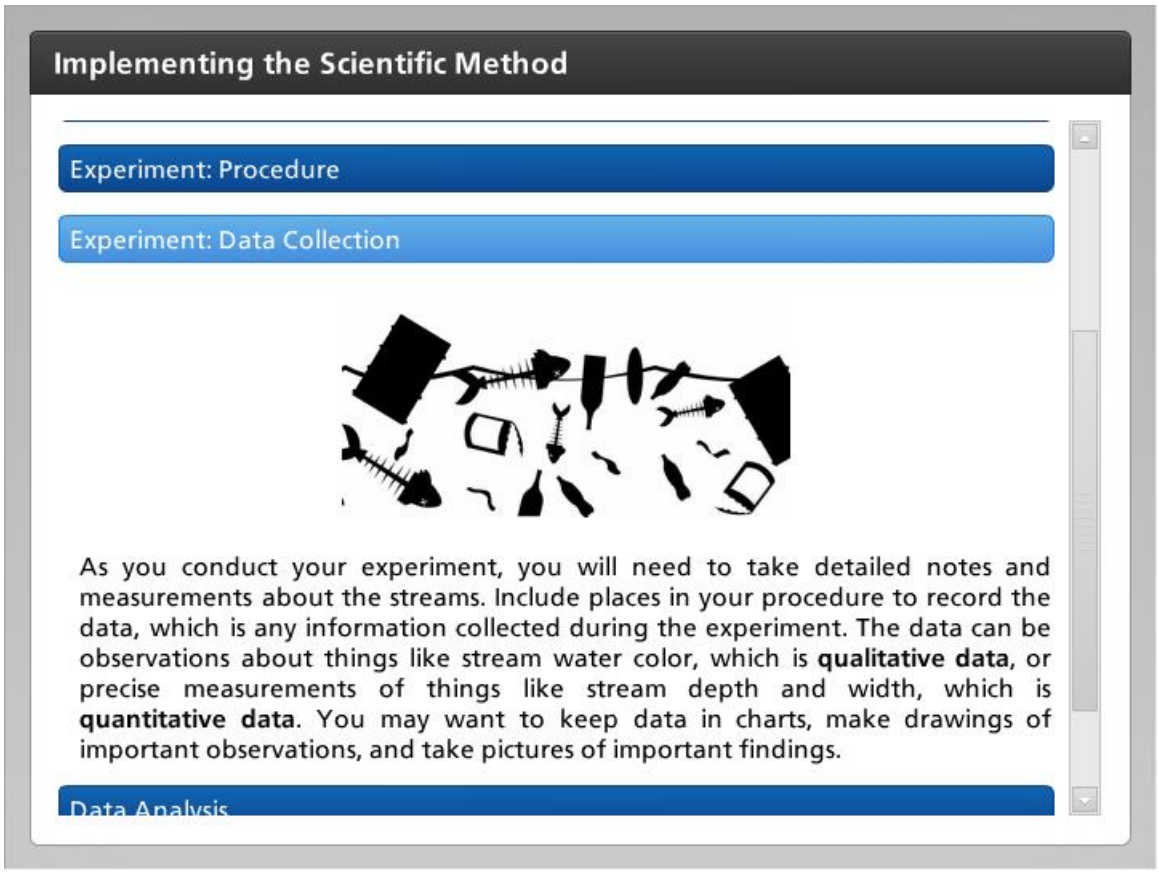
Now you will need to gather your materials. For this scientific investigation, you will need items like boots, gloves, test tubes, stoppers, a dropping pipette, and a water chemistry testing kit. In addition, you may want to have a camera to take pictures of your locations where you took the water samples.

