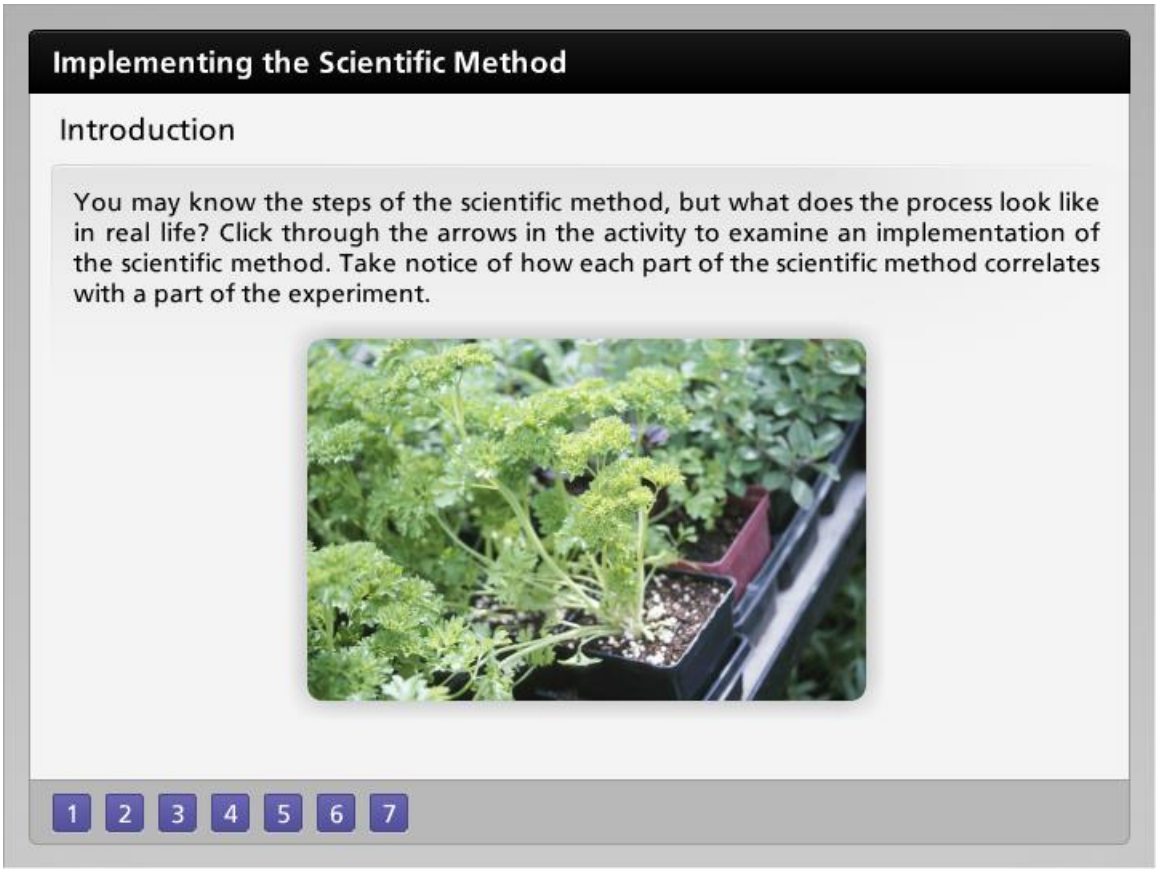
Module 1: What is Astronomy?
Topic 2 Content: Implementing the Scientific Method

Introduction



You may know the steps of the scientific method, but what does the process look like in real life? Click through the arrows in the activity to examine an implementation of the scientific method. Take notice of how each part of the scientific method correlates with a part of the experiment.

