

Using English, Metric, and Apothecary Measurements

Unit: Effective Communication

Problem Area: Use Mathematical Skills

Lesson: Using English, Metric, and Apothecary Measurements

- **Student Learning Objectives.** Instruction in this lesson should result in students achieving the following objectives:

- 1** Convert English to metric volume and weight measurements.
- 2** Convert English to metric linear measurements.
- 3** Apply the apothecary measurement system to drug calculations.

- **List of Resources.** The following resources may be useful in teaching this lesson:

Badasch, Shirley A., and Doreen S. Chesebro. *Introduction to Health Occupations*, 6th ed. Prentice Hall, 2004.

Gerdin, Judith. *Health Careers Today*, 4th ed. Mosby-Elsevier, 2007.

Simmers, Louise. *Diversified Health Occupations*, 7th ed. Delmar, 2009.

Sorrentino, Shelia, *Mosby's Textbook for Nursing Assistants*, 7th ed. Mosby-Elsevier, 2007.

Venes, Donald. *Tabers Cyclopedic Medical Dictionary*, 18th ed. F.A. Davis, 1997.



■ List of Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials

■ **Terms.** The following terms are presented in this lesson (shown in bold italics):

- apothecary system
- English system
- metric system

■ **Interest Approach.** Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Explain to students that although most Americans use the English system for measuring volume, weight, and length, health care most often uses the metric system. Many drug dosages and patient weights/heights are recorded in the metric system measurement style.

Ask the class to brainstorm some common, everyday items they use that list English and metric measurements (e.g., liquid measures of milk, soda, aspirin, and fresh fruit).

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Convert English to metric volume and weight measurements.

Anticipated Problem: How do you convert English volume and weight measurements to the metric equivalent?

- I. English and metric systems of measure
 - A. The **English system** is an age-old American system of measurement.
 1. English liquid volume units
 - a. 1 pint (pt.) = 16 fluid ounces (fl. oz.)

- b. 2 pt. = 1 quart (qt.)
 - c. 4 qt. = 1 gallon (gal.)
- 2. English dry measurements
 - a. 2 pt. = 1 qt.
 - b. 16 oz. = 1 pound (lb.)
- 3. Household measurements
 - a. 1 teaspoon (tsp.) = $\frac{1}{6}$ fluid ounce (fl. oz.)
 - b. 3 tsp. = 1 tablespoon (tbsp.)
 - c. 1 cup (c.) = 8 fl. oz.
 - d. 2 c. = 1 pt.
- B. The **metric system** is a system of measurement used largely in Europe and other countries.
 - 1. Metric volume units
 - a. 1 cubic centimeter (cc) = 1000 cubic millimeters
 - b. 1000 cc = 1 liter
 - c. 1 cc = 1 milliliter (ml)
 - d. 30 cc = 1 ounce
 - 2. Metric weight
 - a. 1 grain (gr) = 0.0648 grams (g)
 - b. 1 ounce = 28.35 g
 - c. 1 pound = 453.6 g
 - d. 1 kilogram (kg) = 2.2 pounds

Assign Chapter 7 in Introduction to Health Occupations. Use VM–A to illustrate the metric conversion factors, and use LS–A to allow students to practice conversions.

Objective 2: Convert English and metric linear measurements.

Anticipated Problem: How do you convert English and metric linear measurements?

- II. Customary units of measurement used in the health care field
 - A. English linear measurements
 - 1. 12 inches = 1 foot
 - 2. 3 feet = 1 yard
 - B. Metric linear units
 - 1. 1 inch = 2.54 centimeters (cm)
 - 2. 1 foot = 30.48 cm
 - 3. 1 cm = 0.3937 inches

- C. Uses in the health care field
1. Patient height
 2. Length of various body parts
 3. Circumference of various body parts

Have students read Chapter 5 in Introduction to Health Occupations to review linear measurements. Use VM-B to assist students in learning the material in this objective. You may also have students measure each other's height and arm length. Then have the students convert the measurements for practice.

Objective 3: Apply the apothecary measurement system to drug calculations.

Anticipated Problem: How do you apply the apothecary measurement system to drug calculations?

- III. The **apothecary system** is an almost obsolete system once commonly used in pharmaceutical preparations.
- A. Units of measurement are grains (gr) for weight and minims (m) for volume.
- B. Household equivalents to apothecary measurements
1. 1 tsp. = 5 ml
 2. 60 gtts. (drops) = 1 tsp.
 3. 1 tsp. = 60 gr
 4. 60 minims = 5 ml

Have students practice conversions with the four simple conversion factors in this objective. Use examples of drug dosages that are in everyday use, like liquid pain relievers for children and liquid medications for adults (e.g., antacids and cough syrups). Use VM-C to review apothecary measurements.

■ **Review/Summary.** Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the ends of chapters in the textbook may also be used in the review/summary.

■ **Application.** Use the included visual masters and lab sheets to apply the information presented in the lesson.

■ **Evaluation.** Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

■ Answers to Sample Test:

Short Answer

1. a. 2,271 g
b. 3,855.6 g
c. 3,288.6 g
2. 45.72 cm
3. 1,540 cc
4. He weighs 0.5 pounds or 8 ounces
5. a. 56.8 kg
b. 81.36 kg
c. 50 kg
d. 100 kg
6. He would receive 31.8 mg of medication.
7. a. 59" or 149.86 cm
b. 73" or 185.42 cm
c. 66" or 167.64 cm
8. 5 ml

Using English, Metric, and Apothecary Measurements

► Short Answer

Instructions: Complete the following.