Experiment: Procedure



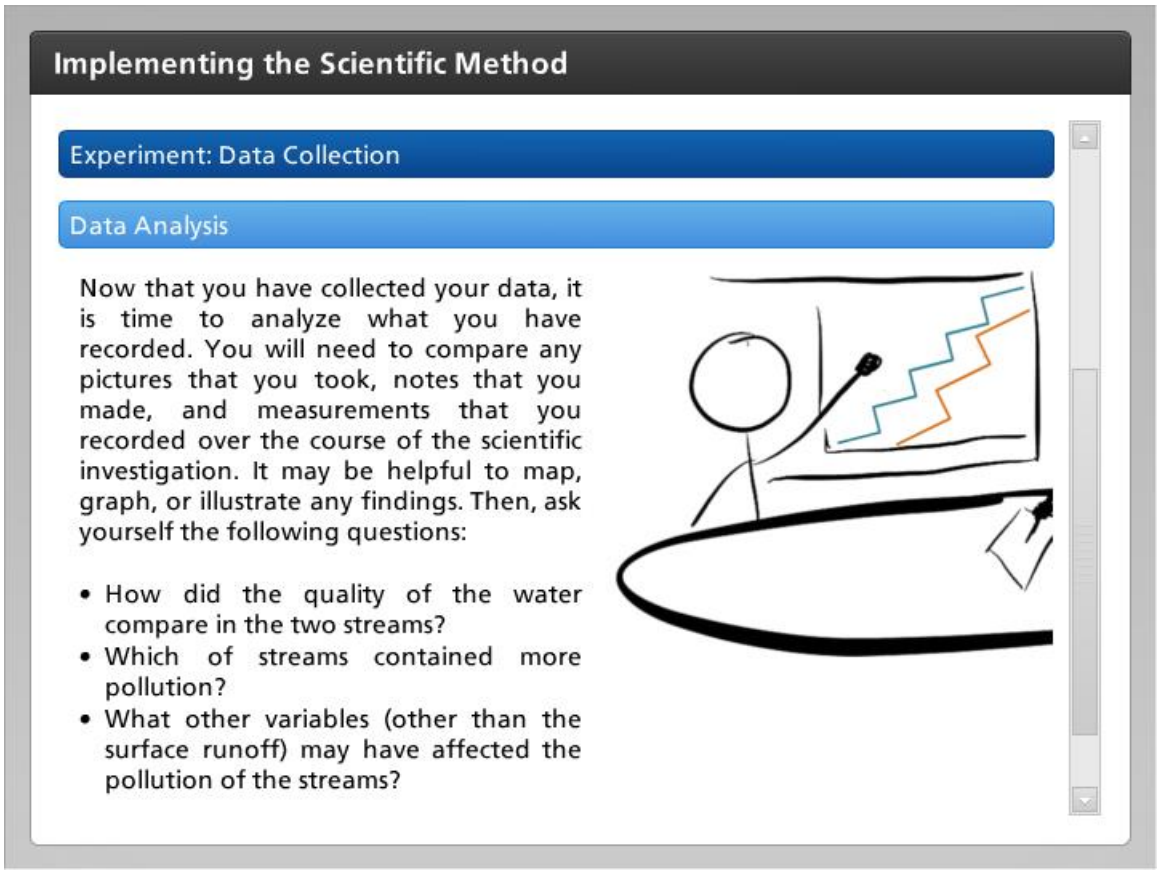
Once you have identified all of the necessary steps to conduct your investigation, write them down as directions. These directions are called the **procedure**, which is a set of instructions that make it possible for anyone else to repeat the experiment. For this experiment, you will need to include information like what streams were tested, the size of the water samples and how they were collected, the location along the stream that was tested, the type of pollutants that were tested, and how often the streams were tested. Any person conducting this experiment after you will need to know everything that you did. Scientists usually conduct the same investigation several times to confirm that they receive the same results each time.

Experiment: Data Collection



As you conduct your experiment, you will need to take detailed notes and measurements about the streams. Include places in your procedure to record the data, which is any information collected during the experiment. The data can be observations about things like stream water color, which is **qualitative data**, or precise measurements of things like stream depth and width, which is **quantitative data**. You may want to keep data in charts, make drawings of important observations, and take pictures of important findings.

