**Weekly Focus:** U.S. and metric
**Weekly Skill:** conversion and application

# LESSON 11: Units of Measure

**Lesson Summary**: First, students will solve a problem about exercise. In Activity 1, they will practice conversion with the U.S. customary system. In Activity 2, they will practice conversions with the metric system. In Activity 3, they will measure some items with both systems. In Activity 4, they will solve word problems in the book. In Activity 5, they will do an application problem using many skills. There are an exit ticket and extra problem at the end. Estimated time for the lesson is two hours.

**Materials Needed for Lesson 11:**

- Liquid measurement containers: cup, pint, quart, ½ gallon, gallon
- Video (length 9:16) from Khan Academy on converting among metric measurements. The video is required for teachers and recommended for students.
- 3 worksheets (11.1, 11.2 and 11.3) with answers (attached)
- Metric Conversion Chart: copy and give to students.
- Measuring tapes or yard/meter sticks
- *Mathematical Reasoning Test Preparation for the 2014 GED Test* Workbook (pages 30-33)
- Exit ticket (attached)

**Objectives**: Students will be able to:

- Practice converting among customary measurement units
- Practice converting among metric measurement units
- Solve problems with metric and customary measurement
- Apply measurement and proportion skills in solving the application problem

**ACES Skills Addressed:** N, CT, LS
**CCRS Mathematical Practices Addressed:** Model with Math, Mathematical Fluency
**Levels of Knowing Math Addressed:** Concrete, Pictorial, Communication and Abstract

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**Notes:**
**You can add more examples if you feel students need them before they work. Any ideas that concretely relates to their lives make good examples.**

**For more practice as a class, feel free to choose some of the easier problems from the worksheets to do together. The "easier" problems are not necessarily at the beginning of each worksheet. Also, you may decide to have students complete only part of the worksheets in class and assign the rest as homework or extra practice.**

The GED Math test is 115 minutes long and includes approximately 46 questions. The questions have a focus on quantitative problem solving (45%) and algebraic problem solving (55%).

Students must be able to understand math concepts and apply them to new situations, use logical reasoning to explain their answers, evaluate and further the reasoning of others, represent real world problems algebraically and visually, and manipulate and solve algebraic expressions.

This computer-based test includes questions that may be multiple-choice, fill-in-the-blank, choose from a drop-down menu, or drag-and-drop the response from one place to another.

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The purpose of the GED test is to provide students with the skills necessary to either further their education or be ready for the demands of today's careers.

| Lesson 11 Warm-up: Solve the exercise problem | Time: 10 Minutes |
|---|---|

<u>Write on the board:</u> Anita and Sasha are starting a new exercise program. Both are using pedometers and want to walk 10,000 steps a day. It took Anita 2,000 steps and Sasha 2,500 steps to walk a mile.

<u>Basic Questions:</u>
- Why did it take Sasha more steps than it did Anita? *(She has a shorter stride)*
- 10,000 steps is how many miles for Anita? *(10,000/2,000 = 5 miles)*
- 10,000 steps is how many miles for Sasha? *(10,000/2,500 = 4 miles)*

<u>Extension Questions:</u>
- Sasha has to walk more steps to reach a mile than Anita does. What % more? *(500/2,000 = ¼ = 25% more)*
- Sasha burns 234 calories when she walks 3 miles. She would burn 294 calories if she ran the same distance instead of walking. What % more calories would she burn? *(294-234= 60/234=0.256=25.6% more)*

| Lesson 11 Activity 1: U.S. Customary Measurement | Time: 15-20 Minutes |
|---|---|

1) Review U.S. customary measurement by having the students put the following in order from least to greatest. Give students time to discuss how to solve.

a) <u>Length:</u> 1 1/3 feet, 30 inches, 1 yard, ½ yard, and 20 inches.
- If students need help, they can convert everything to inches
- Draw a number line on the board. Write 1 foot, 2 feet, and 3 feet at even intervals. Have the students put the measurements approximately in the correct places.
- *Answer: 1 1/3 feet (16 in.), ½ yard (18 in), 20 in., 30 in., 1 yard (36 in.)*

b) <u>Liquid Capacity:</u> 10 oz., ½ quart, ¾ pint, 1 cup, ¼ gallon
- *Answer: 1 cup (8 oz.), 10 oz., ¾ pint (12 oz.), ½ quart (=1 pint= 16 oz.), ¼ gallon (=1 quart=32oz)*

2) Do **worksheet 11.1** on liquid measurement conversions.

