FLASH CHARTS

Measurement

What Do We Measure?

Length	How long something is: a cat's tail or the distance from New York City to San Francisco
Height	How high or tall something is: the Eiffel Tower or a redwood tree
Width	How wide something is: a window, or a curtain that needs to fit across it. Width is sometimes called **breadth**.
Depth	How deep something is: a rain puddle or the Pacific Ocean
Perimeter	The distance around something: a ribbon around a box or a fence around a yard
Area	How large a surface is: a tabletop or a soccer field. This is sometimes called **surface area**.
Circumference	The distance around a circular object: a penny or the Moon
Diameter	The length of a straight line that divides a circle into equal halves
Radius	Half the length of a circle's diameter

Weight	How heavy something is: a bag of potatoes or a boat
Volume	How much an object, such as a box or a bag, can hold. Volume is also called **capacity**. An object's length, height, and width determine its volume.

Speed	How far something travels in one direction over a given period of time: the rate a turtle or a race car moves in two hours. This is also called **velocity**.

Temperature	How hot or cold something is: the surface of the Sun or the wind in Antarctica

Flash Fact We measure other things, too. To measure time, we divide it into many different units, such as years, months, weeks, days, hours, minutes, and seconds.

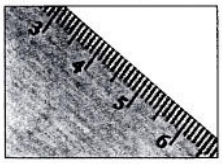
How Do We Measure?

Different kinds of measurement require different kinds of units. Here are a few of the units we use.

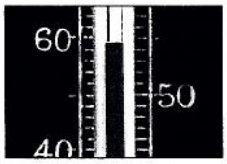
Measurement	Measurement units	Measurement tool
Length, height, width, depth, perimeter, circumference, diameter, radius	inch, foot, yard, mile	ruler, tape measure
Length, height, width, depth	millimeter, centimeter, meter, kilometer	ruler, tape measure
Weight	ounce, pound, ton	scale
Weight	gram, kilogram, metric ton	scale
Volume	liquid ounce, cup, pint, quart, gallon, teaspoon, tablespoon	measuring cups and containers, measuring spoons
Volume	milliliters, liters	measuring cups and containers
Area	square inches, square feet, square yards, square miles, acres	ruler, tape measure
Area	square centimeters, square meters, square kilometers, hectares	ruler, tape measure
Temperature	degrees Fahrenheit	thermometer
Temperature	degrees Celsius, centigrade	thermometer
Speed	miles per hour, miles per second	speedometer, pedometer
Speed	kilometers per hour, kilometers per second	speedometer, pedometer

English measurement

Metric measurement



ruler

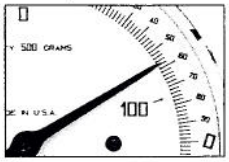


thermometer

tape measure

measuring spoons

speedometer



scale

Flash Fact A **speedometer** measures how fast a car is going. You can also estimate how fast you walk or run using a **pedometer**. This tool works by counting the number of steps you take.

A Perfect 10

Everything in the metric system is based on numbers you can divide by 10.

When the metric system was designed in the early 1790s, it was built around a unit of length called the **meter**. A meter was defined as one ten-millionth of the total length from the North Pole to the equator.

The meter was then divided into 100 smaller units called **centimeters**. Centimeters became the basis for a measurement system for liquid volume, with **grams**, **liters**, and **kilograms**.

English measurements

Length
1 foot = 12 inches
1 yard = 3 feet
1 mile = 5,280 feet or 1,760 yards

Weight
1 pound = 16 ounces
1 short ton = 2,000 pounds

Volume
1 pint = 2 cups = 16 liquid ounces
1 quart = 2 pints
1 gallon = 4 quarts

Metric measurements

Length
1 centimeter = 10 millimeters
1 meter = 100 centimeters
1 kilometer = 1,000 meters

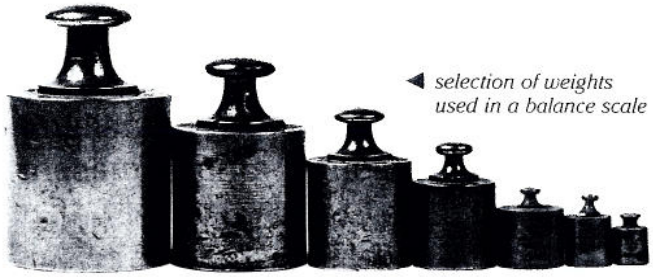
Weight
1 gram = 1,000 milligrams
1 kilogram = 1,000 grams

Volume
1 liter = 1,000 cubic centimeters

balance scale for measuring weight ▶

How Much?

