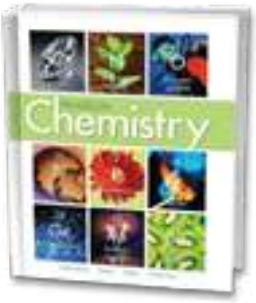

Chapter 1
Introduction to Chemistry

1.1 The Scope of Chemistry
1.2 Chemistry and You

1.3 Thinking Like a Scientist

1.4 Problem Solving in Chemistry

1.3 Thinking Like a Scientist >

How do you think Alexander Fleming tested his hypothesis?

In 1928, Alexander Fleming, a Scottish scientist, noticed that the bacteria he was studying did not grow in the presence of a yellow-green mold.

An Experimental Approach to Science

How did Lavoisier help to transform chemistry?

An Experimental Approach to Science

The word *chemistry* comes from the word *alchemy*.

- Alchemists were concerned with searching for a way to change other metals, such as lead, into gold.
- Alchemists developed the tools and techniques for working with chemicals.
- They designed equipment that is still in use today, including beakers, flasks, tongs, funnels, and the mortar and pestle.

An Experimental Approach to Science

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Lavoisier helped to transform chemistry from a science of observation to the science of measurement that it is today.

An Experimental Approach to Science

- Lavoisier designed a balance that could measure mass to the nearest 0.0005 gram.
- He also settled a long-standing debate about how materials burn.
  - He was able to show that oxygen is required for a material to burn.

Checkpoint

Who is credited with transforming chemistry from a science of observation to a science of measurement?

A. Fleming

B. Lavoisier

C. de Mestral

D. Carothers

Checkpoint

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The Scientific Method

What are the steps in the scientific method?

The Scientific Method

The **scientific method** is a logical, systematic approach to the solution of a scientific problem.

The Scientific Method

Steps in the scientific method include making observations, proposing and testing hypotheses, and developing theories.

Making Observations

When you use your senses to obtain information, you make an **observation**.

- This scientist is making observations with a microscope.
- Observation is an essential step in the scientific method.

Making Observations

Suppose you try to turn on a flashlight and you notice that it does not light.

Testing Hypotheses

If you guess that the batteries in a flashlight are dead, you are making a hypothesis.

- A **hypothesis** is a proposed explanation for an observation.

Testing Hypotheses

Replacing the batteries is an **experiment**, a procedure that is used to test a hypothesis.

Testing Hypotheses

Replacing the batteries is an **experiment**, a procedure that is used to test a hypothesis.

- The variable that you change during an experiment is the **independent variable**, also called the manipulated variable.
- The variable that is observed during the experiment is the **dependent variable**, also called the responding variable.

Testing Hypotheses

For the results of an experiment to be accepted, the experiment must produce the same result no matter how many times it is repeated, or by whom.

- This is why scientists are expected to publish a description of their procedures along with their results.

Testing Hypotheses

Sometimes the experiment a scientist must perform to test a hypothesis is difficult or impossible.

- For example, atoms and molecules, which are some of the smallest units of matter, cannot be easily seen.
- A **model** is a representation of an object or event.
- Chemists may use models to study chemical reactions and processes.

Developing Theories

Once a hypothesis meets the test of repeated experimentation, it may be raised to a higher level of ideas. It may become a theory.

