

Introduction

Measurement – the forgotten domain

Most challenging areas – measurement, modeling, fractions, statistics (i-Ready, Dr. Mark Ellis, mathematics professor, CSUF

Measurement can assist you to help raise your students achievement markedly. Common Core is focused on raising student knowledge in math whether pursuing college or career.

- Place value
- Number sense
- Mental math
- Decomposing, compensation, compatible #s,
- Visualization
- Problem solving
- Hands on – modeling, real life

"The principal **goal of education** in the schools should be creating men and women who are capable of **doing new things**, not simply repeating what other generations have done."

Jean Piaget
Swiss philosopher and scientist, 1988



Agenda

1. Research Says...
2. Who uses?
3. History of Metric System
4. Benchmarks, prefixes
5. Metric units – interconnected: length, capacity, mass
6. Mass vs. weight, capacity vs. volume
7. Measurement Teaching Tools
8. Conversion
9. Unique math tools
10. Post Assessment
11. Performance Task Review
12. STEAM Activities

We teach a subject not to produce little living librarians on that subject, but rather to get a student to think ... for himself, to consider matters ... to take part in the process of knowledge-getting. Knowing is a process, not a product.

Jerome Bruner
Toward a Theory of Instruction



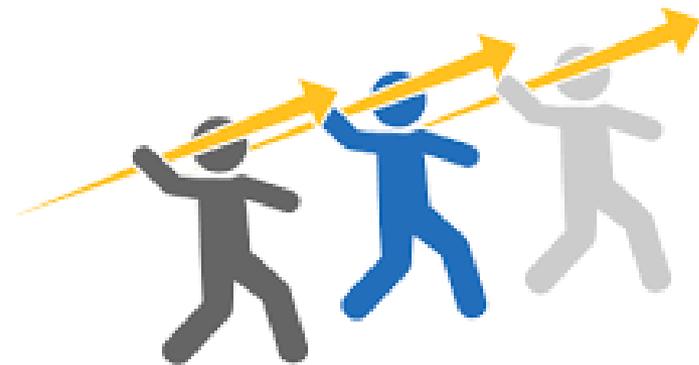
Pre-Assessment

Utilized to elicit:

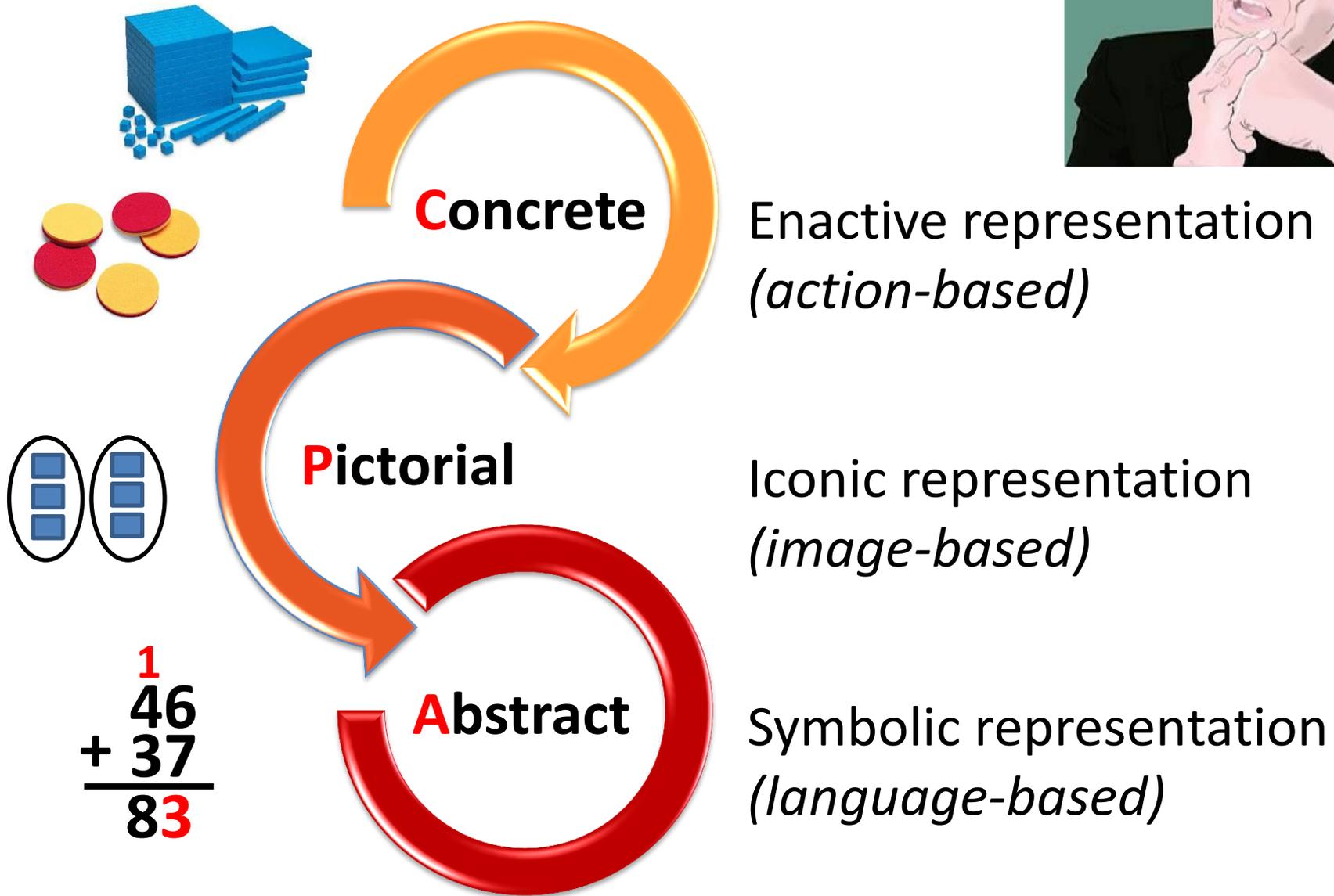
- Readiness to learn skills and concepts
- Information about preferred modes and attitudes of learning
- Areas of interest and initial questions within the study
- Differentiation needs as they begin here
- Decisions needed to be made based on data, and not feelings.

Adapted from: **Pre-Assessment in the Differentiated Classroom** by Catherine M. Brighton, Ph.D., and
Differentiation: It Starts with Pre-Assessment by Emily Pendergrass

Measurement assessment goal: include practical, hands-on types of measures.



Bruner and CPA



Bruner suggests that knowing is a process, not a product.

Who uses? Who doesn't?



United States, Myanmar*, Liberia

Every other country in the world



History of Measurement (Metric System)

In 1793, while Napoleon was emperor of France, the French government adopted a system of measurement standards which they called the metric system. It was based on the meter which was supposed to be one ten-millionth part of the straight-line distance from the North Pole to the Equator through Paris. After establishing the meter as the basic unit of the system, other linear units were aligned in decimal ratios with the meter. Within the metric system, all units are multiples of ten: ten decimeters equal a meter, a hundred centimeters equal a meter, and a thousand millimeters equal a meter. In addition to units smaller than a meter, there are ten meters equal to a decameter, 100 meters equal to a hectometer, and 1000 meters in a kilometer. The meter in comparison is about the length of a baseball bat or the width of a doorway. Compared to the yard, the meter is about three inches longer than the yard.

The metric system also includes volume, capacity, and mass (weight) measurements. The liter is the basic measure of capacity. It corresponds roughly to a quart. For mass (weight), the basic unit in the metric system originally was the gram, although now in the International System of Units (SI) it is the kilogram. The gram is a very small unit about the weight of a small paper clip. It takes 1000 grams, which is known as a kilogram, to equal about 2.2 pounds. Today, most all countries of the world use the SI metric system.

The United States Constitution in 1792 provided to adopt a system of coinage that followed the decimal system. However, the system of measurement that was used at that time was a mixture of many different and non standardized units.

At that time, France tried to convince the United States to use the metric system, however, the Congress did not act. Later, President John Quincy Adams wrote an extensive report dealing with the metric question and recommending an adoption of this type of system in the U.S. For years very little was done in the area of adopting another system of measure other than the U.S. Customary System which was used on a more informal basis throughout the country.

Congress passed the Metric Conversion Act of 1975 "to coordinate and plan the increasing use of the metric system in the United States." A process of voluntary conversion was begun, and the U.S. Metric Board was established. But the efforts of the Metric Board were largely ignored by the American public, and, in 1981, the Board reported to Congress that it lacked the clear Congressional mandate necessary to bring about national conversion. In 1982, the Board was dissolved.

As time passed the U.S. Congress realized the necessity of conforming to international standards for trade, since the United States and only two other small countries were not using the SI. In 1988, Congress passed the Omnibus Trade and Competitiveness Act which designates the metric system as the preferred system of weights and measures for trade and commerce. The legislation states that the Federal Government has the responsibility to assist industry, especially small business, as it voluntarily converts to the metric system of measurement. Federal agencies were required to use the metric system in business related activities by the end of 1992.

Recent efforts toward national metrication is based on the fact that productivity, science and mathematics education, and U.S. services and products will be greatly enhanced by completely changing to the metric system of units.

Benchmarks

Establish early the most commonly used

1. meter: about this long (length), centimeter(cm) and millimeter (mm)
2. gram: about this mass (heavy), kilogram (kg)
3. liter: about this much (capacity), milliliter (mL)

Metric prefixes* – know them

kilo 1000 thousand k	hecto 100 hundred h	deka 10 ten da	UNIT 1 meter liter gram	deci 0.1 tenth d	centi 0.01 hundredth c	milli 0.001 thousandth m
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meter m

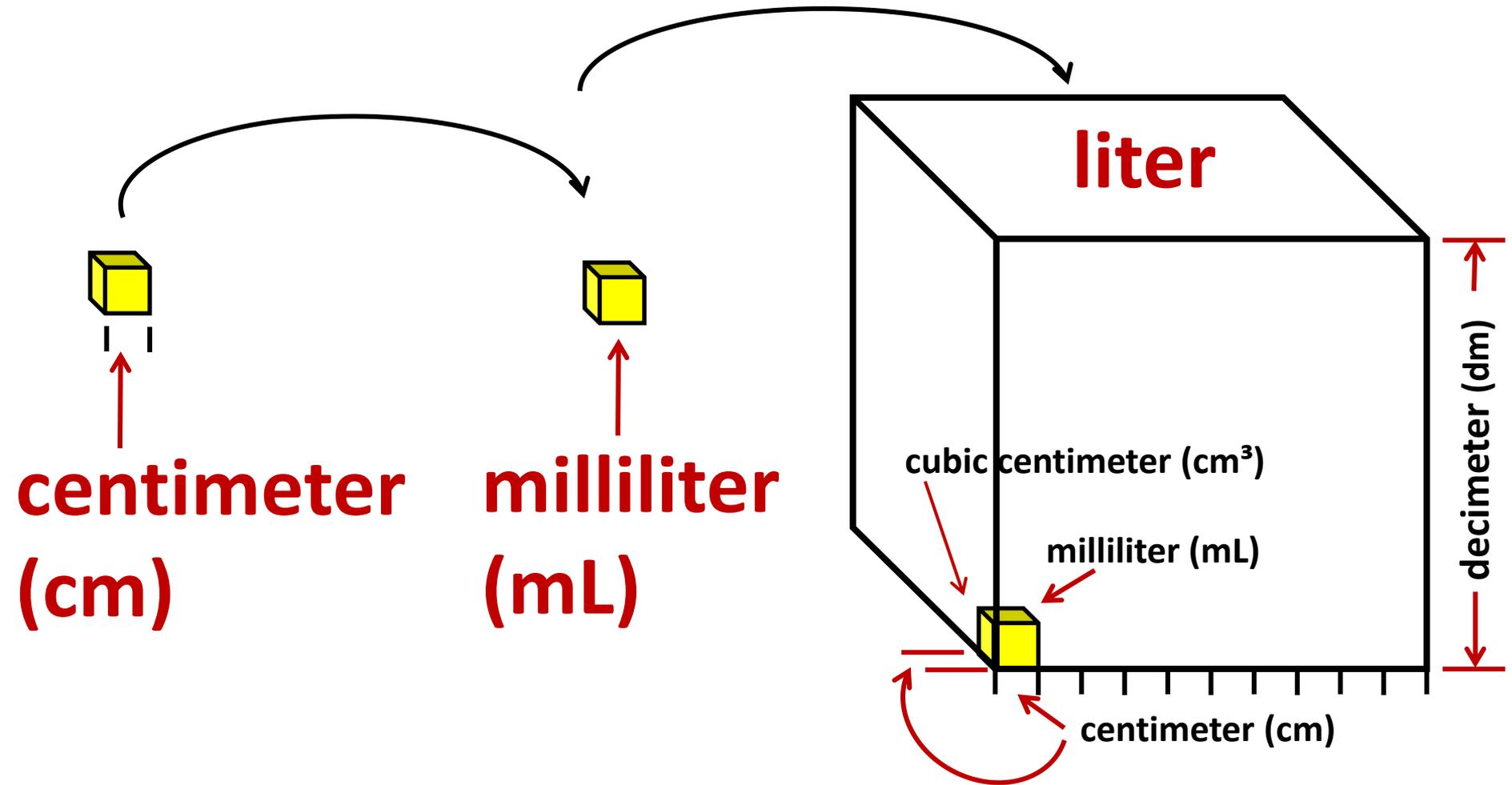
liter L or cursive l

gram g

khdu dcm

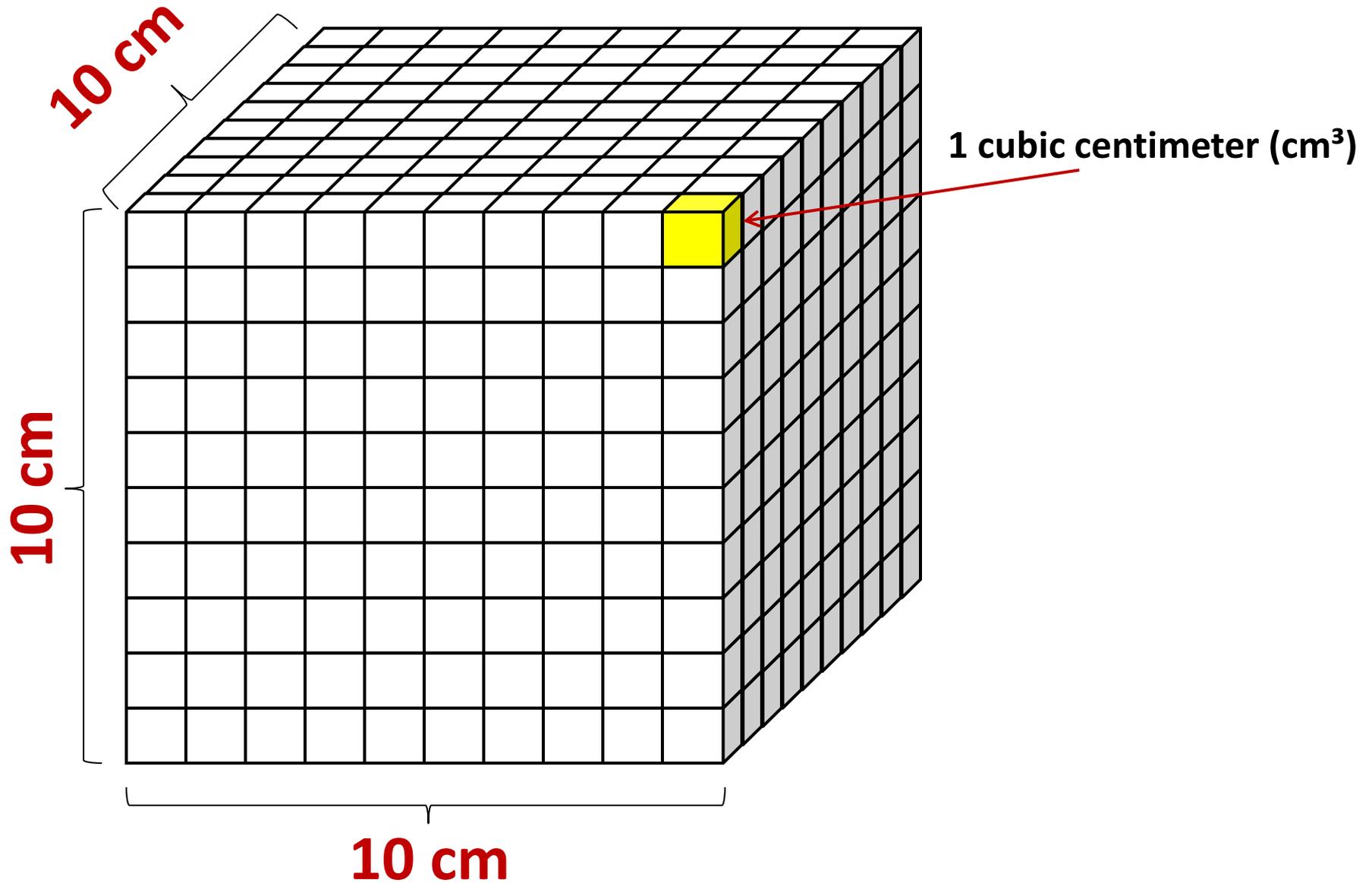
*symbols NOT abbreviations, no periods (SI)

How the metric system is interconnected



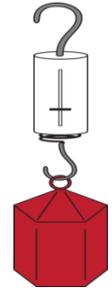
What is the mass of 1 liter of water (at melting point of ice)?

cubic decimeter





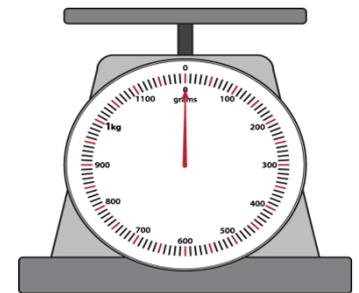
Mass vs Weight



Mass is a measure of how much matter an object has.