| Lesson 11 Activity 2: Metric Measurement | Time: 25-30 Minutes |
|---|---|

1) Every measurement in the metric system is based on 10. To find an equivalent measurement, you multiply or divide by 10, 100, or 1000. Once you memorize the prefixes, it is easy to make conversions:

| | |
|---|---|
| **Milli**- means $\frac{1}{1000}$ <br><br> **Centi**- means $\frac{1}{100}$ <br><br> **Deci**- means $\frac{1}{10}$ | **Deca**- means 10 <br><br> **Hecto**- means 100 <br><br> **Kilo**- means 1,000 |

2) When converting from a lesser unit to a greater unit, divide by 10, 100, or 1000. Why? Because we need fewer of the greater unit. For example, 55 cm = ? meters. Since there are 100 cm in 1 m, we divide 55/100= 0.55 m. So 55 cm is a bit more than half a meter.

3) When converting from a greater unit to a lesser unit, we multiply. For example, 33 grams = ? mg? Since gram is the base weight, we multiply 33 x 1000 = 33,000 mg.

4) If there are several conversion steps to do because you are converting from a very large unit to a very small unit (or vice-versa), it is a good idea to convert to the base unit first and then from the base unit to the small unit. For example, #13 on the worksheet below:

56.01 kg to mg. First, convert from kg to base unit of g: $\frac{56.01kg}{1}$ x $\frac{1000g}{1kg}$ = 56,010 g (cancel the kg like you would in fractions). Then continue with $\frac{56,010g}{1}$ $x$ $\frac{1000mg}{1g}$ = 56,010,000 mg.

5) There is a **chart of the units of measure** included in this lesson.

6) Practice converting units with **Worksheet 11.2.** Do a few together.

## Worksheet 11.1—Liquid Measurement Conversion Practice

**Fill in the blank to make each conversion true.**

One trick to remember the American Capacity conversions is to remember the numbers:

8 2 2 4

These correspond to the measurement units needed for the next higher measurement unit (see the example to the right).