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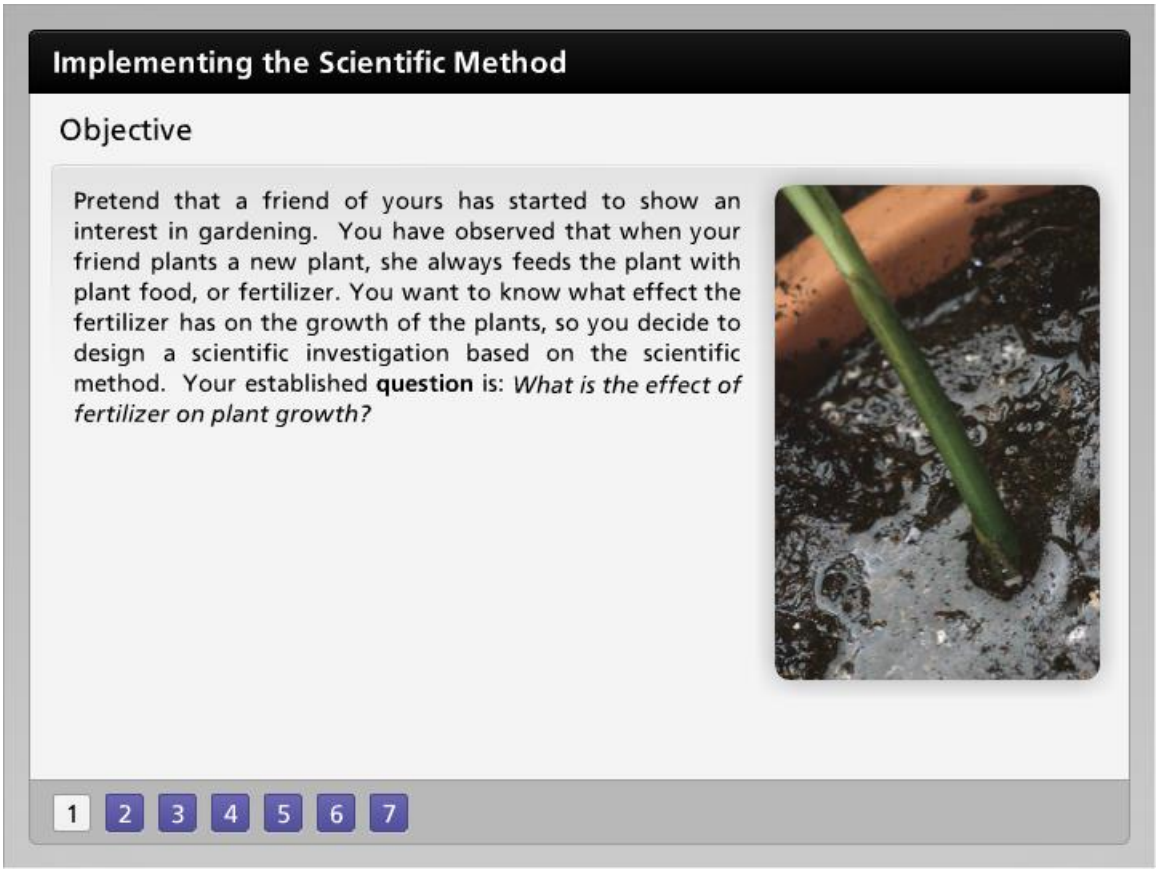
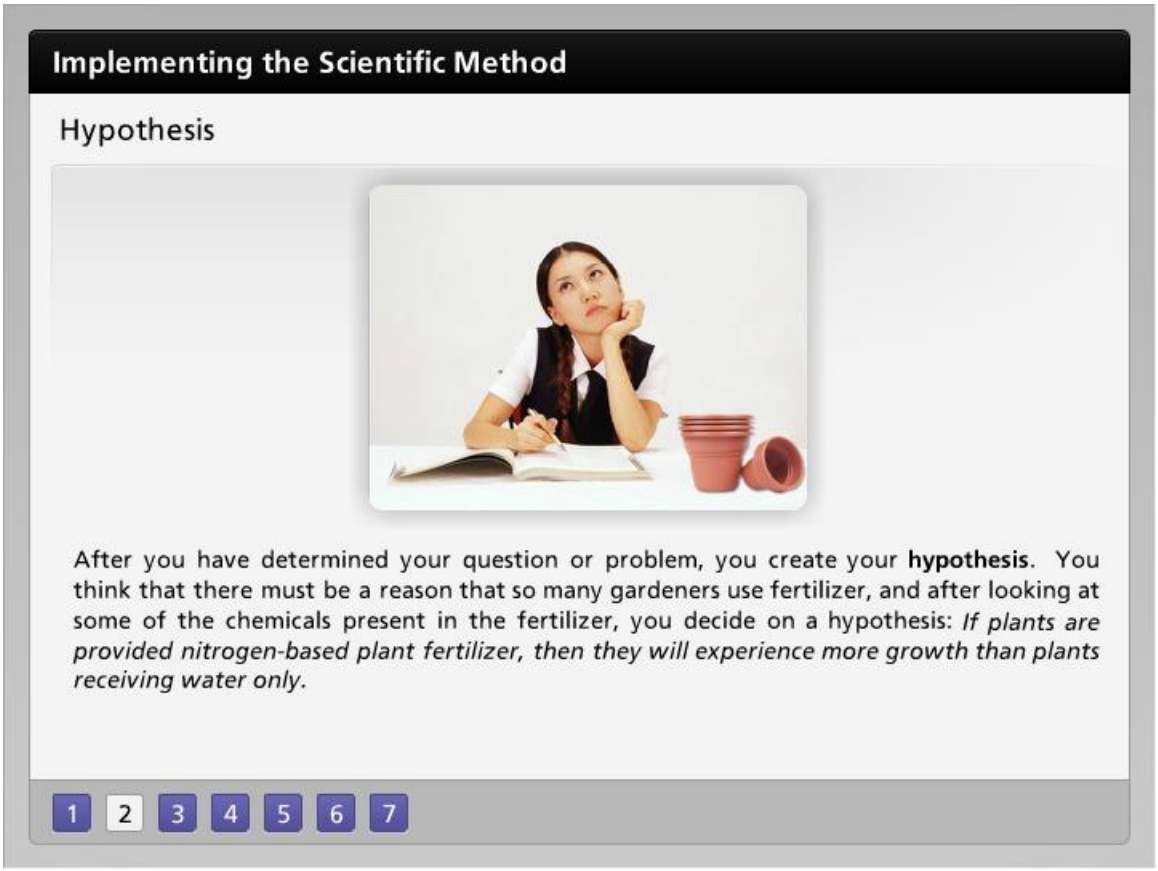
Objective