Weight is a measure of how strongly gravity pulls on that matter. *Thus if you were to travel to the moon your weight would change because the pull of gravity is weaker there than on Earth but, your mass would stay the same because you are still made up of the same amount of matter.*

Just remember that the weight of an object depends on where it is, while its mass stays the same.





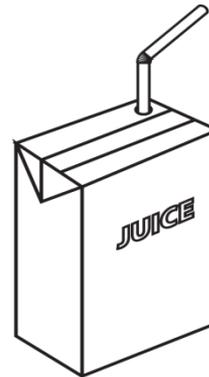
Capacity vs Volume



Capacity is how 'much' can fit into something. For example, the capacity of a container may be 2 cups of rice or 500 mL of water.

Volume is the amount of 'space' that is taken up (whether or not there is something in it or it is solid), expressed in cubic cm (or m or km). How much can be held.

Volume refers to the amount of three-dimensional space that it occupies. Capacity refers to the ability of something to hold, receive, or absorb. It is similar in concept to volume, but there are a few differences.



Length Demo

Length (Metric System)

[how long something is, distance]

millimeter (mm)

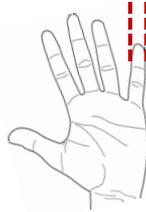


about thickness of dime



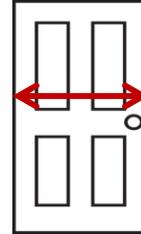
tip of pencil lead

centimeter (cm)



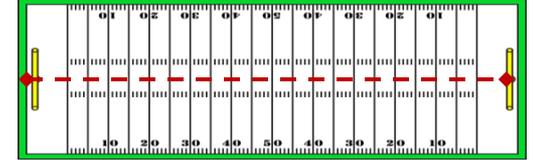
about width of little finger

meter (m)



about width of a door

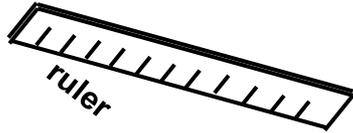
kilometer (km)



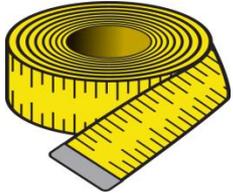
about length of 11 football fields (gl./gl.)

devices (tools) to measure

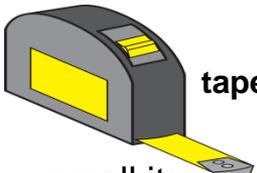
millimeter (mm)



ruler



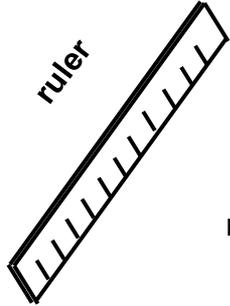
tape measure



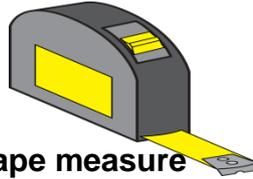
tape measure

small items: pencil, book, crayon

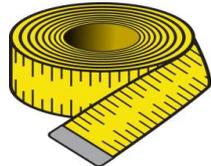
centimeter (cm)



ruler



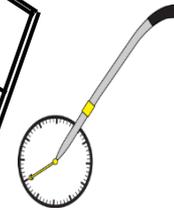
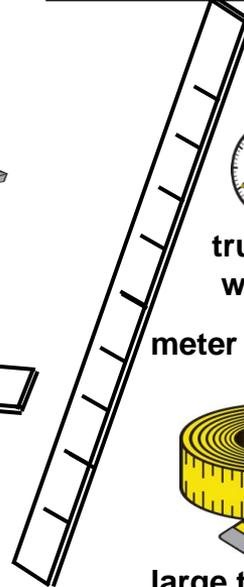
tape measure
meter stick



tape measure

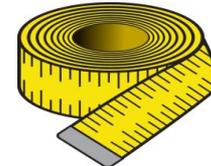
small, medium items: books, height, clothes patterns

meter (m)



trundle wheel

meter stick



large tape measure

medium, big items: football, soccer fields, house, barn, track

kilometer (km)



kilometer
odometer

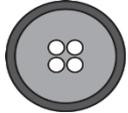
distance: city to city, miles to grandparents house, airplane

Mass* (Metric System)

gram (g)

kilogram (kg)

tonne (t)



small button

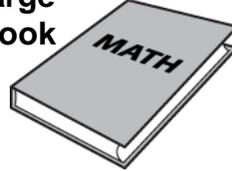


paperclip

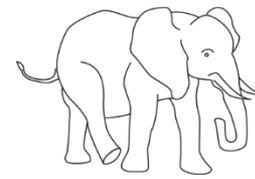


about weight of dime

large book



pair of men's shoes



elephant or small car

$$1000 \text{ g} = 1 \text{ kg}$$

$$1000 \text{ kg} = 1 \text{ t}$$

devices (tools) to measure

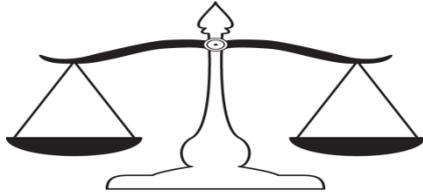
gram (g)

kilogram (kg)

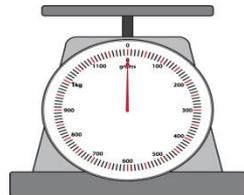
tonne (t)



spring scale



balance scale



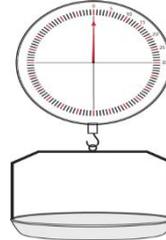
scale



bathroom scale



scale



grocery scale



spring scale

**ALL TRUCKS
MUST ENTER
WEIGH
STATION**

large objects: cars, trucks, large animals, airplanes

small items: crayons, doll, coins, light food

medium - big items: books, shoe, fruit, vegetables, child, adult, animals

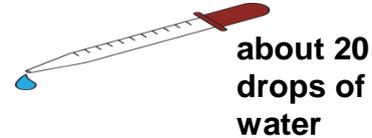
* Technically mass is how much matter there is but for everyday use we use mass to refer to weight.

Capacity Demo

Capacity (Metric System)

[amount a container can hold]

milliliter (ml)



liter (L or l)

Middle size milk container at store. Slightly more than quart.



soda

kiloliter (kl)



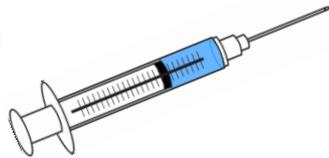
1000 liters

milli = 1 thousandth, kilo = 1000, 1000 milliliters = 1 liter, 1000 liters = 1 kiloliter, 1000 ml = 1L, 1000L = 1 kl

devices (tools) to measure

milliliter (ml)

liquid measuring cup



syringe

small amounts:
recipes, medicines,
child drinks

liter (L or l)

liquid measuring cup



medium/large amounts: recipes,
punches, drinks

kiloliter (kl)



250 L



250 L



250 L



250 L

large liquid amounts:
pools, tanks, fuel
containers

Measurement Metric System

Time

Temperature

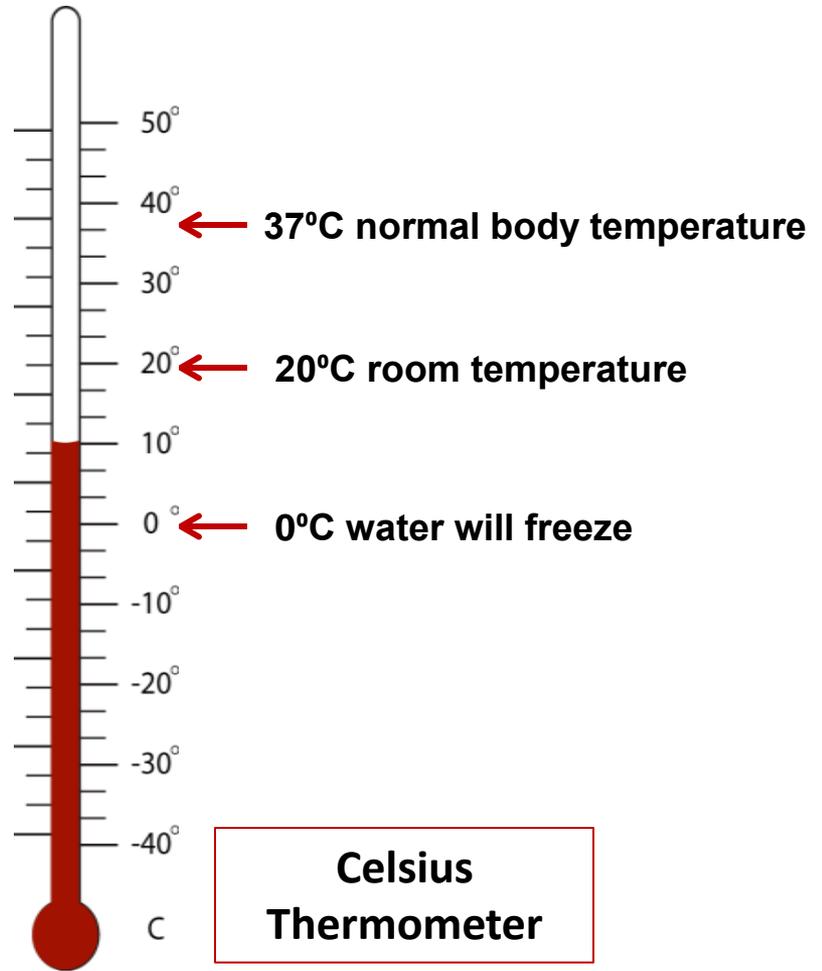
A measured period where actions and processes take place. A quantity that can be measured – clock, calendar...

Temperature is how hot or cold it is. It is measured in degrees (°) Celsius (C).
← 100°C water boils



12:05

- 1 minute = 60 seconds**
- 1 hour = 60 minutes**
- 1 day = 24 hours**
- 1 week = 7 days**
- 1 month = 30-31 days***
- 1 year = 365 days**

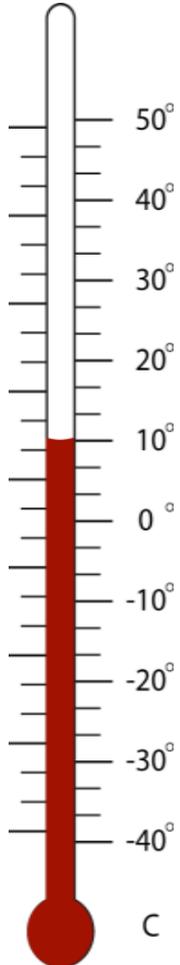


Celsius Thermometer

*February has 28 days normally, but every four years it has 29 (leap year).

A degree Celsius memory device:

There are several memory aids that can be used to help the novice understand the degree Celsius temperature scale. One such mnemonic is:

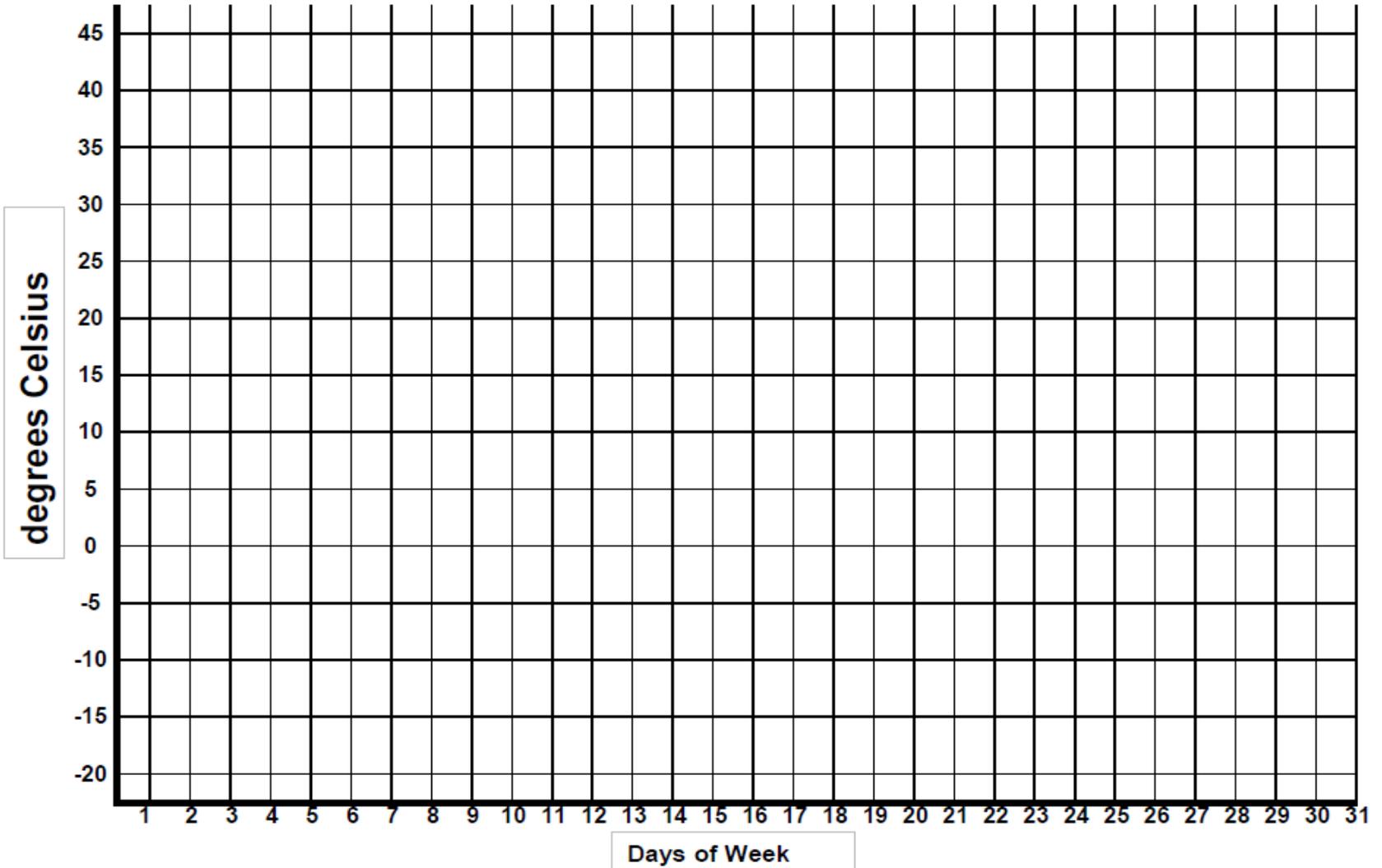


***When it's zero it's freezing,
when it's 10 it's not,
when it's 20 it's warm,
when it's 30 it's hot!***

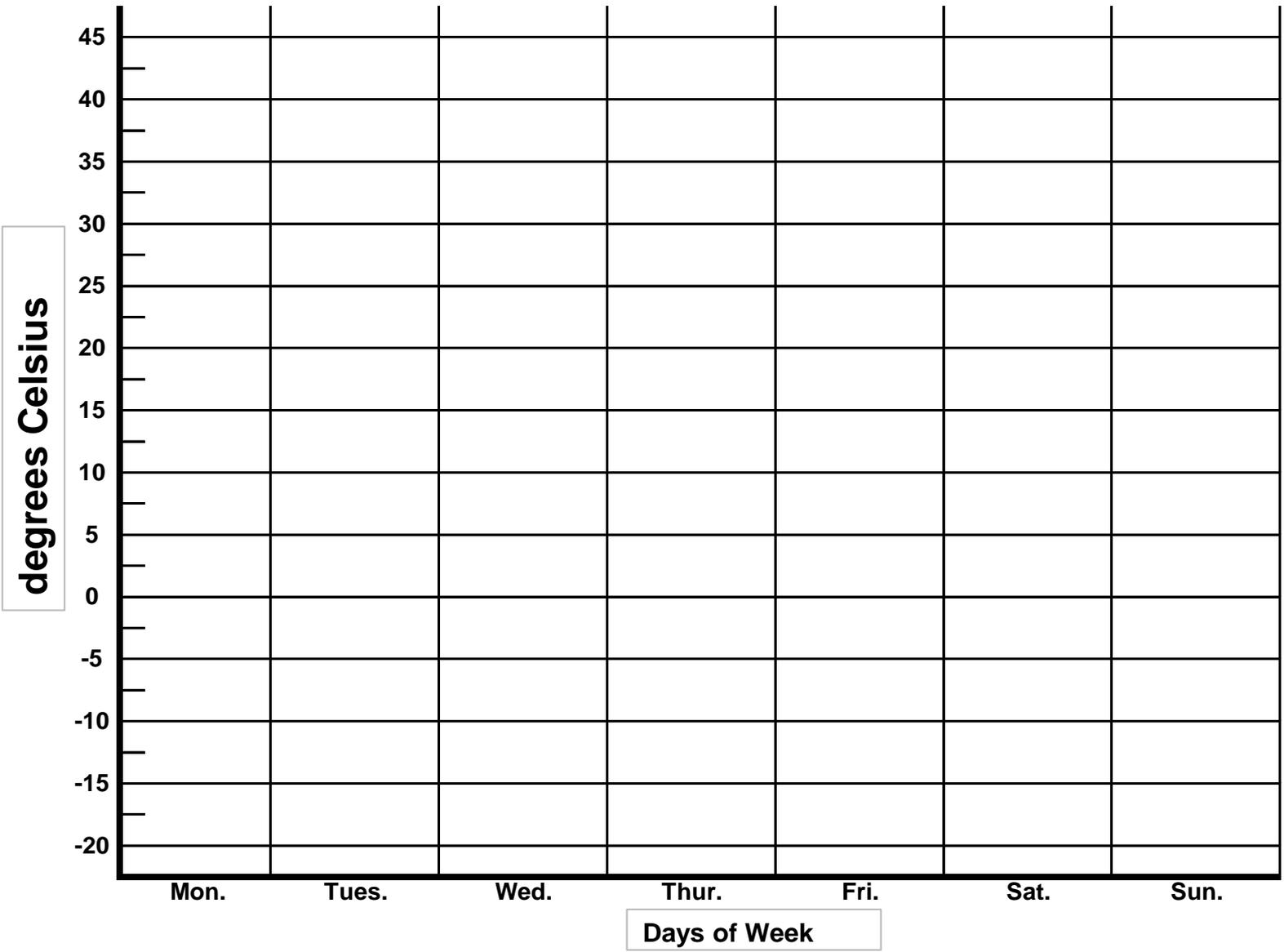
Or, another one to remember:

***Thirty is hot
Twenty is nice
Ten is cool
Zero is ice***

Month _____



Weekly Chart, Week of _____ to _____



Converting between metric system and U.S. customary system



Teach children to convert within the system of measure they are using - (metric to metric) and (customary to customary).

Converting Metric Units

kilo 1000 thousand k	hecto 100 hundred h	deca 10 ten da	UNIT 1 meter liter gram	deci 0.1 tenth d	centi 0.01 hundredth c	milli 0.001 thousandth m
--------------------------------------	-------------------------------------	--------------------------------	--	----------------------------------	--	--

← divide by power of 10

→ multiply by power of 10



Suggestion: start out with length, make 3 lines on white board same length, label in proper units – cm, dm, m

_____	160 cm
_____	16 dm
_____	1.6 m

Emphasize that the length doesn't change, the unit of measure changes.

khdu dcm

King henry died unexpectedly drinking chocolate milk

Kids have done unbelievable deeds converting metrics

$$1.6 \text{ m} = \underline{160} \text{ cm}$$

$$16.2 \text{ g} = \underline{16\,200} \text{ mg}$$

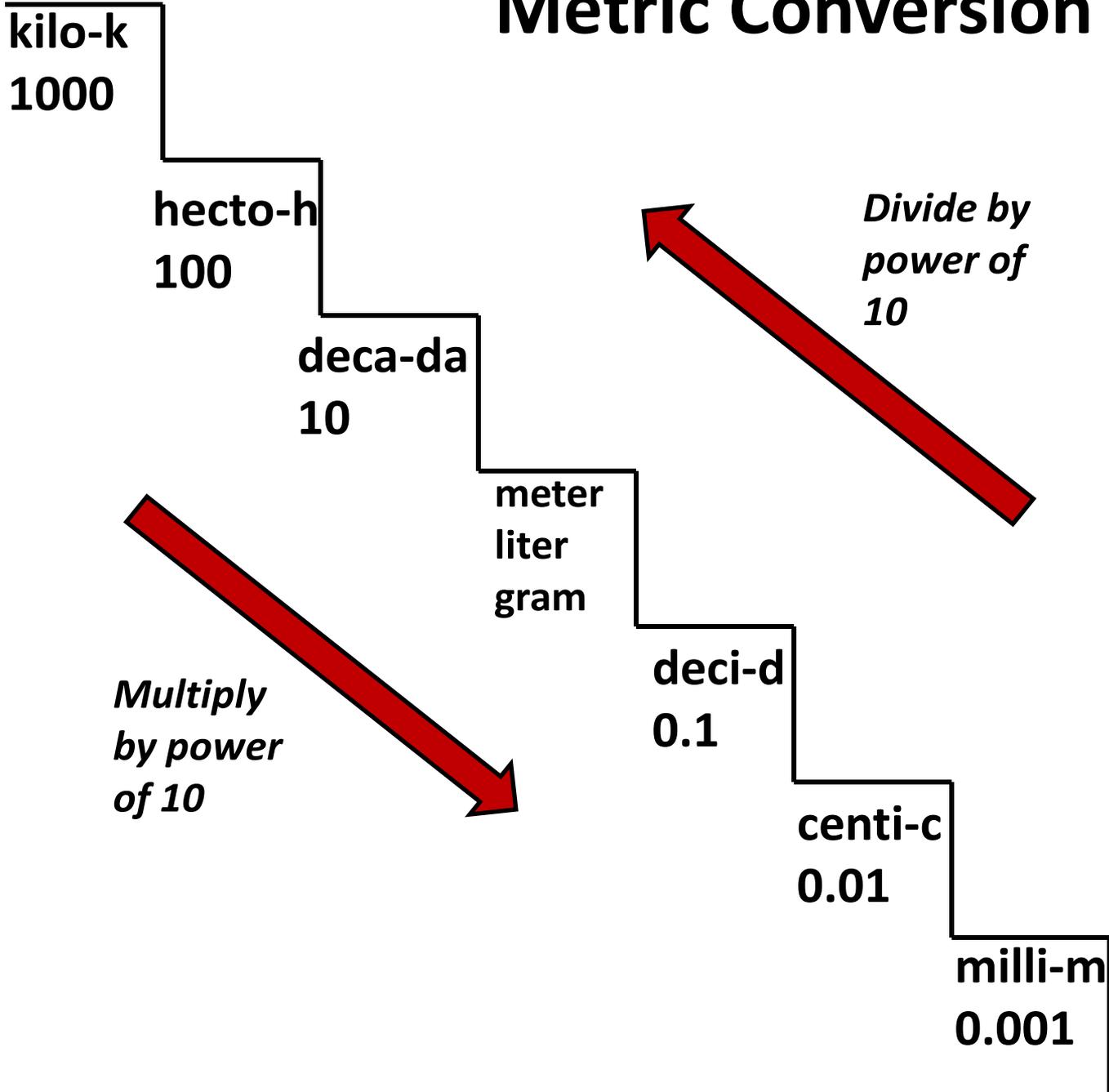
$$1345 \text{ m} = \underline{1.345} \text{ km}$$

$$1105 \text{ mL} = \underline{1.105} \text{ L}$$

$$15 \text{ kg} = \underline{15,000} \text{ g}$$

$$3.05 \text{ L} = \underline{3.050} \text{ mL}$$

Metric Conversion Chart



Unique Math Tools

LCM
4 and 9



GCF
12 and 16



+ - whole #s
26 + 39
73 - 38



Measurement

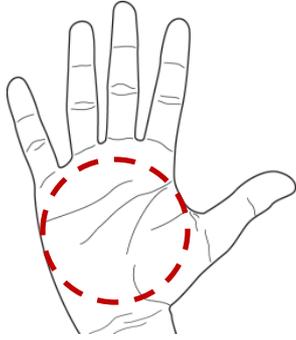
centimeter, meter

Measurement Scavenger Hunt

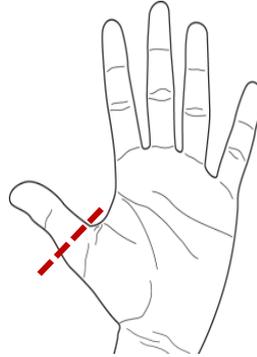
Find something that measures:

1. More than 30 centimeters _____
2. Less than 10 centimeters _____
3. Between 10 and 30 centimeters _____
4. About 5 centimeters longer than your foot _____
5. About one meter _____
6. More than a meter _____
7. Less than a meter but more than 30 centimeters _____
8. Less than 10 centimeters _____

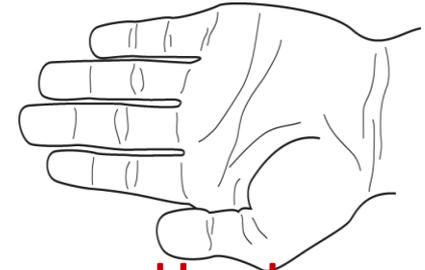
Hand Serving Sizes



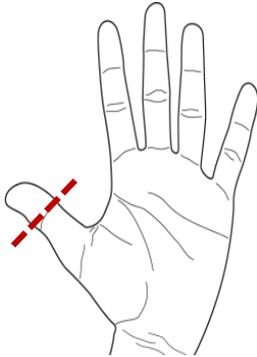
**palm,
3 ounces meat**



**thumb,
1 ounce cheese**



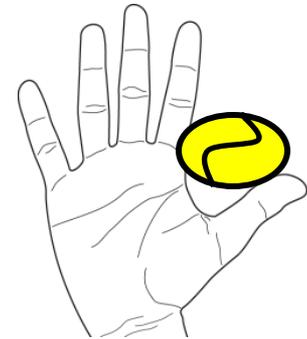
**fist, cupped hand
1 cup**



**thumb tip,
1 teaspoon**



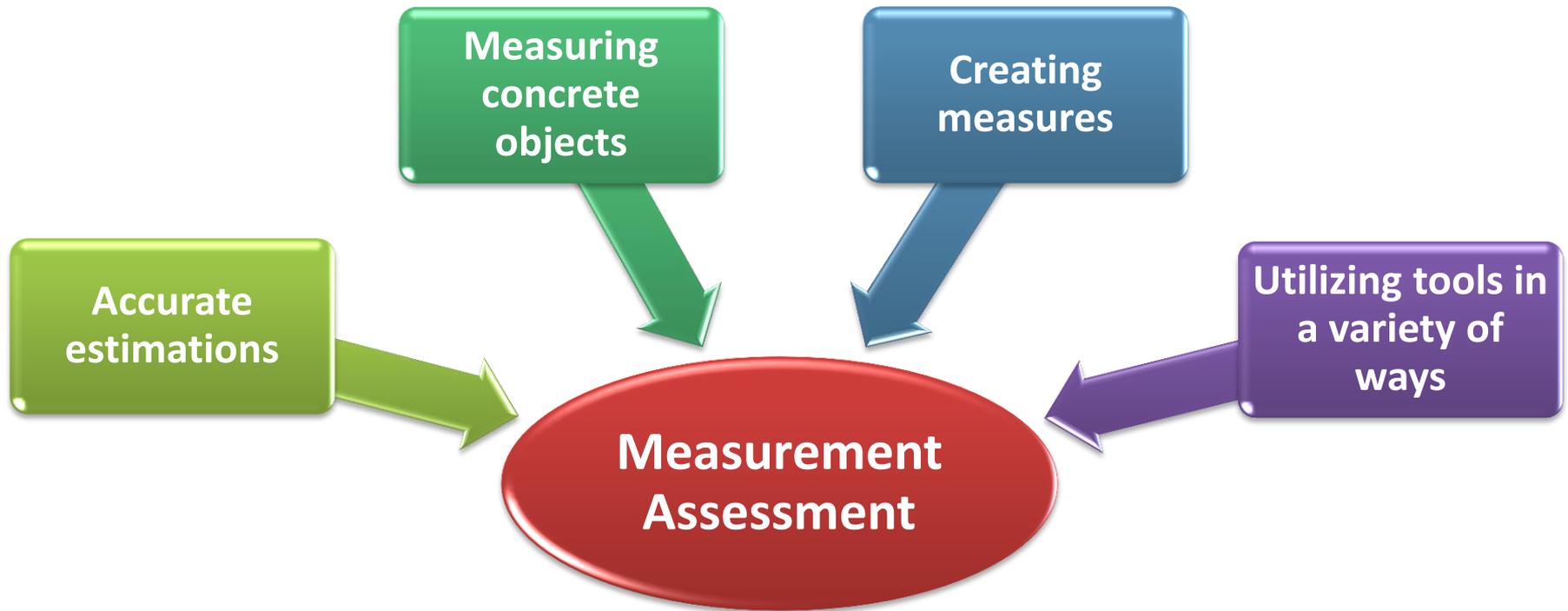
**handful,
1-2 oz. snack food**



**tennis ball,
1 serving fruit**

Post-Assessment Ideas

Remember: The goal for assessment purposes in measurement should be to include practical, hands-on types of measures, rather than solely rely on the more traditional, abstract approaches.



It is not a bunch of tests!

Performance Tasks

Requires students to apply their knowledge and skills in order to solve problems, create original products, or demonstrate particular skills.



Majority Involved:

- Solving real problems
- Engaging in oral or psychomotor skills
 - no product produced
- Writing or demonstrating a skill
 - product produced

Burke 2009

Extended Performance Tasks

- Refers to tasks that include numerous instructional objectives and standards
- Tend to be less structured
- Broader in scope
- More time consuming

Gronlund 1998



STEAM Activities

Weather unit—see packet

Art unit—see packet

Power of 10 [video](#) by Eames

A Measurement e-Book

(Version 4)

S.P.A.R.K.

Standards Practice & Academic Review Kit

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Mathematics

Grade 2-8

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Metric Conversion Answers (90)

U.S. Customary Conversion Answers (91)

Pretest Answers – metric/U.S. Customary (92), Metric trundle wheel (93-94), 50 cm trundle wheel (95), Gallon Guy (96), Homemade thermometer (97), elapsed time line – individual (98), elapsed time poster (99), hand servings (100), Water clock (clepsydra) (101), Sundial (102), Quart net (103), Liter net (104), cubic decimeter – 1 liter (105), sand timer (106), mass/weight bags (107)

Foreword

Under the category of measurement, virtually all of the most functional math skills are needed to be competent regardless if one is pursuing college or career.

