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Chapter Preview Questions

1. To perform tests, collect data, and display data, scientists must

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b. study physics and chemistry.

c. use appropriate tools and technology.

d. consult reference materials.

Chapter Preview Questions

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   a. read scientific journals.
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b. gathering data.

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4. Scientists analyze their observations and data to
   a. develop a hypothesis.
   b. determine whether their evidence supports their hypothesis.
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Focus on the BIG Idea

How do scientists investigate the natural world?

Suppose you want to test whether sugar dissolves more quickly in cold water or hot water. How would you find out? How would you know if your answer is reliable?

Build Science Vocabulary

High-Use Academic Words

Word	Definition	Example Sentence
constant	*adj.* Staying the same	The temperature was kept constant in the experiment.

Build Science Vocabulary

High-Use Academic Words

Word	Definition	Example Sentence
procedure	*n.* The method of doing some action, especially the sequence of steps to be followed	Follow the procedure explained in the laboratory manual.

Build Science Vocabulary

High-Use Academic Words

Word	Definition	Example Sentence
significant	*adj.* Having importance or meaning	A significant number of people voted against the bill.

Build Science Vocabulary

Apply It!

From the high-use academic words, choose the word that best completes each sentence.

1. The amount of energy needed to move a piano is _____.

significant

2. Be sure to follow the correct _____ during a fire drill.

procedure

3. The driver maintained a _____ speed.

constant

End of Chapter Preview

Section 1: What is Physical Science?

- What skills do scientists use to learn about the world?
- What do physical scientists study?

More on Scientific Thinking

Click the PHSchool.com button for an activity about scientific thinking.

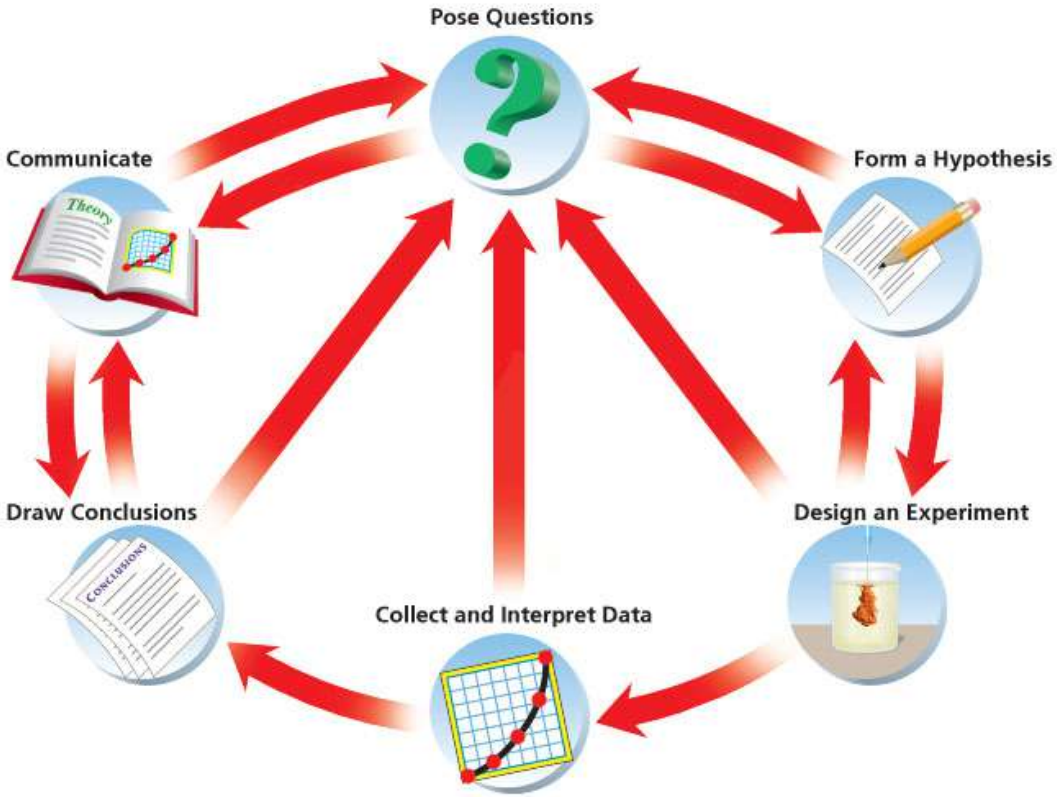
End of Section: What is Physical Science?

Section 2: Scientific Inquiry

- How do scientists investigate the natural world?
- What role do models, theories, and laws play in science?

The Nature of Inquiry

There is no set path that a scientific inquiry must follow. Different scientists may choose different paths when studying the same event.



The Nature of Inquiry Activity

Click the Active Art button to open a browser window and access Active Art about the nature of inquiry.

End of Section: Scientific Inquiry

Section 3: Measurement

- Why do scientists use a standard measurement system?
- What are the SI units of measurement for length, mass, volume, density, time, and temperature?

A Standard Measurement System

Using SI as the standard system of measurement allows scientists to compare data and communicate with each other about their results. SI units are based on multiples of 10.

Common SI Prefixes

Prefix	Symbol	Meaning
kilo-	k	1,000
hecto-	h	100
deka-	da	10
deci-	d	0.1 (one tenth)
centi-	c	0.01 (one hundredth)
milli-	m	0.001 (one thousandth)

Length

The basic unit of length in SI is the meter (m).

Common Conversions for Length		
1 km	=	1,000 m
1 m	=	100 cm
1 m	=	1,000 mm
1 cm	=	10 mm

Mass

The SI unit of mass is the kilogram (kg).

Common Conversions for Mass	
1 kg	= 1,000 g
1 g	= 1,000 mg

Volume

The SI unit of volume is the cubic meter (m^3).