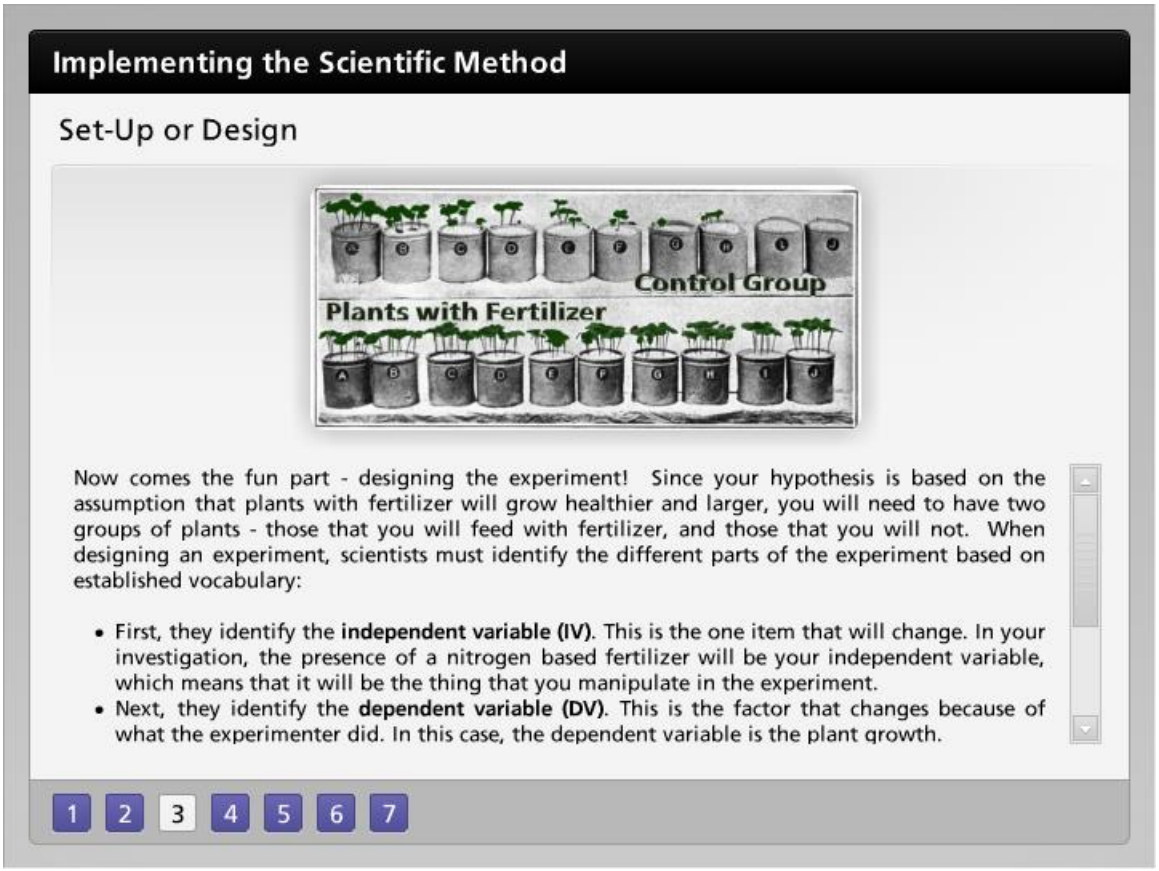
Pretend that a friend of yours has started to show an interest in gardening. You have observed that when your friend plants a new plant, she always feeds the plant with plant food, or fertilizer. You want to know what effect the fertilizer has on the growth of the plants, so you decide to design a scientific investigation based on the scientific method. Your established **question** is: *What is the effect of fertilizer on plant growth?*