Time spent on measurement during a child's school career in the past has been minimal regardless of the grade. Measurement generally includes length, weight (or mass), capacity (or volume), area, time, temperature and money. The majority of time spent with these terms is done through the use of a worksheet or two and very little time is actually spent on "hands on" or doing activities that use devices to measure what we are looking to learn.

Today, basic living requires knowing money, time and temperature and many jobs require an ability to measure length, capacity, and weight accurately. Cooking from recipes requires understanding measures of volume, such as cups, pints, quarts and gallons in the U.S. Customary System and liters and milliliters in the Metric System.

Some very common, but extremely important, areas where we use measurement on an everyday basis are as follows.

1. Cooking: measurement plays a role in temperature, time and being able to follow recipes which include accuracy with weight and capacity.
2. Prescriptions/medicine: following a prescription accurately and using the proper amount can be a matter of life or death as well as being able to get the proper benefit from the medicine.
3. Clothing: selecting clothes that fit properly, look good, and appeal to a person's weight and physical make-up use several forms of measurement.
4. Recreation/sports: whether a person plays or is a spectator, almost all sports and recreational activities involve measurement.
5. Temperature: keeping cool or warm is essential to a safe and comfortable life. Being able to read and understand a thermometer either in Fahrenheit or Celsius is becoming more important in a changing world.

6. Weight (mass): buying groceries, cooking and personal health all involve weight and the need to understand and measure accurately as daily problems that everyone faces.
7. Telling time: time is a consequence of daily lives which requires the ability to use analog and digital timepieces daily. Being on-time is essential not only in a work situation but a social one as well.
8. Transportation: from amount of fuel, time needed to arrive, how much pressure or how much weight, our own transportation or using other transportation involves measurement of many types.

In the world of work, commerce, and the scientific communities, the ability to measure in every area as well as knowing and being able to use all systems of measure is extremely important and required in many occupations now and those that will evolve in the future.

We have developed this book as a resource for teachers to use on a regular basis and insure that students have “hands on” experiences and a sound knowledge of all forms of measurement. It was developed to follow the Common Core Standards of Mathematics and the recommendations of the National Council of Teachers of Mathematics

NCTM Measurement Expectations for PreK-2

Understand measurable attributes of objects and the units, systems, and processes of measurement

- recognize the attributes of length, volume, weight, area, and time;
- compare and order objects according to these attributes;
- understand how to measure using nonstandard and standard units;
- select an appropriate unit and tool for the attribute being measured.

Apply appropriate techniques, tools, and formulas to determine measurements

- measure with multiple copies of units of the same size, such as paper clips laid end to end;
- use repetition of a single unit to measure something larger than the unit, for instance, measuring the length of a room with a single meter stick;
- use tools to measure;
- develop common referents for measures to make comparisons and estimates.

NCTM Measurement Expectations for Grades 3-5

Understand measurable attributes of objects and the units, systems, and processes of measurement

- understand such attributes as length, area, weight, volume, and size of angle and select the appropriate type of unit for measuring each attribute;
- understand the need for measuring with standard units and become familiar with standard units in the customary and metric systems;
- carry out simple unit conversions, such as from centimeters to meters, within a system of measurement;
- understand that measurements are approximations and how differences in units affect precision;
- explore what happens to measurements of a two-dimensional shape such as its perimeter and area when the shape is changed in some way.

Apply appropriate techniques, tools, and formulas to determine measurements

- develop strategies for estimating the perimeters, areas, and volumes of irregular shapes;
- select and apply appropriate standard units and tools to measure length, area, volume, weight, time, temperature, and the size of angles;
- select and use benchmarks to estimate measurements; develop, understand, and use formulas to find the area of rectangles and related triangles and parallelograms;
- develop strategies to determine the surface areas and volumes of rectangular solids.

NCTM Measurement Expectations for Grades 6-8

Understand measurable attributes of objects and the units, systems, and processes of measurement

- understand both metric and customary systems of measurement;
- understand relationships among units and convert from one unit to another within the same system;
- understand, select, and use units of appropriate size and type to measure angles, perimeter, area, surface area, and volume.

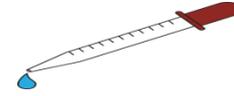
Apply appropriate techniques, tools, and formulas to determine measurements

- use common benchmarks to select appropriate methods for estimating measurements;
- select and apply techniques and tools to accurately find length, area, volume, and angle measures to appropriate levels of precision;
- develop and use formulas to determine the circumference of circles and the area of triangles, parallelograms, trapezoids, and circles and develop strategies to find the area of more-complex shapes;
- develop strategies to determine the surface area and volume of selected prisms, pyramids, and cylinders;
- solve problems involving scale factors using ratio and proportion;
- solve simple problems involving rates and derived measurements for such attributes as velocity and density.

Measurement Metric System



meter



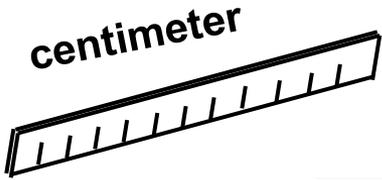
milliliter



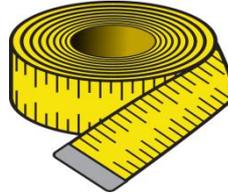
liter

length

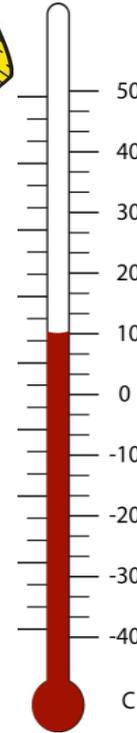
capacity



centimeter

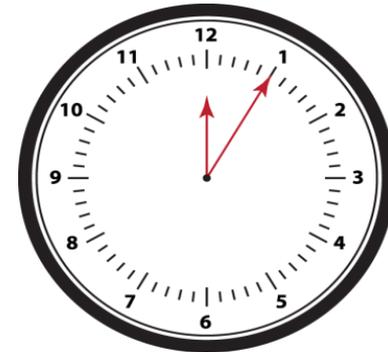


kilometer



temperature

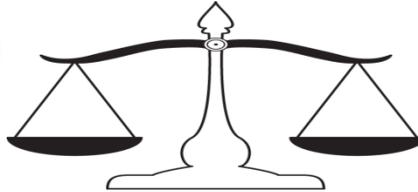
Celsius
(degrees)



time

minutes

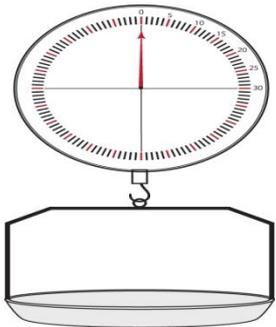
gram



mass



kilogram



Measurement Metric System

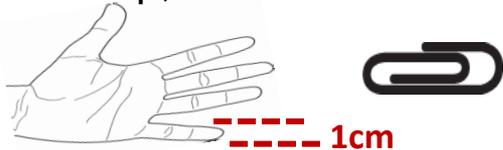
Length

Measure of how long an object is, distance from one point to another



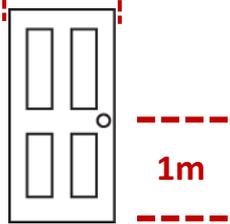
1mm

millimeter (mm) – width of a pencil tip, thickness of dime



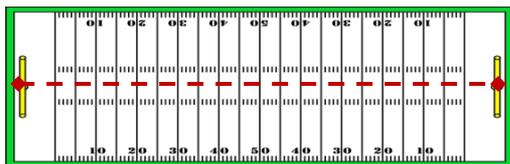
1cm

centimeter (cm) – about width of little finger, small paper clip



1m

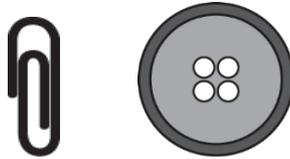
meter (m) – width of door, distance from door knob to floor



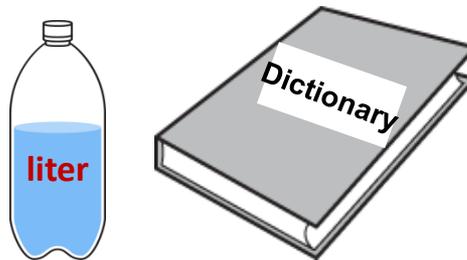
kilometer (km) – about length of 11 football fields (goal/goal)

Mass/Weight

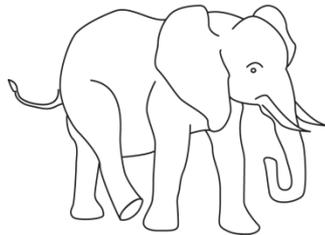
How heavy or light an object is



gram (g) – about mass of small paper clip, or button



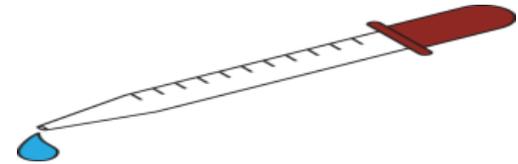
kilogram (kg) – dictionary, 1 liter of water, 1000 grams



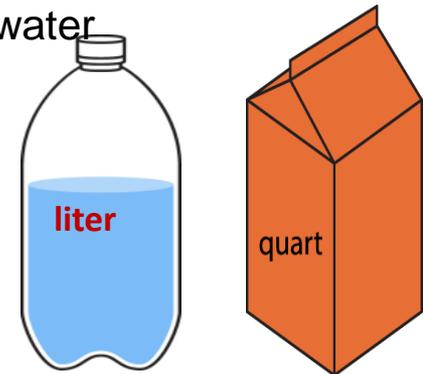
tonne (t) – called the metric ton, equal to 1000 kg

Capacity

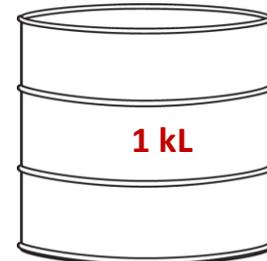
Amount a container can hold



milliliter (ml) – about 20 drops of water



liter (l or L) – little larger than a quart, middle size milk carton at store



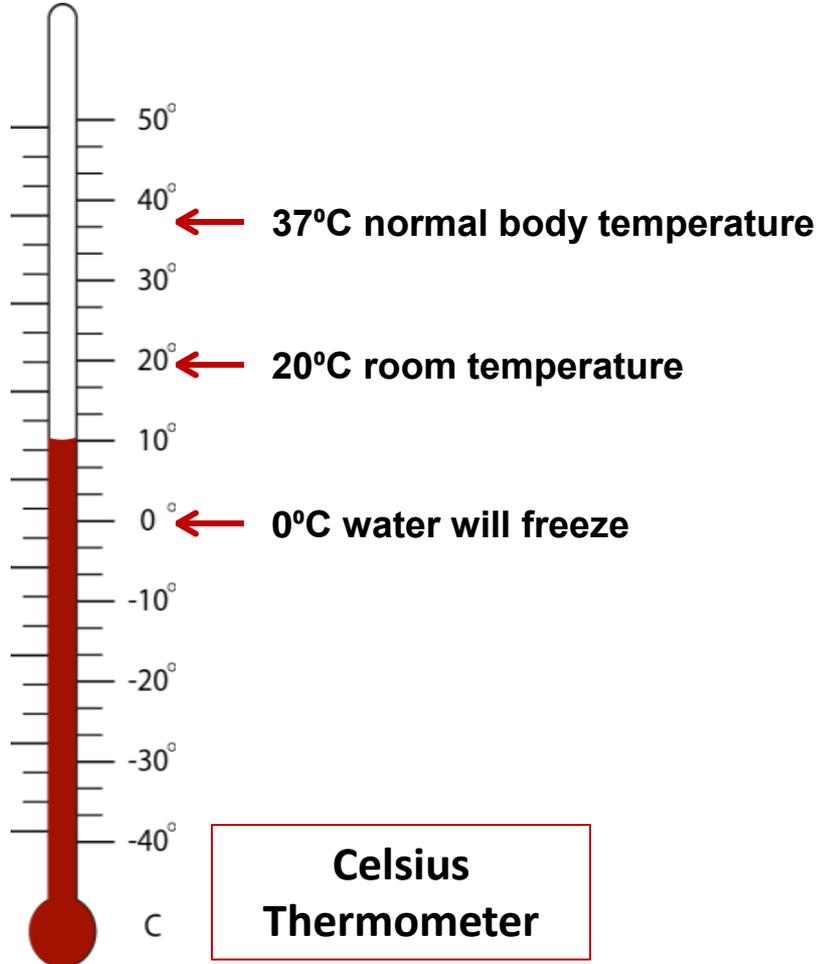
kiloliter (kl) – about 4 common barrels, 1000 liters

Measurement Metric System

Temperature

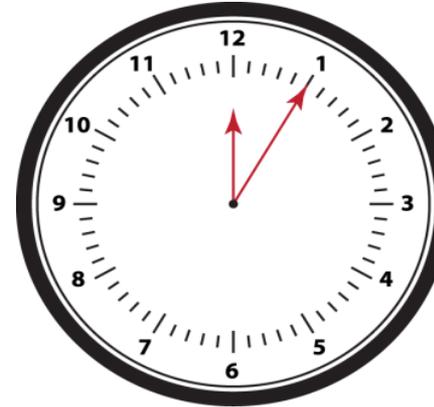
Temperature is how hot or cold it is. It is measured in degrees ($^{\circ}$) Celsius (C).

← 100°C water boils



Time

A measured period where actions and processes take place. A quantity that can be measured – clock, calendar...



12:05

1 minute = 60 seconds
1 hour = 60 minutes
1 day = 24 hours
1 week = 7 days
1 month = 30-31 days*
1 year = 365 days

*February has 28 days normally, but every four years it has 29 (leap year).

Length (Metric System)

[how long something is, distance]

millimeter (mm)

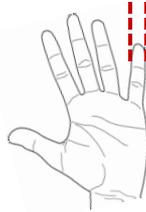


about thickness of dime



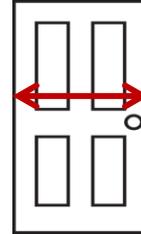
tip of pencil lead

centimeter (cm)



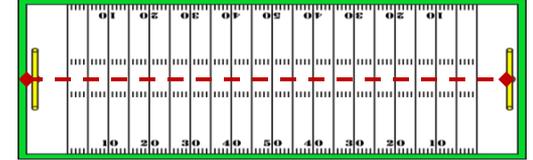
about width of little finger

meter (m)



about width of a door

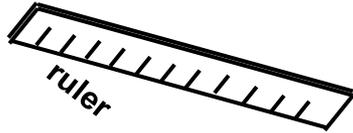
kilometer (km)



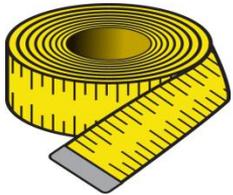
about length of 11 football fields (gl./gl.)

devices (tools) to measure

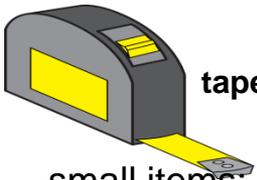
millimeter (mm)



ruler



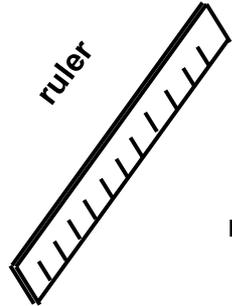
tape measure



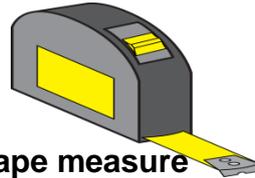
tape measure

small items: pencil, book, crayon

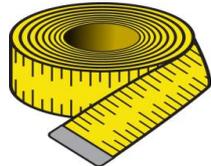
centimeter (cm)



ruler



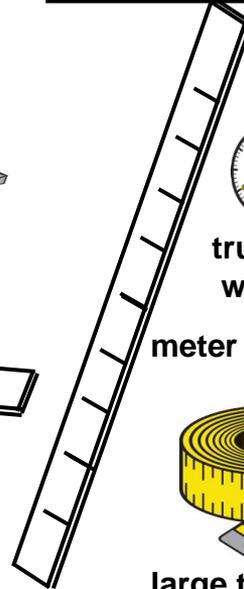
tape measure
meter stick



tape measure

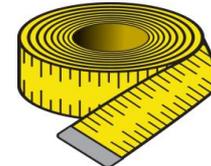
small, medium items: books, height, clothes patterns

meter (m)



trundle wheel

meter stick



large tape measure

medium, big items: football, soccer fields, house, barn, track

kilometer (km)



kilometer
odometer

distance: city to city, miles to grandparents house, airplane

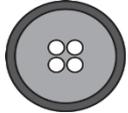
Mass* (Metric System)

[how heavy something is]

gram (g)

kilogram (kg)

tonne (t)



small button

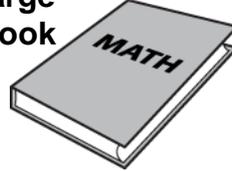


paperclip

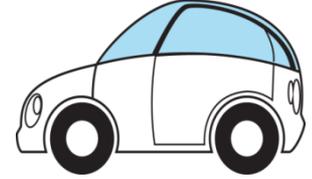
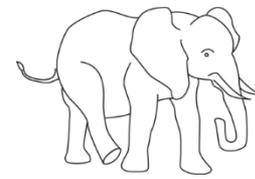


about weight of dime

large book



pair of men's shoes



elephant or small car

$$1000 \text{ g} = 1 \text{ kg}$$

$$1000 \text{ kg} = 1 \text{ t}$$

devices (tools) to measure

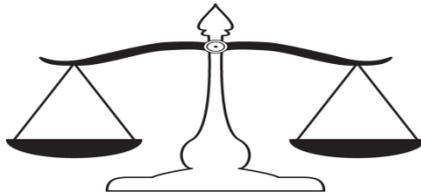
gram (g)

kilogram (kg)

tonne (t)



spring scale



balance scale



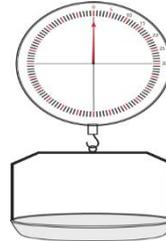
scale



bathroom scale



scale



grocery scale



spring scale

**ALL TRUCKS
MUST ENTER
WEIGH
STATION**

large objects: cars, trucks, large animals, airplanes

small items: crayons, doll, coins, light food

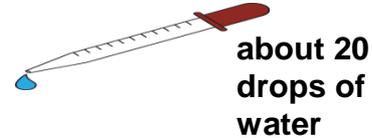
medium - big items: books, shoe, fruit, vegetables, child, adult, animals

* Technically mass is how much matter there is but for everyday use we use mass to refer to weight.