Common Conversions for Volume		
1 L	=	1,000 mL
1 L	=	1,000 cm^3
1 mL	=	1 cm^3

Math Sample Problem

Calculating Density

Suppose that a metal object has a mass of 57 g and a volume of 21 cm^3. Calculate its density.

Read and Understand

What information are you given?

Mass of metal object = **57 g**

Volume of metal object = **21 cm^3**

Math Sample Problem

Calculating Density

Suppose that a metal object has a mass of 57 g and a volume of 21 cm^3. Calculate its density.

Plan and Solve

What quantity are you trying to calculate?

The density of the metal object = __

What formula contains the given quantities and the unknown quantity?

Density = **Mass**/**Volume**

Perform the calculation.

Density = **Mass**/**Volume** = **57 g**/**21 cm^3** = 2.7 g/cm^3

Math Sample Problem

Calculating Density

Suppose that a metal object has a mass of 57 g and a volume of 21 cm^3. Calculate its density.

Look Back and Check

Does your answer make sense?

The answer tells you that the metal object has a density of 2.7 g/cm^3. The answer makes sense because it is the same as the density of a known metal–aluminum.

Math Analyzing Data

Calculating Density

Practice Problem

Q. What is the density of a wood block with a mass of 57 g and a volume of 125 cm^3?

A. 0.46 g/cm^3

Math Analyzing Data

Calculating Density

Practice Problem

Q. What is the density of a liquid with a mass of 45 g and a volume of 48 mL?

A. 0.94 g/mL

Density

Because density is actually made up of two other measurements–mass and volume–an object's density is expressed as a combination of two units. The density of a substance stays the same no matter how large or small a sample of the substance is.

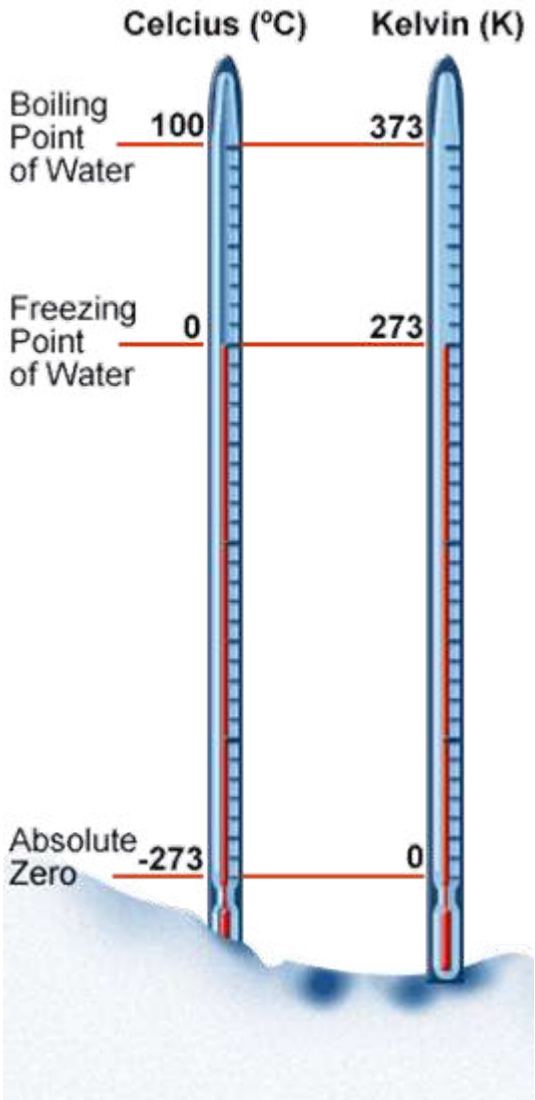
Densities of Some Common Substances

Substance	Density (g/cm^3)
Air	0.001
Ice	0.9
Water	1.0
Aluminum	2.7
Gold	19.3

Time

The second (s) is the SI unit of time.

Common Conversions for Time		
1 s	=	1,000 ms
1 min	=	60 s
1 h	=	60 min



Temperature

Scientists use the Celsius and Kelvin scales to measure temperature. The kelvin (K) is the SI unit of temperature.

Common Conversions for Temperature		
0°C	=	273 K
100°C	=	373 K

More on Measurement

Click the PHSchool.com button for an activity about measurement.