Hypothesis



After you have determined your question or problem, you create your **hypothesis**. You think that there must be a reason that so many gardeners use fertilizer, and after looking at some of the chemicals present in the fertilizer, you decide on a hypothesis: *If plants are provided nitrogen-based plant fertilizer, then they will experience more growth than plants receiving water only.*

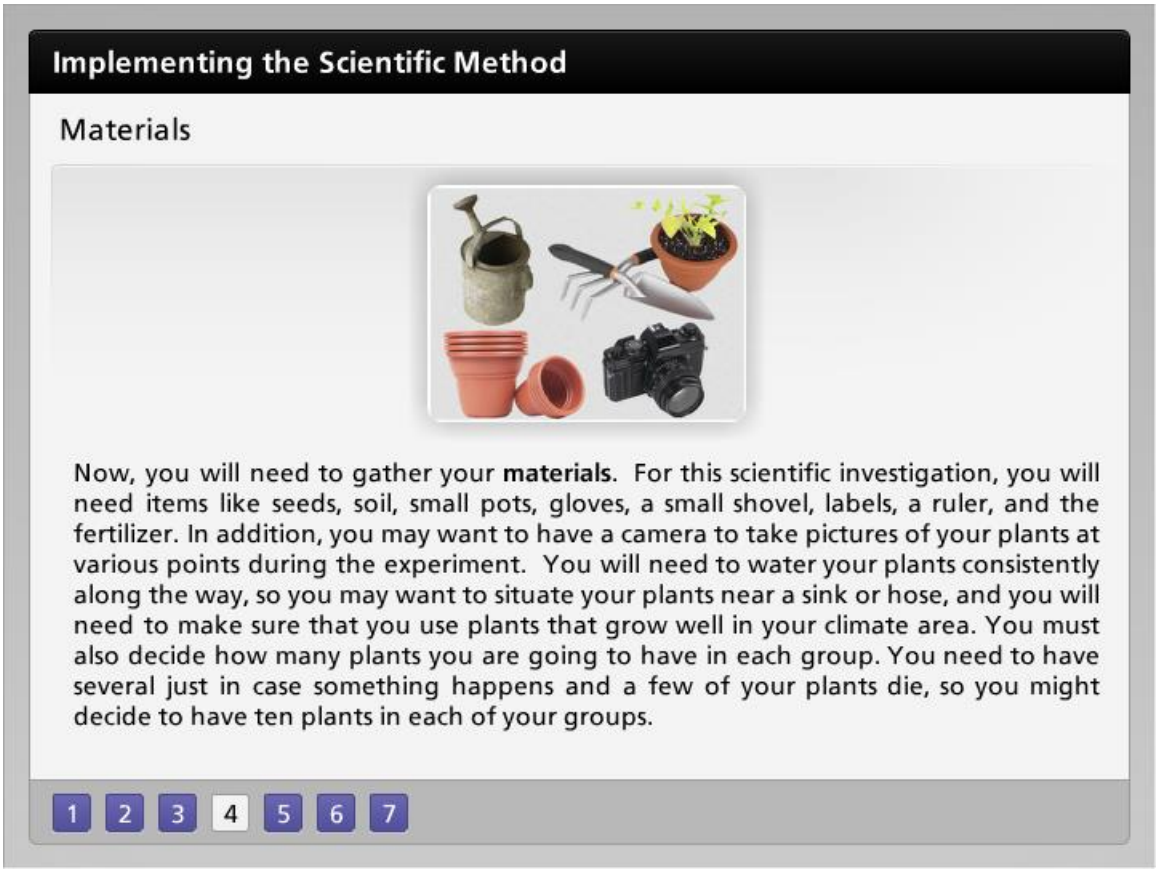
Set-Up or Design



Now comes the fun part - designing the experiment! Since your hypothesis is based on the assumption that plants with fertilizer will grow healthier and larger, you will need to have two groups of plants - those that you will feed with fertilizer, and those that you will not. When designing an experiment, scientists must identify the different parts of the experiment based on established vocabulary:

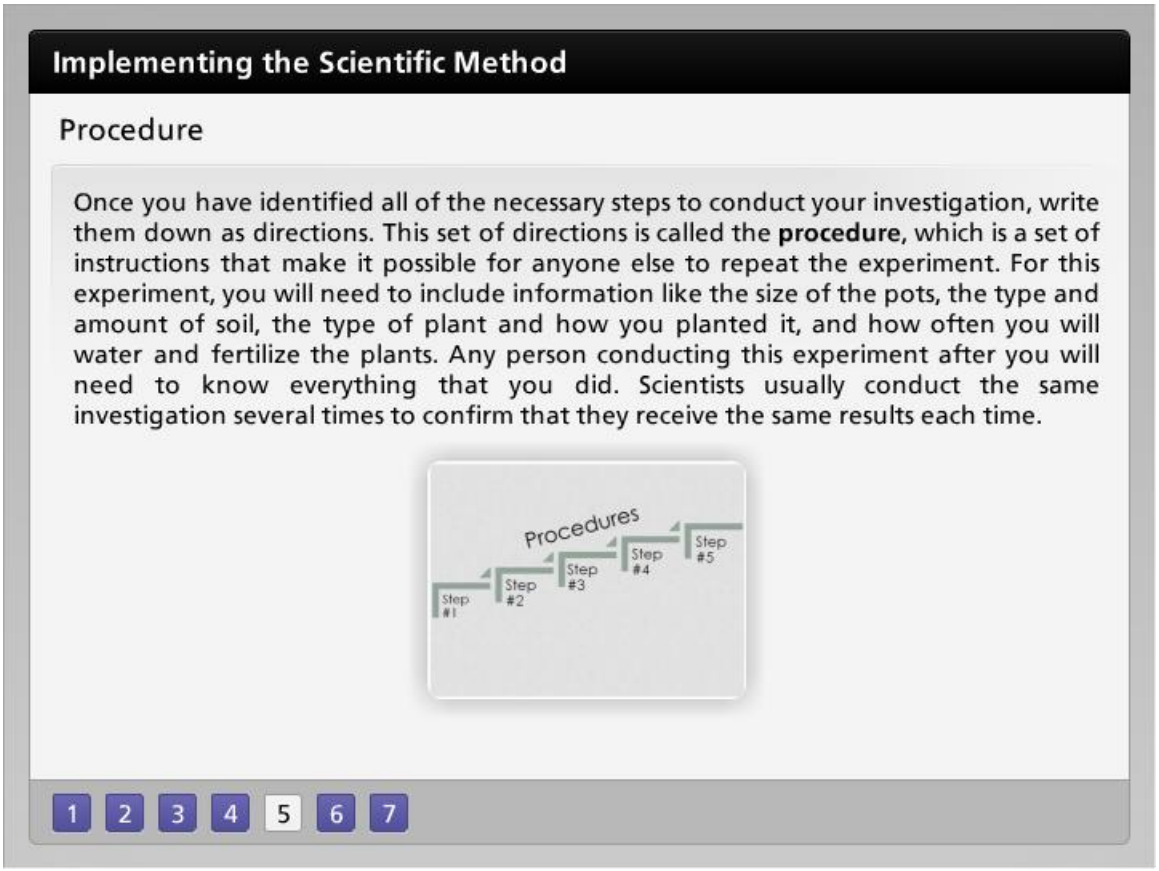
- First, they identify the **independent variable (IV)**. This is the one item that will change. In your investigation, the presence of a nitrogen based fertilizer will be your independent variable, which means that it will be the thing that you manipulate in the experiment.
- Next, they identify the **dependent variable (DV)**. This is the factor that changes because of what the experimenter did. In this case, the dependent variable is the plant growth.
- 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 the group of plants with no fertilizer.
- Other than the fertilizer, the two groups must be treated the same. They must have the same light, same water, and same soil. They must grow for the same time. These are all examples of **constants**, which are factors that are the same for both groups.