Capacity (Metric System)

[amount a container can hold]

milliliter (ml)



liter (L or l)

Middle size milk container at store. Slightly more than quart.



soda

kiloliter (kl)



1000 liters

milli = 1 thousandth, kilo = 1000, 1000 milliliters = 1 liter, 1000 liters = 1 kiloliter, 1000 ml = 1L, 1000L = 1 kl

devices (tools) to measure

milliliter (ml)

liquid measuring cup



syringe

small amounts:
recipes, medicines,
child drinks

liter (L or l)

liquid measuring cup



medium/large amounts: recipes,
punches, drinks

kiloliter (kl)



250 L



250 L



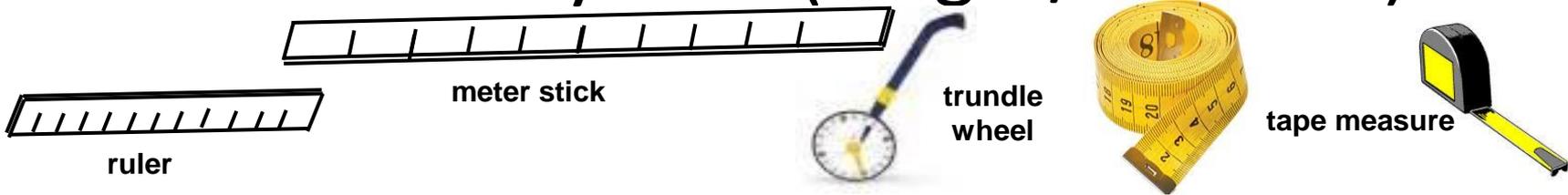
250 L



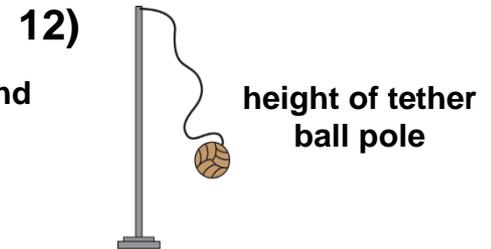
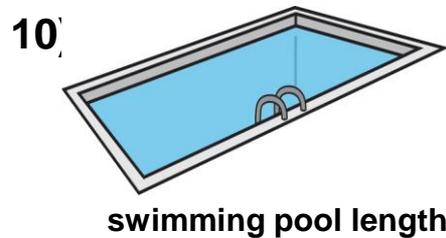
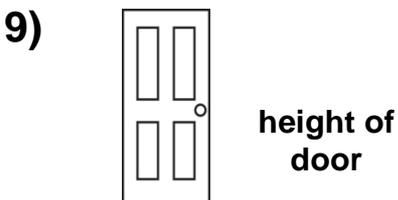
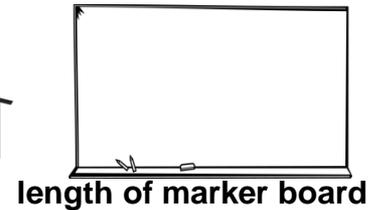
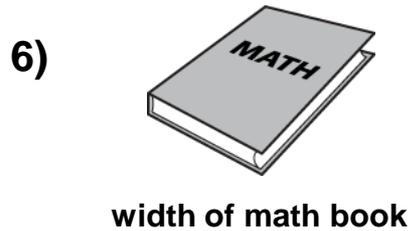
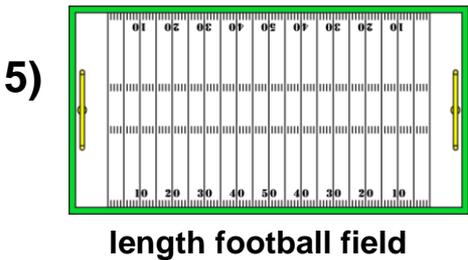
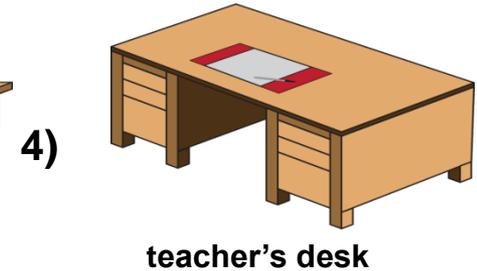
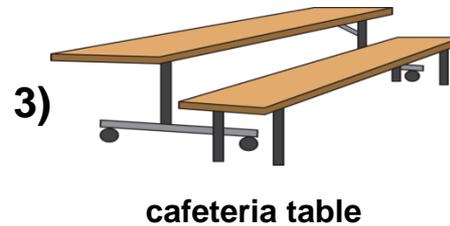
250 L

large liquid amounts:
pools, tanks, fuel
containers

Metric System (length/distance)



Decide which device (tool) is BEST to measure the various lengths/distances.



Metric Table

kilo 1000 thousand k	hecto 100 hundred h	deka 10 ten da	UNIT 1 meter liter gram	deci 0.1 tenth d	centi 0.01 hundredth c	milli 0.001 thousandth m
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Kids have done unbelievable deeds converting metrics

When changing from a larger unit to a smaller unit (kilo to hecto), you **multiply**. (move decimal to right)

When changing from a smaller unit to a larger unit (milli to centi), you **divide**. (move decimal to left)

BIG > small
(multiply)

small > Big
(divide)

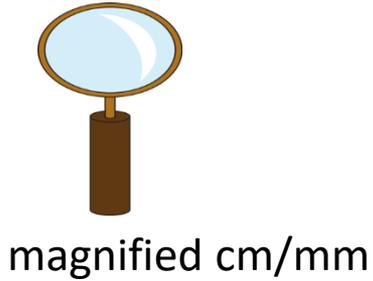
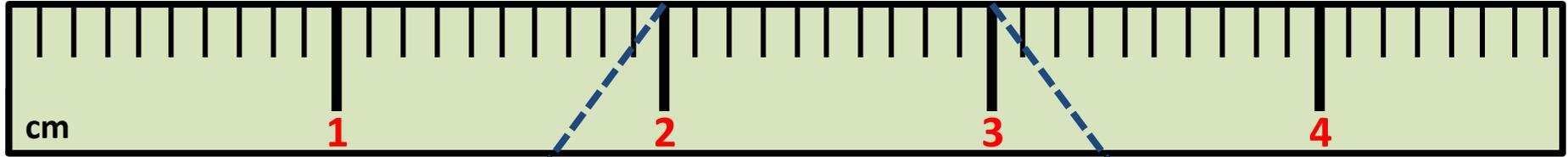
24 L = _____ mL, L is bigger than mL.
mL is 3 places to right (mult. by 10,
100, 1000. Thus, $24 \times 1000 = 24000$.

24 L = 24000 mL

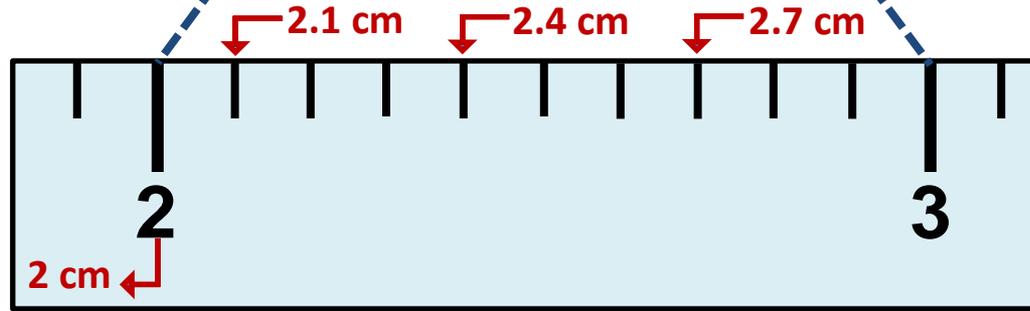
4550 cm = _____ m, cm is smaller than
m. m is 2 places to left (divide by 10,
100. Thus, $4550/100 = 45.5$.

4550 cm = 45.50 m

Metric Measurement (cm/mm ruler)

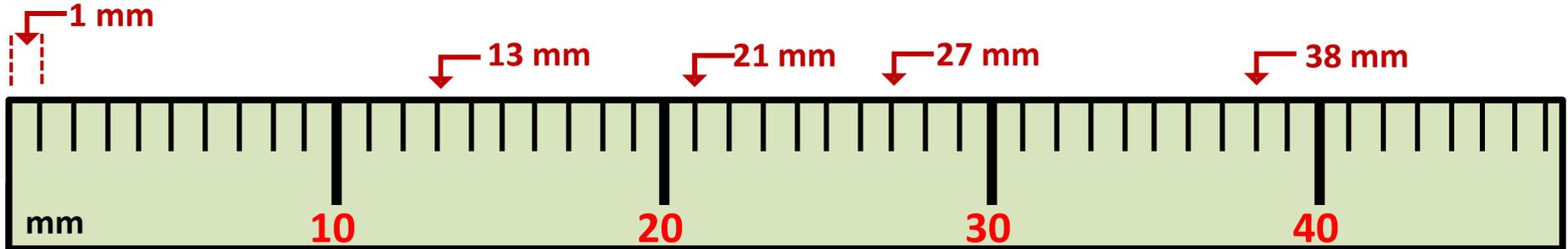


magnified cm/mm



Rulers not to scale

On a centimeter ruler that is divided into smaller units (millimeters), there are 10 equal graduations between each major divider (centimeter). The smaller graduations are 1/10 of a centimeter (cm) which are known as one millimeter (mm).



magnified mm

On a millimeter ruler there are 10 equal graduations between each major divider. The smaller graduations are one millimeter (1 mm). Notice above that 3 graduations past 10 = 13 mm and the next measure is one graduation past 20 which is 21 mm.

Metric Conversion

Answers on slide 89

1) 356 m = _____ cm

2) 3 km = _____ m

3) 16.35 kg = _____ g

4) 14.2 L = _____ mL

5) 0.165 g = _____ mg

6) 17 m = _____ cm

7) 7L = _____ mL

8) 4.1 km = _____ m

9) 7.5L = _____ mL

10) 43 cm = _____ mm

11) 50 kg = _____ g

12) 900 cm = _____ m

13) 12000 mL = _____ L

14) 900 m = _____ km

15) 250 g = _____ hg

16) 25 mm = _____ cm

17) 15.4 L = _____ mL

18) 235 mL = _____ L

19) 5.6 kg = _____ g

20) 2000 mg = _____ g

21) 6.3 cm = _____ mm

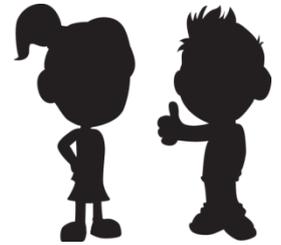
22) 5.6 m = _____ cm

23) 1220 cL = _____ L

24) 12.25 kg = _____ dag

“Hands On” (Metric System)

[length/width]



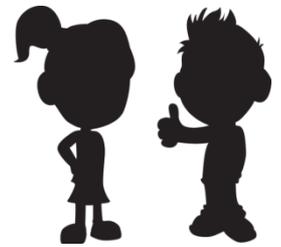
Activity 1 (centimeter)

- Material: cm ruler 15/30, 100/150 cm tape, classroom objects that can be measured

item	estimate	actual measure	difference
paper clip	_____ cm	_____ cm	_____ cm
crayon	_____ cm	_____ cm	_____ cm
pencil	_____ cm	_____ cm	_____ cm
math book	_____ cm	_____ cm	_____ cm
board eraser	_____ cm	_____ cm	_____ cm
sheet of paper	_____ cm	_____ cm	_____ cm
desk length	_____ cm	_____ cm	_____ cm
desk width	_____ cm	_____ cm	_____ cm
_____	_____ cm	_____ cm	_____ cm
_____	_____ cm	_____ cm	_____ cm

“Hands On” (Metric System)

[length/width]



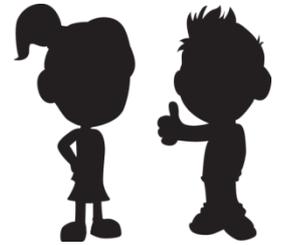
Activity 2 (nearest meter)

- Material: meter stick, 100/150 cm tape, items/objects in classroom to measure

item	estimate	actual measure	difference
length of desk	_____ m	_____ m	_____ m
width of desk	_____ m	_____ m	_____ m
height of door	_____ m	_____ m	_____ m
width of door	_____ m	_____ m	_____ m
length marker board	_____ m	_____ m	_____ m
width marker board	_____ m	_____ m	_____ m
length of room	_____ m	_____ m	_____ m
width of room	_____ m	_____ m	_____ m
height of file cabinet	_____ m	_____ m	_____ m
_____	_____ m	_____ m	_____ m
_____	_____ m	_____ m	_____ m

“Hands On” (Metric System)

[length/width]



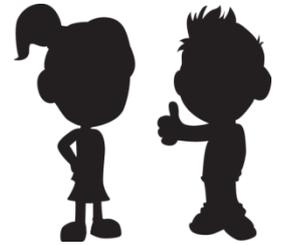
Activity 3 (meter, cm)

- Material: meter stick, 100/150 cm tape, items/objects in classroom to measure

item	estimate	actual measure	difference
length of desk	___ m ___ cm	___ m ___ cm	___ m ___ cm
width of desk	___ m ___ cm	___ m ___ cm	___ m ___ cm
height of door	___ m ___ cm	___ m ___ cm	___ m ___ cm
width of door	___ m ___ cm	___ m ___ cm	___ m ___ cm
length marker board	___ m ___ cm	___ m ___ cm	___ m ___ cm
width marker board	___ m ___ cm	___ m ___ cm	___ m ___ cm
length of room	___ m ___ cm	___ m ___ cm	___ m ___ cm
width of room	___ m ___ cm	___ m ___ cm	___ m ___ cm
volunteer student ht.	___ m ___ cm	___ m ___ cm	___ m ___ cm
_____	___ m ___ cm	___ m ___ cm	___ m ___ cm
_____	___ m ___ cm	___ m ___ cm	___ m ___ cm

“Hands On” (Metric System)

[mass]



Activity 4 (grams)

- Material: Use balance scale, spring scale.

