
Module 2
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BIOC 141

Uncertainty in Measurement (Section 1.5)

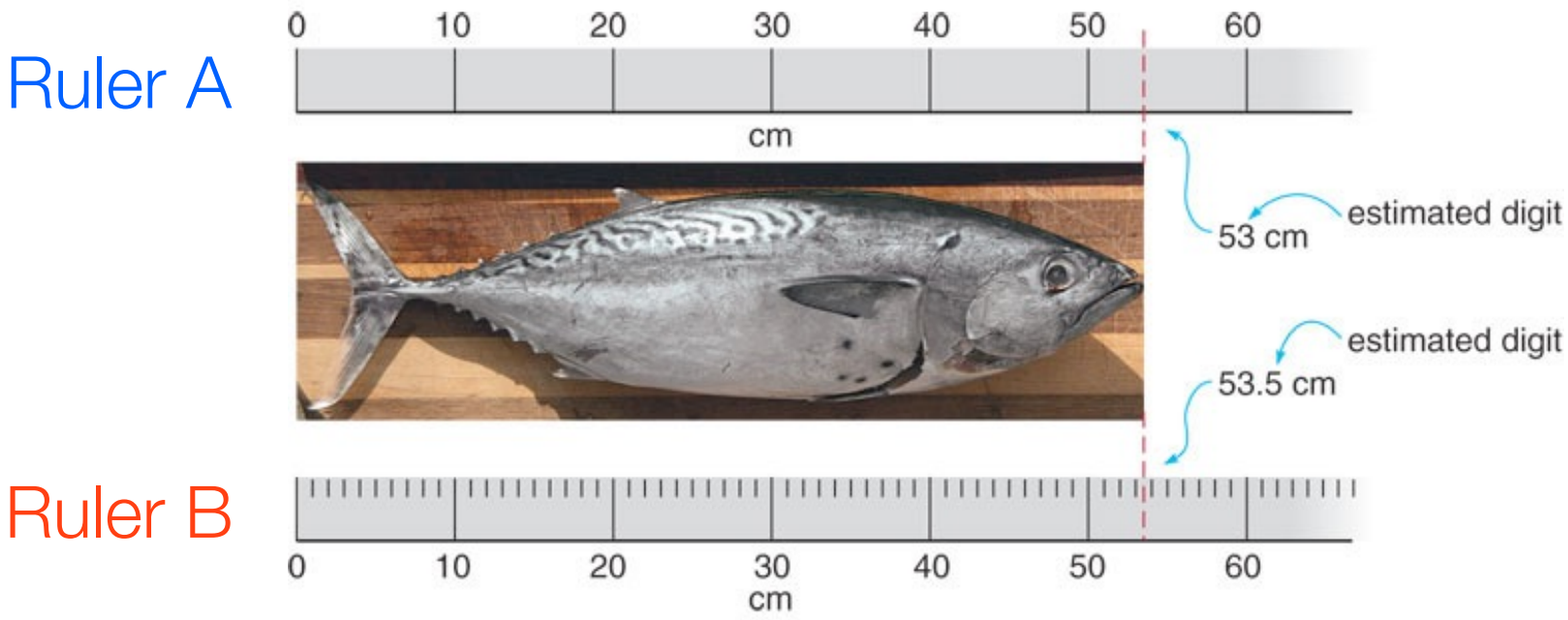
An exact number results from counting objects or is part of a definition.

10 fingers, 35 students, 1 m = 1000 mm

An inexact number results from a measurement or observation.

29439.223450 m, 1000 g, 0.0053 dL

Uncertainty from the Measuring Device



Significant Figures aka “Sig Figs”

Rule 1: All non-zero digits are always significant.

Rule 2: A zero counts as a sig fig when it is:

1. between two non-zero digits
2. at the end of a number with a decimal point

Rule 3: A zero does not count as a sig fig when it is:

1. before the first non-zero digit
2. at the end of a number that does not have a decimal point

Concept Check

Determine the number of sig figs in each number

When You Multiply and Divide

The answer has the same number of sig. figs. as the original number with the fewest sig. figs.

Round digits up/down when necessary.

$$\frac{351.2 \text{ miles}}{5.5 \text{ hour}} =$$

$0.00345 \times 123.45 =$

When You Add and Subtract

The answer has the same number of decimal places as the original number with the fewest decimal places.

12.721 - 3.43 =

95.3 + 3.020 =

482.11 + 2.0 + 0.0032 =

Concept Review (Section 1.5)

CONCEPT REVIEW EXERCISES

1. Explain why the concept of significant figures is important in numerical calculations.
2. State the rules for determining the significant figures in a measurement.
3. When do you round a number up, and when do you *not* round a number up?

Practice Problems: 1-12

The International System of Units (Section 1.6)

Base units are modified by powers of 10 called prefixes.

Prefixes modify the size of the base unit.

