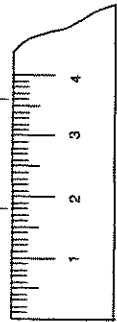


1-4 How are length and area measured?

Lesson Review

Complete the following.

- The letters "SI" stand for _____.
- What do each of these prefixes mean?
 - kilo- _____
 - centi- _____
 - deci- _____
 - milli- _____
- What is the basic unit of length in the metric system? _____
- How many millimeters are in a centimeter? _____
- When you multiply length times width, you get _____.



- Give the number of millimeters at point C. _____
- Give the number of millimeters at point D. _____

Skill Challenge

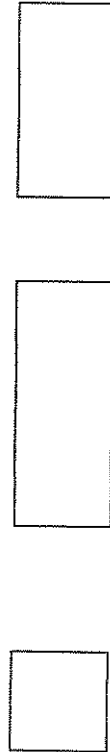
Skills: measuring, calculating

Use a metric ruler to find the length of each object in centimeters.



- _____
- _____

Find the area of each rectangle in square centimeters.



- _____
- _____
- _____

1-4 How are length and area measured?

Objective ▶ Identify the SI and metric units used to measure length and area.

TECH TERMS

- meter (MEE-tur)**: basic SI and metric unit of length
- unit (YOU-nit)**: amount used to measure something

Scientific Measurements The metric system is an international system of measurement. It is used in most countries. Everyday measurements are given in metric units (YOU-nits). A unit is an amount used to measure something. In the United States, the English system and the metric system are used.

Since 1960, scientists have used a more modern form of the metric system. This measurement system is called SI. The letters "SI" stand for Systems International. Many of the units in SI are the same as in the metric system.

Name: What are two internationally used measurement systems?

Changing Size The metric system is based on units of 10. This makes it easy to use. Each unit in the metric system is ten times greater or smaller than the next unit. To change the size of a unit, you add a prefix to the unit. The prefix makes the unit larger or smaller.

PREFIX	MEANING
kilo- (KILL-uh)	one thousand (1,000)
hecto- (HEC-tuh)	one hundred (100)
deca- (DEC-uh)	ten (10)
deci- (DESS-ih)	one tenth (1/10)
centi- (SEN-tih)	one hundredth (1/100)
milli- (MILL-ih)	one thousandth (1/1,000)

Describe: How do you change the size of a metric unit?

Units of Length In the metric system, length and distance are measured by a unit called the meter (MEE-tur). The meter is the basic unit of length. You use prefixes to make larger or smaller units of length. A kilometer (KIL-uh-mee-tur) is 1,000 meters. A centimeter (SEN-tih-mee-tur) is 1/100 of a meter. Table 2 compares units of length. The table also shows the symbols for each unit.

1000 millimeters (mm)	=	1 meter (m)
100 centimeters (cm)	=	1 meter
10 decimeters (dm)	=	1 meter
10 millimeters	=	1 centimeter
1000 meters	=	1 kilometer (km)

Compare: How many centimeters are there in one meter?

Measuring Length and Area A meter stick is used to measure length. A meter stick is divided into 100 equal parts by numbered lines. The distance between two numbered lines is equal to one centimeter (1 cm). Each centimeter is divided into 10 equal parts. Each of these parts is one millimeter (1 mm). One millimeter is 1/1000 of a meter.

Do you know how people find the right size rug for a room? They find the area of the room. You can find the area of any rectangle by multiplying its length by its width. Area is expressed in square units, such as square meters (m²) or square centimeters (cm²).



Calculate: How many millimeters are there in one meter?

1-5 How are mass and weight measured?

Objectives ▶ Identify the SI unit of mass.
▶ Compare mass and weight.

Terms

- ▶ **kilogram** (KIL-uh-gram): basic SI unit of mass
- ▶ **mass**: amount of matter in an object
- ▶ **weight**: measure of the pull of gravity on an object

Mass The amount of matter in an object is its mass. There is more matter in a car than in a bicycle. The car has more mass than the bicycle.

