You are caught in the rain. Should you run or walk? Maybe you should run–less time in the rain means less water falls down on you. Maybe you should walk–moving slower causes you to run into fewer drops. This is a question that you can try to answer with a scientific approach.

Scientific Methods

What is the goal of a scientific method?

Scientific Methods

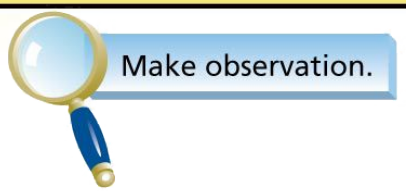
An organized plan for gathering, organizing, and communicating information is called a **scientific method.**

- You can use a scientific method to search for the answer to a question.
- Scientific methods can vary from case to case, depending on the question and how the researcher decides to look for an answer.

Scientific Methods

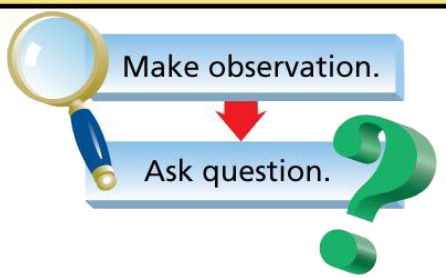
The goal of any scientific method is to solve a problem or to better understand an observed event.

Scientific Methods



Here is an example of a scientific method. Each step uses specific skills. The order of steps can vary. Sometimes you will use all of the steps and other times only some of them.

Scientific Methods



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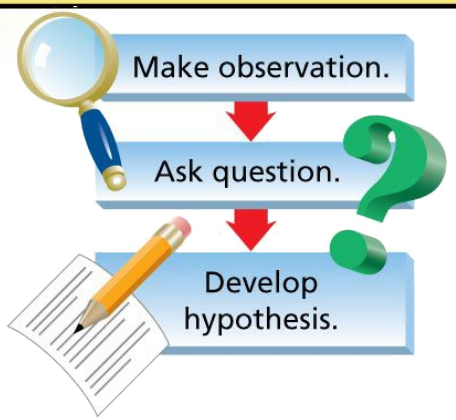

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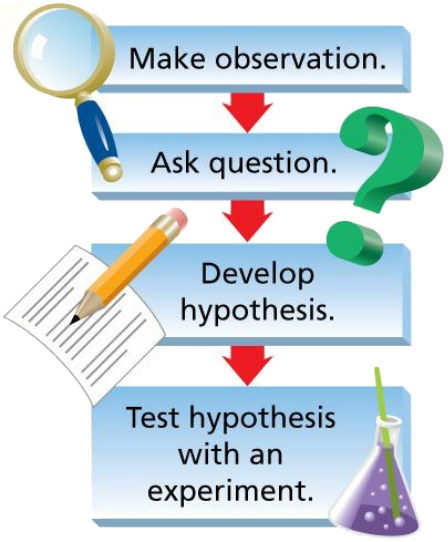

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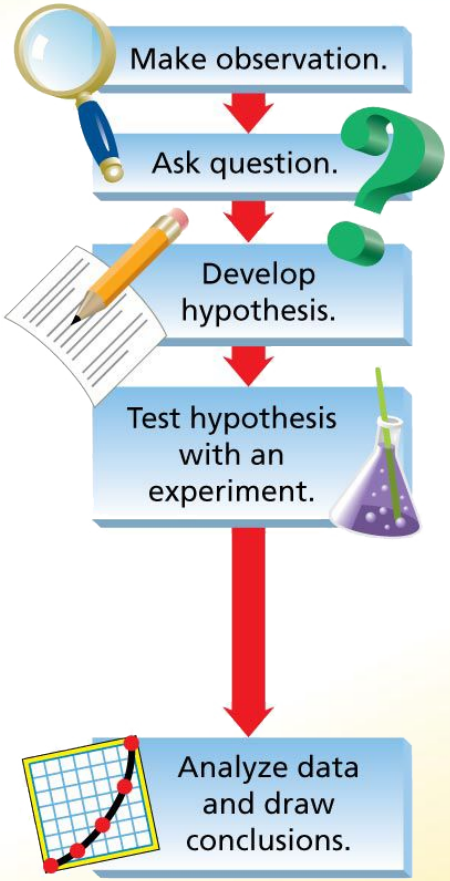

