Name _____ Class _____ Date _____

The International System of Units (SI)

Introduction

Earth science, the study of Earth and its neighbors in space, involves investigations of natural objects that range in size from the very smallest parts of an atom to the largest galaxy. To measure and describe objects here on Earth as well as those far from our planet, Earth scientists use the **International System of Units (SI),** which is a decimal system of weights and measures. The base units of this system are shown in Data Table 1 on the next page. **Length,** which is the distance between two points, is measured in meters (m). The quantity of matter in an object, or **mass,** is measured in kilograms (kg). The amount of a substance is measured in **moles** (mol). The SI unit used to measure time is the second (s), and the unit for temperature is kelvins (K). Electric current is measured in units called amperes (A), and luminous intensity is measured in candelas (cd). Derived SI units, which are formed from combinations of the base units, are also shown in Data Table 1.

Prefixes are added to SI base units to indicate how many times more or what fraction of the base unit is present. For example, one thousand meters is a kilometer (km). One-thousandth of a meter is a millimeter (mm). Common metric prefixes and their symbols are shown in Data Table 2 on the next page.

To convert one SI unit into another, you simply move the decimal point either to the left or to the right. If you are changing a smaller unit into a larger unit, the decimal point is moved to the left. If you are converting a larger unit into a smaller unit, the decimal point is moved to the right. Figure 1 can be used to determine how many places the decimal point is moved during a conversion.

In this investigation, you will make measurements using SI units and convert SI units.

Problem

What are common SI units, and how can they be converted and compared to other units of measure?

Pre-Lab Discussion

Read the entire investigation. Then work with a partner to answer the following questions.

1. **Measuring** Which SI unit would you use to measure the amount of juice in a glass?

_____

Name _____ Class _____ Date _____

2. **Comparing and Contrasting** Which is larger—143.0 millimeters or 143.0 decimeters?

_____

3. **Calculating** How many millimeters are 1.43 decimeters?

_____

4. **Calculating** The average human body temperature in degrees Fahrenheit is 98.6. Use the Metric Conversion Table in the front of this manual to convert this value to degrees Celsius. Show your work.

DATA TABLE 1

SI Base Units			Derived Units		
Quantity	**Unit**	**Symbol**	**Quantity**	**Unit**	**Symbol**
Length	meter	m	Area	square meter	m^2
Mass	kilogram	kg	Volume	cubic meter	m^3
Temperature	kelvin	K	Density	kilograms per cubic meter	kg/m^3
Time	second	s	Pressure	pascal ($kg/m \cdot s^2$)	Pa
Amount of substance	mole	mol	Energy	joule ($kg \cdot m^2/s^2$)	J
Electric current	ampere	A	Frequency	hertz (1/s)	Hz
Luminous intensity	candela	cd	Electric charge	coulomb (A•s)	C

DATA TABLE 2

Prefixes and Symbols		
Prefix[1]	**Symbol[2]**	**Meaning**
giga-	G	one billion times base unit (1,000,000,000 × base)
mega-	M	one million times base unit (1,000,000 × base)
kilo-	k	one thousand times base unit (1000 × base)
hecto-	h	one hundred times base unit (100 × base)
deka-	da	ten times base unit (10 × base)
deci-	d	one-tenth times base unit (0.1 × base)
centi-	c	one-hundredth times base unit (0.01 × base)
milli-	m	one-thousandth times base unit (0.001 × base)
micro-	μ	one-millionth times base unit (0.000001 × base)
nano-	n	one-billionth times base unit (0.000000001 × base)

[1]A prefix is added to the base unit to indicate how many times more, or what fraction of, the base unit is present.
For example, a kilometer (km) means one thousand meters and a millimeter (mm) means one-thousandth of a meter.
[2]When writing in the SI system, periods are not used after the unit symbols and symbols are not made plural.
For example, if the length of a stick is 50 centimeters, it would be written as "50 cm" (not "50 cm." or "50 cms").