Materials



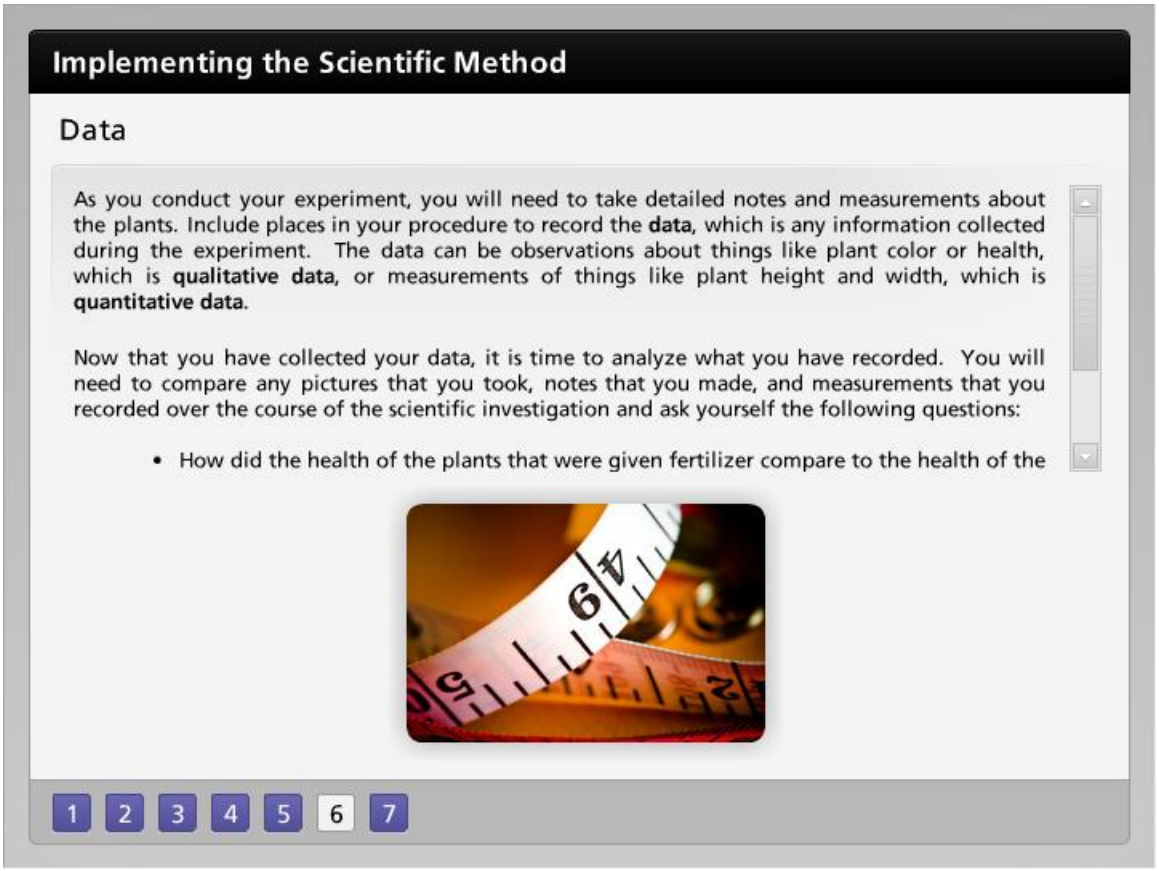
Now, you will need to gather your **materials**. For this scientific investigation, you will need items like seeds, soil, small pots, gloves, a small shovel, labels, a ruler, and the fertilizer. In addition, you may want to have a camera to take pictures of your plants at various points during the experiment. You will need to water your plants consistently along the way, so you may want to situate your plants near a sink or hose, and you will need to make sure that you use plants that grow well in your climate area. You must also decide how many plants you are going to have in each group. You need to have several just in case something happens and a few of your plants die, so you might decide to have ten plants in each of your groups.

