

## Objectives

- **Differentiate** among the four major branches of Earth science.
- **Contrast** the four systems of Earth.
- **Discuss** how Earth science affects your daily life.

## Vocabulary

 – astronomy

 – asthenosphere

 – meteorology

 – hydrosphere

 – geology

 – atmosphere

 – oceanography

 – biosphere


 – lithosphere

## 4 Branches of Earth Science

- 🔊 – **#1 Geology** -materials that make up Earth and the processes that form and change these materials.

- **#2 Meteorology** is the branch of Earth science that studies the air that surrounds our planet.

- **#3 Oceanography** is the study of Earth's oceans, which cover nearly three-fourths of the planet.

-  **#4 Astronomy** is the study of objects beyond Earth's atmosphere.

# The Scope of Earth Science

**Table 1-1 Some Subspecialties of Earth Science**

<b>Subspecialty</b>	<b>Subjects Studied</b>
<b>Climatology</b>	Patterns of weather over a long period of time; effects of human activities on weather and climate
<b>Paleontology</b>	Remains of organisms that once lived on Earth; ancient environments
<b>Hydrology</b>	Water flow on and below Earth's surface; sources of and solutions to water pollution



# The Scope of Earth Science

**Table 1-1 Some Subspecialties of Earth Science**

<b>Subspecialty</b>	<b>Subjects Studied</b>
<b>Ecology</b>	Habitats of organisms and how organisms interact with each other and their environments
<b>Geochemistry</b>	Earth's composition and the processes that change it
<b>Tectonics</b>	Effects of internal processes on Earth's surface, including earthquakes and mountain building

# Earth's Systems

## 4 Main Earth SYSTEMS


### A. The Lithosphere

- Earth's **lithosphere** is the rigid outer shell of the planet and includes the crust and the outer mantle.
  - Below is the molten asthenosphere...




# Earth's Systems

## B. Hydrosphere

-  – The **hydrosphere** consists of the water in Earth's oceans, seas, lakes, rivers, and glaciers, as well as the water in the atmosphere.
- About 97 percent of Earth's water exists as salt water;


# Earth's Systems

## C. The Atmosphere

-  – The **atmosphere** is the blanket of gases that surrounds our planet.
- Earth's atmosphere is necessary for respiration and protects life from harmful Sun radiation.

# Earth's Systems

## D. The Biosphere

-  – The **biosphere** includes all organisms on Earth as well as the environments in which they live.

## Technology

- This application of scientific discoveries in everyday life is called technology.