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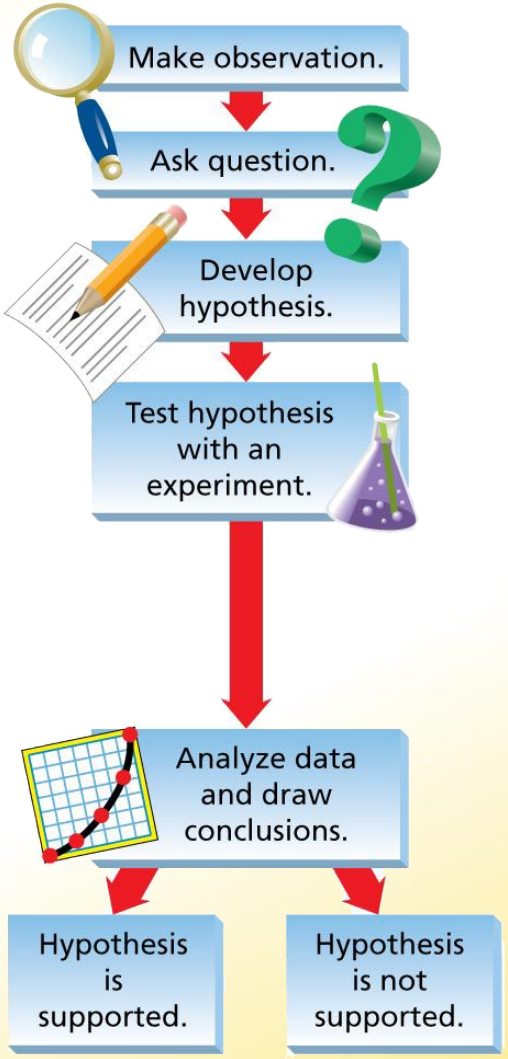

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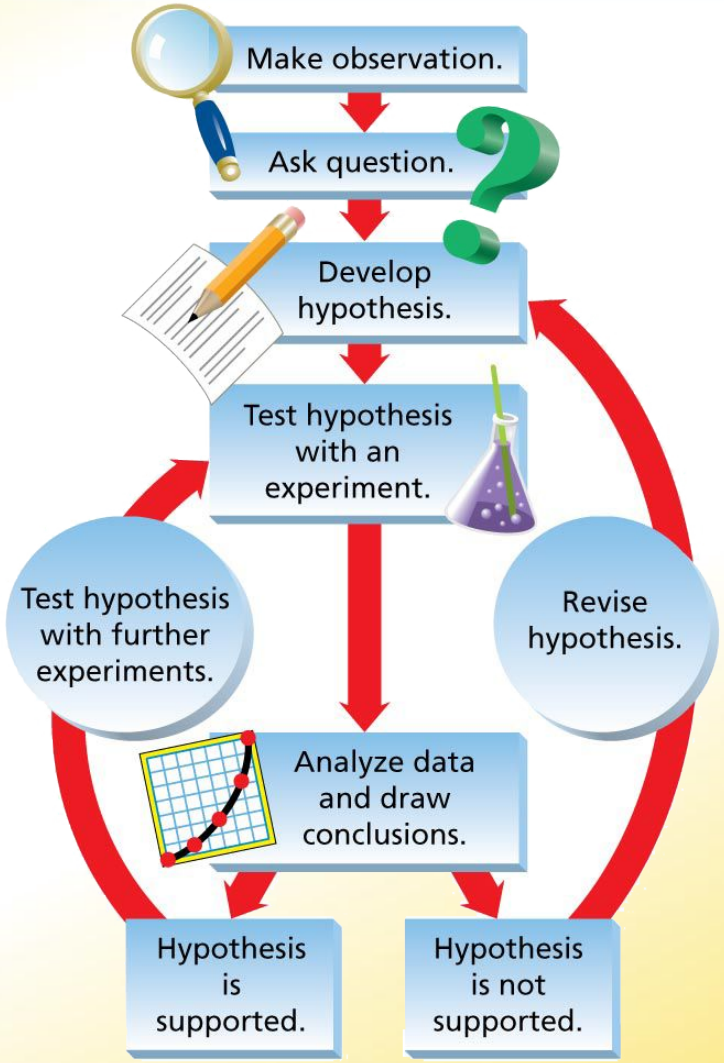