Property	Unit	Abbreviation
length	meter	m
mass	kilogram	kg
time	second	s
amount	mole	mol
temperature	kelvin	K
electrical current	ampere	amp
luminous intensity	candela	cd

Metric Prefixes

Prefix	Value
mega	1,000,000
kilo	1,000
deci	10
centi	100
milli	1000
micro	1,000,000

Blue box = x times larger

Red box = x times smaller

Measuring Length

1 kilometer (km) = 1,000 meters (m)

1 km = 1,000 m

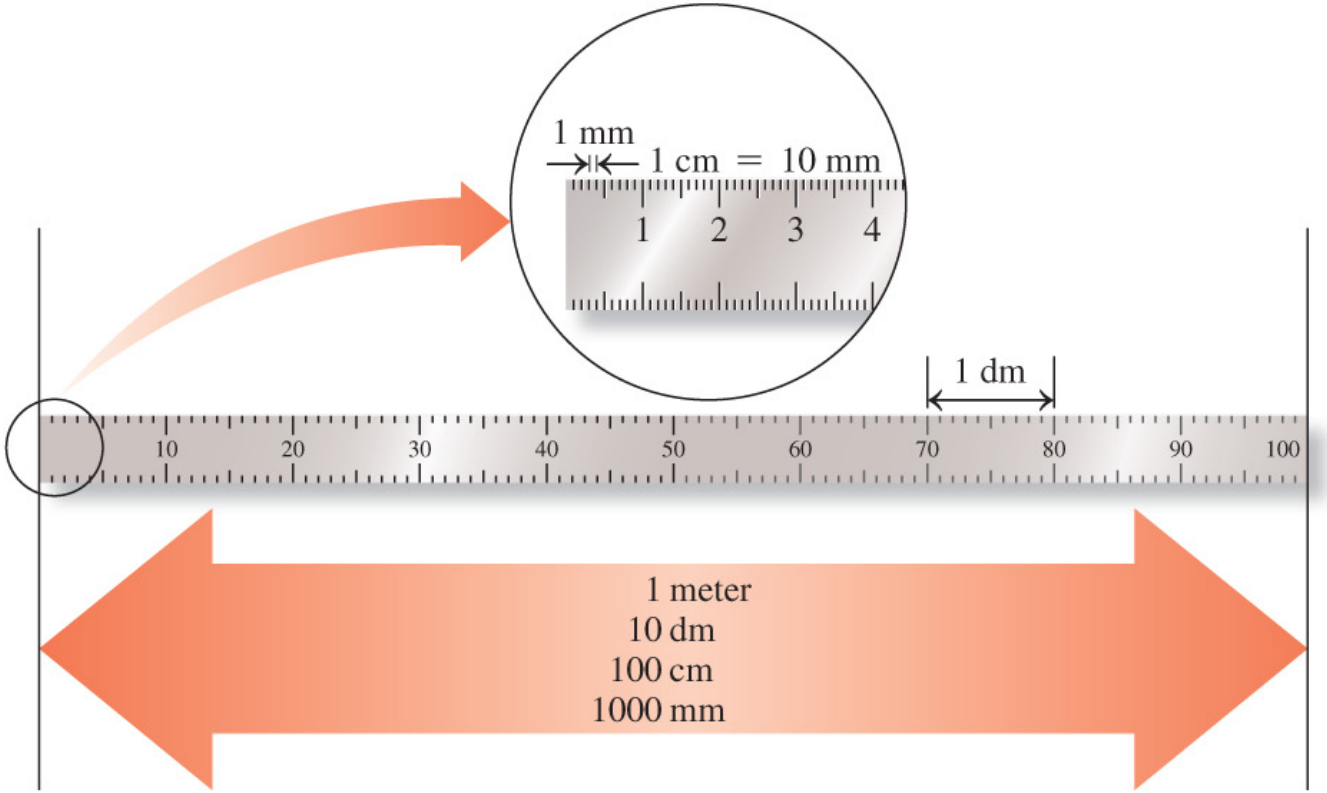
1 meter (m) = 1,000 millimeters (mm)