## Section Assessment

1. Match the following terms with their definitions.

C geology

D oceanography

B meteorology

A astronomy

A. the study of objects beyond Earth's atmosphere

B. the study of the air that surrounds Earth

C. the study of the materials that make up Earth and the processes that form and change these materials

D. the study of Earth's oceans

## Section Assessment

2. Which subspecialties of Earth science would apply to the following subjects?

Tectonics Earthquakes along the San Andreas fault

Paleontology Effects of climatic change on dinosaurs

Hydrology Water flow into the Ogallala aquifer

Ecology The effects of logging on the Spotted Owl

Climatology Long term weather patterns in New England



## Section Assessment

3. Identify whether the following statements are true or false.

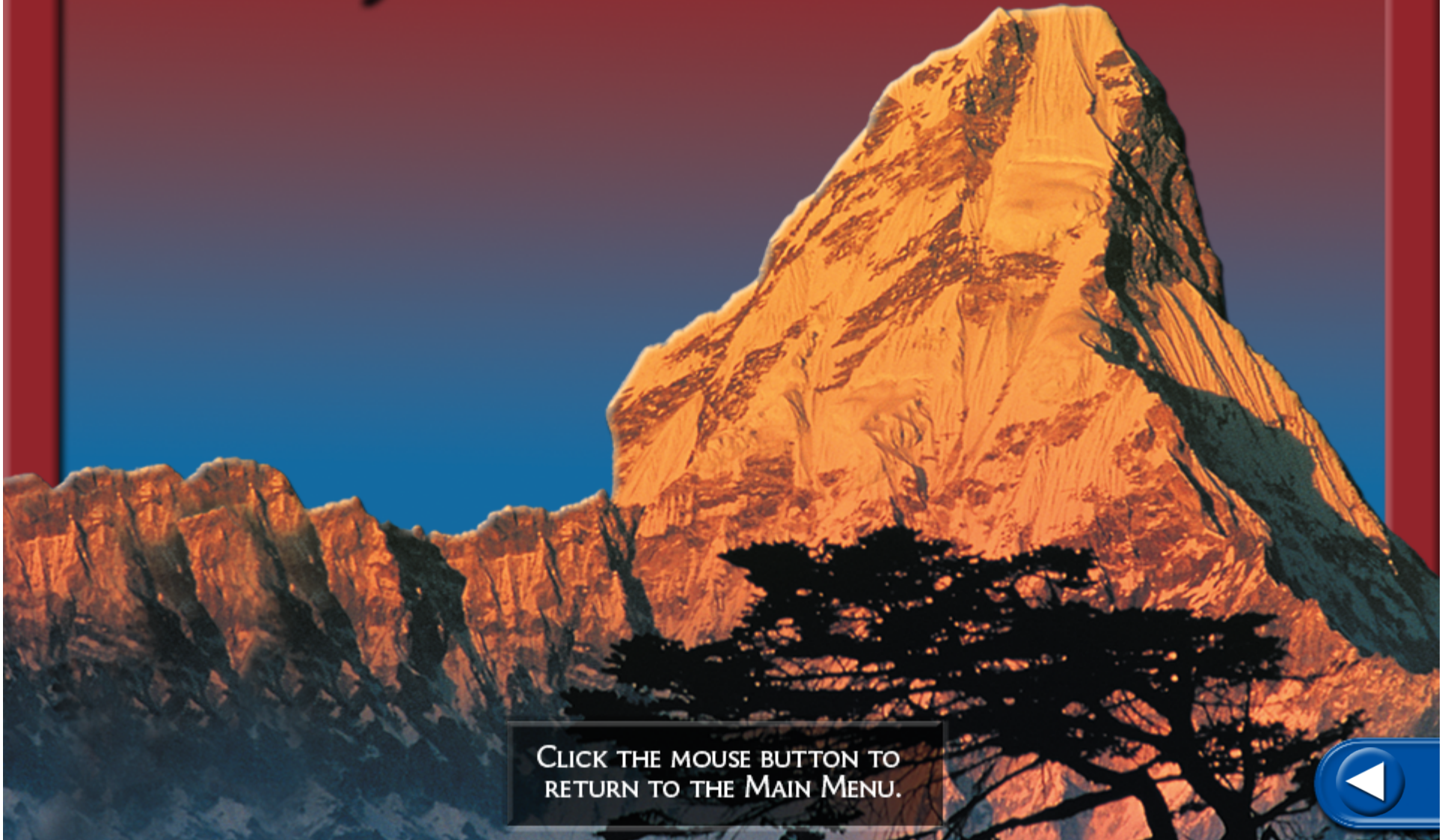
false The asthenosphere is part of the lithosphere.

true You are part of the biosphere.

true Less than 5% of Earth's water is fresh water.

false The Earth's biosphere, lithosphere, hydrosphere, and atmosphere are independent systems.

# *End of the Section*



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## Objectives

- **List** the steps used in a scientific method.
- **Compare** and **contrast** experimental variables and controls.
- **Identify** basic SI units.
- **Explain** how to write numbers using scientific notation.