Item/object	estimate	actual mass	difference
pencil	_____ g	_____ g	_____ g
crayon	_____ g	_____ g	_____ g
box of crayons	_____ g	_____ g	_____ g
marker	_____ g	_____ g	_____ g
writing journal	_____ g	_____ g	_____ g
scissors	_____ g	_____ g	_____ g
watch	_____ g	_____ g	_____ g
board eraser	_____ g	_____ g	_____ g
computer mouse	_____ g	_____ g	_____ g
_____	_____ g	_____ g	_____ g
_____	_____ g	_____ g	_____ g

“Hands On” (Metric System)

[mass]

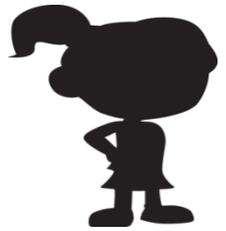
Activity 5 (grams, kilograms)

- Material: Use spring scale, bathroom scale, grocery scale.

Item/object	estimate	actual mass	difference
small can fruit/veg.	_____ kg	_____ kg	_____ kg
large can fruit/veg.	_____ kg	_____ kg	_____ kg
liter of water	_____ kg	_____ kg	_____ kg
dictionary	_____ kg	_____ kg	_____ kg
math book	_____ kg	_____ kg	_____ kg
telephone book	_____ kg	_____ kg	_____ kg
small chair	_____ kg	_____ kg	_____ kg
globe	_____ kg	_____ kg	_____ kg
volunteer student	_____ kg	_____ kg	_____ kg
_____	_____ kg	_____ kg	_____ kg
_____	_____ kg	_____ kg	_____ kg

“Hands On” (Metric System)

[My Personal Record]



Activity 6 (centimeter) Name _____

- Material: cm ruler 15/30, 100/150 cm tape, classroom objects that can be measured

item	estimate	actual measure
my height	_____ cm	_____ cm
around head (hat size)	_____ cm	_____ cm
around neck (collar size)	_____ cm	_____ cm
shoulder to wrist (sleeve length)	_____ cm	_____ cm
waist (belt size)	_____ cm	_____ cm
fingertip to fingertip	_____ cm	_____ cm
around wrist	_____ cm	_____ cm
around ankle	_____ cm	_____ cm
hand span (little finger to thumb stretched)	_____ cm	_____ cm
my choice _____	_____ cm	_____ cm

“Hands On” (Metric System)

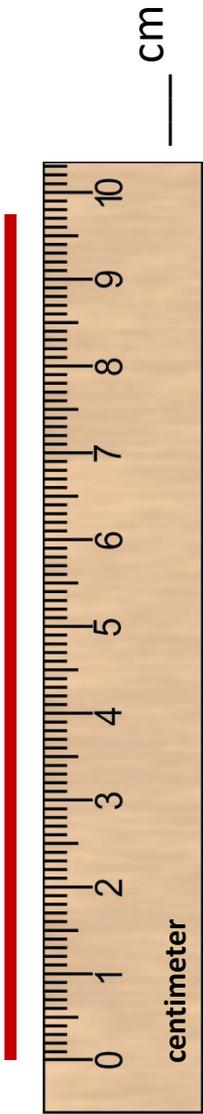
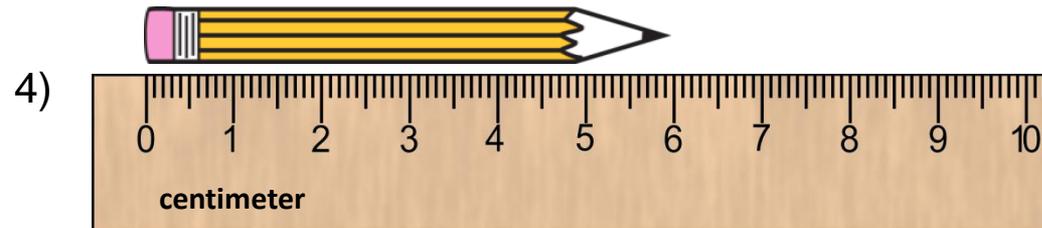
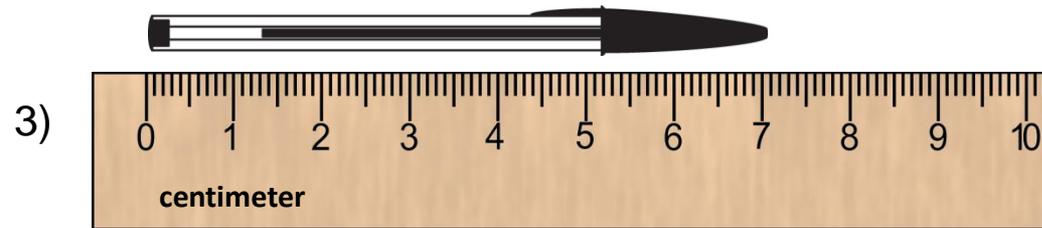
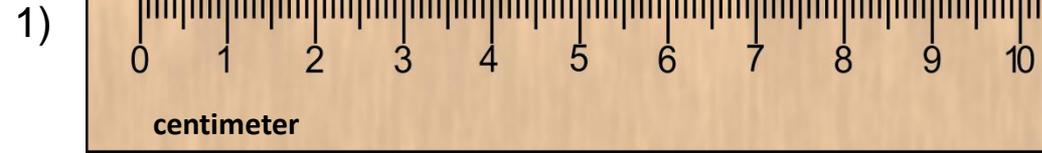
[length/width]



Activity 7 (nearest centimeter)

- Material: use the centimeter ruler to measure the lines & objects to the nearest cm.

Note: the edge of the ruler is NOT always zero (o). Always begin at ZERO.



“Hands On” (Metric System)

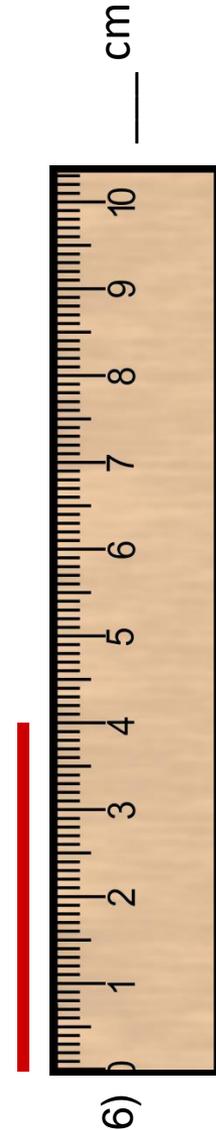
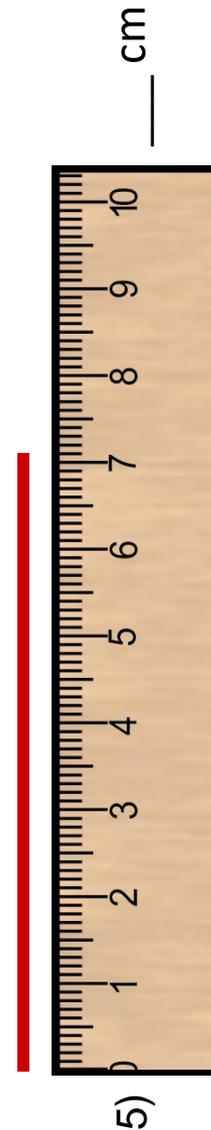
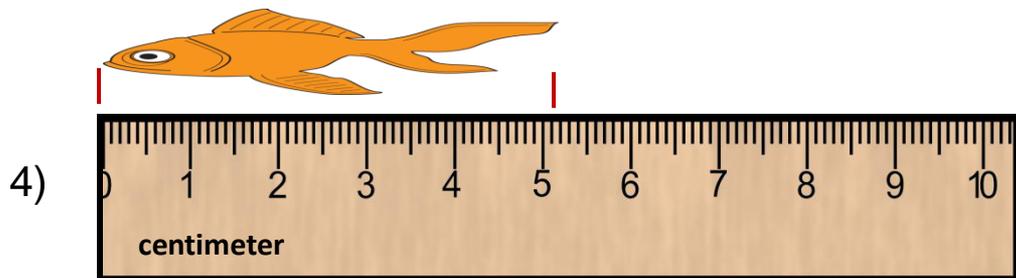
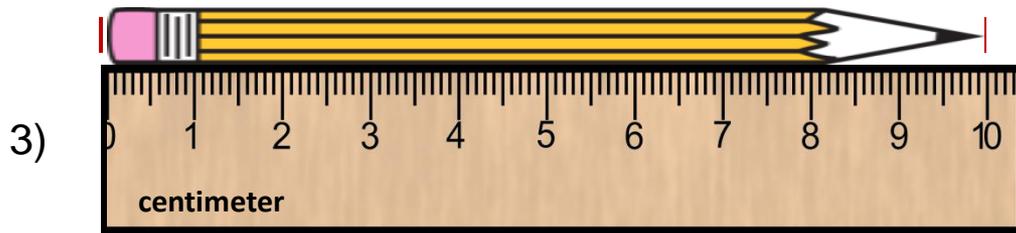
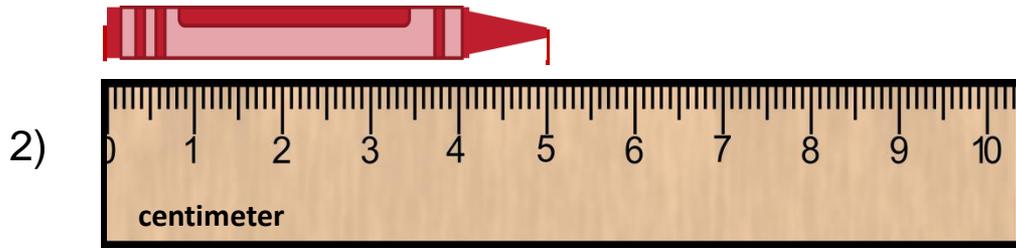
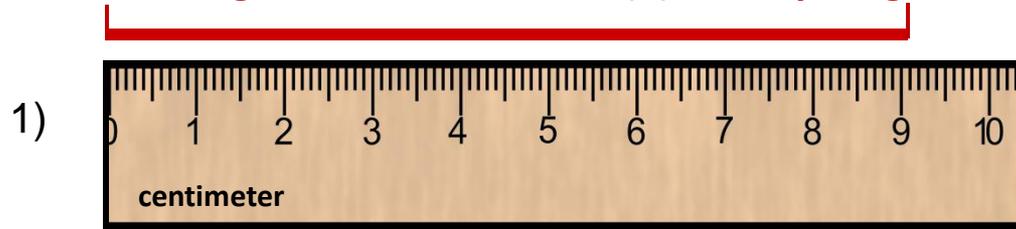


[length/width]

Activity 8 (nearest centimeter)

- Material: use the centimeter ruler to measure the lines & objects to the nearest cm.

Note: the edge of this ruler is zero (0). Always begin measuring at ZERO.



rulers not to scale

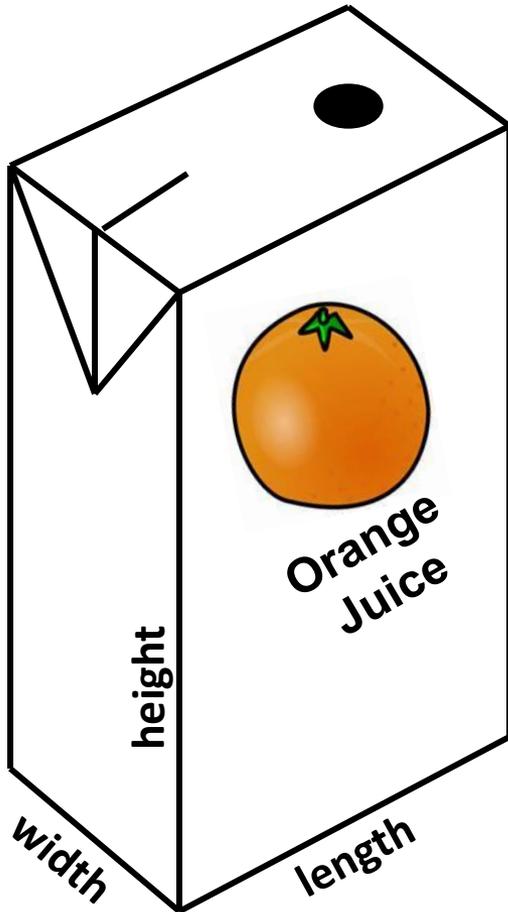
“Hands On” (Metric System)

[length/width]

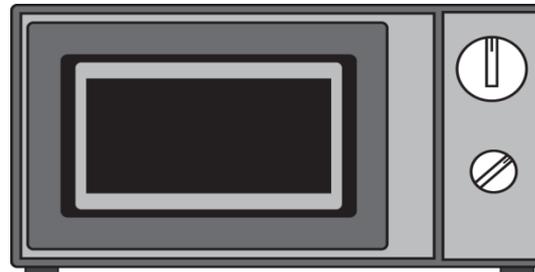


Activity 9 (nearest centimeter)

- Material: use your own centimeter ruler to measure the lines & objects to the nearest cm.



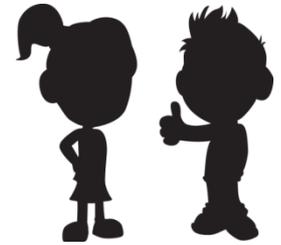
- 1) Estimate the width of the juice box. ____ cm
- 2) Measure the width of the juice box. ____ cm
- 3) Estimate the length of the juice box. ____ cm
- 4) Measure the length of the juice box. ____ cm
- 5) Estimate the height of the juice box. ____ cm
- 6) Measure the height of the juice box. ____ cm



- 7) Measure the height of the above microwave. ____ cm
- 8) Measure the length of the above microwave. ____ cm

“Hands On” (Metric)

[capacity]
Orange Surprise



Activity 10 (Recipes)

- 1.9 L, 1900 mL milk
- 1.9 L, 1900 mL water
- 4 cans o. j. concentrate (1.4 L, 1440 ml)
- 960 mL sugar
- 40 mL vanilla
- 8 trays of ice cubes

Blend in blender until ice is chopped. It should make adequate liquid for class of 20+ students.

Chocolate Chip Cookies

- 240 mL margarine
- 240 mL white sugar
- 240 mL brown sugar
- 2 eggs
- 480 mL oatmeal
- 480 mL flour
- 5 mL soda
- 5 mL salt
- 240 mL chocolate chips

Cream the margarine and sugars together. Add eggs and beat until light and fluffy. In a separate large bowl combine the dry ingredients except for the chocolate chips. Add the dry ingredients a little at a time to the creamed mixture until all is very well mixed. Then stir in the chocolate chips. Place on cookie sheets a teaspoon full at a time and bake at 350° for about 10 minutes. Will make about 6 dozen cookies.

Jello Cookies

- 960 mL flour, sifted
- 360 mL butter
- 240 mL sugar
- 5 mL baking powder
- 1 small package of Jello
- 1 egg
- 5 ml vanilla

Sift the flour with the baking soda. Cream the butter and slowly add sugar and Jello. Gradually add the rest of the dry ingredients. Cream after each addition until smooth. Force through a cookie press onto an ungreased baking sheet. Bake at 400° for about 12 minutes. Will make about 5 dozen cookies.