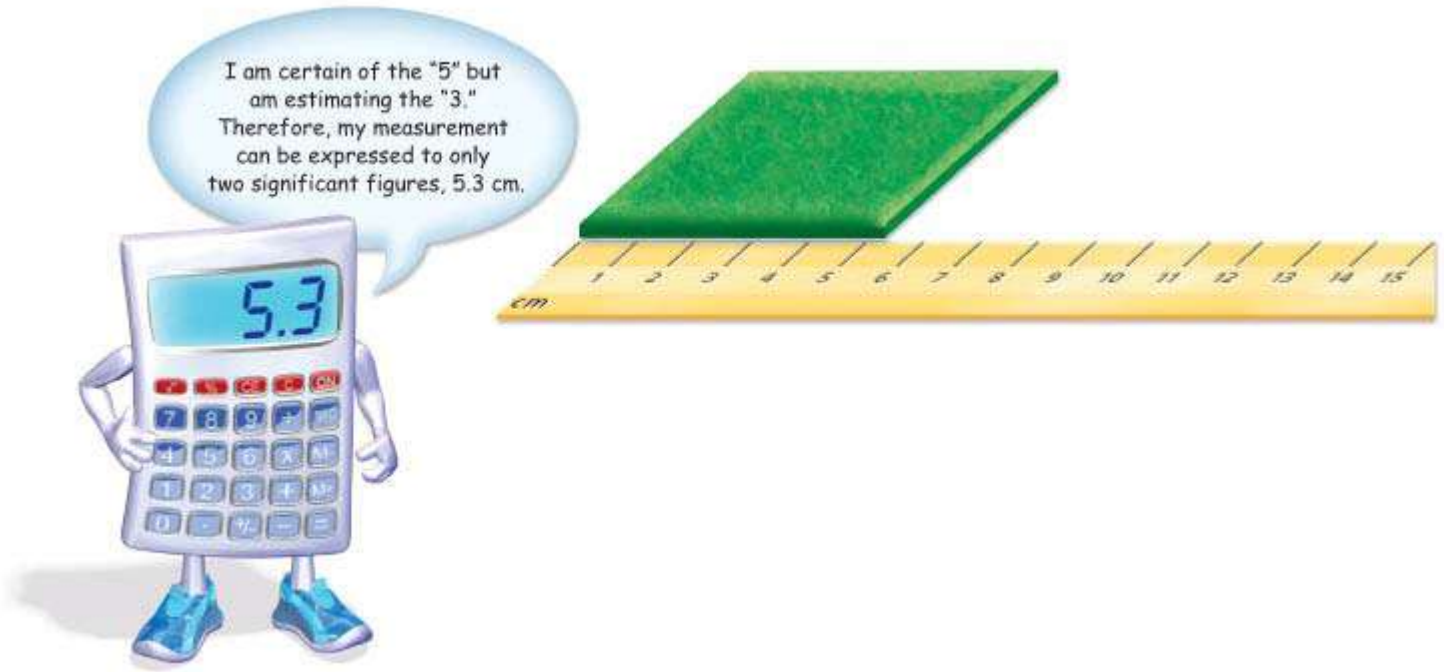
End of Section: Measurement

Section 4: Mathematics and Science

- What math skills do scientists use in collecting data and making measurements?

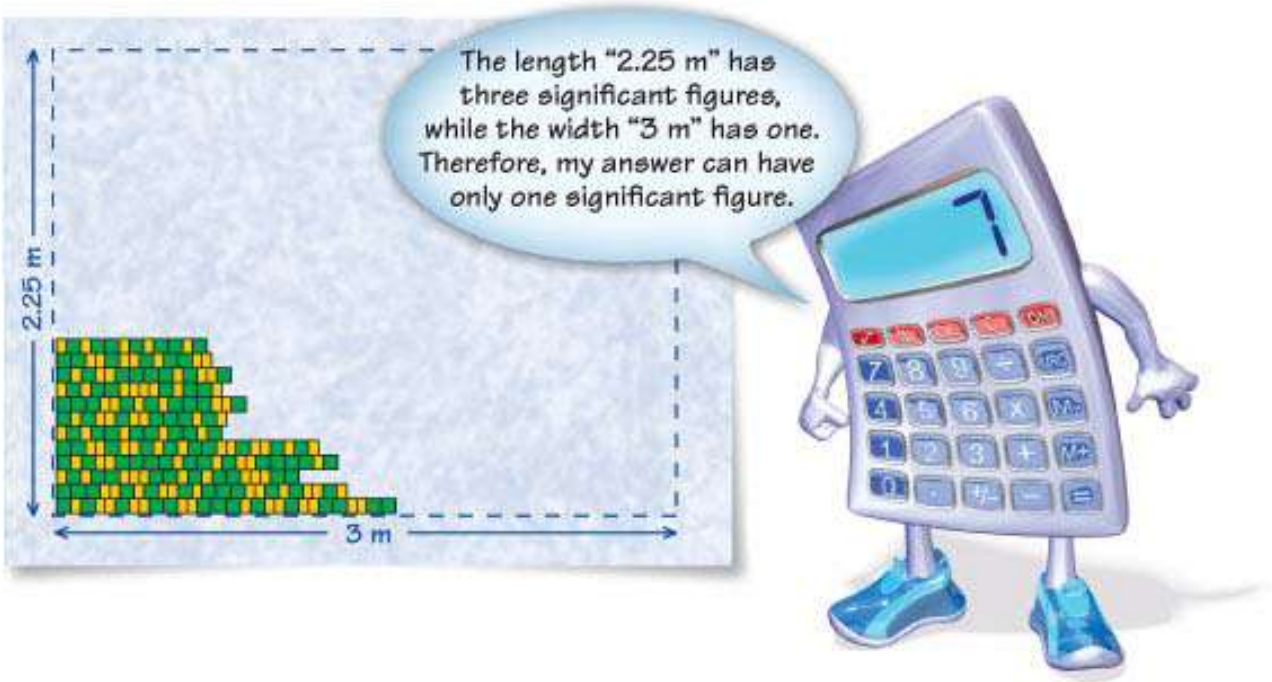
Significant Figures

A measurement should contain only those numbers that are significant.



Multiplying Measurements

When you multiply measurements, your answers can have only the same number of significant figures as the measurement with the fewest significant figures.



Math Analyzing Data

Area

To find the area of a surface, multiply its length by its width. Suppose a sheet of paper measures 27.5 cm by 21.6 cm.

$$\text{Area} = 27.5 \text{ cm} \times 21.6 \text{ cm} = 594 \text{ cm}^2$$

Practice Problem

Q. What is the area of a ticket stub that measures 3.5 cm by 2.2 cm?

A. $3.5 \text{ cm} \times 2.2 \text{ cm} = 7.7 \text{ cm}^2$

Links on Math and Science

Click the SciLinks button for links on math and science.