1. You are working in a pediatrician's office. Several newborns have come in today for their first check-up. The doctor asks you to weigh the infants and to report their weights in grams. The only available scale measures in pounds and ounces. Convert the following English measurement weights into grams:
 - a. 6 pounds
 - b. 8 pounds, 8 ounces
 - c. 7 pounds, 4 ounces
2. In that same pediatrician's office, you measure an infant and tell the mother that her baby is 18 inches long. Being of western European decent, she asks you what that measurement is in centimeters. Determine the answer.



3. You are asked to calculate the fluid intake of a patient in a kidney dialysis unit. Today he consumed these beverages: a 12-ounce can of diet soda, two pints of milk, and one cup of tea. What is his total intake (calculated in cc)?

4. You are working in a neonatal nursery with many premature infants. One baby girl weighs 226.8 g at birth. How many pounds does she weigh? How many ounces does she weigh?

5. You are asked to measure the weights of all students in Mrs. Smith's physical education class and to report those weights in kilograms. Convert the following students' weights to kg.
 - a. Sarah S: 125 pounds
 - b. Lucas M. 179 pounds
 - c. Alicia R. 110 pounds
 - d. Robert W 220 pounds

6. A doctor orders a patient to have 1 mg of medication for every kg, and the patient weighs 70 pounds. How many mg of the medication would the patient need to receive?

7. Convert the following heights to inches and then into centimeters.
 - a. 4'11"
 - b. 6'1"
 - c. 5'6"

8. How many mls is 60 gtts of a medication?

ENGLISH AND METRIC CONVERSION FACTORS

English volume units

Liquid measurements:

- ◆ 1 pt. = 16 oz. (1 pound)
- ◆ 2 pt. = 1 qt.
- ◆ 4 qt. = 1 gal.
- ◆ 1 tsp. = $\frac{1}{6}$ fl. oz.
- ◆ 3 tsp. = 1 tbsp.
- ◆ 1 c. = 8 fl. oz.
- ◆ 2 c. = 1 pt.

Solid measurements:

- ◆ 16 oz. = 1 pound (lb.)



Metric volume units

Liquid measurements

- ◆ $1 \text{ cc} = 1000 \text{ cubic millimeters}$
- ◆ $1000 \text{ cc} = 1 \text{ liter}$
- ◆ $1 \text{ cc} = 1 \text{ ml}$
- ◆ $30 \text{ cc} = 1 \text{ ounce}$

Solid measurements:

- ◆ $1 \text{ gr} = 0.648 \text{ g}$
- ◆ $1 \text{ ounce} = 28.35 \text{ g}$
- ◆ $1 \text{ pound} = 453.6 \text{ g}$
- ◆ $1 \text{ kg} = 2.2 \text{ pounds}$

ENGLISH TO METRIC LINEAR CONVERSION FACTORS

English linear conversions

◆ 12 inches = 1 foot

◆ 3 feet = 1 yard

Metric linear conversions

◆ 1 inch = 2.54 cm

◆ 1 foot = 30.48 cm

◆ 1cm = 0.3937 inches



APOTHECARY MEASURES

Apothecary system

- ◆ Units of measurement are grains (gr) for weight and minims (m) for volume (fluids).
- ◆ Household equivalents to apothecary measurements
 - 1 tsp. = 5 ml
 - 60 gtts. (drops) = 1 tsp.
 - 1 tsp. = 60 gr
 - 60 minims = 5 ml



English and Metric Volume and Weight Conversions

Purpose

The purpose of this activity is to provide practice in utilizing English and metric conversions in health care situations.

Objective

Accurately convert English volume and weights to the metric equivalent.

Materials

- ◆ lab sheet
- ◆ writing utensil
- ◆ copy of VM-A
- ◆ calculators, if desired

Procedure

Complete each of the conversion problems listed below.

Conversion Worksheet

Part I: Solve the following conversion problems.

1. 1 gal., 3qts., and 2 pts. + 6 gal., 2 qts., and 1 pt.



2. 8 gal., 2 qts. – 3qts., 1 pt.

3. 12 gal. = _____ pts.

4. A physician has ordered that a patient be weighed and the weight reported in kilograms. The only scale available measures in pounds. The patient weighs 124 pounds. What is her weight in kilograms?

5. When directed by a pharmacist to dilute a medicine using 15 ccs of water per 1 g. of powder, how many ccs would you use if you started with 3 pounds of powder?

6. A newborn baby boy weighs 7 pounds. How many ounces does he weigh? What is his weight in grams?

7. How many ml are contained in a 12-ounce can of soda?

Part II: Fill in the blanks.

1. 8 qts. = _____ gal.
2. 3 pts. = _____ qts.
3. 2 cups = _____ fl. oz.
4. 3 ccs = _____ ml
5. 2 tbsp. = _____ tsp.

English and Metric Linear Conversions

Purpose

The purpose of this activity is to practice using English and metric linear conversions in health care situations.

Objective

Convert linear measurements.

Materials

- ◆ lab sheet
- ◆ writing utensil
- ◆ scale with weight and height capabilities
- ◆ measuring tape
- ◆ VM-A, VM-B, and VM-C

Procedure

1. Measure the height of three classmates. Report the results to them in feet and inches. (Example: 5 feet, 3 inches)
2. Convert their heights into inches and record the information.
3. Convert those inch measurements to centimeters and record the information.
4. Now, measure one of your feet in inches, and record that number. (Use the tape measure for this procedure.)
5. Convert the measurement of your foot into centimeters.
6. Exchange your foot measurement in centimeters with three students, and convert those measurements back to inches.



Linear Conversion Worksheet

A. Height in feet and inches:

B. Height converted to inches:

C. Height of three classmates

inches conversion

cm conversion

1.

2.

3.

D. Foot measurement in inches:

E. Foot measurement converted to cm:

F. Foot measurement of three classmates in cm and measurement converted to inches:

1.

2.

3.