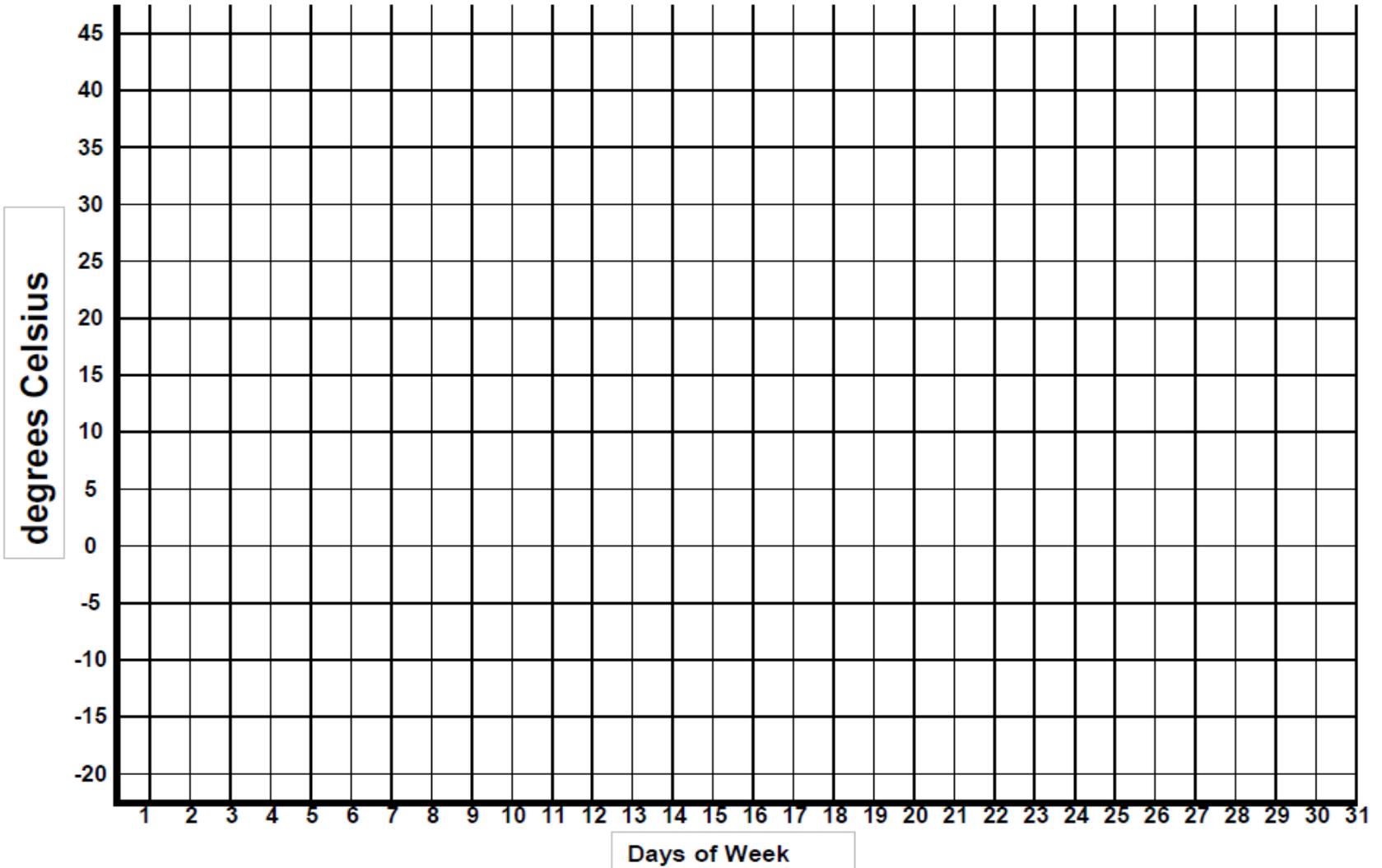
Metric Measurement
(Choose the best unit of Length)

- 1) Length of a board eraser:
 - a) millimeter
 - b) centimeter
 - c) meter
 - d) kilometer
- 2) Length of the classroom:
 - a) millimeter
 - b) centimeter
 - c) meter
 - d) kilometer
- 3) Length of your reading book:
 - a) millimeter
 - b) centimeter
 - c) meter
 - d) kilometer
- 4) Length of your foot:
 - a) millimeter
 - b) centimeter
 - c) meter
 - d) kilometer
- 5) Length of a cafeteria:
 - a) millimeter
 - b) centimeter
 - c) meter
 - d) kilometer
- 6) Length of the library:
 - a) millimeter
 - b) centimeter
 - c) meter
 - d) kilometer
- 7) Length of soccer field:
 - a) millimeter
 - b) centimeter
 - c) meter
 - d) kilometer
- 8) Length of your notebook:
 - a) millimeter
 - b) centimeter
 - c) meter
 - d) kilometer
- 9) Length of a pencil:
 - a) millimeter
 - b) centimeter
 - c) meter
 - d) kilometer
- 10) Length of the chalkboard:
 - a) millimeter
 - b) centimeter
 - c) meter
 - d) kilometer
- 11) Distance from LA to New York:
 - a) millimeter
 - b) centimeter
 - c) meter
 - d) kilometer
- 12) Height of your classroom:
 - a) a) millimeter
 - b) centimeter
 - c) meter
 - d) kilometer

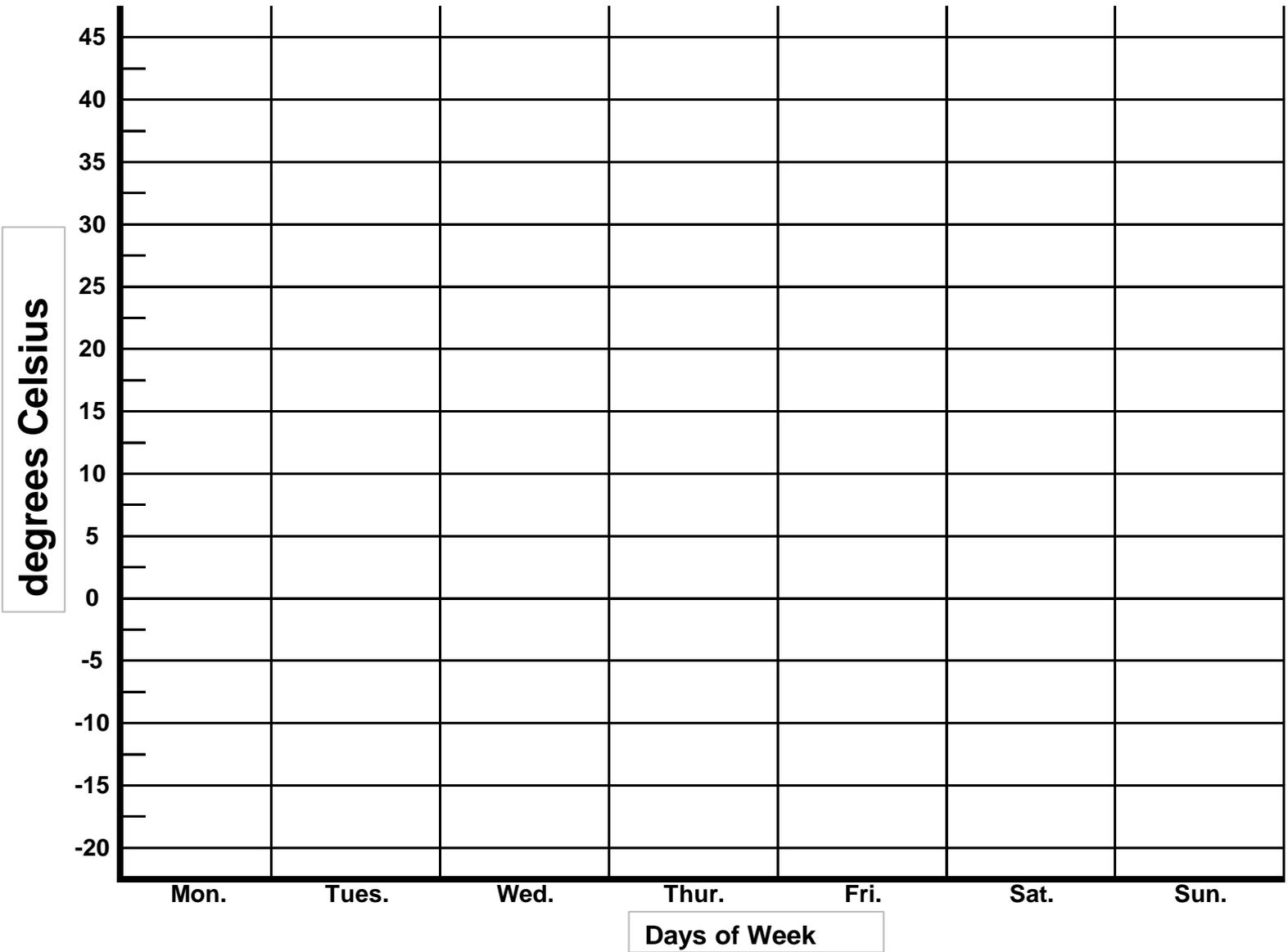
Metric Measurement
(Choose the best unit of Mass)

- 1) How heavy a chalkboard eraser is:
 - a) grams
 - b) kilograms
 - c) tonne
- 2) The weight of a classmate:
 - a) grams
 - b) kilograms
 - c) tonne
- 3) How much a box of crayons weighs:
 - a) grams
 - b) kilograms
 - c) tonne
- 4) The weight of a truck:
 - a) grams
 - b) kilograms
 - c) tonne
- 5) How heavy a large watermelon is:
 - a) grams
 - b) kilograms
 - c) tonne
- 6) The weight of your teacher's desk:
 - a) grams
 - b) kilograms
 - c) tonne
- 7) How much a magic marker weighs:
 - a) grams
 - b) kilograms
 - c) tonne
- 8) The weight of the principal's automobile:
 - a) grams
 - b) kilograms
 - c) tonne
- 9) How heavy a student desk is:
 - a) grams
 - b) kilograms
 - c) tonne
- 10) The weight of a can of soup:
 - a) grams
 - b) kilograms
 - c) tonne
- 11) How much a dozen pencils weighs:
 - a) grams
 - b) kilograms
 - c) tonne
- 12) The weight of all of the students in sixth grade:
 - a) grams
 - b) kilograms
 - c) tonne

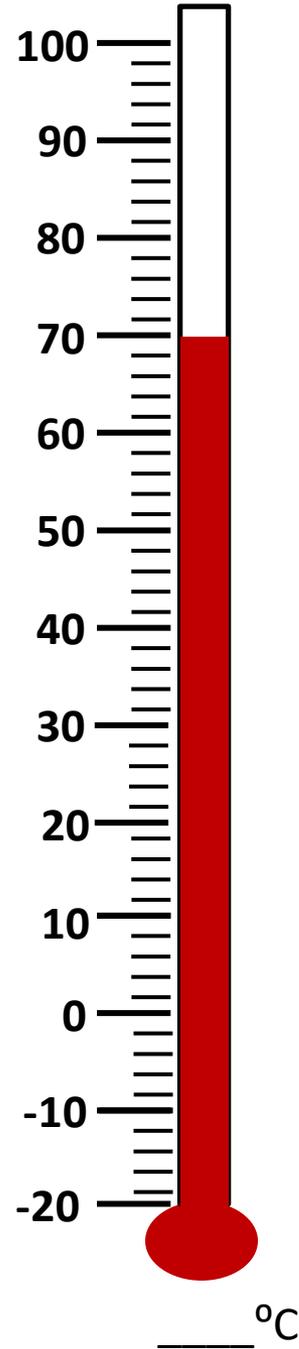
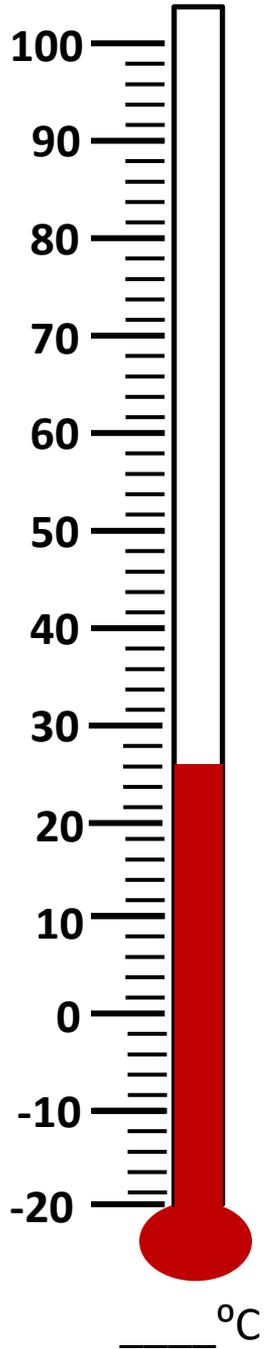
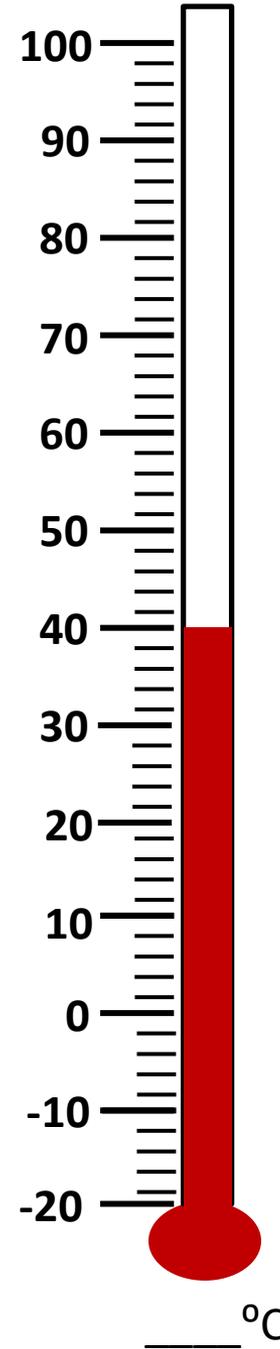
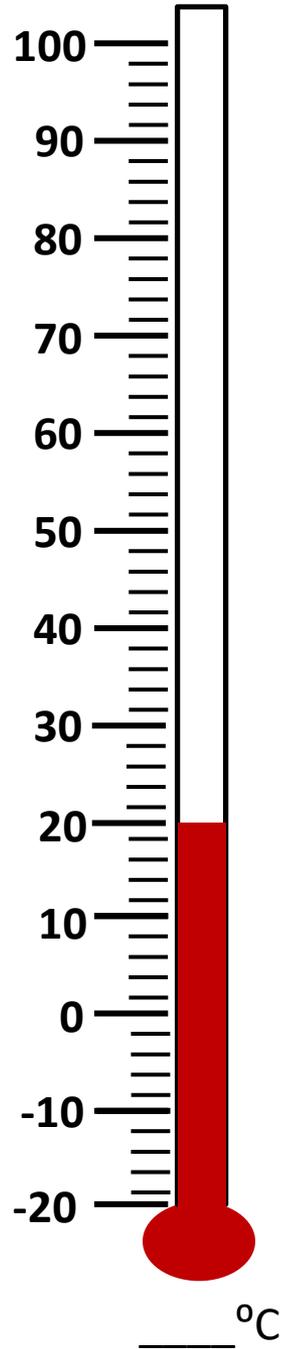
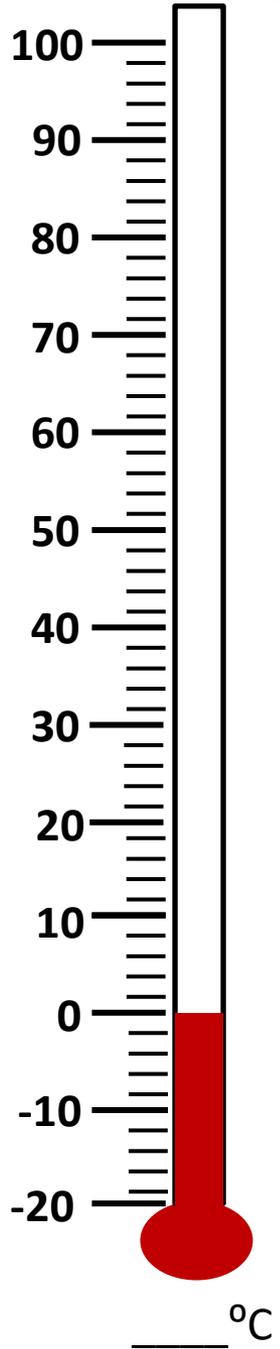
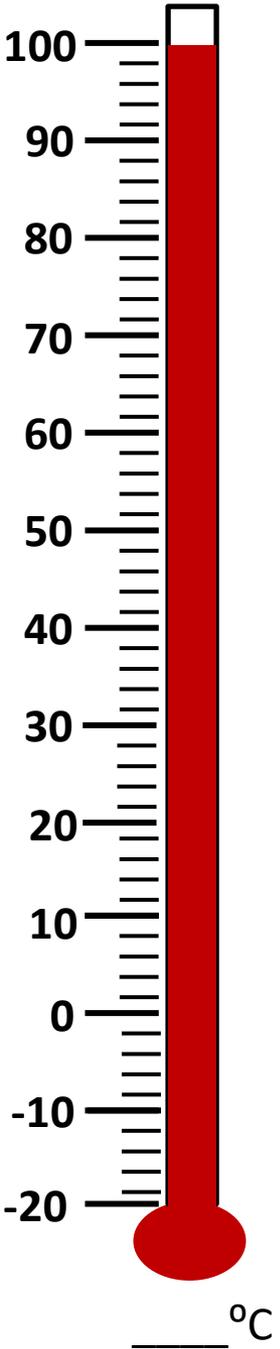
Month _____