End of Section: Mathematics and Science

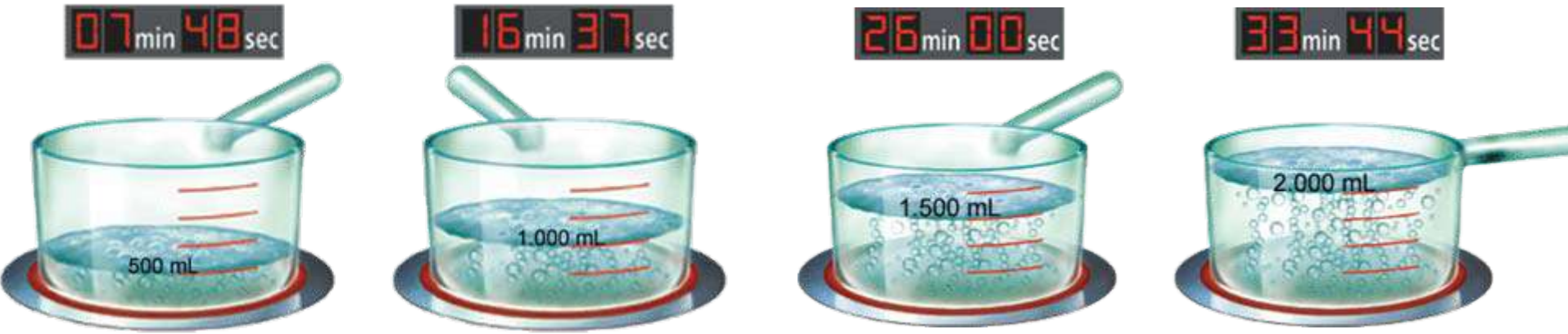
Section 5: Graphs in Science

- What type of data can line graphs display?
- How do you determine a line of best fit or the slope of a graph?
- Why are line graphs powerful tools in science?

The Importance of Graphs

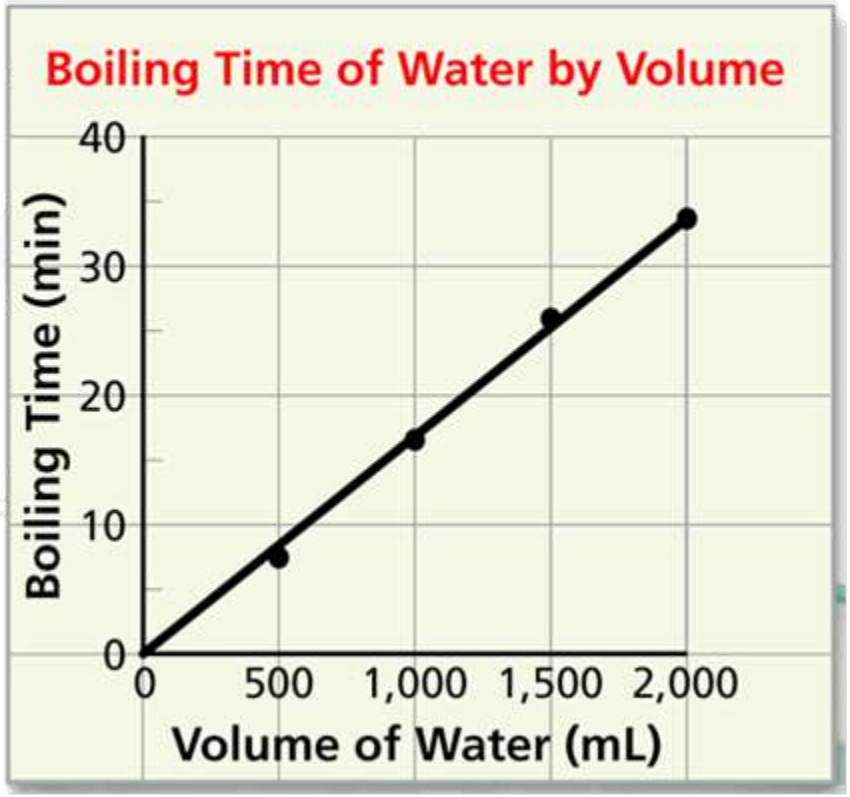
Line graphs are used to display data to show how one variable changes in response to another variable. In this experiment, the responding variable is the time it takes for the water to boil. The manipulated variable is the volume of water in the pot.

Data Table	
Volume of Water (mL)	Boiling Time
500	7 min 48 s (7.8 min)
1,000	16min 37 s (16.6 min)
1,500	26min 00 s (26.0 min)
2,000	33min 44 s (33.7 min)



Plotting a Line Graph

6 Add a Title

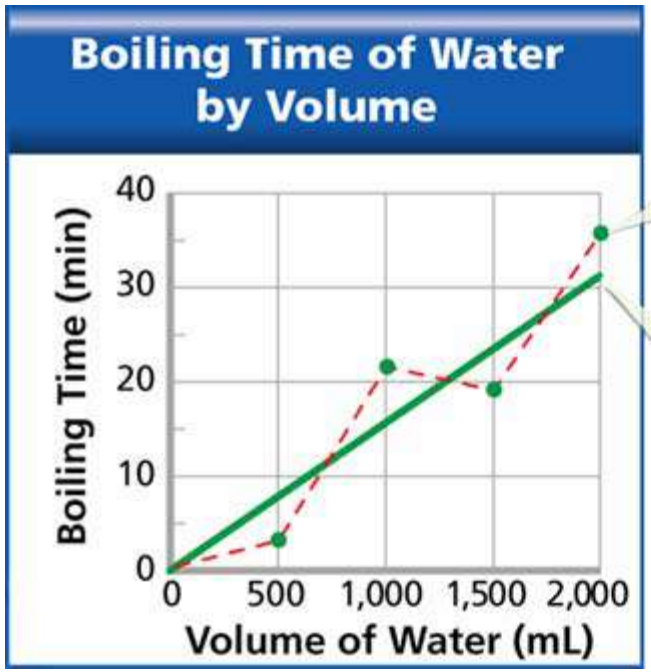


Plotting a Line Graph Activity

Click the Active Art button to open a browser window and access Active Art about plotting a line graph.