## Vocabulary

 – hypothesis

 – independent variable

 – dependent variable

 – control

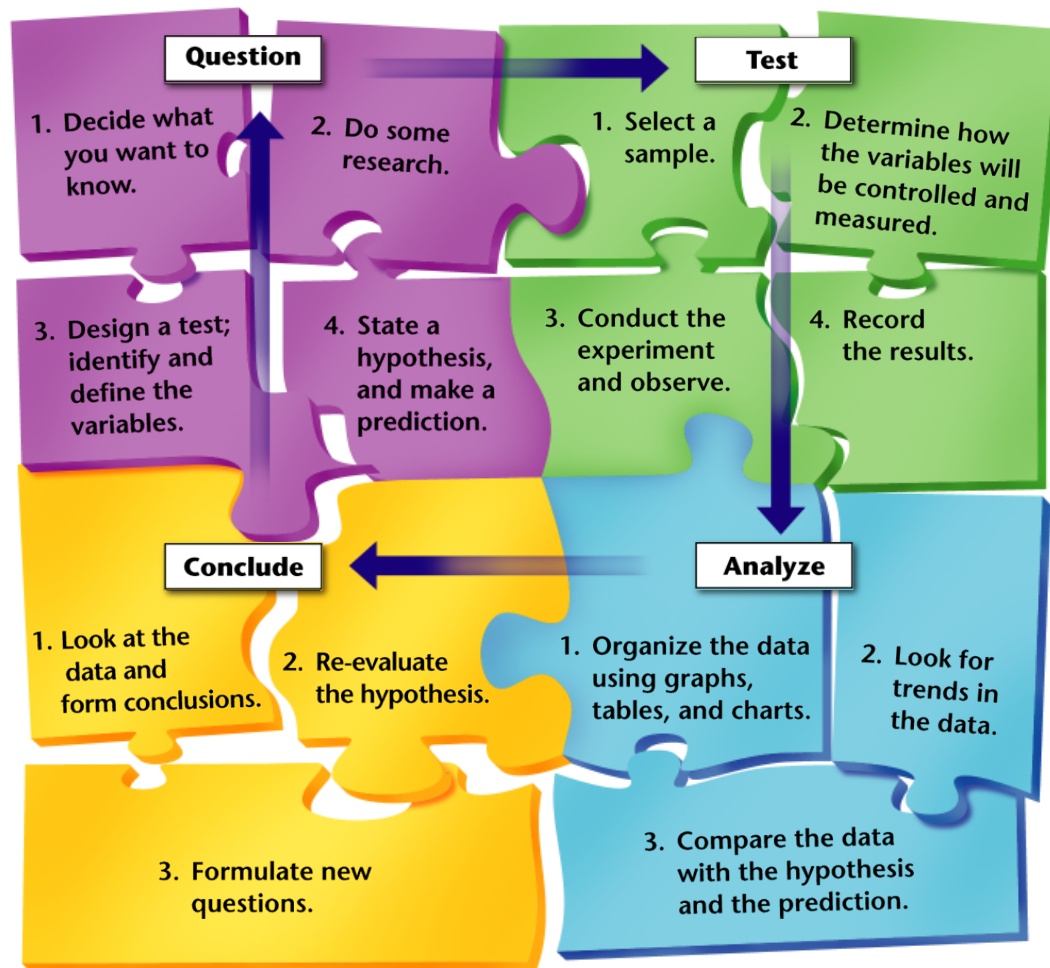
 – Le Système International d'Unités (SI)

 – scientific notation

- Once the problem is defined and research is complete, a **hypothesis**, or suggested explanation for an observation, is made.



# The Nature of Scientific Investigations



## S

- The **independent variable** in an experiment is the factor that is manipulated by the experimenter.
- A **dependent variable** is a factor that can change if the independent variable is changed.
- A **control** is used to show that the results of an experiment are a result of the condition being tested.



# The Nature of Scientific Investigations

## Safety in the Science Classroom

- When conducting any scientific investigation, it is important to use all materials and equipment only as instructed.
- Follow the safety rules listed in [Table 1-2](#) to help prevent injury to you and others in the lab as well as make you aware of possible hazards in a science lab.



- Once an experiment is complete, the data must be formatted so that they can be studied, or analyzed.



- SI is a modern version of the metric system (based on 10).

# Measurement

## Length

- The standard SI unit to measure length is the meter (m).

# Measurement

## Weight and Mass

- Weight is a measure of the gravitational force on an object.
- Weight varies with location depending on gravitational force.
- Weight is a force, and the SI unit for force is the newton (N).
- Mass is the amount of matter in an object.
- The mass of an object, unlike weight, does not change with an object's position.





# Measurement

## Area and Volume

- Area is the amount of surface \*\*\*\*, such as square meters ( $m^2$ ).
- The amount of space occupied by an object is the object's volume.
- The basic SI unit of volume for a regularly shaped, solid object is the cubic meter ( $m^3$ )



# Measurement

## Density

- Density is a measure of the amount of matter that occupies a given space.
- Density is calculated by dividing the mass of the matter by its volume.

## Time

- Time is the interval between two events and is usually measured with a watch or clock.
- The SI unit of time is the second (s).

# Measurement

## Temperature

- In science, temperature is often measured on the Celsius (C) scale.
- In SI, temperature is measured on the Kelvin (K) scale.

## Scientific Notation

- 🔊 To express numbers that are very large or small, scientists use a type of shorthand called **scientific notation** to express the number as a multiplier and a power of 10.

## Scientific Notation

- If the decimal point must be shifted to the left, the exponent of 10 is positive.
- If the decimal point in a number must be shifted to the right, then the exponent of 10 is negative.