The basic unit of mass in SI is the **kilogram** (KIL-uh-gram) (kg). The gram (g) is sometimes used as a smaller unit of mass. Remember that the prefix "kilo-" means 1000. There are 1000 g in a kilogram.

Identify: What is the basic SI unit of mass?

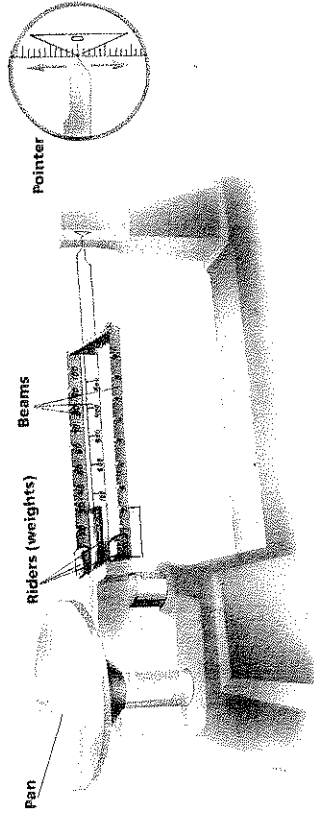
Mass and Weight Mass and weight are related, but they are not the same. Weight is a measure of the pull of gravity on an object. Gravity is a force that acts between all objects. The strength of the pull of gravity depends on the mass of the objects and how far apart they are. On Earth, gravity pulls all objects toward the center of the earth. Your

weight can change because the pull of gravity is not the same everywhere on Earth. You would weigh slightly less on top of a high mountain than at sea level. As an astronaut moves farther away from the earth, the pull of the earth's gravity becomes weaker. The astronaut weighs less in space than on Earth. However, the astronaut's mass stays the same.

Apply: Explain why an astronaut's mass would be the same on the moon as on the earth.

Measuring Mass Mass is measured with an instrument called a balance. A balance works like a seesaw. It compares an unknown mass with a known mass. One kind of balance that is commonly used to measure mass is a triple-beam balance. A triple-beam balance has a pan on which the object being measured is placed. It also has three beams. Weights, or riders, are moved along each beam until the object on the pan is balanced. Each rider gives a reading in grams. The mass of the object is equal to the total readings of all three riders.

Measure: What is an instrument used to measure mass?



1-5 How are mass and weight measured?

Lesson Review

Complete the following.

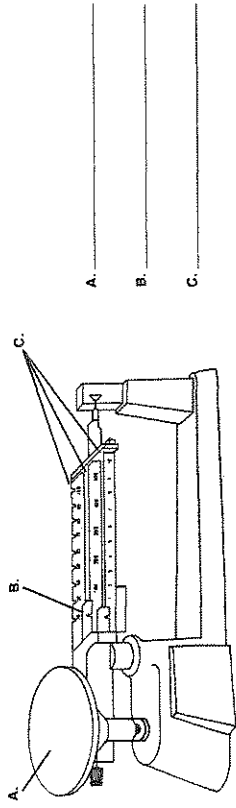
1. What is mass? _____
2. What is the basic unit of mass in SI? _____
3. What is weight? _____
4. What instrument is used to measure the mass of an object? _____
5. How many grams are in a kilogram? _____
6. a. Where would you weigh the least—on a mountaintop, in an airplane, or at the beach? _____
- b. Would your mass change in each location? Explain your answer. _____

Skill Challenge

Skills: Identifying, analyzing

Complete the following.

1. Label the parts of the triple-beam balance.



2. What metric unit of mass would you use to express the mass of each of the following? Choose from gram (g), kilogram (kg), or milligram (mg). Write the correct symbol in the space provided.

- _____ a. Elephant _____ d. Car
- _____ b. Paper clip _____ e. Penny
- _____ c. Your weight _____ f. Contents of a box of cereal

1-6

How are volume and density measured?