1 m = 1,000 mm

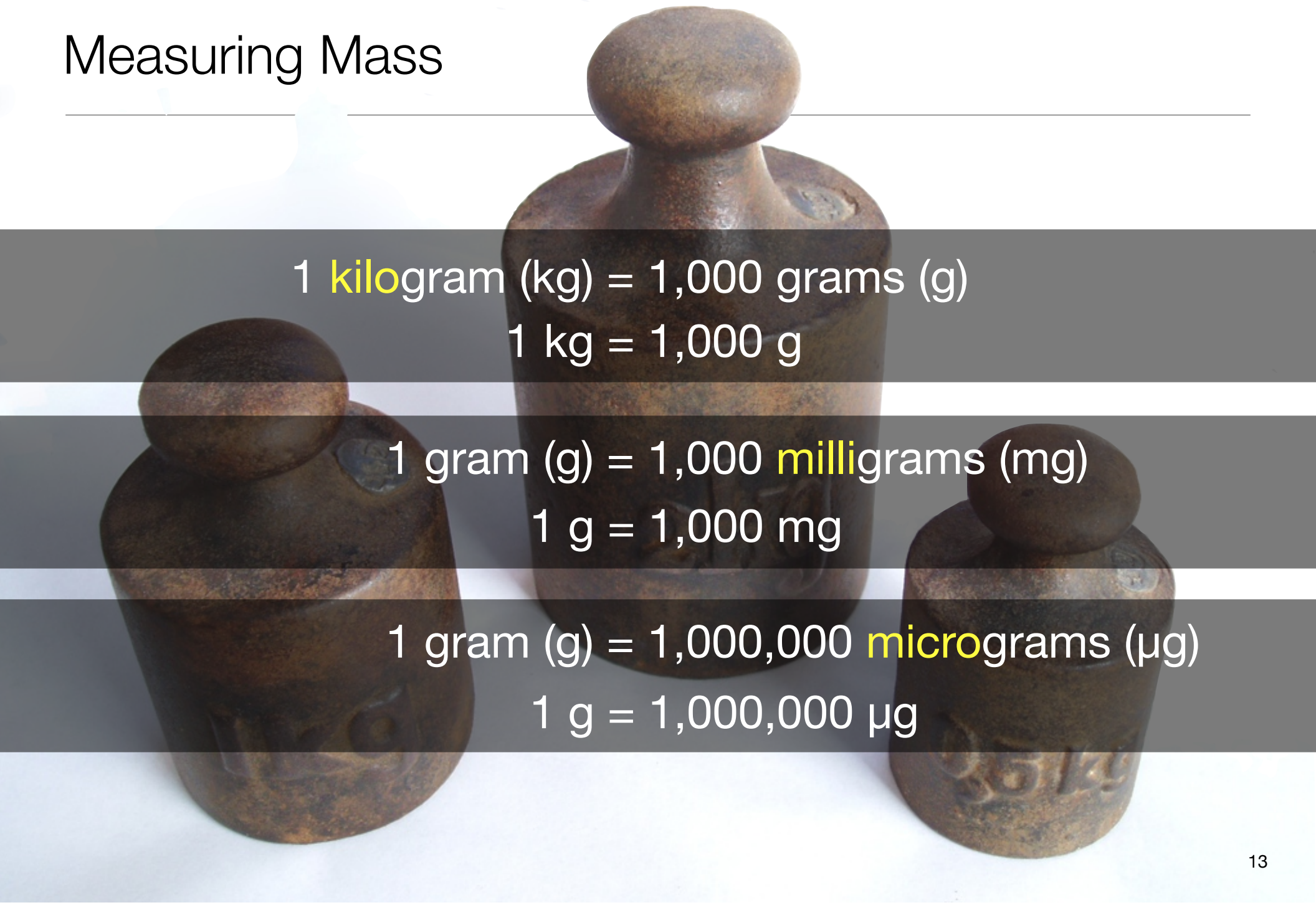
1 meter (m) = 100 centimeters (cm)

1 m = 100 cm

Measuring Length



Measuring Mass



1 kilogram (kg) = 1,000 grams (g)

1 kg = 1,000 g

1 gram (g) = 1,000 milligrams (mg)

1 g = 1,000 mg

1 gram (g) = 1,000,000 micrograms (µg)

1 g = 1,000,000 µg

US Food and Drug Administration Nutrient Values

Nutrient	Amount Recommended
Protein	44 g
Vitamin C	60 mg
Vitamin B_{12}	6 μg (6 mcg)
Calcium	1000 mg
Copper	2 mg
Iodine	150 μg (150 mcg)
Iron	18 mg
Magnesium	400 mg
Niacin	20 mg
Potassium	3500 mg
Selenium	55 μg (55 mcg)
Sodium	2400 mg
Zinc	15 mg

Measuring Volume

1 kiloliter (kL) = 1,000 liters (L)

1 kL = 1,000 L

1 liter (L) = 10 deciliters (dL)

1 L = 10 dL

1 liter (L) = 1,000,000 microliters (µL)

1 L = 1,000,000 µL


medicina
5
10
15
20
ml
parenteral syringe
Female Luer
medicina
2
4
6
8
10
ml
medicina
1
2
3
4
5
ml
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
ml