Procedure



Once you have identified all of the necessary steps to conduct your investigation, write them down as directions. This set of directions is 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 the size of the pots, the type and amount of soil, the type of plant and how you planted it, and how often you will water and fertilize the plants. 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.

Data

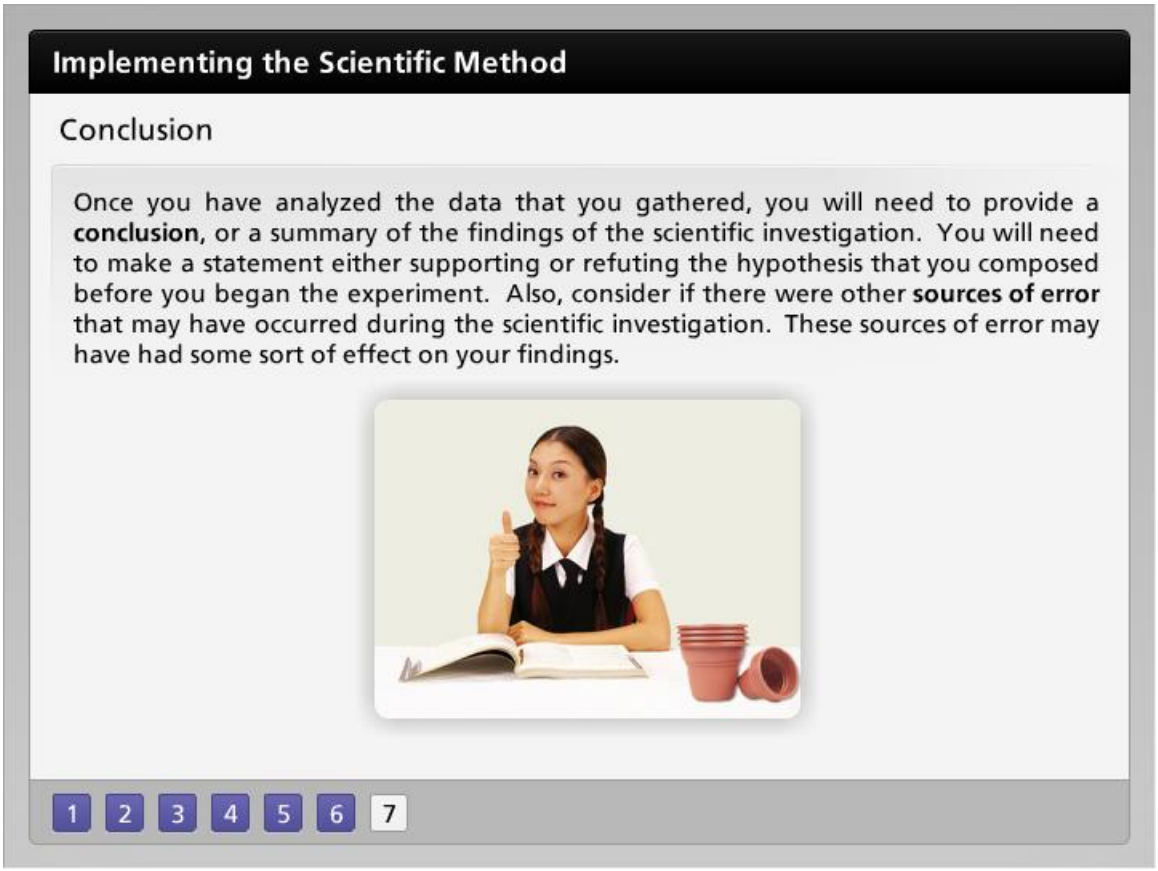


As you conduct your experiment, you will need to take detailed notes and measurements about the plants. Include places in your procedure to record the **data**, which is any information collected during the experiment. The data can be observations about things like plant color or health, which is **qualitative data**, or measurements of things like plant height and width, which is **quantitative data**.

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 and ask yourself the following questions:

- How did the health of the plants that were given fertilizer compare to the health of the plants that were not given fertilizer?
- Which set of plants were larger?
- What other variables (other than the fertilizer) may have affected the growth of the plants?

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** that may have occurred during the scientific investigation. These sources of error may have had some sort of effect on your findings.