**For example:**

$$\underline{90\ 000\ 000\ 000} = 9 \times 10^{10}$$

$$\underline{5.974\ 200\ 000\ 000\ 000\ 000\ 000\ 000} = 5.9742 \times 10^{24}$$

$$\underline{0.0000000001} = 1 \times 10^{-10}$$

## Section Assessment

1. Match the following terms with their definitions.

D hypothesis

B independent variable

A dependent variable

C control

A. factor in an experiment that can change if the factor that is manipulated by the experimenter is changed

B. factor that is manipulated by the experimenter in an experiment

C. standard for comparison in an experiment

D. suggested explanation for an observation often stated in the form of a question that can be answered by the results of an experiment

## Section Assessment

2. Match the following SI units with the type of measurement.

D Second (s)

E Kelvin (K)

C Newton (N)

B Meter (m)

A Kilogram (kg)

A. mass

B. length

C. weight

D. time

E. temperature



## Section Assessment

3. Express the following numbers in scientific notation.

96,000,000,000

$$\underline{9.6 \times 10^{10}}$$

0.000037

$$\underline{3.7 \times 10^{-5}}$$

7,234,000

$$\underline{7.234 \times 10^6}$$

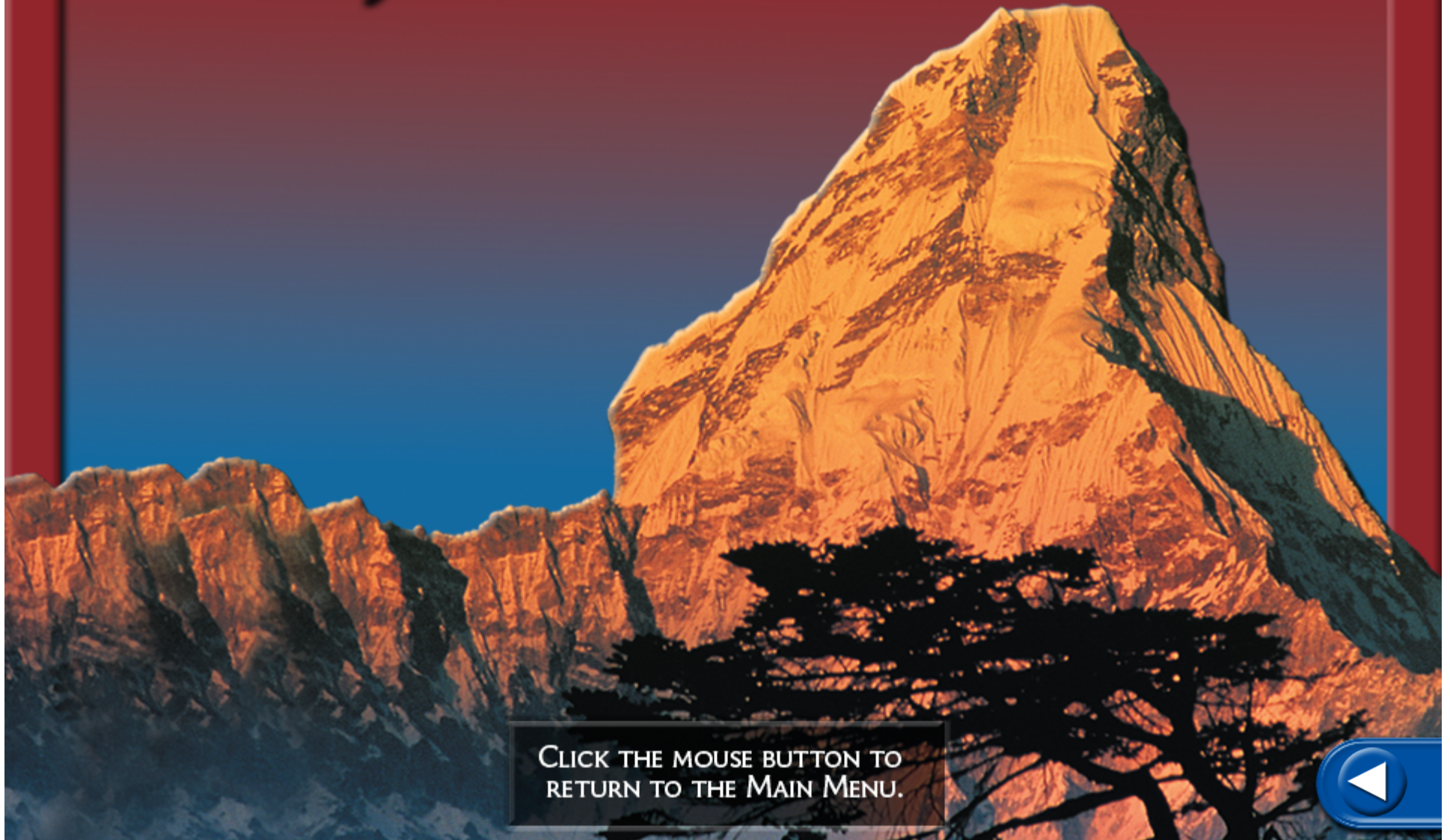
0.001

$$\underline{1 \times 10^{-3}}$$

5,284,200,000,000

$$\underline{5.2842 \times 10^{12}}$$

# *End of the Section*



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## Objectives

- **List** several ways in which scientific information is communicated.
- **Differentiate** between a scientific theory and a scientific law.