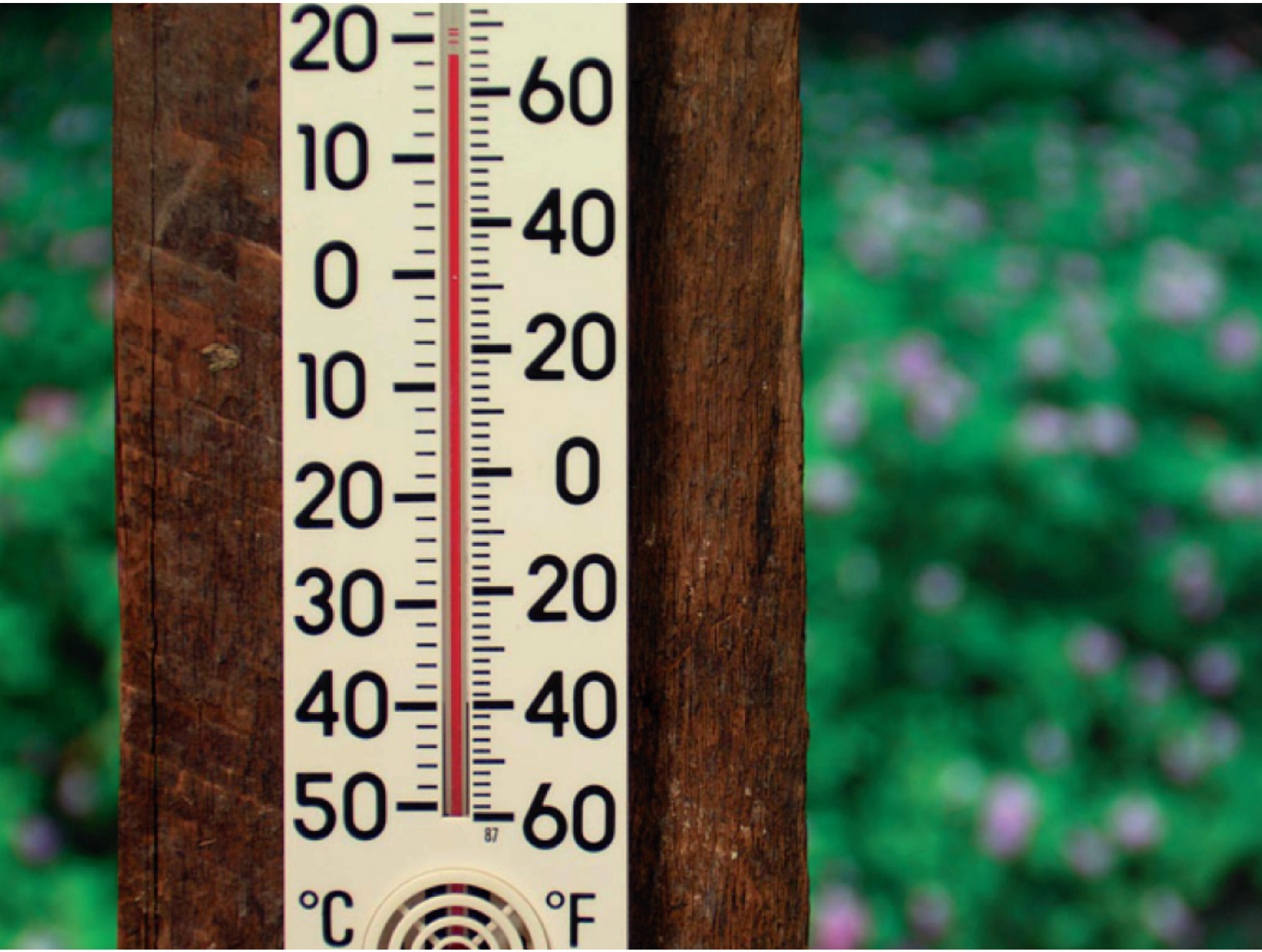
Concept Check - Find the Error

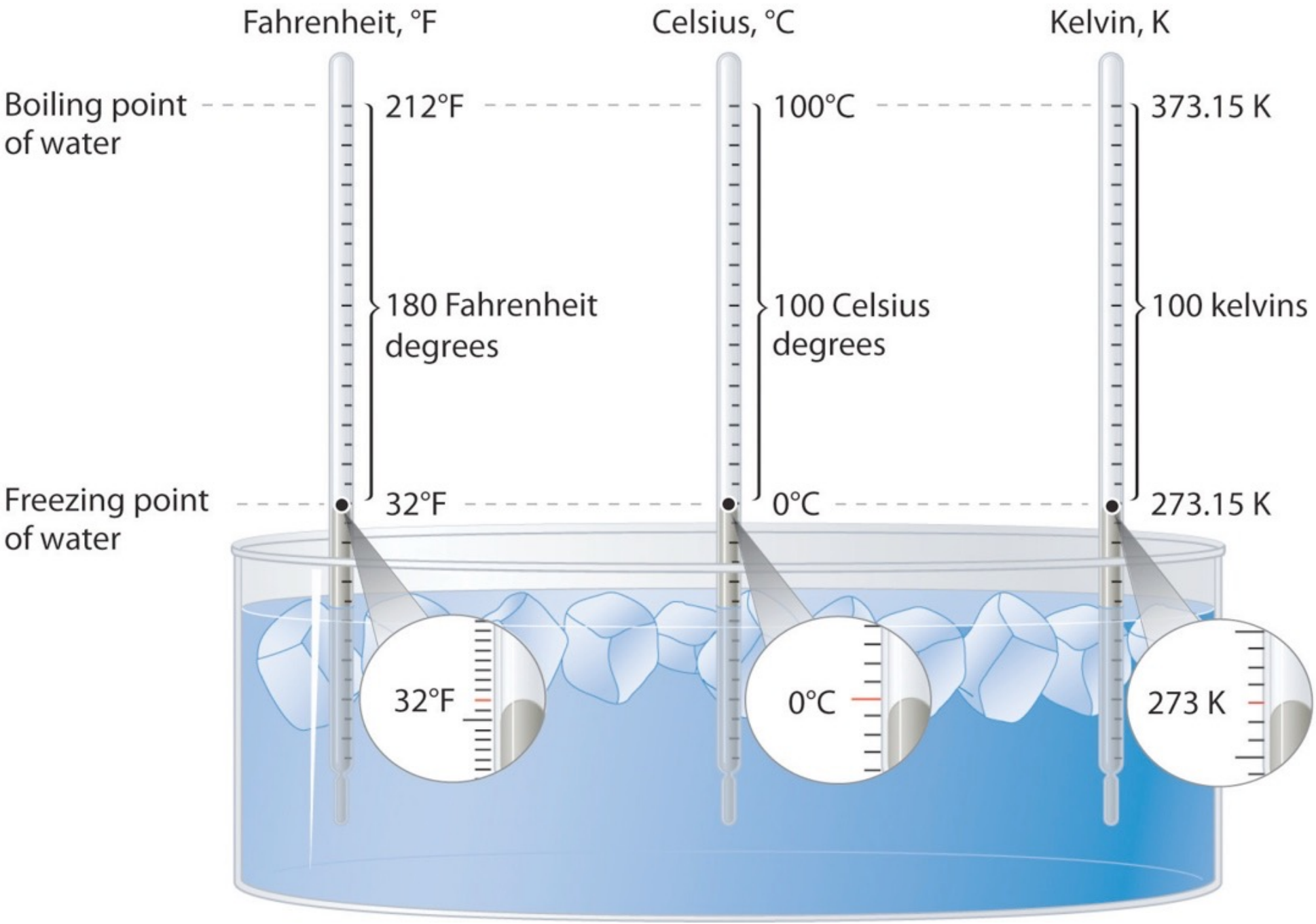
a consumer fee.