**8** Ounces = 1 Cup

**2** Cups = 1 Pint

**2** Pints = 1 Quart

**4** Quarts = 1 Gallon

1)  _____ ounces = 2 cups

2)  _____ ounces = 9 cups

3)  _____ cups = 40 ounces

4)  _____ cups = 80 ounces

5)  _____ cups = 48 ounces

6)  _____ cups = 8 pints

7)  _____ cups = 3 pints

8)  _____ pints = 18 cups

9)  _____ pints = 10 cups

10)  _____ pints = 12 cups

11)  _____ pints = 8 quarts

12)  _____ pints = 5 quarts

13)  _____ quarts = 12 pints

14)  _____ quarts = 18 pints

15)  _____ quarts = 20 pints

16)  _____ quarts = 10 gallons

17)  _____ quarts = 6 gallons

18)  _____ gallons = 16 quarts

## Worksheet 11.1—Liquid Measurement <span style="color:red">Answers</span>

1) <u>16</u> ounces = 2 cups

2) <u>72</u> ounces = 9 cups

3) <u>5</u> cups = 40 ounces

4) <u>10</u> cups = 80 ounces

5) <u>6</u> cups = 48 ounces

6) <u>16</u> cups = 8 pints

7) <u>6</u> cups = 3 pints

8) <u>9</u> pints = 18 cups

9) <u>5</u> pints = 10 cups

10) <u>6</u> pints = 12 cups

11) <u>16</u> pints = 8 quarts

12) <u>10</u> pints = 5 quarts

13) <u>6</u> quarts = 12 pints

14) <u>9</u> quarts = 18 pints

15) <u>10</u> quarts = 20 pints

16) <u>40</u> quarts = 10 gallons

17) <u>24</u> quarts = 6 gallons

18) <u>4</u> gallons = 16 quarts

**Worksheet 11.2—Converting Between Metric Units**

1) 36.31 m to cm _____

2) 66,920 cm to m _____

3) 37.61 m to mm _____

4) 20,200 mm to m _____

5) 86.68 km to m _____

6) 122,550 m to km _____

7) 28.53 cm to mm _____

8) 151,700 mm to cm _____

9) 318.84 L to mL _____

10) 31,170 mL to L _____

11) 55.71 g to mg _____

12) 9,070 mg to g _____

13) 56.01 kg to mg _____

14) 485 mg to kg _____

15) 15.94 m to cm _____

16) 154,210 cm to m _____

**Worksheet 11.2—Converting between Metric Units Answers**

1) 36.31  m to cm  3,631

2) 66,920  cm to m  669.2

3) 37.61  m to mm  37,610

4) 20,200  mm to m  20.2

5) 86.68  km to m  86,680

6) 122,550  m to km  122.55

7) 28.53  cm to mm  285.3

8) 151,700  mm to cm  15,170

9) 318.84  L to mL  318,840

10) 31,170  mL to L  31.17

11) 55.71  g to mg  55,710

12) 9,070  mg to g  9.07

13) 56.01  kg to mg  56,010,000

14) 485  mg to kg  0.000485

15) 15.94  m to cm  1,594

16) 154,210  cm to m  1,542.1

# Metric Conversion Chart

## Into Metric

| If you know | Multiply by | To Get |
|---|---|---|
| **Length** | | |
| inches | 2.54 | centimeters |
| foot | 30 | centimeters |
| yards | 0.91 | meters |
| miles | 1.6 | kilometers |
| **Area** | | |
| sq. inches | 6.5 | sq. centimeters |
| sq. feet | 0.09 | sq. meters |
| sq. yards | 0.8 | sq. meters |
| sq. miles | 2.6 | sq. kilometers |
| **Mass (Weight)** | | |
| ounces | 28 | grams |
| pounds | 0.45 | kilograms |
| short ton | 0.9 | metric ton |
| **Volume** | | |
| teaspoons | 5 | milliliters |
| tablespoons | 15 | milliliters |
| fluid ounces | 30 | milliliters |
| cups | 0.24 | liters |
| pints | 0.47 | liters |
| quarts | 0.95 | liters |
| gallons | 3.8 | liters |
| cubic feet | 0.03 | cubic meters |
| cubic yards | 0.76 | cubic meters |
| **Temperature** | | |
| Fahrenheit | Subtract 32, then multiply by 5/9ths to get | Celsius |

## Out of Metric

| If you know | Multiply by | To Get |
|---|---|---|
| **Length** | | |
| millimeters | 0.04 | inches |
| centimeters | 0.4 | inches |
| meters | 3.3 | feet |
| kilometers | 0.62 | miles |
| **Area** | | |
| sq. centimeters | 0.16 | sq. inches |
| sq. meters | 1.2 | sq. yards |
| sq. kilometers | 0.4 | sq. miles |
| hectares | 2.47 | acres |
| **Mass (Weight)** | | |
| grams | 0.035 | ounces |
| kilograms | 2.2 | pounds |
| metric tons | 1.1 | short tons |
| **Volume** | | |
| milliliters | 0.03 | fluid ounces |
| liters | 2.1 | pints |
| liters | 1.06 | quarts |
| liters | 0.26 | gallons |
| cubic meters | 35 | cubic feet |
| cubic meters | 1.3 | cubic yards |
| **Temperature** | | |
| Celsius | Multiply by 9/5ths, then add 32 to get | Fahrenheit |

| **Lesson 11 Activity 3: Comparing U.S. to Metric** | **Time:  15 Minutes** |
|---|---|

1) It is a good idea to understand some of the basic equivalents between the U.S. customary system and the metric system. Some measures that are good to know are:

- One inch = 2.54 cm (so about 2 and a half cm per inch)
- 1 mile = 1.6 km (so 1 km = 0.6 mile, a little over half a mile)
- 1 pound = 0.45 kg (so about half a kilo)

2) Measure a few familiar items with the U.S. customary system and then the metric system, but estimate first. If you cannot actually measure something, convert your U.S. estimate to metric by guessing first and them actually calculating it.

| Item | Estimate U.S. | Actual U.S. | Estimate Metric | Actual Metric |
|---|---|---|---|---|
| Pencil | | | | |
| Length of paper | | | | |
| Perimeter of cell phone | | | | |
| Weight of water bottle | | | | |
| Weight of backpack | | | | |
| Distance to your house | | | | |

3) For more practice with estimating metric measurements, do **worksheet 11.3.**

| **Lesson 11 Activity 4: Word Problems** | **Time:  20 Minutes** |
|---|---|

Do the word problems from the **workbook pages 30-33**. Circulate to help. Have students volunteer to do any of the more challenging problems on the board.

| Lesson 11 Activity 5 Application: Road Trip to Canada | Time: 15 Minutes |
|---|---|

Josh and his family are taking a 7-day road trip from Minnesota to Canada. Since Canada is on the metric system, Josh needs to do some calculations to make sure they have saved enough money. Here are their travel plans:

- Drive about 100 miles a day. Their van gets 25 miles to the gallon.
- Camp 5 nights at $40 CDN per night and buy 2 bundles of wood for each night at $5 CDN a bundle
- Spend about $125 CDN a day in restaurants (7 days)

Here are the current prices in Canada:

- Gas costs $1.42 a liter
- One U.S. dollar (USD) is currently worth $1.09 Canadian (CDN).