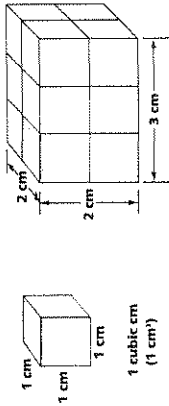
Objective ▶ Explain how volume and density are measured.

TECH TERMS

- ▶ **density** (DEN-sub-tice): amount of mass in a given volume
- ▶ **liter** (LEE-tur): basic metric unit of volume
- ▶ **volume**: amount of space something takes up

Measuring Volume The amount of space something takes up is its **volume**. The volume of a liquid is often measured in **liters** (LEE-turs). The **liter** (L) is the basic unit of volume in the metric system. Smaller volumes can be measured in milliliters (MILL-ih-lee-turs). There are 1000 milliliters (mL) in a liter.

Define: What is a liter?



Cubic Centimeters Volume can be measured in cubic centimeters. Look at the drawing of the cube. Each side is 1 cm long. The volume of the cube is 1 cubic centimeter (cm³). One cubic centimeter is the same as 1 milliliter. Now look at the drawing of the box. Its length is 3 cm. Its width is 2 cm. Its height is 2 cm. The volume of the box can be found by multiplying its length by its width by its height. The volume of the box is 12 cm³.

If you have a box that is 10 cm on each side, its volume would be 1000 cm³. A liter is the same as 1000 cm³. One liter of liquid will fill the box exactly.

Analyze: How many milliliters of water would fill a 12-cm³ box?

Density Did you ever pick up a large object and find that it was not as heavy as you thought? Did you ever pick up a small object that was very heavy? This happens because objects are made of different materials. Different materials have different **densities** (DEN-sub-tecz). Density is a measurement of how much mass is in a given volume. For example, the density of iron is 8 grams per cubic centimeter (8 g/cm³). This means that a piece of iron with a volume of 1 cm³ has a mass of 8 g. Gold has a density of 19 g/cm³. It is more than twice as dense as iron. If a piece of gold and a piece of iron are the same size, the gold will have a weight and mass more than twice iron.

The density of a material does not depend on the amount of material you have. A large piece of iron has the same density as a small piece. If you cut a copper tube in half, each piece has the same density as the whole tube.

Analyze: What is the mass of 1 cm³ of a metal if its density is 11 g/cm³?

Finding Density You can find the density of any material. You need a piece of the material. You need to find the volume and mass of the piece. Mass divided by the volume gives density.

$$\frac{\text{mass}}{\text{volume}} = \text{density}$$

Calculate: A piece of lead has a mass of 72 g. Its volume is 6 cm³. What is its density?



Name _____ Class _____ Date _____

1-6 How are volume and density measured?

Lesson Review

Complete the following.

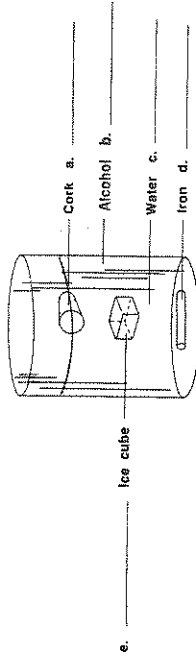
- Check the units that can be used to measure volume.
 - a. liters _____ c. square liters _____ e. cubic meters _____
 - b. cubic centimeters _____ d. centimeters _____ f. milliliter _____
- What is volume? _____
- What is the basic unit of liquid volume in the metric system? _____
- Check the pairs of units that equal the same volume.
 - a. 1000 cm³ = 1 L _____ b. 6 cm³ = 60 mL _____ c. 1 cm³ = 1 mL _____
- What is density? _____
- Circle the metal with the greatest density. gold = 19g/cm³; iron = 8 g/cm³; aluminum = 2.7 g/cm³
- Which has a greater density—a 10-meter long bar of iron or a 5-meter long bar of iron? Explain. _____

Skill Challenge

Skills: calculating, sequencing, analyzing

Complete the following.