Current law allows businesses to hand out compostable and reusable plastic bags that are at least 2.5 milliliters thick.

http://www.hawaiinewsnow.com/story/35326451/city-proposal-could-repeal-oahus-contentious-plastic-bag-ban

Temperature is a measurement of how hot or cold an object is.


20
10
0
10
20
30
40
50
60
40
20
0
20
40
60
87
°C
°F


Fahrenheit, °F
Celsius, °C
Kelvin, K
Boiling point of water
212°F
100°C
373.15 K
180 Fahrenheit degrees
100 Celsius degrees
100 kelvins
Freezing point of water
32°F
0°C
273.15 K
32°F
0°C
273 K

Temperature Conversion

$$K = °C + 273$$

$$°F = 1.8(°C) + 32$$

A patient has a temperature of 105°F.
What is her temperature in °C?

Derived Units vs Base Units

Density

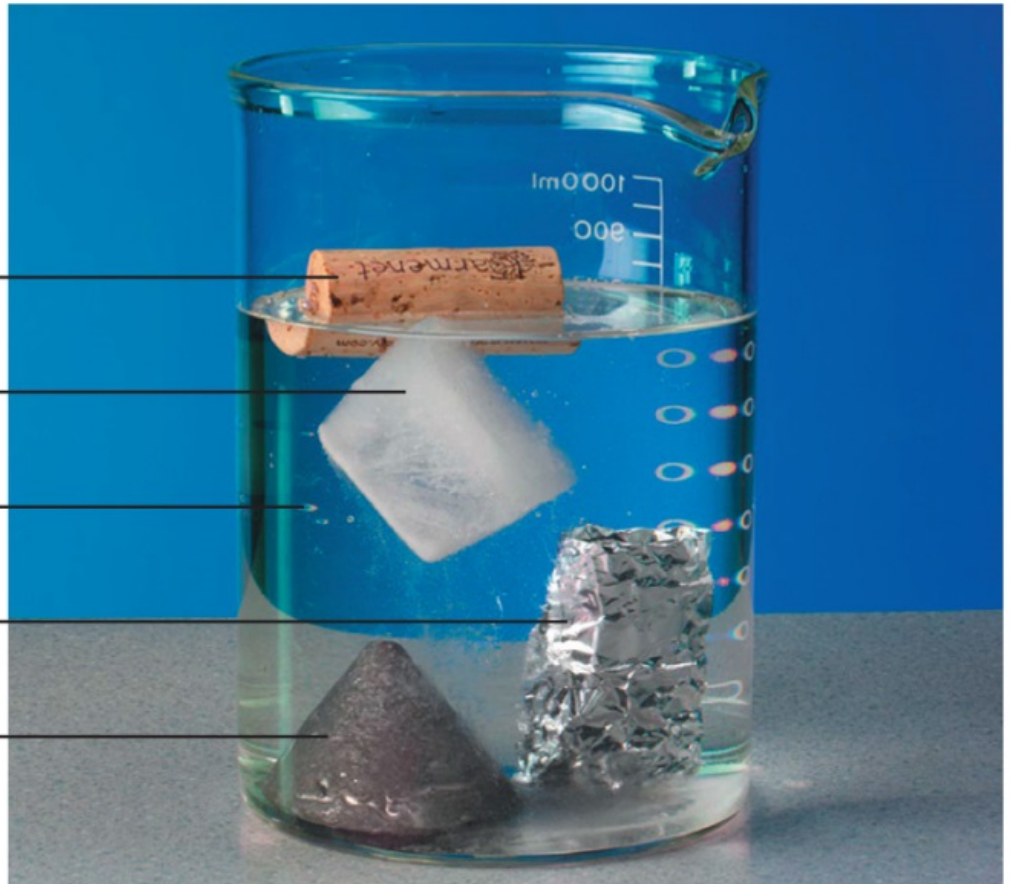
Cork (D = 0.26 g/mL)