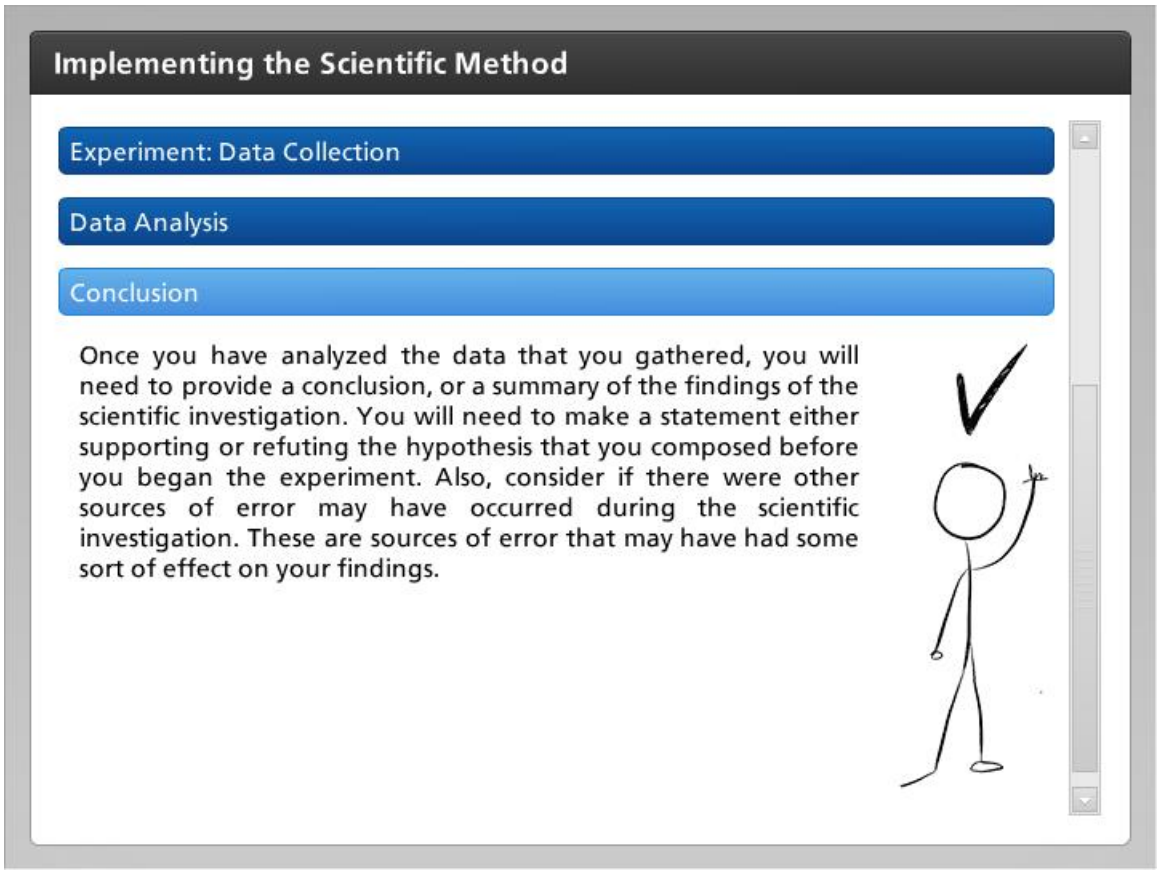
Data Analysis



Now that you have collected your data, it is time to analyze what you have recorded. You will need to compare any pictures that you took, notes that you made, and measurements that you recorded over the course of the scientific investigation. It may be helpful to map, graph, or illustrate any findings. Then, ask yourself the following questions:

- How did the quality of the water compare in the two streams?
- Which of streams contained more pollution?
- What other variables (other than the surface runoff) may have affected the pollution of the streams?

Conclusion



Once you have analyzed the data that you gathered, you will need to provide a conclusion, or a summary of the findings of the scientific investigation. You will need to make a statement either supporting or refuting the hypothesis that you composed before you began the experiment. Also, consider if there were other sources of error may have occurred during the scientific investigation. These are sources of error that may have had some sort of effect on your findings.