Name _____ Class _____ Date _____

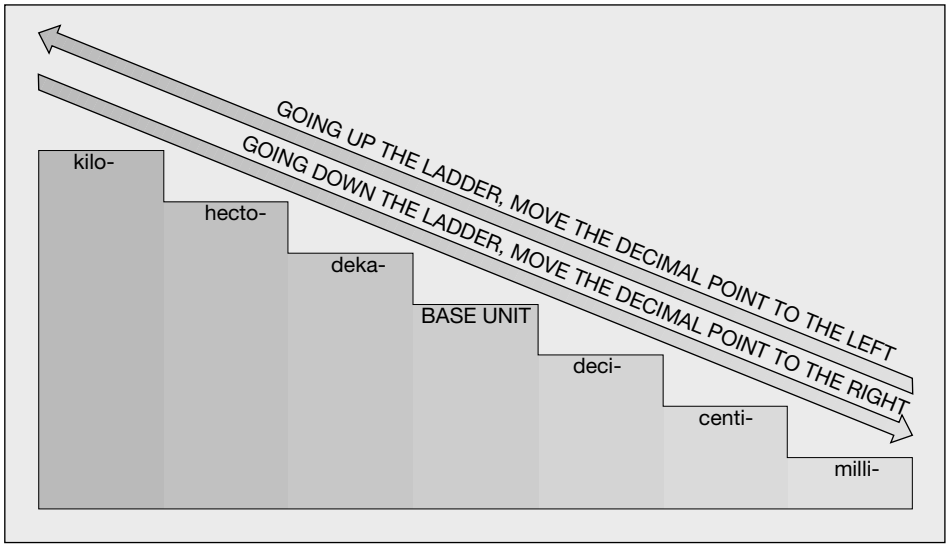

Figure 1 Metric Conversion Diagram

Materials *(per group of students)*

metric ruler
metric tape measure or meter stick
paper clip
nickel
paper cup
small rock
laboratory balance
large graduated cylinder
calculator
Metric Conversion Tables on page ix in this manual

Safety

Be careful to avoid breakage when working with glassware.

Procedure

1. Work with a partner. Use the measuring tape or meter stick to measure either your height or your partner's height as accurately as possible to the nearest hundredth of a meter, or centimeter. Record your value in Data Table 3.
2. Change your value from Step 1 from centimeters to meters. Record this value in column 4 in Data Table 3. Use your calculator if necessary.
3. Repeat Steps 1 and 2 for all other measurements listed in Data Table 3 using the appropriate measuring device.
4. Use your data, the Metric Conversion Tables, and Figure 1 to answer the questions in the **Analysis and Conclusions** section.

Name _____ Class _____ Date _____

Observations

DATA TABLE 3

Height (cm)		Height (m)	
Length of page (cm)		Length of page (mm)	
Length of shoe (mm)		Length of shoe (m)	
Length of paper clip (mm)		Length of paper clip (km)	
Diameter of coin (mm)		Diameter of coin (μm)	
Volume of paper cup (mL)		Volume of paper cup (L)	
Volume of rock (mL)		Volume of rock (μL)	
Mass of paper clip (g)		Mass of paper clip (μg)	
Mass of paper cup (g)		Mass of paper cup (kg)	
Mass of coin (g)		Mass of coin (cg)	
Mass of rock (g)		Mass of rock (kg)	

Name _____ Class _____ Date _____

Analysis and Conclusions

1. Calculating Use Figure 1 to make the following conversions.

a. 2.05 meters (m) = _____ centimeters (cm)

b. 1.50 meters (m) = _____ millimeters (mm)

c. 9.81 liters (l) = _____ deciliters (dL)

d. 5.4 grams (g) = _____ milligrams (mg)

e. 6.8 meters (m) = _____ kilometers (km)

f. 4214.6 centimeters (cm) = _____ meters (m)

g. 321.50 grams (g) = _____ kilograms (kg)

h. 70.73 hectoliters (hL) = _____ dekaliters (daL)

2. Calculating Use the information on page ix in this manual to make the following conversions.

a. On a cold day it was 8°F, or _____ °C.

b. Ice melts at 0°C, which is _____ °F.

c. Room temperature is 72°F, or _____ °C.

d. On a hot summer day, the temperature was 35°C, which is _____ °F.

e. Water temperature in a warm shower is 27°C, or _____ °F.

f. Hot soup can be 72°C, which is _____ °F.

g. Water boils at 212°F, or _____ K.

Work Space for Calculations

Name _____ Class _____ Date _____

3. **Analyzing Data** Use what you have learned about SI and the data you collected during this investigation to answer each of the following questions.
   - **a.** The outdoor thermometer reads 28°C. Will you need your winter coat? _____
   - **b.** If your body temperature is 40°C, do you have a fever? _____
   - **c.** The thermostat in your classroom reads 37°C. Are you shivering or perspiring? _____
   - **d.** Can an average man weigh 90 kilograms? _____
   - **e.** About how many meters tall is a fire hydrant? _____
   - **f.** Can one person drink 250 mL of coffee at breakfast? _____
   - **g.** What is average room temperature in K? _____
   - **h.** About how thick is a dime? _____
   - **i.** Can a typical bathtub hold 80 liters of water? _____
   - **j.** Can a pork roast that weighs 18 grams feed a family of four? _____

4. **Inferring** Explain why you think SI is used by most scientists around the world.

_____

_____

_____

_____

_____