Ice (D = 0.92 g/mL)

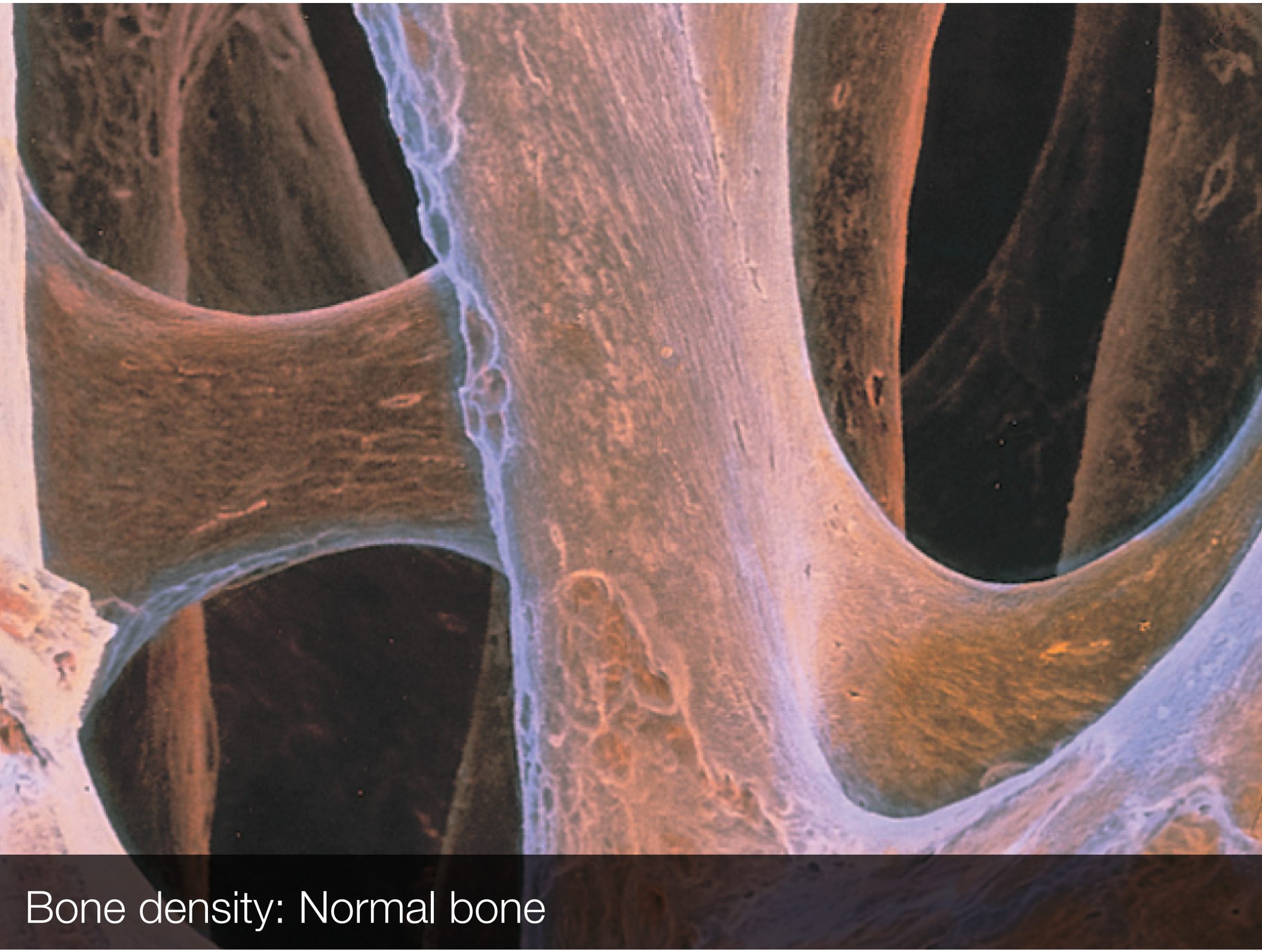
Water (D = 1.00 g/mL)

Aluminum (D = 2.70 g/mL)

Lead (D = 11.3 g/mL)



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



Bone density: Normal bone

Bone density: Bone with osteoporosis

What is the density of drinking alcohol if a 488 mL sample has a mass of 385 grams?