Why Draw a Line of Best Fit?

A line of best fit emphasizes the overall trend shown by all the data taken as a whole.



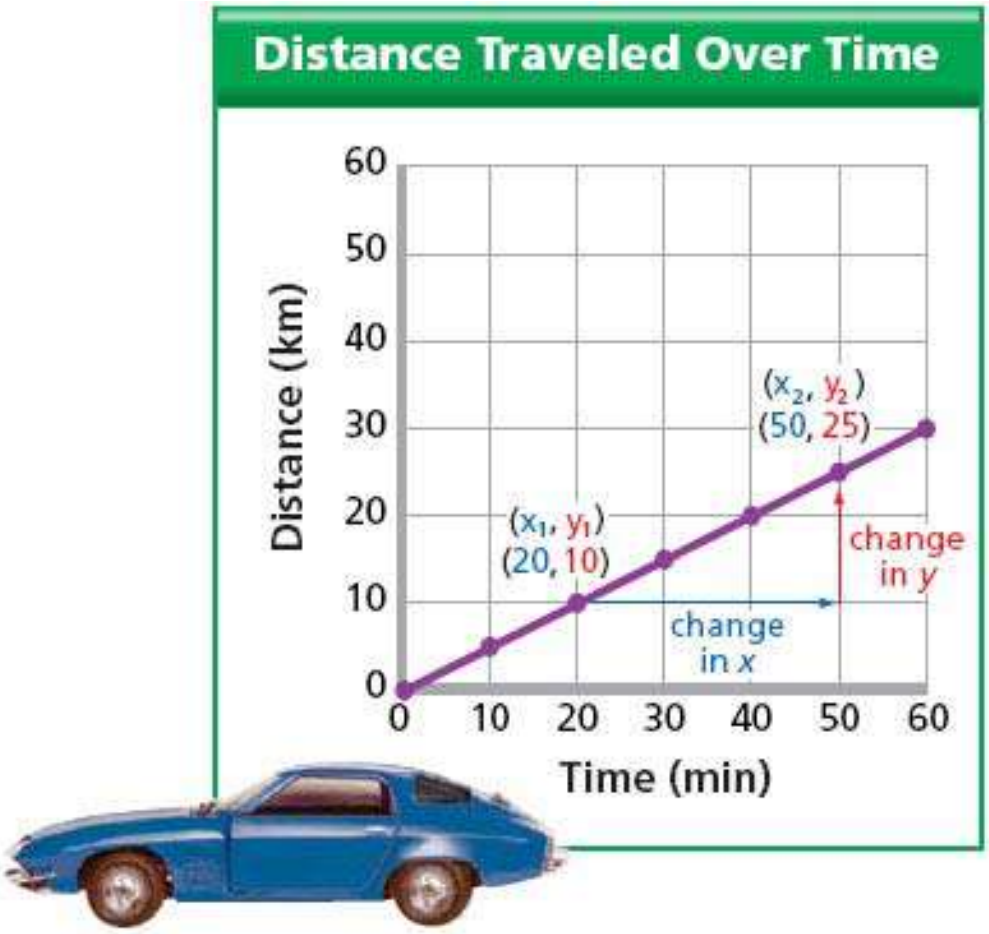
Simply connecting the dots is incorrect and may be misleading.

Drawing a line of best fit is the proper way to reflect the overall trend in the data.

Tips for Drawing a Line of Best Fit

- If the data points seem to follow along a straight line, draw a straight line.
- Include as many data points as possible directly on the line.
- For data points that don't easily fit on the line, try to have the same number of points above the line as below the line.

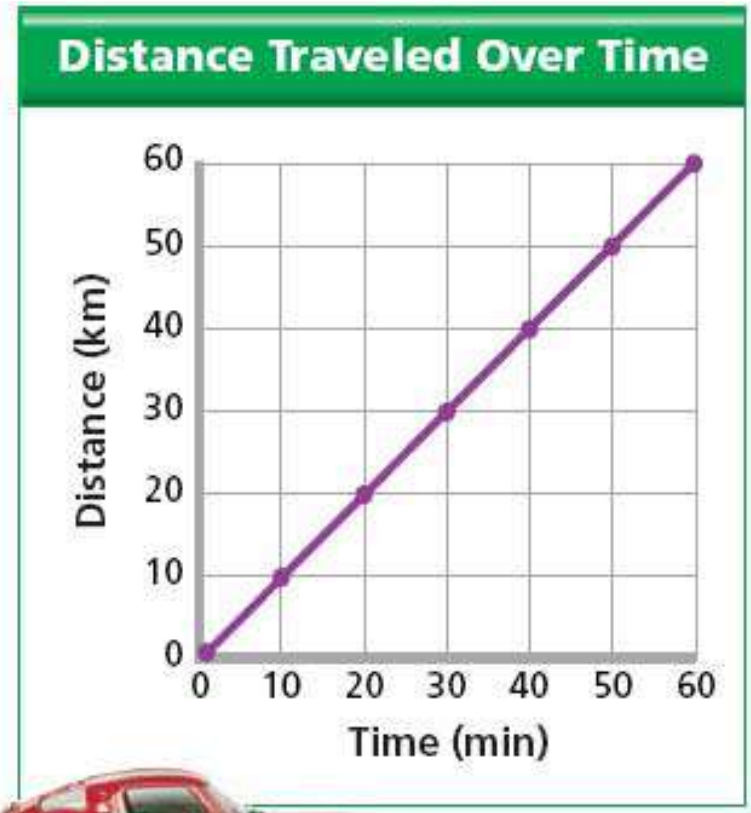
Slope



The slope of a graph line tells you how much *y* changes for every change in *x*.