The metric system makes it easy to understand the relationship between small units of measurement and large ones by using **prefixes** at the beginning of the measurement term. Prefixes describe how many units you have. If you have 1,000 grams of something, you can use the prefix *kilo-* and call the amount a *kilogram*. Here are the prefixes that can be attached to all the metric units of measure, to create smaller or larger units. (Many are not commonly used.)



◀ *selection of weights used in a balance scale*

Prefix	**Pronunciation**	**How many units?**
yotta	YAH tuh	1,000,000,000,000,000,000,000,000 (one septillion)
zetta	ZEH tuh	1,000,000,000,000,000,000,000 (one sextillion)
exa	EHK suh	1,000,000,000,000,000,000 (one quintillion)
peta	PEH tuh	1,000,000,000,000,000 (one quadrillion)
tera	TEHR uh	1,000,000,000,000 (one trillion)
giga	GIHG uh	1,000,000,000 (one billion)
mega	MEHG uh	1,000,000 (one million)
kilo	KIHL uh	1,000 (one thousand)
hecto	HEHK tuh	100 (one hundred)
deca	DEHK uh	10 (ten)
deci	DEHS uh	0.1 (one-tenth)
centi	SEHN tuh	0.01 (one-hundredth)
milli	MIHL uh	0.001 (one-thousandth)
micro	MY kroh	0.000001 (one-millionth)
nano	NA noh	0.000000001 (one-billionth)
pico	PEE koh	0.000000000001 (one-trillionth)

about 14 inches ⟶

A Good Guess: Estimating

How would you measure the length of a large room without any kind of ruler? You could use your own footsteps to **estimate** the room's size.

1. Take one normal step.
2. Have someone measure the distance from the heel of your back foot to the heel of your front foot. This is the length of one **pace**.
3. Walk across the room, counting your steps as you go.
4. Multiply the number of steps by the length of your pace. This figure is an estimation of the length of the room.

length of your pace		number of steps		length of the room
about 14 inches	X	35	=	about 490 inches (about 41 feet)

Flash Fact Many measurements were originally based on parts of the body. A horse's height (from the ground to the top of its shoulder) is measured in units called "hands." Today the standard unit for "hand" is four inches—about the width of an adult's hand.

Mixing Measurements

Sometimes it's necessary to convert, or change, measurements from the English system to the metric system. For example, you might know that a football field is 100 yards long, but not how long it is in meters. To convert one unit to another, multiply using the figures in these charts.

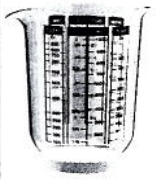
Length and Distance

When you know	multiply by	to find
inches (in)	2.54	centimeters
feet (ft)	30.48	centimeters
yards (yd)	0.914	meters
rods (rd)	5.029	meters
miles (mi)	1.609	kilometers
millimeters (mm)	0.039	inches
centimeters (cm)	0.394	inches
meters (m)	1.094	yards
kilometers (km)	0.621	miles

▲ *ruler*

Volume and Capacity (liquid)

When you know	multiply by	to find
fluid ounces (oz)	29.57	milliliters
cups, U.S. (c)	0.237	liters
pints, U.S. (pt)	0.473	liters
quarts, U.S. (qt)	0.946	liters
gallons, U.S. (gal)	3.785	liters
milliliters (ml)	0.034	fluid ounces
liters (L)	4.227	cups
liters (L)	2.113	pints
liters (L)	1.057	quarts
liters (L)	0.264	gallons



▲ *measuring cup for liquids*

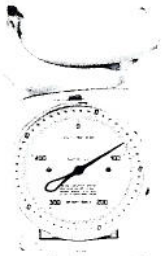
Surface or Area

When you know	multiply by	to find
square inches (sq in)	6.452	square centimeters
square feet (sq ft)	929.0	square centimeters
square yards (sq yd)	0.8361	square meters
square miles (sq mi)	2.590	square kilometers
acres (ac)	0.4047	hectares
square centimeters (sq cm)	0.1550	square inches
square meters (sq m)	10.76	square feet
square kilometers (sq km)	0.3861	square miles
hectares (ha)	2.471	acres

