

Measurement and Data: math lesson, Grade 4 – download the PDF

Every day you measure things: how tall a plant grew, how much juice is in a pitcher, how long a movie lasts, how much fence a garden needs. In this chapter you will learn to choose the right unit, to convert from one unit to another, to work with time and money, to find the perimeter and area of rectangles, and to read line plots with fractions.

1. Customary units of length, weight and capacity

In the United States we often use **customary units**. We measure **length** in inches, feet, yards and miles, **weight** in ounces and pounds, and **capacity** (how much a container holds) in cups, pints, quarts and gallons.

Measure	Customary equivalents
Length	1 foot (ft) = 12 inches (in) 1 yard (yd) = 3 ft 1 mile (mi) = 5,280 ft
Weight	1 pound (lb) = 16 ounces (oz)
Capacity	1 cup (c) = 8 fluid ounces 1 pint (pt) = 2 c 1 quart (qt) = 2 pt 1 gallon (gal) = 4 qt

Pick a unit that fits the object. A pencil is about 7 inches long, a classroom door is about 7 feet tall, a long soccer field is about 100 yards, and the walk to a far park may be 2 miles. An apple weighs a few ounces, a backpack weighs a few pounds. A bathtub holds many gallons, while a cup of milk is just 1 cup.



Watch out Capacity ladders are not all powers of ten. A gallon is 4 quarts, but a quart is only 2 pints. Always check the table before you convert.

2. Metric units of length, mass and volume

The **metric system** is used in science and in most of the world. Its units are linked by 10, 100 and 1,000, which makes them easy to convert. A paper clip is about 3 centimeters long, a door is about 2 meters tall, and a road trip may be 50 kilometers. A paperclip has a mass of about 1 gram and a bag of flour about 1 kilogram. A spoonful of medicine is a few milliliters, and a large soda bottle holds 2 liters.

Measure	Metric equivalents
Length	1 centimeter (cm) = 10 millimeters (mm) 1 meter (m) = 100 cm 1 kilometer (km) = 1,000 m
Mass	1 kilogram (kg) = 1,000 grams (g)
Volume	1 liter (L) = 1,000 milliliters (mL)



Zyro's tip On my planet we use one unit for everything, but on Earth the prefix tells you the size: *kilo* means 1,000 times bigger, *centi* means 100 times smaller and *milli* means 1,000 times smaller.

3. Converting within a measurement system

Converting means writing the same measure with a different unit. The measure does not change, only its name does.

D Definition

To **convert** a measure is to find an equal measure in another unit of the same system. A **larger unit** needs fewer of them to make the same amount, a **smaller unit** needs more of them.

M Method: converting a larger unit to a smaller unit

1. Find how many small units make 1 large unit (use the tables).
2. Multiply the number of large units by that number.
3. Write the answer with the small unit.

To go from a smaller unit to a larger unit, **divide** instead.

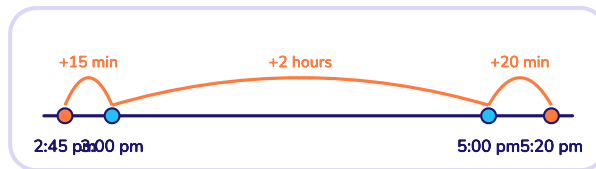
E Example 1: feet to inches Convert 7 ft to inches. One foot is 12 inches, so $7 \times 12 = 84$. Therefore **7 ft = 84 in.**

E Example 2: kilometers and meters Convert 3 km 250 m to meters. First **3 km = $3 \times 1,000 = 3,000$ m.** Then add the 250 m: **$3,000 + 250 = 3,250$.** So the measure is 3,250 m.

You can also convert several steps in a row. To change gallons to cups, go gallons to quarts, quarts to pints, pints to cups: **2 gal = 8 qt = 16 pt = 32 c.**

4. Time and elapsed time

Remember that 1 hour = 60 minutes and 1 minute = 60 seconds. **Elapsed time** is the amount of time that passes between a start time and an end time. A number line helps: jump first to the next full hour, then jump by hours, then add the last minutes.



E Example 3: elapsed time A bike class starts at 2:45 pm and ends at 5:20 pm. From 2:45 to 3:00 is 15 minutes. From 3:00 to 5:00 is 2 hours. From 5:00 to 5:20 is 20 minutes. In total, $15 + 20 = 35$ minutes and 2 hours, so the class lasts **2 hours 35 minutes**.

To find an end time, do the jumps the other way: start at the beginning time and add the hours and the minutes.