**Josh plans on needing about $1,000 USD dollars. Will he have enough money?**

*If students need help getting started, give them hints:*

- *Figure out first how much Canadian money his $1000 USD is worth. This can be done first or last.* $\frac{\$1.09 CAD}{\$1.00 US} = \frac{x}{1000}$. *X = $1090 CAD. So he has $1090 set aside for the trip.*

- *Calculate how many gallons of gas they will need for the 7 days. (100 miles a day divided by 25 mpg = 4 gallons a day x 7 days = 28 gallons for the whole trip)*
- *Convert the gallons to liters ($\frac{28 gal}{1} x \frac{3.8 L}{1 gal}$ = 106.4 liters of gas)*
- *Calculate the cost of the gas (106.4L x $1.42 per liter = $151.09 for gas for the trip)*
- *Add the camping ($50 a night for camping and wood x 5 nights = $250) and restaurant costs ($125 x 7 = $875 CDN)*

*They need $151.09 (gas) + $250 (camping and wood), $875 (restaurants) = $1276 CAD. He doesn't have enough saved up.*

| Lesson 11 Exit Ticket | Time:  5 Minutes |
|---|---|

Write on board—match the equivalent measurements: *(C, A, D, B)*

| | |
|---|---|
| 1. 2000 grams<br>2. 200 grams<br>3. 2 grams<br>4. 20000 milligrams | A. 0.2 kg<br>B. 0.02 kg<br>C. 2 kg<br>D. 0.002 kg |

| Lesson 11 Extra Problem | Time:  5 Minutes |
|---|---|

<u>Write on the board:</u>

The White family has four children that weigh 22 lbs., 45 lbs., 78 lbs. and 120 lbs.

<u>Basic Questions:</u>
- How many pounds total do all of the children weigh? *(265 lbs.)*
- If they all increase in weight by 15% over the next year as they grow, how much will each child weigh? *(22x 1.15=25.3 lbs., 51.75 lbs., 89.7 lbs., 138 lbs.)*

<u>Challenge Question:</u>
- How much does each child weigh in kg currently? *(22 x 0.4536=9.97kg, 20.41kg, 35.38kg, 54.43kg)*

**Worksheet Lesson 11.3—Estimating Metric Length**

**Determine which choice best answers each question.**

1) Which choice best represents the length of a dvd?
   A. 10 millimeters
   B. 10 meters
   C. 10 kilometers
   D. 10 centimeters

2) Which choice best represents the height of a stove?
   A. 1 centimeter
   B. 1 kilometer
   C. 1 meter
   D. 1 millimeter

3) Which choice best represents the length of a bug?
   A. 25 centimeters
   B. 25 millimeters
   C. 25 meters
   D. 25 kilometers

4) Which choice best represents the height of a new pencil?
   A. 18 kilometers
   B. 18 centimeters
   C. 18 meters
   D. 18 millimeters

5) Which choice best represents the length of a river?
   A. 24 meters
   B. 24 centimeters
   C. 24 millimeters
   D. 24 kilometers

6) Which choice best represents the height of a ferris wheel?
   A. 25 meters
   B. 25 kilometers
   C. 25 centimeters
   D. 25 millimeters

7) Which choice best represents the width of a piece of bread?
   A. 10 kilometers
   B. 10 meters
   C. 10 centimeters
   D. 10 millimeters

8) Which choice best represents the height of a can of soda?
   A. 10 centimeters
   B. 10 millimeters
   C. 10 meters
   D. 10 kilometers

9) Which choice best represents the length of a loaf of bread?
   A. 31 kilometers
   B. 31 centimeters
   C. 31 millimeters
   D. 31 meters

10) Which choice best represents the height of a cooking pot?
    A. 25 kilometers
    B. 25 millimeters
    C. 25 centimeters
    D. 25 meters

11) Which choice best represents the length of a clothes iron?
    A. 18 millimeters
    B. 18 centimeters
    C. 18 meters
    D. 18 kilometers

12) Which choice best represents the height of a piece of popcorn?
    A. 25 meters
    B. 25 millimeters
    C. 25 kilometers
    D. 25 centimeters

**Worksheet Lesson 11.3—Estimating Metric Length**

## Answers

1. **D**

2. **C**

3. **B**

4. **B**

5. **D**

6. **A**

7. **C**

8. **A**

9. **B**

10. **C**

11. **B**

12. **B**