## Vocabulary

 – theory

 – law

## Communicating Results

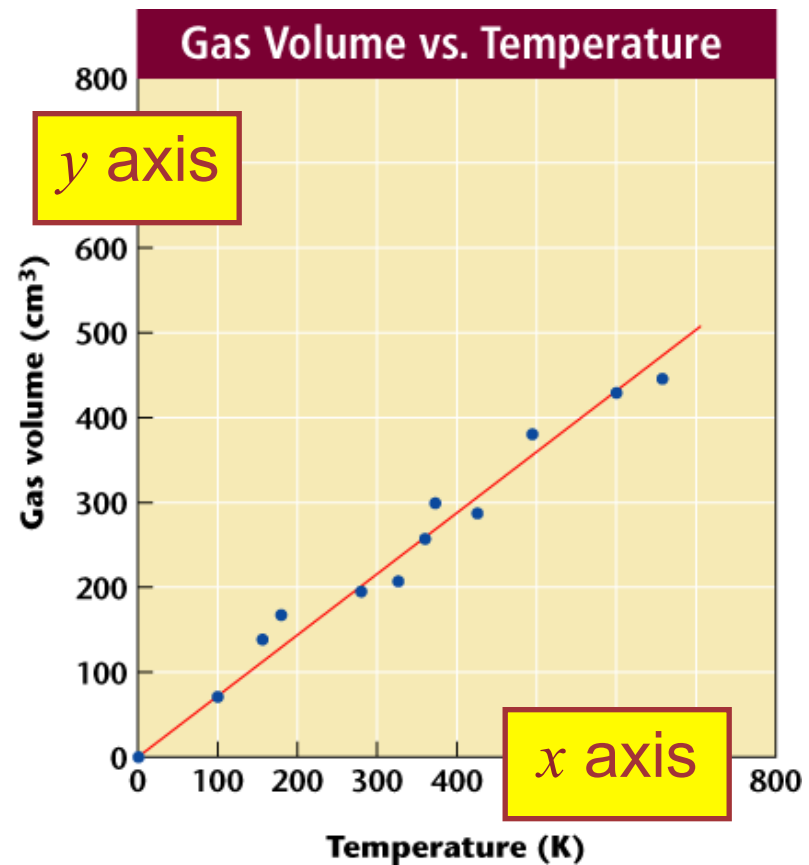
- One important goal of science is to make results available to others.



# Communicating Results

## Graphs

- A line graph is a visual display that shows how two variables are related.
- Independent—X
- Dependent—Y





## Models

- A scientific model is an idea, a system, or a mathematical expression that is similar to the idea being explained.

## Theories and Laws

- 🔊 A scientific **theory** is an explanation based on many observations during repeated experiments.

## Theories and Laws

- 🔊 A scientific **law** is a basic fact that describes the behavior of a natural phenomenon.
  - Like A RULE OF NATURE.