▲ *tape measure*

Weight and Mass

When you know	multiply by	to find
ounces (oz)	28.350	grams
pounds (lb)	0.454	kilograms
tons (tn)	0.907	metric tons
grams (g)	0.035	ounces
kilograms (kg)	2.205	pounds
metric tons (t)	1.102	short tons



▲ *scale measuring the weight of some bananas*

Temperature

When you know	use this formula	to find
degrees Celsius (°C)	x 9 ÷ 5 + 32	degrees Fahrenheit
degrees Fahrenheit (°F)	– 32 x 5 ÷ 9	degrees Celsius

▲ *thermometer*

▲ *measuring spoons for baking*

Don't Be Half Baked

Baking is a precise science. Ingredients must be measured exactly, with the proper measuring spoons and cups. Careful measurement and baking at the right temperature make the difference between a light, fluffy cake and a goopy mess.

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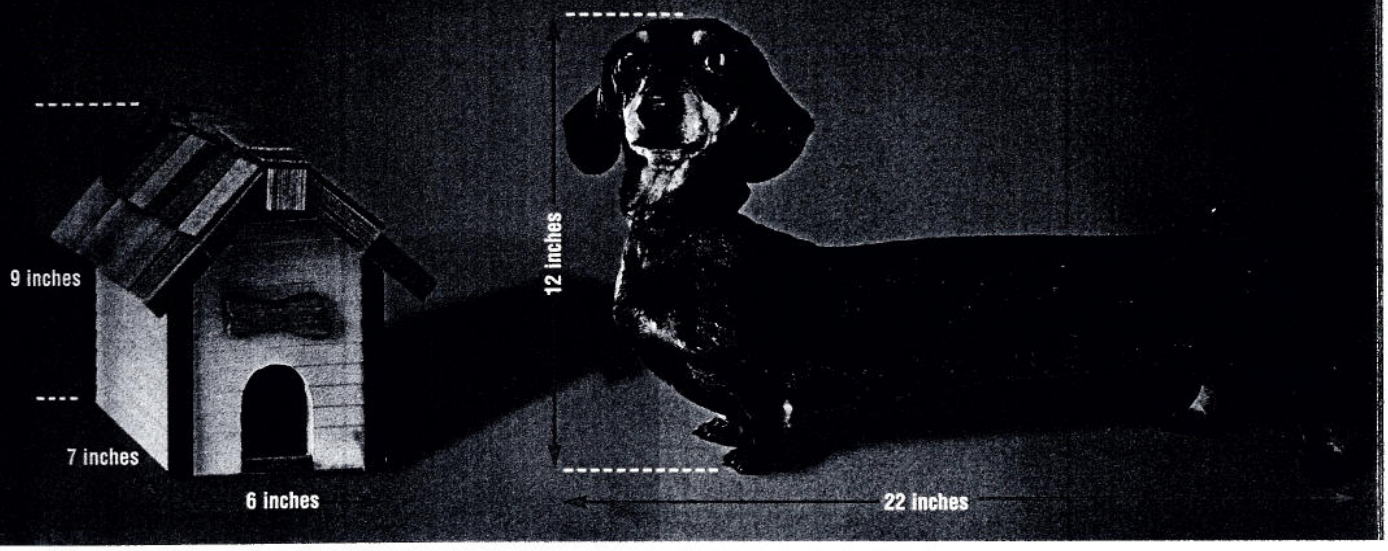
Measurement

FLASH CHARTS

Measuring Up

Measurements help us describe something by its size—how wide, thin, tall, short, heavy, or light. Measurements also help us build things to the right size. How could someone build the perfect doghouse without knowing the size of the dog?



Setting Standards

Humans have used many systems of measurement. One big problem was making them standard—that is, making sure that a unit of something meant the same thing to everybody. For instance, a foot of something used to mean the length of someone's foot—but *whose* foot?

The metric system is used by most countries in the world. Most Americans, however, still prefer an old system of measurement called the English system, which uses inches and feet, and quarts and gallons. The metric system is used in the United States by scientists and engineers.

Below and at right are some measurements, in both English and metric units.

Eiffel Tower
height: 986 feet
(301 meters)

Niagara Falls
height: 182 feet
(55 meters)

747 Airplane
weight: 710,000 pounds
(322,051 kilograms)

Cheetah
speed: 70 miles/hour
(113 kilometers/hour)

Snail
speed: 0.03 miles/hour
(0.048 kilometers/hour)

Moon
circumference: 6,782 miles
(10,915 kilometers)