- **A theory is a well-tested explanation for a broad set of observations.**

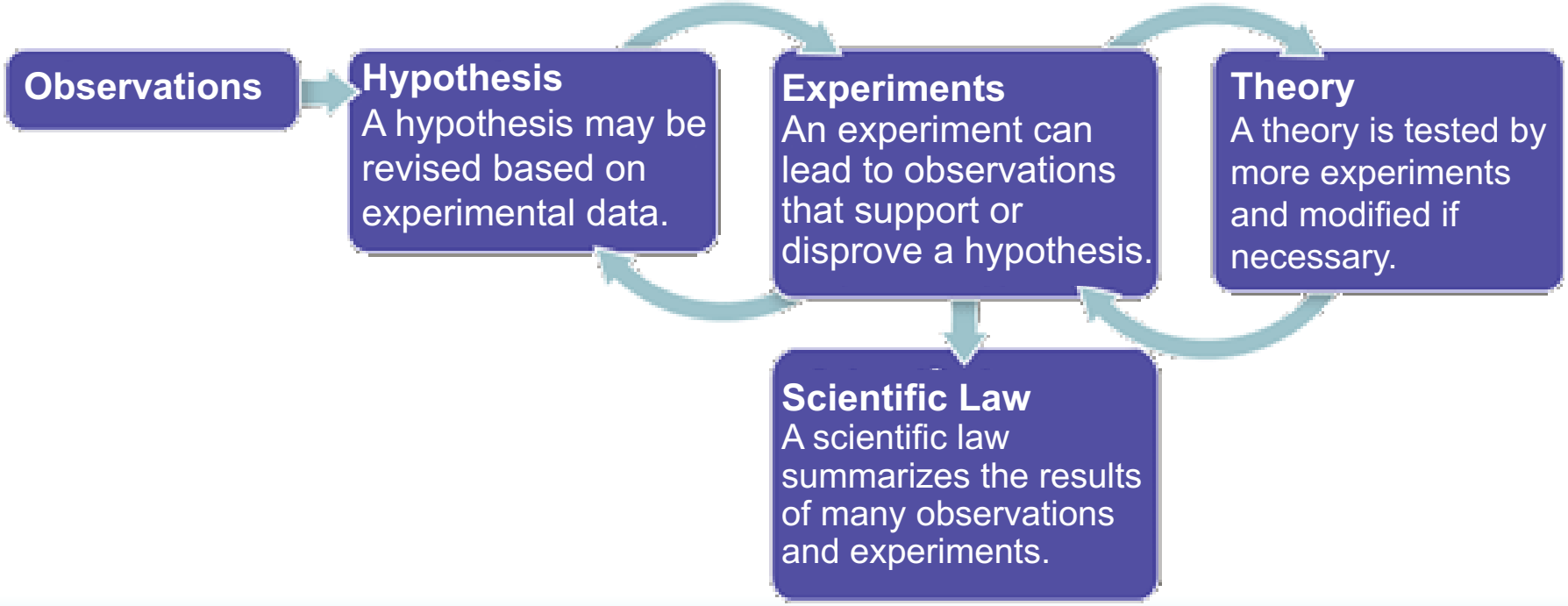
Developing Theories

- **When scientists say that a theory can never be proved, they are not saying that a theory is unreliable.**

- **They are simply leaving open the possibility that a theory may need to be changed at some point in the future to explain new observations or experimental results.**

Scientific Laws

The figure below shows how scientific experiments can lead to laws as well as theories.



Scientific Laws

A **scientific law** is a concise statement that summarizes the results of many observations and experiments.

Scientific Laws

A **scientific law** is a concise statement that summarizes the results of many observations and experiments.

- A law doesn't try to explain the relationship it describes.
- That explanation requires a theory.

1.3 Thinking Like a Scientist >

What was Alexander Fleming's hypothesis? How could he test his hypothesis?

1.3 Thinking Like a Scientist >

What was Alexander Fleming's hypothesis? How could he test his hypothesis?

Other scientists had made the same observation, but Fleming was the first to recognize its importance. He assumed that the mold had released a chemical that prevented the growth of the bacteria.

Checkpoint

What is a hypothesis?

A. information obtained from an experiment

B. a proposed explanation for observations

C. a concise statement that summarizes the results of many experiments

D. a thoroughly tested model

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PEARSON

Collaboration and Communication

What role do collaboration and communication play in science?

Collaboration and Communication

- **No matter how talented the players on a team may be, one player cannot ensure victory for the team.**

- **Individuals must collaborate, or work together, for the good of the team.**

Collaboration and Communication

When scientists collaborate and communicate with one another, they increase the likelihood of a successful outcome.

Collaboration

Scientists choose to collaborate for different reasons.

- Some research problems are so complex that no one person could have all the knowledge, skills, and resources to solve the problem.

Collaboration

Collaboration isn't always a smooth process.

- Working in pairs or in a group can be challenging, but it can also be rewarding.

Communication

The way scientists communicate with each other and with the public has changed over the centuries.

- Scientists working as a team can communicate face to face.
- They also can exchange ideas by e-mail, by phone, and at local and international conferences.
- They publish their results in scientific journals.

Communication

Scientific journals are the most reliable source of information about new discoveries.

- Articles are published only after being reviewed by experts in the author's field.
- Reviewers may find errors in experimental design or challenge the author's conclusions.
- This review process is good for science because work that is not well founded is usually not published.

Checkpoint

Why are articles in scientific journals the most reliable source of information about new scientific discoveries?

A. The articles are reviewed by experts in the author's field.

B. Any article that is submitted is published.

C. Everyone has access to the information.

D. The articles are short and easy to read.

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Key Concepts

- Lavoisier helped to transform chemistry from a science of observation to the science of measurement that it is today.
- Steps in the scientific method include making observations, testing hypotheses, and developing theories.
- When scientists collaborate and communicate with one another, they increase the likelihood of a successful outcome.

Glossary Terms

- **scientific method: a logical, systematic approach to the solution of a scientific problem; steps in the scientific method include making observations, testing hypotheses, and developing theories**
- **observation: information obtained through the senses; observation in science often involves a measurement**
- **hypothesis: a proposed explanation for an observation**
- **experiment: a repeatable procedure that is used to test a hypothesis**

Glossary Terms

- **independent variable: the variable that is changed during an experiment; also called manipulated variable**
- **dependent variable: the variable that is observed during an experiment; also called responding variable**
- **model: a representation of an event or object**
- **theory: a well-tested explanation for a broad set of observations**
- **scientific law: a concise statement that summarizes the results of many observations and experiments**

BIG IDEA

Chemists use the scientific method to solve problems and develop theories about the natural world.

END OF 1.3