## Section Assessment

1. Match the following terms with their definitions.

C theory

A model

B law

**A.** an idea, a system, or mathematical expression that is similar to the idea being explained

**B.** a basic fact that describes the behavior of a natural phenomenon

**C.** an explanation based on many observations during repeated experiment

## Section Assessment

2. On a line graph, what is plotted on the horizontal ( $x$ ) axis?

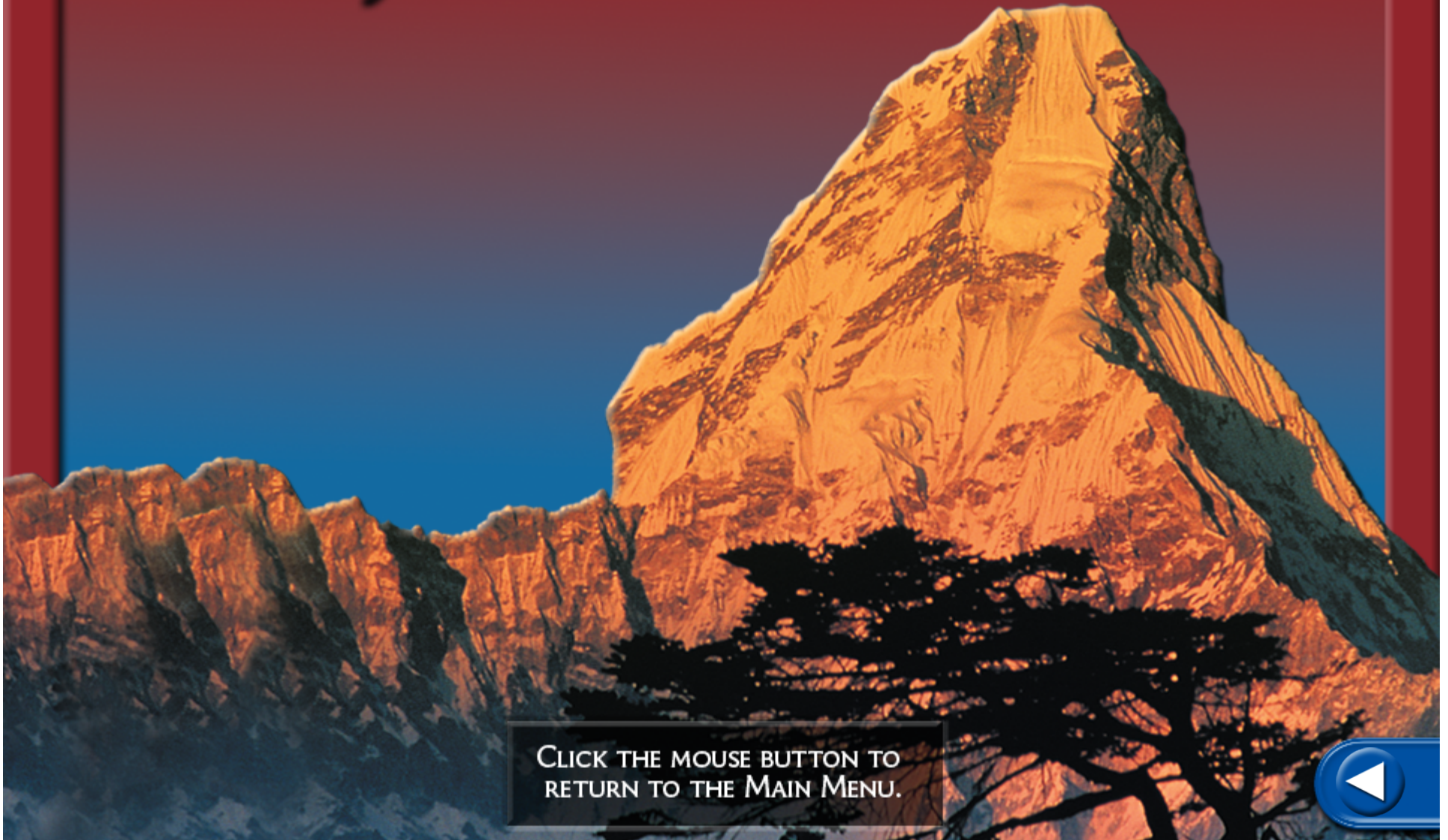
The independent variable is plotted on the horizontal ( $x$ ) axis.

3. On a line graph, what is plotted on the vertical ( $y$ ) axis?

The dependent variable is plotted on the vertical ( $y$ ) axis.



# *End of the Section*



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## Study Guide

[Section 1.1](#)

[Section 1.2](#)

[Section 1.3](#)

[Chapter Assessment](#)

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## Section 1.1 Main Ideas

- There are four major areas in Earth science. Astronomy is the study of objects beyond Earth's atmosphere. Meteorology is the branch of Earth science that deals with Earth's atmosphere. The study of the materials that make up Earth and the processes that form and change these materials is known as geology. The study of Earth's oceans is called oceanography.
- Earth can be divided into four main systems. The lithosphere includes the rocks that make up the crust and rigid, upper mantle. The atmosphere is the blanket of gases that surrounds Earth. Earth's hydrosphere is the system of all of the water on the planet. The biosphere is Earth's inhabitants and their environments.
- All of Earth's systems interact. You are part of the biosphere and you live on the crust, which is part of the lithosphere. You breathe the gases in that atmosphere and depend in many ways on the water in the hydrosphere.





## Section 1.2 Main Ideas

- The order of steps in a scientific method can vary. Most scientific methods to solving a problem, however, include defining the problem, stating a hypothesis, testing the hypothesis, analyzing the results of the test, and drawing conclusions.
- Variables are factors that change in an experiment. A dependent variable can change in response to changes in the independent variable. A control is a standard for comparison.
- Basic units used in SI include the liter, the meter, the second, the kilogram, the Newton, and degrees Celsius.
- In scientific notation, a number is expressed as a multiplier and a power of 10.