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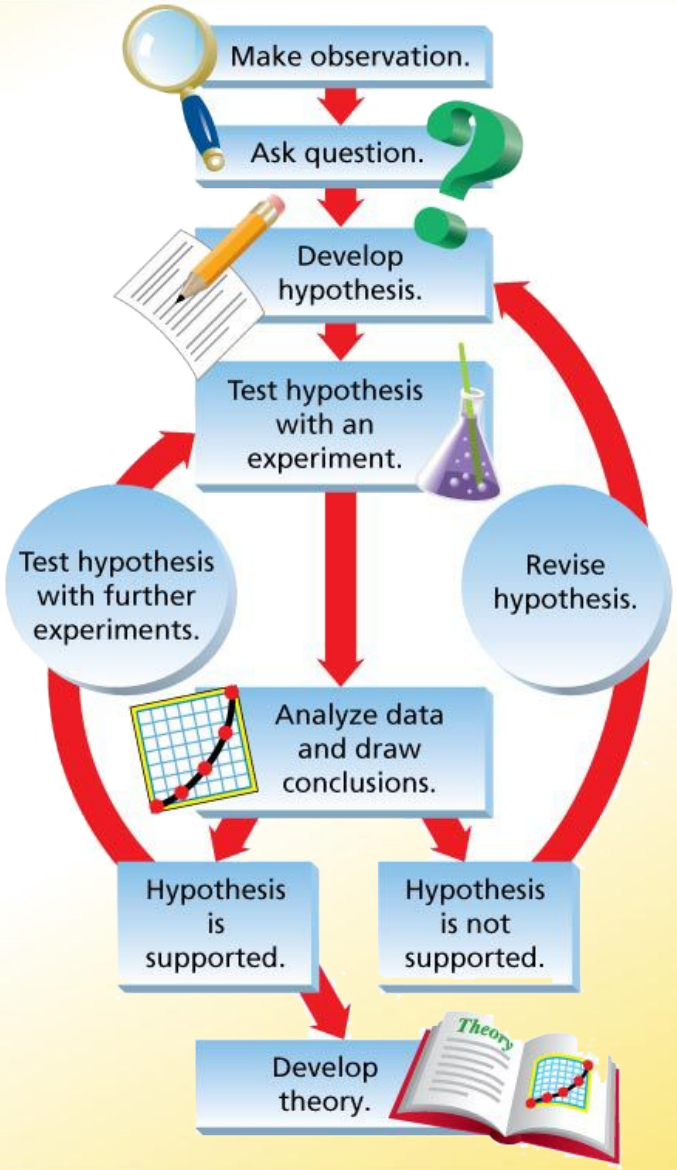

Scientific Methods

Making Observations

Scientific investigations often begin with observations. An **observation** is information that you obtain through your senses.

Forming a Hypothesis

A **hypothesis** is a proposed answer to a question.

Scientific Methods

Testing a Hypothesis

In an experiment, any factor that can change is called a variable.

- The **manipulated variable** causes a change.
- The **responding variable** changes in response to the manipulated variable.
- A **controlled experiment** is an experiment in which only one variable, the manipulated variable, is deliberately changed at a time.

Scientific Methods

Drawing Conclusions

A conclusion describes how facts apply to a hypothesis.

Developing a Theory

A **scientific theory** is a well-tested explanation for a set of observations or experimental results. Once a hypothesis has been supported in repeated experiments, scientists can begin to develop a theory.

Scientific Methods

Question: How does speed affect how wet you get in the rain?

Hypothesis: The faster your speed, the drier you will stay.

Experiment: Test whether speed affects how wet you get in the rain.