Math Analyzing Data

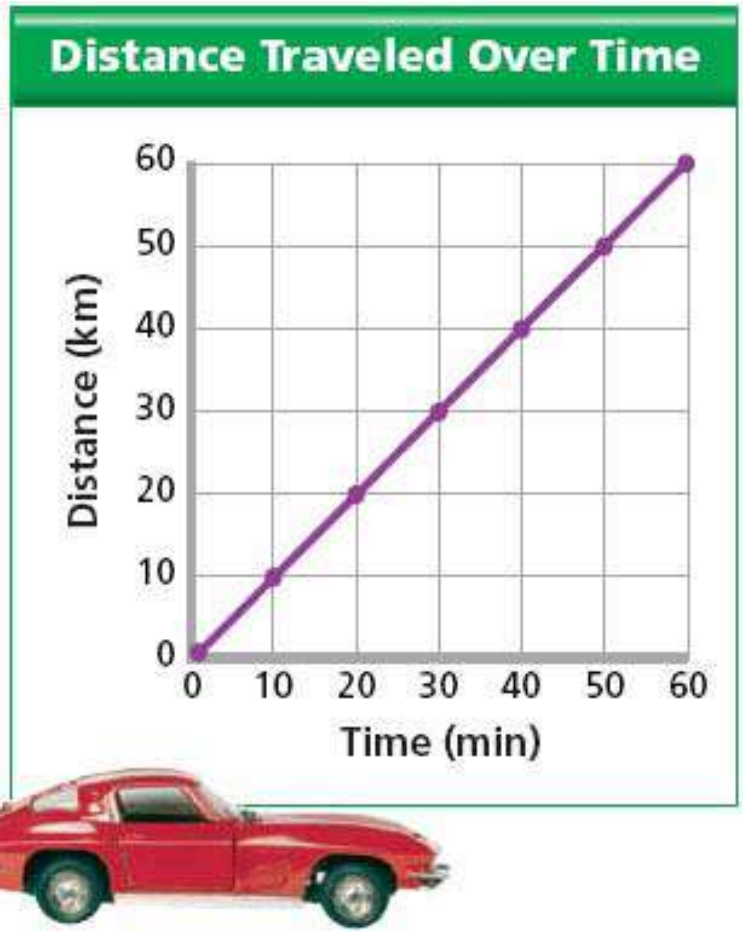
Car Travel



The graph shows the distance a car travels in a one-hour period. Use the graph to answer the questions that follow.

Math Analyzing Data

Car Travel



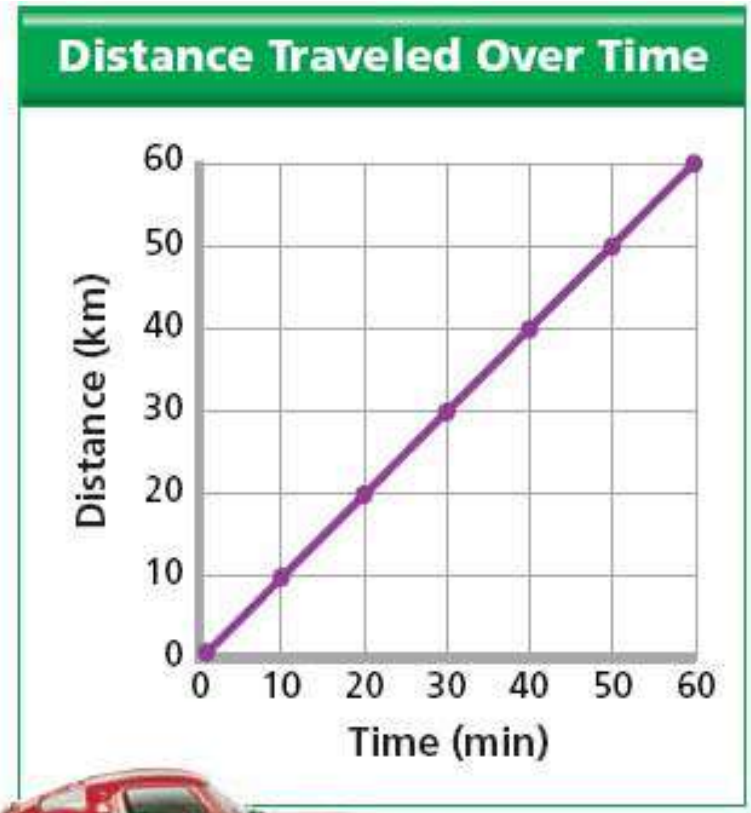
Reading Graphs:

Q. What variable is plotted on the horizontal axis? The vertical axis?

A. Time (min), the manipulated variable, is plotted on the horizontal axis. Distance (km), the responding variable, is plotted on the vertical axis.

Math Analyzing Data

Car Travel



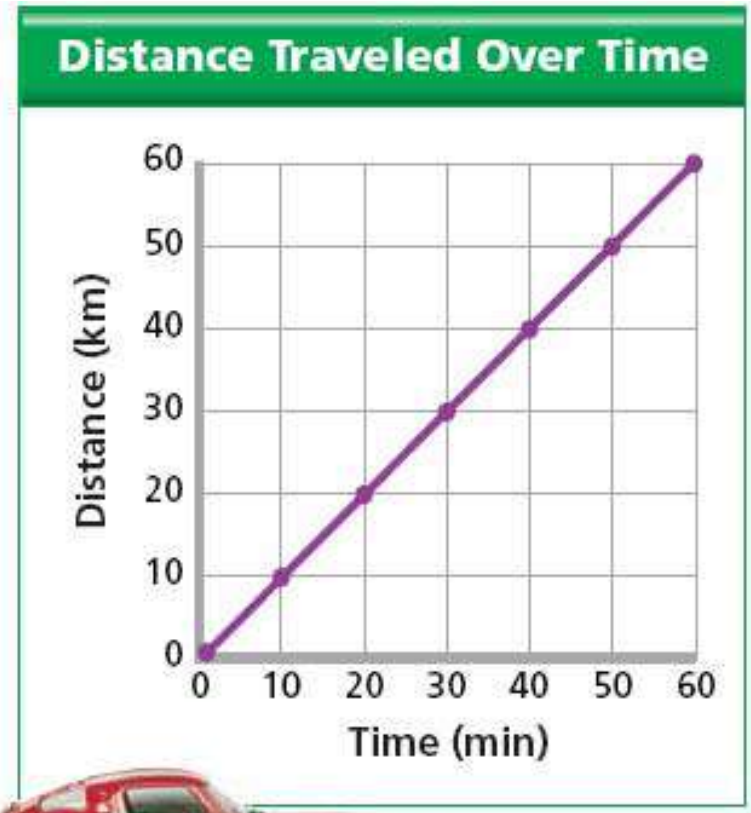
Interpreting Data:

Q. How far does the car travel in the first 10 minutes? In 40 minutes?

A. The car travels 10 km in 10 minutes and 40 km in 40 minutes.

Math Analyzing Data

Car Travel



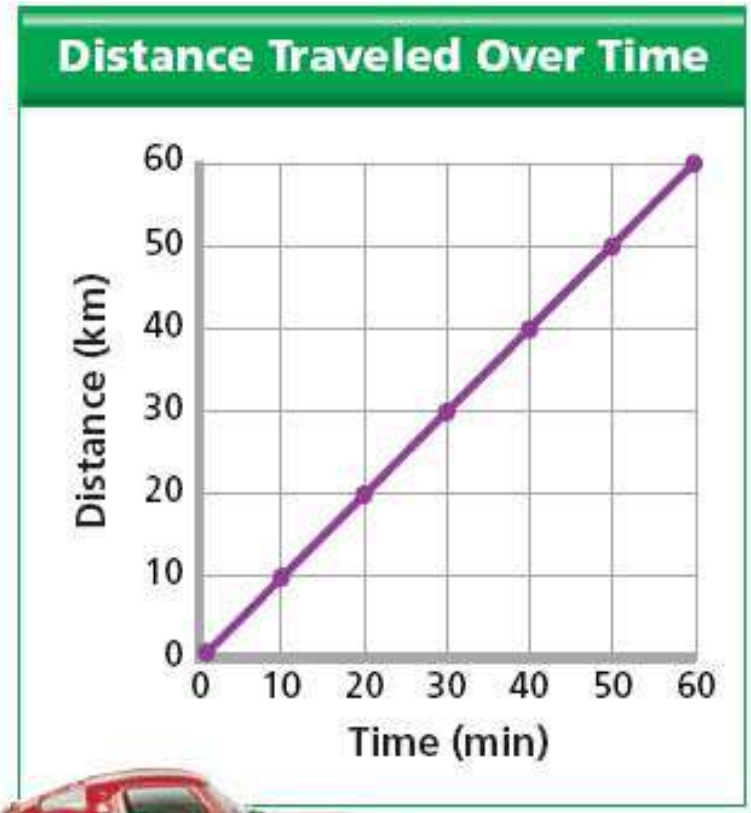
Predicting:

Q. Use the graph to predict how far the car would travel in 120 minutes. Assume the car continues to travel at the same speed.

A. The car is traveling 1 km per minute. It would travel 120 km in 120 minutes.

Math Analyzing Data

Car Travel



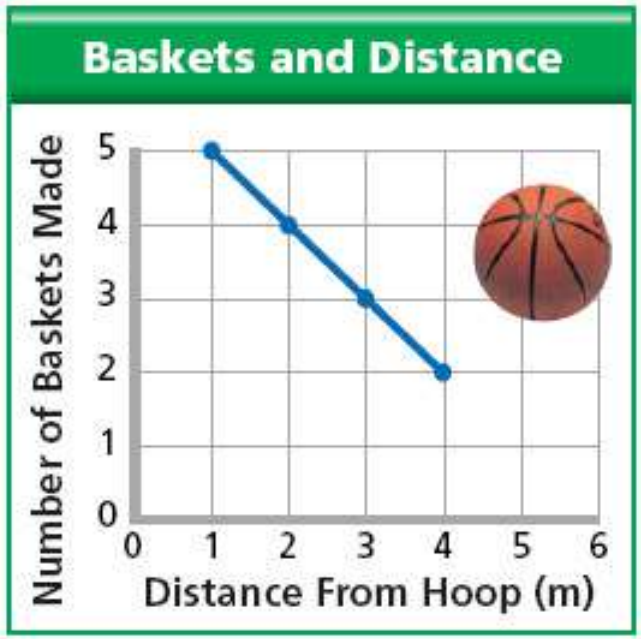
Calculating:

Q. Calculate the slope of the graph. What information does the slope provide?

A. The slope is 1 km/min. The slope provides information about the car's average speed.

Using Graphs to Identify Trends

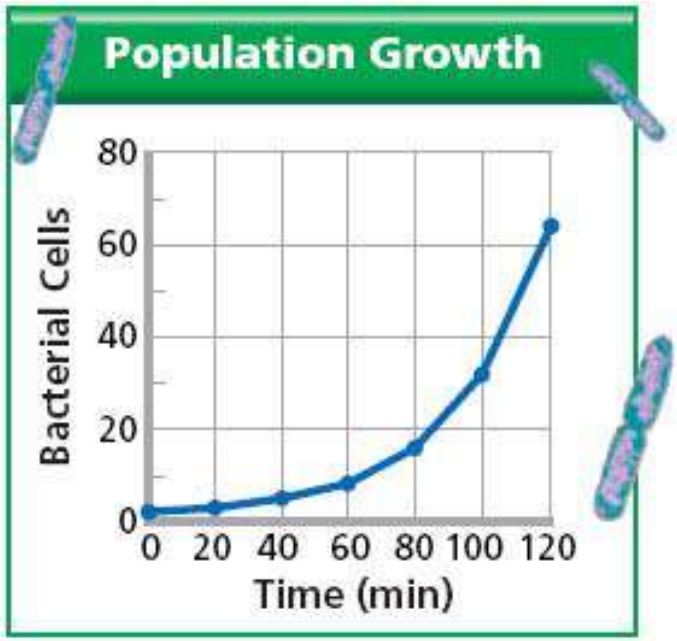
Line graphs are powerful tools in science because they allow you to identify trends and make predictions.