Concept Review (Section 1.6)

CONCEPT REVIEW EXERCISES

1. What is the difference between a base unit and a derived unit? Give two examples of each type of unit.

2. Do units follow the same mathematical rules as numbers do? Give an example to support your answer.

Practice Problems: 1-7

Converting Units (Section 1.7)

Ratio between two quantities

Conversion factors **within** a system are definitions

Examples: $\frac{12\text{ in}}{1\text{ ft}}$ $\frac{3\text{ ft}}{1\text{ yd}}$ $\frac{16\text{ oz}}{1\text{ lb}}$ $\frac{5280\text{ ft}}{1\text{ mi}}$ $\frac{1\text{ km}}{1000\text{ m}}$ $\frac{1\text{ g}}{10^6\ \mu\text{g}}$

Don’t limit sig. figs. of a calculation by definitions

Conversion Factors (from Exam 1 Handout)

Length:
12 in = 1 ft
3 ft = 1 yd
1 mile = 5280 ft
1.00 km = 0.621 mile
1.00 m = 39.4 in
1.00 m = 3.28 ft
1.00 inch = 2.54 cm

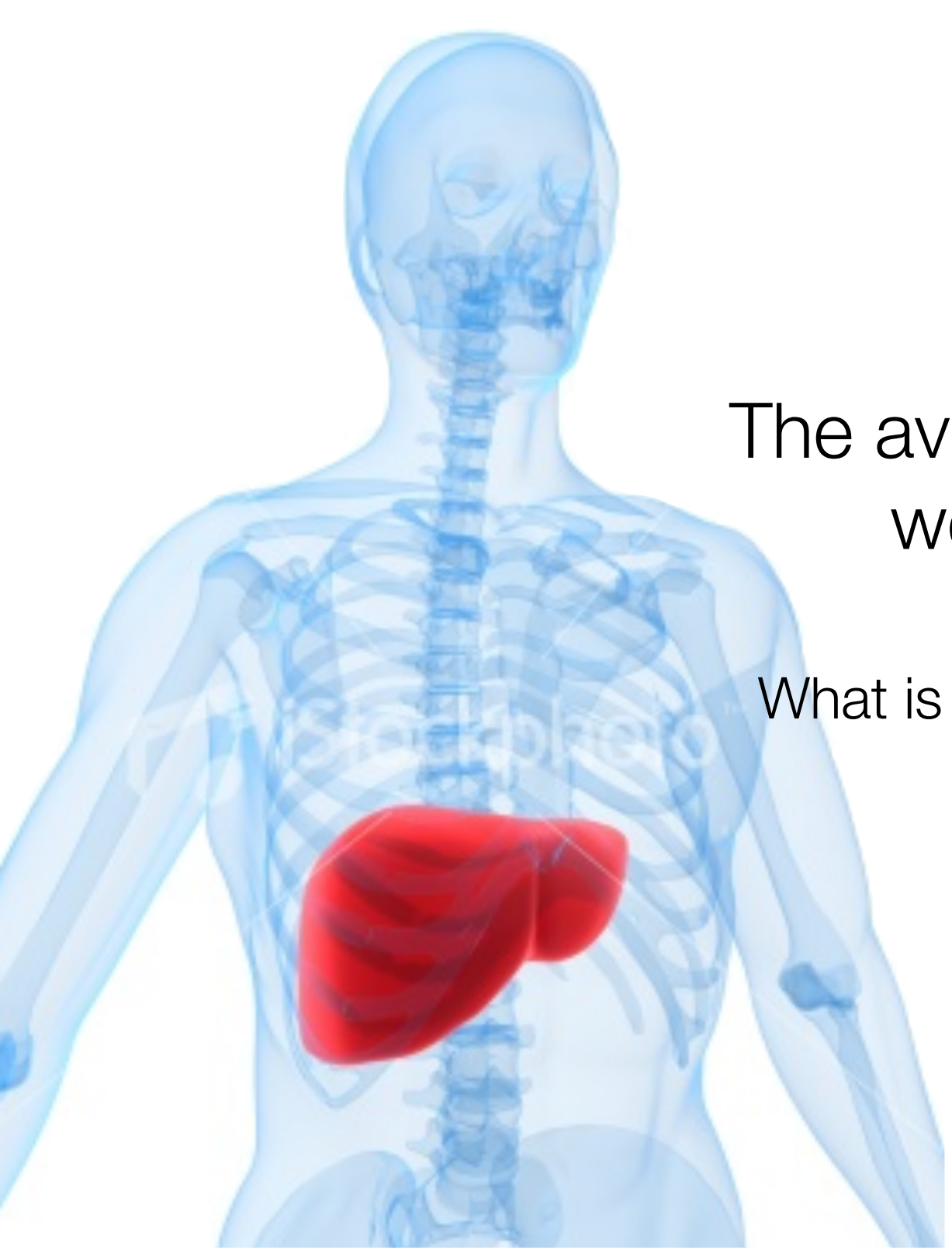
Mass:
1 pound = 16 ounces
1.00 kg = 2.20 pounds
1.00 ounce = 28.3 grams

Volume:
1 quart = 4 cups
1 gallon = 4 quarts
1.00 L = 0.264 gallon
1.00 quart = 0.946 liter
1.00 mL = 0.0338 fluid ounce