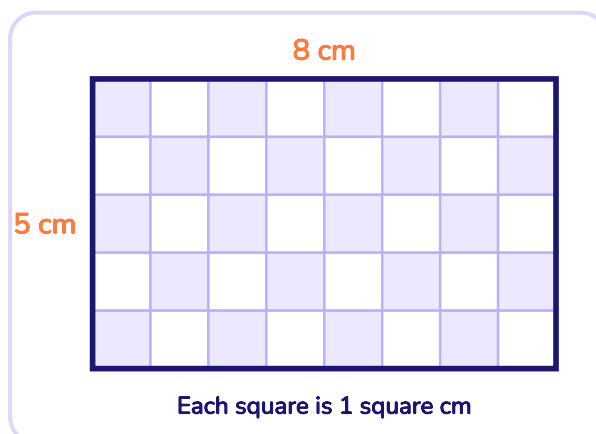
5. Perimeter and area of rectangles

The **perimeter** is the distance around a shape. The **area** is the amount of flat space inside it, counted in square units (square centimeters, square feet...).

P Formulas for a rectangle

If the length is ℓ and the width is w , then

$$P = 2 \times (\ell + w) \quad \text{and} \quad A = \ell \times w.$$



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Example 4: a patio A patio is 9 ft long and 6 ft wide. Its perimeter is

$2 \times (9 + 6) = 2 \times 15 = 30$ ft. Its area is $9 \times 6 = 54$ square feet. The picture above shows the same idea with an 8 cm by 5 cm rectangle: 40 small squares, so an area of 40 square centimeters.

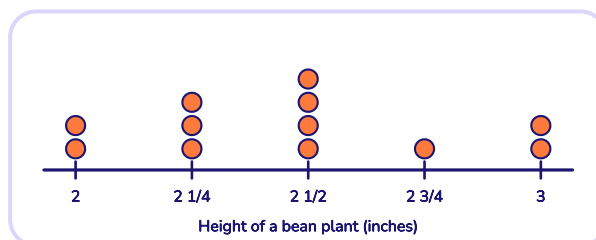
If you know the area and one side, divide to find the other side: a rectangle with area 72 square feet and width 8 ft has length $72 \div 8 = 9$ ft. An **L-shaped** figure can be split into two rectangles, or built as a big rectangle with a corner taken away. Then add or subtract the areas.



Watch out Perimeter is measured in plain units (ft, cm). Area is measured in **square** units (sq ft, sq cm). Never mix the two.

6. Line plots with fractions

A **line plot** shows data above a number line. Each data value gets one mark (a circle or an X) above its place on the line. When the measures are fractions, the tick marks on the line are fractions too.



This line plot shows the heights of 12 bean plants. Four plants are $2\frac{1}{2}$ inches tall. Three plants are taller than $2\frac{1}{2}$ inches (one at $2\frac{3}{4}$ and two at 3). The tallest plant is 3 inches and the shortest is 2 inches, so the difference is 1 inch.

M**Method: reading a line plot**

1. Read the title and the scale under the line.
2. Count the marks above each tick.
3. To add all the data, multiply each fraction by its number of marks, then add the results.

7. Word problems and money

For a measurement word problem, read twice, find the question, choose the operations, and check that your answer has a unit that makes sense. When a problem mixes units, convert them to the **same** unit first.

With money, write amounts with a decimal point and two decimal places, like \$4.50. Remember that 100 cents make 1 dollar, so \$0.25 is 25 cents. To find change, subtract the cost from the amount paid.

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Example 5: shopping Leo buys a notebook for \$2.75 and a pen for \$1.40, and pays with a \$5 bill. The total is $2.75 + 1.40 = 4.15$ dollars. The change is $5.00 - 4.15 = 0.85$. Leo gets \$0.85 back.

Key takeaways

- Customary: 1 ft = 12 in, 1 yd = 3 ft, 1 mi = 5,280 ft, 1 lb = 16 oz, 1 gal = 4 qt, 1 qt = 2 pt, 1 pt = 2 c.
- Metric: 1 m = 100 cm, 1 cm = 10 mm, 1 km = 1,000 m, 1 kg = 1,000 g, 1 L = 1,000 mL.
- Large unit to small unit: multiply. Small unit to large unit: divide.
- 1 h = 60 min. Elapsed time: jump to the next hour, then by hours, then add minutes.
- Rectangle: $P = 2 \times (\ell + w)$ in units, $A = \ell \times w$ in square units.
- On a line plot, count the marks above each fraction; compare and add fractions to answer questions.
- Money: line up the decimal points, and change = amount paid minus total cost.



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