A Linear Trend As the distance from the hoop increases, the number of baskets made decreases. The graph line descends to the right.

Using Graphs to Identify Trends

Line graphs are powerful tools in science because they allow you to identify trends and make predictions.



B Nonlinear Trend Bacteria reproduce by dividing in two every 20 minutes. The number of bacterial cells increases sharply. The graph is a steep curve.

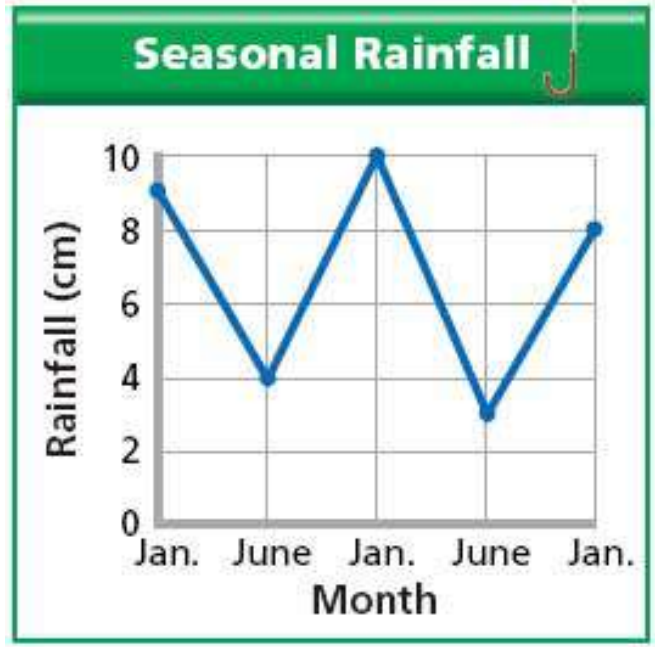
Using Graphs to Identify Trends

Line graphs are powerful tools in science because they allow you to identify trends and make predictions.

C Nonlinear Trend On a bike ride, the distance you bike increases with time. If you stop to rest, the distance remains the same and the graph levels off.

Using Graphs to Identify Trends

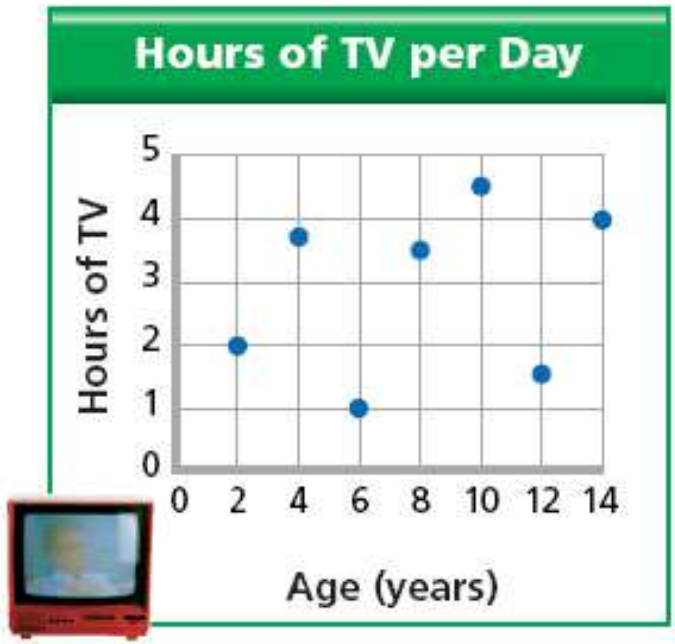
Line graphs are powerful tools in science because they allow you to identify trends and make predictions.



D Nonlinear Trend In many places, rainfall varies with the seasons. The graph shows a repeating, or cyclical, pattern.

Using Graphs to Identify Trends

Line graphs are powerful tools in science because they allow you to identify trends and make predictions.



E No Trend The amount of television children watch and their ages are not related. The data points are scattered, and the graph shows no recognizable pattern.

End of Section: Graphs in Science

Section 6: Science Laboratory Safety

- Why is preparation important when carrying out scientific investigations in the lab and in the field?
- What should you do if an accident occurs?

Safety in the Lab

These safety symbols remind you to work carefully when performing labs in this textbook series. Make sure you are familiar with each safety symbol and what it means.

Safety Symbols

In Case of an Accident

When any accident occurs, no matter how minor, notify your teacher immediately. Then listen to your teacher's directions and carry them out quickly.

In Case of Emergency

ALWAYS NOTIFY YOUR TEACHER IMMEDIATELY

Injury	What to Do
Burns	Immerse burns in cold water.
Cuts	Cover cuts with a clean dressing. Apply direct pressure to the wound to stop bleeding.
Spills on Skin	Flush the skin with large amounts of water.
Foreign Object in Eye	Flush the eye with large amounts of water. Seek medical attention.

Links on Laboratory Safety

Click the SciLinks button for links on laboratory safety.

End of Section: Scientific Laboratory Safety

QuickTake Quiz

Click to start quiz.