## Section 1.3 Main Ideas

- Scientific information is communicated through lab reports, professional papers, tables and graphs, and models.
- A scientific theory is an explanation based on many observations during repeated experiments. A scientific theory is valid only if it is consistent with observations, makes predictions that can be tested, and is the simplest explanation of observations. A theory can be changed or modified if it is found to be incorrect.
- A scientific law is a basic fact that describes the behavior of a natural phenomenon. A scientific law can be thought of as a “rule of nature,” even though the cause of the law may not be known.





## Multiple Choice

1. Which branch of Earth science studies the air that surrounds our planet?
- a. astronomy
  - b. meteorology**
  - c. geology
  - d. oceanography

*Astronomy* is the study of objects beyond Earth's atmosphere; *geology* is the study of the materials that make up Earth and the processes that form and change these materials; and *oceanography* is the study of Earth's oceans.

## Multiple Choice

2. Which subspecialty of Earth science studies water flow on and below Earth's surface?
- a. climatology
  - b. tectonics
  - c. ecology
  - d. hydrology

*Climatology* studies patterns of weather over a long period of time; *tectonics* studies the effects of internal processes on Earth's surface; and *ecology* studies habitats of organisms and how organisms interact with each other and their environment.

## Multiple Choice

3. The asthenosphere is part of the \_\_\_\_\_.
- a. lithosphere
  - b. hydrosphere
  - c. mantle
  - d. atmosphere

The *asthenosphere* is the partially molten layer in the upper mantle. This is below the *lithosphere* which is the rigid outer shell of Earth. The *hydrosphere* is the water on the surface of Earth and in the atmosphere. The *atmosphere* is the blanket of gases surrounding Earth.

## Multiple Choice

4. A(n) \_\_\_\_\_ is used in an experiment to show that the results of an experiment are actually a result of the condition being tested.
- a. control                      c. dependent variable  
b. independent variable      d. hypothesis

The *independent variable* in an experiment is the factor that is manipulated by the experimenter. A *dependent variable* is a factor that can change if the independent variable is changed. A *hypothesis* is a suggested explanation for an observation.

## Multiple Choice

5. The SI unit of mass is the \_\_\_\_\_.
- a. m
  - b. N
  - c. kg
  - d. K

The *meter (m)* is the SI unit to measure length; the *newton (N)* is the SI unit to measure weight; and in SI, temperature is measured on the *Kelvin (K)* scale.



## Short Answer

6. What are the four major steps and processes in the scientific approach to problem solving?

The four major steps and processes in the scientific approach to problem solving are question, test, analyze, and conclude.