Dimensional Analysis

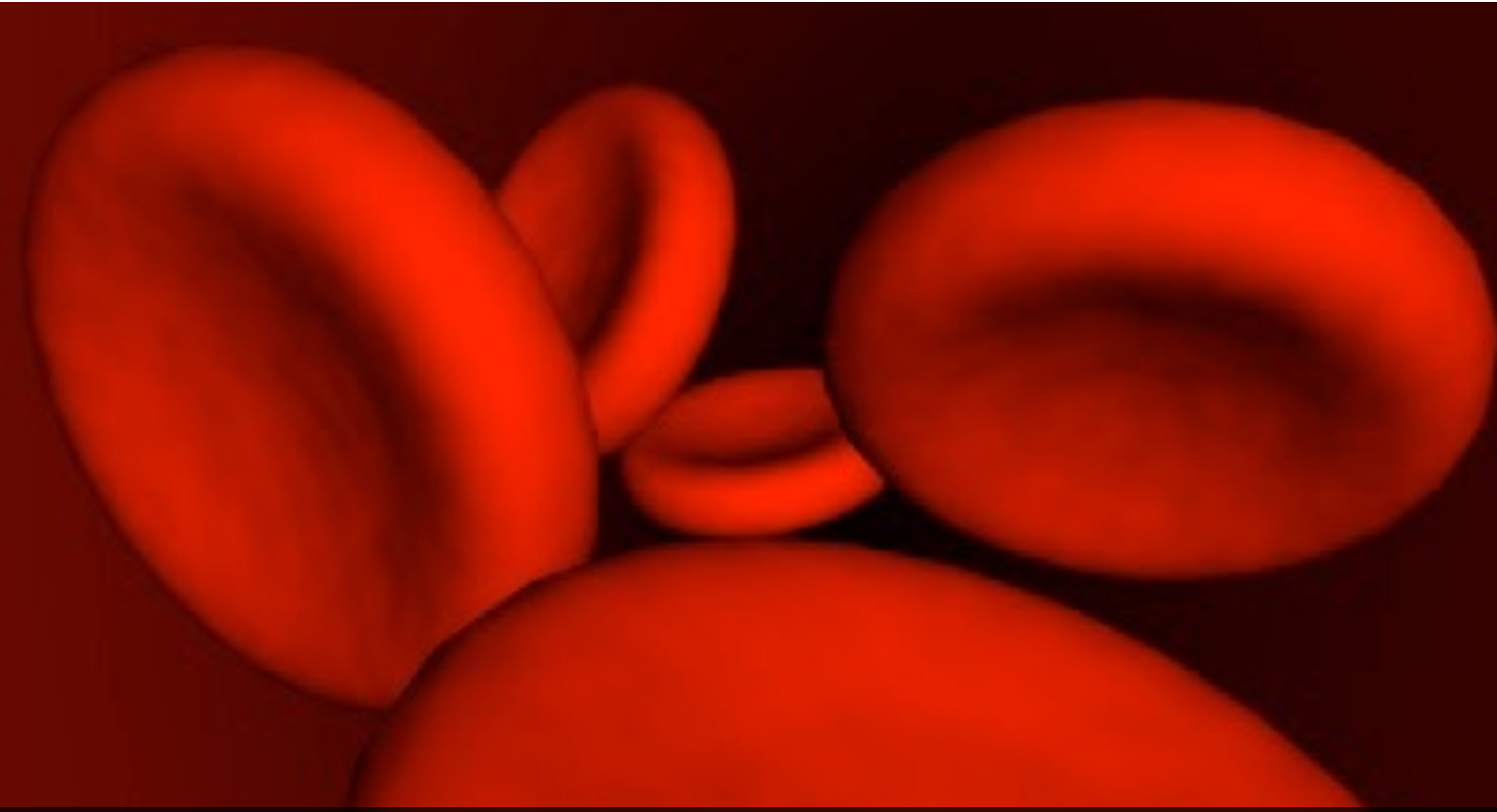
Best method for unit conversion.

Three Steps:



The average human liver weighs 1.5 kg.

What is the weight in pounds?



Capillaries carry blood from small arteries to small veins and are 1 mm in length. How long are they in inches?

Food for Thought

Chocolate and Chocolate Liquor	Insect filth (AOAC 965.38)	Average is 60 or more insect fragments per 100 grams when 6 100-gram subsamples are examined OR Any 1 subsample contains 90 or more insect fragments
	Rodent filth (AOAC 965.38)	Average is 1 or more rodent hairs per 100 grams in 6 100-gram subsamples examined OR Any 1 subsample contains 3 or more rodent hairs
	Shell (AOAC 968.10-970.23)	For chocolate liquor, if the shell is in excess of 2% calculated on the basis of alkali-free nibs
	DEFECT SOURCE: *Insect fragments - post harvest and/or processing insect infestation, Rodent hair - post harvest and/or processing contamination with animal hair or excreta, Shell - processing contamination* Significance: *Aesthetic*	

Food for Thought

Chocolate and Chocolate Liquor	Insect filth (AOAC 965.38)	Average is 60 or more insect fragments per 100 grams when 6 100-gram subsamples are examined

How many insect fragments do you eat in a Hershey's chocolate bar (mass = 43 grams)?

Concept Review (Section 1.7)

CONCEPT REVIEW EXERCISES

1. How do you determine which quantity in a conversion factor goes in the denominator of the fraction?

2. State the guidelines for determining significant figures when using a conversion factor.

Practice Problems: 1-16 in Section 1.7
1-14 in Section 1.8