Scientific Investigations

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Scientific investigations *are typically performed to solve a problem or answer a question. The* ***scientific method*** *is a process that provides a logical approach to problem solving.*

Although there is not a universal fixed procedure that all scientists must follow when performing scientific investigations, most investigations start with the steps discussed below.

Identify a Testable Question

Only *testable* questions can be answered through scientific investigations. "Does fertilizer make roses grow taller?" is an example of a good, testable question. However, questions about opinions, emotions, or supernatural events do not make good testable questions for scientific experiments, even though some information may be gathered about opinions by performing a survey.

Testable questions may come about as a result of research, observations, or even data gathered from another investigation.

Research the Topic

Before proceeding with an investigation, it is often useful to perform some basic research on the topic that is to be studied. Research may include making observations or gaining information from *reliable* sources.


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Reliable sources of information should include scientific evidence or data that has been interpreted by individuals who are knowledgeable about the topic of investigation. Experts, scientific journals, and textbooks are examples of reliable sources of information. Newspaper editorials and interviews with non-experts are not reliable sources of information because they are often based on opinions rather than facts. The Internet should also be used with caution because it is not always clear if the author of an article or website is an expert in a particular field.

Form a Prediction

A prediction is an idea of what a scientific investigation might show. Predictions are based on observations or other information gathered through research.

In science, a prediction must be testable. This means that it must be possible to carry out an investigation and to gather evidence that will either support or disprove the prediction.

When forming a prediction, it is important to make sure that it has the following traits:

- *The prediction is written as a statement.* Since predictions are meant to be educated guesses about what the experiment will show, they should not be written as a question. So, "Why do some objects fall faster than

others?" is not a good prediction, but "A round object will fall faster than a flat object" is an example of a good prediction.

- *The prediction should be clear.* Vague terms should not be used when forming a prediction. Instead, these terms should be clearly defined. For example, the statement, "Sometimes there is morning dew on the grass" is not a clear prediction, but "When the temperature drops below 50°F at night, the grass will have dew in the morning" is a clear prediction because it details the exact conditions under which dew is expected to appear.
- *The prediction should be testable.* It must be possible to carry out a scientific investigation and gather evidence that will either support or disprove the prediction. "Dogs are happier than cats" is not a testable prediction because it is not possible to clearly define "happy" nor is it possible to design an experiment to test this prediction.

Good predictions should exhibit all of the above traits to be considered meaningful or *valid*. It is not necessary, however, for a prediction to be proven correct in order to be valid. Even if a prediction is eventually found to be incorrect, meaningful data can still be derived from experiments related to the prediction.

Design an Investigation to Test the Prediction

Once a testable question and a prediction are identified, a scientific investigation must be designed to test the prediction.

There are many different kinds of scientific investigations that can be done, including observing objects or events, collecting specimens, performing controlled experiments, and making models.

Collect Relevant Data

Scientific investigations produce *data* or evidence. Data include observations and measurements that are made during investigations. Observations involve the senses of sight, hearing, touch, and smell. In most cases, scientists use special tools, like microscopes, to increase the power of their senses or make their observations more precise.

Data can be recorded by writing or drawing in a scientific notebook or journal. Data can also be recorded by using computers, cameras, videotapes, and other tools. Recording data in tables can also help keep observations neatly organized.

Comment on Lesson