

## VII. THE UNIT OF MASS: The amount of Matter

### A. INTRODUCTION:

1. Lengths are measured in meters and volumes are measured in liters.

### B. THE KILOGRAM:

1. The metric unit of mass is the KILOGRAM.
  - a. Kilo means 1000X the unit. So there are 1000 grams in a kilogram.
  - b. Kilograms, abbreviated kg, are used for expressing the mass of people, potatoes, and other large amounts.
  - c. GRAMS, abbreviated g, are used for smaller amounts.
  - d. The milligram, mg, is used to measure really tiny amounts. The (mg) = 1000<sup>th</sup> part of a gram.;
2. Mass and weight are not the same thing.
3. Mass is a measurement of the amount of matter in an object.
  - a. Matter is the material that things are made of.
  - b. When you mass an object on a mass balance, you are comparing pulls.
  - c. The balance tells you when the pull on an object is equal to the pull on a known mass. It is the pull, or forces, that balance.
4. Weight is the pull of gravity on matter.
  - a. Gravity is the pull between the earth and all other objects.
  - b. You weigh something with a scale.
  - c. Scales don't balance; they work with springs. The pull of gravity stretches the springs.
  - d. If gravity changes, the pull changes and, therefore, the weight changes.
5. Mass does not change.
  - a. A kilogram of mass will be a kilogram anywhere. Only weight will change with location.
  - b. While 1 kilogram of mass weighs about 2.2 pounds on earth, it will weight only about one sixth of that on the moon. But it is still 1 kilogram of mass whether it is on the moon or on earth and the mass will not change.
6. Scientists use mass because it is more reliable than weight.

### C. METERS, LITERS, AND MASS

1. Meters and liters are related.
  - a. A cube with a length, width, and height of 10 centimeters, holds 1 liter of water. Water is the liquid used to show the relationship between mass, volume, and length.
  - b. One liter of water has a mass of 1 kilogram.

- c. One milliliter of water and 1 cubic centimeter of water both have both masses of 1 gram.
  - d. A cubic meter of water is 1000 liters and has a mass of 1000 kilogram or a metric tonne.
2. A gallon of water has a volume of 231 cubic inches. That much water weighs 8.33 pounds.
- a. None of these units is related to the other. Multiplying or dividing them is not easy.

D. QUESTIONS:

1. In the metric system, what units are used to measure lengths?
2. In the metric system, what units are used to measure volume?
3. What is the metric unit of mass?
4. What does weight measure?
5. How does a balance work?
6. Why do scientists use mass rather than weight when they work?
7. What is the mass of 50 cubic centimeters of water?
8. What is the volume of 100 grams of water?
9. How many grams are in 2 kilograms?
10. What metric unit would you use to measure each of the following?
 

a. The height of a table	e. the distance from San Francisco to New York
b. The length of an automobile	f. the width of a postage stamp
c. A sack of rice	g. a dose of penicillin
d. The milk in a carton	i. gasoline or diesel fuel
11. Convert these values.
  - 100 ml to l
  - 2000 ml to l
  - 1.5 l to ml
12. What do the following abbreviations stand for?
 

a. g	ml
b. l	kg
c. mm	cm
d. km	m
13. Fill in the missing labels.
  - a. 5.0 cm = 50\_\_\_\_\_
  - b. 200 mm = 20.0\_\_\_\_\_
  - c. 1500 mm = 1.500\_\_\_\_\_
14. Find the missing amounts.
  - a. 30 mm = \_\_\_\_\_ cm = \_\_\_\_\_ m

b. \_\_\_\_\_ mm = \_\_\_\_\_ cm = 1 m

c. \_\_\_\_\_ mm = 55 cm = \_\_\_\_\_ m

15. Convert these values.

a. 1500 g = \_\_\_\_\_ kg

b. 300 g = \_\_\_\_\_ kg

c. \_\_\_\_\_ g = 0.83 kg

16. What instrument would you use to measure the mass of a hot dog?

17. What instrument would you use to measure the length of a living room?

18. What instrument would you use to measure the volume of a soda bottle?

19. A plastic shoe box is 30 cm long, 15 cm wide, and 12 cm deep. The box is filled with water. Answer the following questions about it.

a. What is its volume in cubic centimeters?

b. What is its volume in milliliters?

c. What is the mass of the water in grams?

d. What is the mass of the water in kilograms?

E. ACTIVITY: THE MASS OF WATER (Materials: Mass balance and graduated cylinder)

1. Find the mass of the graduated cylinder when it's empty and dry.

2. What is the mass of the dry graduated cylinder?

3. Pour exactly 100 ml of water into the graduated cylinder. The water has a curved surface. The curve is called a meniscus. The bottom of the meniscus should be on the 100 ml line.

4. Dry the outside of the graduated cylinder and find its mass again.

5. Subtract the mass in step #1 from the mass found in step #4. The difference is the mass of the water.

6. What is the mass of the 100 ml of water?

7. How close is the mass of water in grams to its volume in milliliters? What does this show?

8. Pour off the 100 ml of water and try some other amount. Put in 50 ml or 75 ml. Dry the outside and find the mass of the graduated cylinder again.

9. What volume of water did you use the second time?

10. Subtract the mass of the empty graduate from the mass of the partly filled graduate.

11. What is the mass this time?

12. When you subtracted the mass of the empty graduated cylinder from the mass of the partly filled graduated cylinder, what did you find was the mass of the water?

13. How close is the mass of the water in grams to its volume in milliliters? What does this show?