Scientific Methods

In 1997, two meteorologists conducted a controlled experiment to determine if moving faster keeps you drier in the rain.

One scientist walked 100 yards and the other ran the same distance. Variables, such as type of clothes, were controlled.

Scientific Methods

The clothes of the walking scientist accumulated 217 grams of water; the clothes of the running scientist accumulated 130 grams of water.

Draw a Conclusion: The scientists concluded that running in the rain keeps you drier.

Scientific Laws

How does a scientific law differ from a scientific theory?

Scientific Laws

After repeated observations or experiments, scientists may arrive at a scientific law.

- A **scientific law** is a statement that summarizes a pattern found in nature.
- For example, Newton's law of gravity is a scientific law that has been verified over and over. Scientists have yet to agree on a theory that explains how gravity works.

Scientific Laws

A scientific law describes an observed pattern in nature without attempting to explain it. The explanation of such a pattern is provided by a scientific theory.

Scientific Models

Why are scientific models useful?

A **model** is a representation of an object or event. A street map is a model of a city.

Scientific models make it easier to understand things that might be too difficult to observe directly.

Scientific Models

This computer model represents the interior of an airplane. It helps the engineers visualize the layout of the plane.

Scientific Models

Models help you visualize things that are too small to see, such as atoms, or things that are large, such as the solar system.

An example of a mental, rather than physical, model might be that comets are like giant snowballs, primarily made of ice.

As new data are collected, models can be changed or be replaced by new models.

Working Safely in Science

Safety plays an important role in science. Laboratory work may involve flames or hot plates, electricity, chemicals, hot liquids, sharp instruments, and breakable glassware.

Always follow your teacher's instructions and the textbook directions exactly.

Assessment Questions

1. What is a hypothesis?
   a. a statement that summarizes a pattern found in nature
   b. a well-tested explanation for a set of observations or experimental results
   c. an experiment in which only one variable is deliberately changed at a time
   d. a proposed answer to a question

Assessment Questions

1. What is a hypothesis?

   a. a statement that summarizes a pattern found in nature

   b. a well-tested explanation for a set of observations or experimental results

   c. an experiment in which only one variable is deliberately changed at a time

   d. a proposed answer to a question

   ANS: D

Assessment Questions

2. How does a scientific law differ from a theory?
   a. A scientific law describes observations while a theory provides an explanation.
   b. A scientific law cannot be changed by additional observations, but a theory can be changed.
   c. A theory is a possible explanation, but a scientific law is a proven explanation.
   d. There is no difference because scientific law and theory are two terms that mean the same thing.

Assessment Questions

2. How does a scientific law differ from a theory?

   a. A scientific law describes observations while a theory provides an explanation.

   b. A scientific law cannot be changed by additional observations, but a theory can be changed.

   c. A theory is a possible explanation, but a scientific law is a proven explanation.

   d. There is no difference because scientific law and theory are two terms that mean the same thing.

   ANS: A

Assessment Questions

3. What is the main purpose of a scientific model?
   a. to show how a hypothesis was developed
   b. to prove a theory
   c. to make complex concepts easier to understand
   d. to show a large object, such as the Earth, in a smaller form

Assessment Questions

3. What is the main purpose of a scientific model?

   a. to show how a hypothesis was developed

   b. to prove a theory

   c. to make complex concepts easier to understand

   d. to show a large object, such as the Earth, in a smaller form

   ANS: C

Assessment Questions

4. How does a scientific law differ from a theory?

   a. Assume that it is safe because the school would not allow unsafe chemicals.

   b. Assume that it is a hazardous chemical because all chemicals are dangerous.

   c. Ask your teacher or check the procedure to find the correct safety precautions.

   d. Ask your lab partner whether the chemical is hazardous or not.

Assessment Questions

4. How does a scientific law differ from a theory?

   a. Assume that it is safe because the school would not allow unsafe chemicals.

   b. Assume that it is a hazardous chemical because all chemicals are dangerous.

   c. Ask your teacher or check the procedure to find the correct safety precautions.

   d. Ask your lab partner whether the chemical is hazardous or not.

   ANS: C