## Conversion

7. Complete the following SI conversions.

$$100 \text{ mm} \quad \underline{\quad .1 \quad} \text{ m}$$

$$50 \text{ kg} \quad \underline{\quad 50,000 \quad} \text{ g}$$

$$287 \text{ mL} \quad \underline{\quad .287 \quad} \text{ L}$$

$$2.3 \text{ km} \quad \underline{\quad 2,300 \quad} \text{ m}$$

$$30 \text{ m}^3 \quad \underline{\quad 3,000 \quad} \text{ cm}^3$$

$$14 \text{ cm}^3 \quad \underline{\quad 14 \quad} \text{ mL}$$



## True or False

8. Identify whether the following statements are true or false.

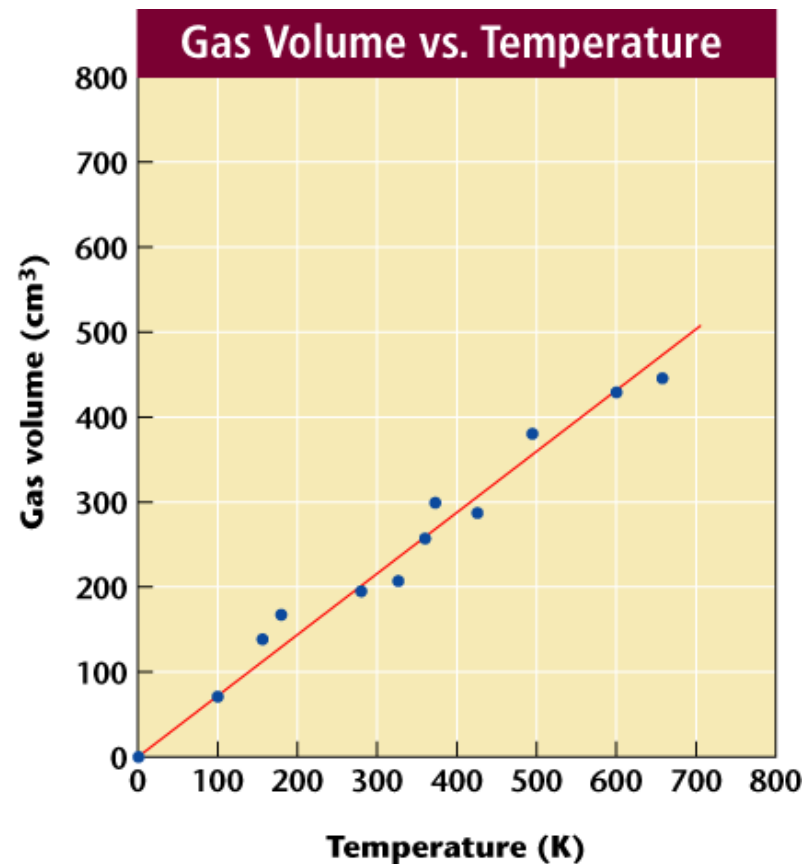
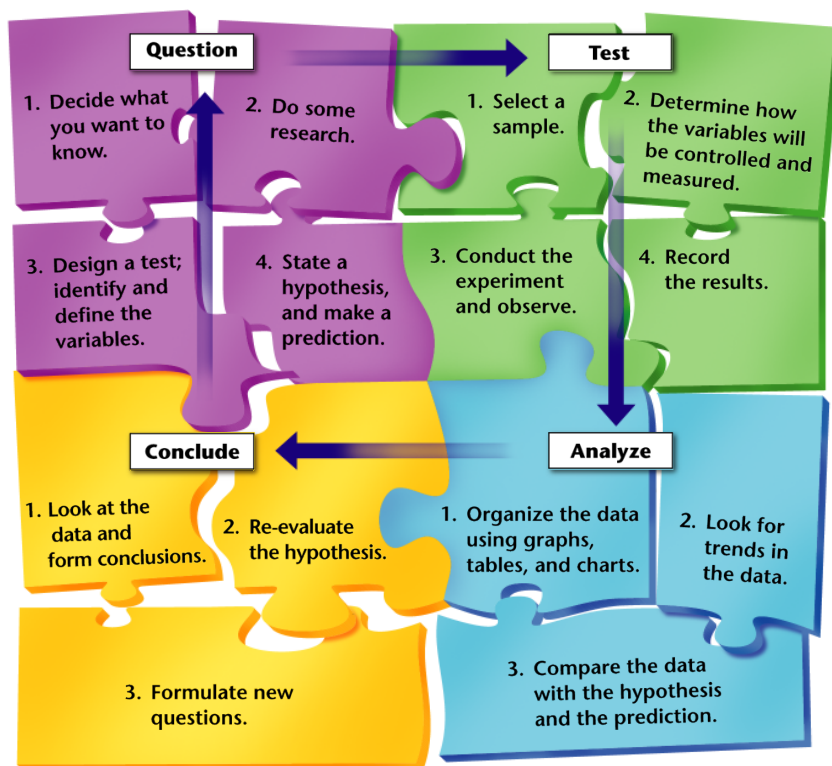
false A scientific theory is a basic fact that describes the behavior of a natural phenomenon.

true Scientific methods are not rigid, step-by-step outlines to solve problems.

true A paleontologist would study the composition of the ancient atmosphere.

false Earth's atmosphere is about 78% oxygen.

# Chapter 1 Images



## Table 1-2 Some Important Safety Rules for the Science Lab

1. Before beginning any investigation, understand the safety symbols that are noted.
2. Wear safety goggles and a safety apron during all investigations that involve heating, pouring, or using chemicals.
3. Tie back long hair and loose clothing before you begin any investigation.
4. Always slant test tubes away from yourself and others when heating the tubes. Keep all materials away from open flames.
5. Never eat or drink in the lab and never use laboratory glassware as food or drink containers.






## Table 1-2 Some Important Safety Rules for the Science Lab


6. Never inhale chemicals, and never taste any substance used in the lab. Also, don't draw any material into a tube with your mouth.
7. Know what to do in case of fire. Also, know the location and proper use of the fire extinguisher, safety shower, fire blanket, first-aid kit, and fire alarm.
8. Report any spill, accident, or injury to your teacher immediately.
9. When cleaning up, dispose of chemicals and other materials only as directed by your teacher.
10. Always wash your hands thoroughly with soap after working in the lab.




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