- Place the objects in order from greatest density (1) to lowest density (5). Use the numbers 1 - 5.



- Calculate the density of each object.

Object A: mass = 10 g, volume = 2 cm³

Object B: mass = 29 g, volume = 9 cm³

Object C: mass = 55 g, volume = 10 cm³

Densities: Object A _____

Object B _____

Object C _____

How is temperature measured?

Objective ▶ Explain how temperature is measured.

TechTerms

- ▶ **degree Celsius** (SEL-see-us): metric unit of temperature
- ▶ **temperature**: measure of how hot or cold something is

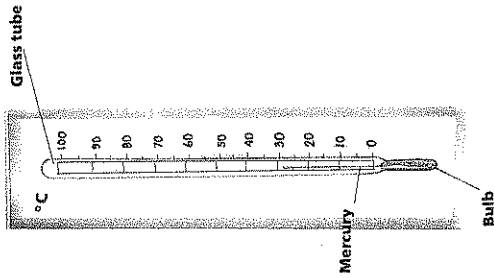
Temperature The temperature of anything is a measure of how hot or cold it is. You also can say it is the amount of heat energy something contains. For example, warm water has more heat than the same mass of ice.

Define: What is temperature?

The Thermometer Temperature is measured with an instrument called a thermometer. A thermometer is a glass tube. At the bottom of the tube is a wider part called the bulb. The bulb is filled with a liquid. Some liquids that are often used are mercury, colored alcohol, or colored water. The liquid can rise or fall in the tube. When heat is added, the liquid expands, or gets larger. It rises in the glass tube. When heat is taken away, the liquid contracts, or gets smaller. The liquid falls in the tube. On the side of the tube are a series of marks. You read the thermometer by looking at the mark on the tube where the liquid stops.

Name: What instrument is used to measure temperature?

Measuring Temperature Temperature is usually measured on one of two scales. They are the Fahrenheit (FAHR-uh-n-ht) scale and the Celsius (SEL-see-us) scale. The Fahrenheit (F) scale is used in the United States. Most other countries use the Celsius (C) scale. The Celsius scale is usually used in science. Each unit on the Celsius scale is a **degree Celsius** (°C). The degree Celsius is the metric unit of temperature.



Scientists working with very low temperatures use another temperature scale. It is the Kelvin (K) scale. The Kelvin scale is a part of SI. The Kelvin scale begins at absolute zero, or 0 K. There is no heat energy at absolute zero.

	°C	K	°F
Absolute zero	-273	0	-459
Freezing Point (Water)	0	273	32
Room Temperature	22	295	72
Human Body Temperature	37	310	98.6
Boiling Point (Water)	100	373	212

Observe: What is the freezing point of water on the Celsius scale?

1-7 How is temperature measured?

Lesson Review

Part A Write the name of the temperature scale being used — °C, K, or °F. Write your answer in the space provided.

1. Absolute zero is 0 _____ 4. Absolute zero is -273 _____
2. Human body temperature is 98.6 _____ 5. Boiling point of water is 100 _____
3. Freezing point of water is 273 _____ 6. Freezing point of water is 32 _____

Part B

Complete the following.

1. What are the names of three temperature scales? _____
2. What instrument is used to measure temperature? _____
3. What is temperature? _____

Skill Challenge

Skills: observing, interpreting, modeling

Use the Celsius thermometers to complete the following.

1. a. How many units are there between 0 °C and 5 °C on thermometer A? _____
and 5 °C on thermometer B? _____
- b. How many degrees does each marking on thermometer A represent? _____
on thermometer B represent? _____

2. a. How many units are there between 0 °C and 10 °C on thermometer B? _____
and 10 °C on thermometer A? _____
- b. How many degrees does each marking on thermometer B represent? _____
on thermometer A represent? _____

3. What temperature is shown on each thermometer?
A _____ B _____

4. On thermometer C, draw in liquid to show -9 °C.

5. On thermometer D, draw in liquid to show 44° C.