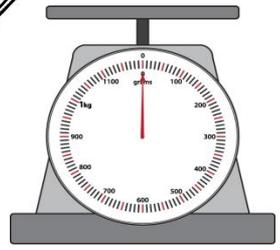
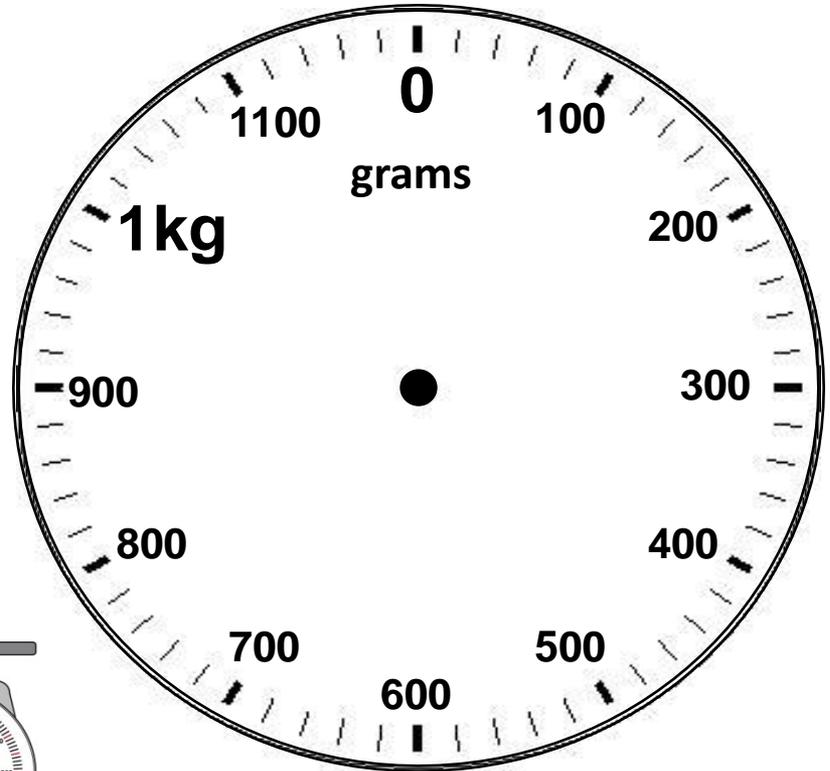
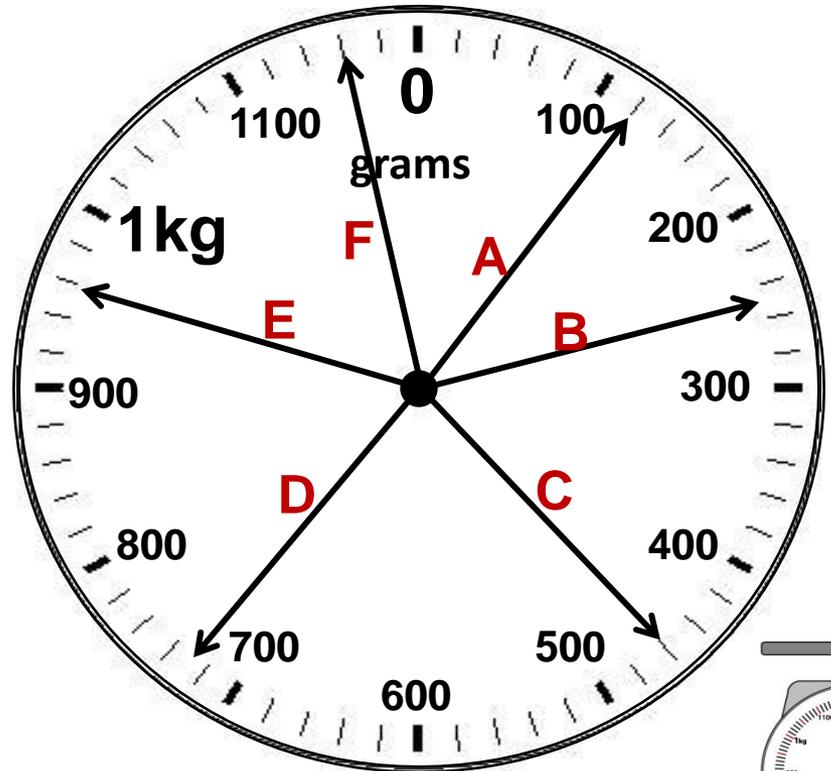
Weekly Chart, Week of _____ to _____



Find the temperature on the Celsius thermometers



A weighing scale is similar to a clock. When the weight increases, the dial moves clockwise. Dial A (below left scale) shows 120 g., Dial B shows 250 g.



Use the above scale to answer questions 1-4.

Draw arrows & label the indicated mass to answer questions 5-8.

- 1) Dial C shows what mass? _____g
- 2) Dial D shows what mass? _____g
- 3) Dial E shows what mass? _____g
- 4) Dial F shows what mass? _____g

- 5) Dial G to show 480g
- 6) Dial H to show 660g
- 7) Dial I to show 820g
- 8) Dial J to show 1000g

History of Measurement (Metric System)

In 1793, while Napoleon was emperor of France, the French government adopted a system of measurement standards which they called the metric system. It was based on the meter which was supposed to be one ten-millionth part of the straight-line distance from the North Pole to the Equator through Paris. After establishing the meter as the basic unit of the system, other linear units were aligned in decimal ratios with the meter. Within the metric system, all units are multiples of ten: ten decimeters equal a meter, a hundred centimeters equal a meter, and a thousand millimeters equal a meter. In addition to units smaller than a meter, there are ten meters equal to a decameter, 100 meters equal to a hectometer, and 1000 meters in a kilometer. The meter in comparison is about the length of a baseball bat or the width of a doorway. Compared to the yard, the meter is about three inches longer than the yard.

The metric system also includes volume, capacity, and mass (weight) measurements. The liter is the basic measure of capacity. It corresponds roughly to a quart. For mass (weight), the basic unit in the metric system originally was the gram, although now in the International System of Units (SI) it is the kilogram. The gram is a very small unit about the weight of a small paper clip. It takes 1000 grams, which is known as a kilogram, to equal about 2.2 pounds. Today, most all countries of the world use the SI metric system.

The United States Constitution in 1792 provided to adopt a system of coinage that followed the decimal system. However, the system of measurement that was used at that time was a mixture of many different and non standardized units. At that time, France tried to convince the United States to use the metric system, however, the Congress did not act. Later, President John Quincy Adams wrote an extensive report dealing with the metric question and recommending an adoption of this type of system in the U.S. For years very little was done in the area of adopting another system of measure other than the U.S. Customary System which was used on a more informal basis throughout the country.

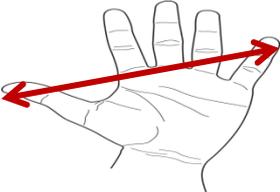
Congress passed the Metric Conversion Act of 1975 "to coordinate and plan the increasing use of the metric system in the United States." A process of voluntary conversion was begun, and the U.S. Metric Board was established. But the efforts of the Metric Board were largely ignored by the American public, and, in 1981, the Board reported to Congress that it lacked the clear Congressional mandate necessary to bring about national conversion. In 1982 the Board was dissolved.

As time passed the U.S. Congress realized the necessity of conforming to international standards for trade, since the United States and only two other small countries were not using the SI. In 1988 Congress passed the Omnibus Trade and Competitiveness Act which designates the metric system as the preferred system of weights and measures for trade and commerce. The legislation states that the Federal Government has the responsibility to assist industry, especially small business, as it voluntarily converts to the metric system of measurement. Federal agencies were required to use the metric system in business related activities by the end of 1992.

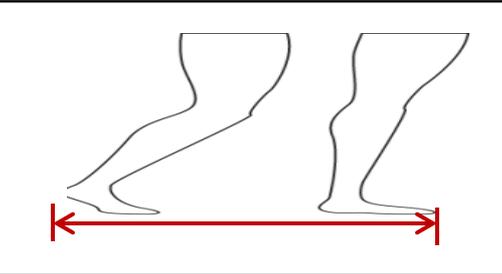
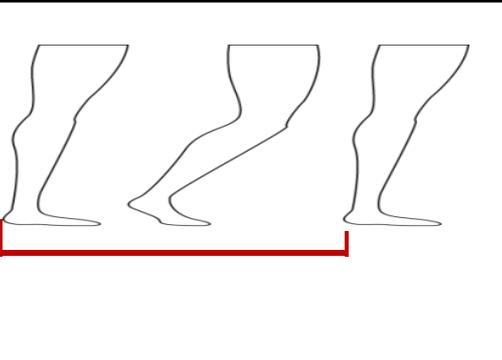
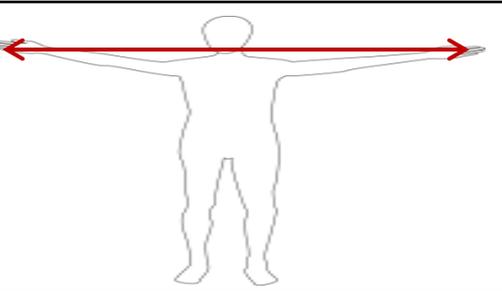
Recent efforts toward national metrication is based on the fact that productivity, science and mathematics education, and U.S. services and products will be greatly enhanced by completely changing to the metric system of units.

Historical Measure

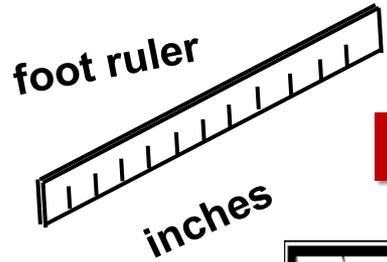
With a partner and using the older historic measures and customary measuring devices (ruler, tape, etc.) see what your measurements currently are:

Name	Picture	Measure
foot		___ cm
hand		___ cm
span		___ cm
cubit	 <p data-bbox="794 1110 1122 1146">elbow to tip of finger</p>	___ cm

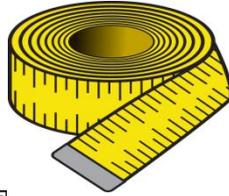
Historical Measure

Name	Picture	Measure
pace	 A diagram showing two legs in profile, one forward and one back, representing a single step. A red double-headed arrow is drawn below the feet, spanning the distance between them.	— cm
Roman pace	 A diagram showing three legs in profile, one forward, one back, and one forward again, representing two steps. A red double-headed arrow is drawn below the feet, spanning the distance from the first to the third foot.	— cm
fathom	 A diagram of a human figure with arms extended horizontally to the sides. A red double-headed arrow is drawn above the arms, spanning the full width of the arms.	— cm

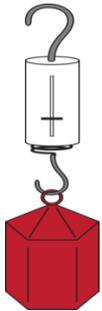
Measurement U.S. Customary System



length



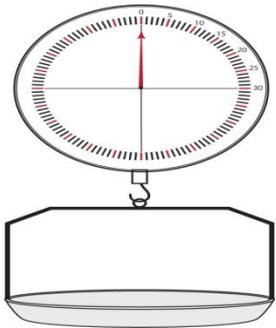
miles



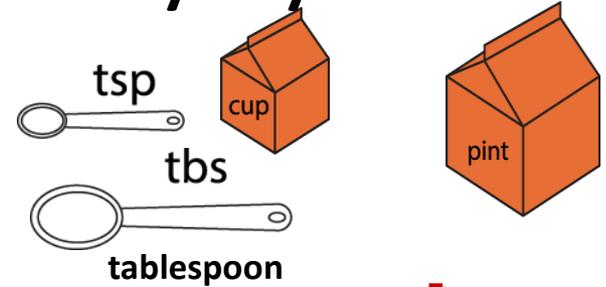
ounces



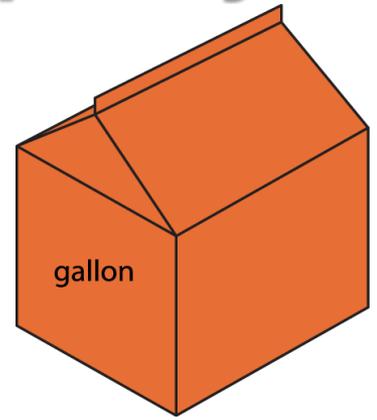
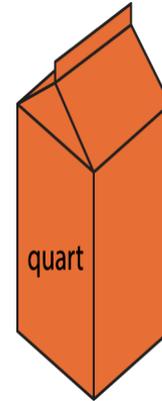
weight



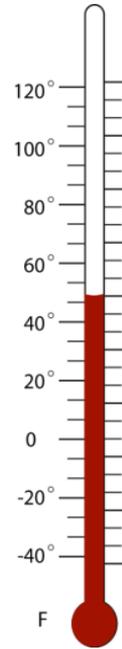
pounds



capacity

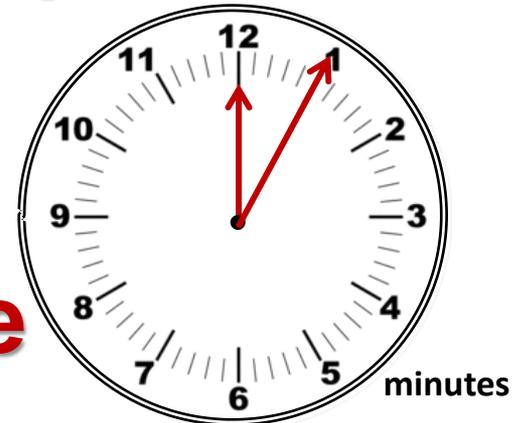


temperature



Fahrenheit
(degrees)

time



Measurement U.S. Customary System

Length

measure of how long an object is, distance from one point to another



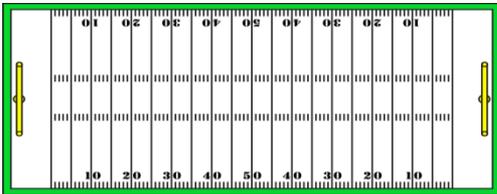
inch (in.) – width of an adult thumb, width of a quarter



foot (ft.) – length of an adult foot, length of math book



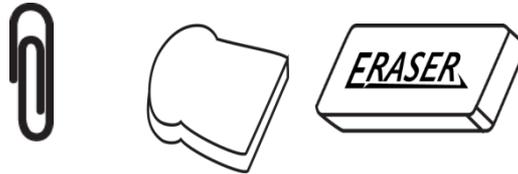
yard (yd.) – width of a door way, length from adult tip of nose to tips of fingers, baseball bat



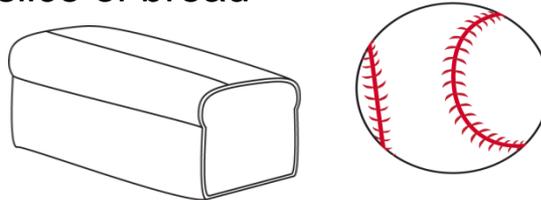
mile (mi.) – about the length of 15 football fields from goal post to goal post.

Mass/Weight

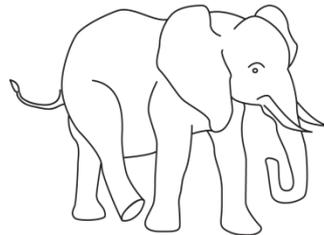
how heavy or light an object is



ounce (oz.) – small paper clip, slice of bread



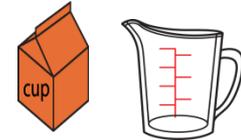
pound (lb.) – weight of a loaf of bread, a softball



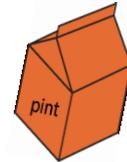
ton (T.) – the weight of an elephant, weight of 10 adult men

Capacity

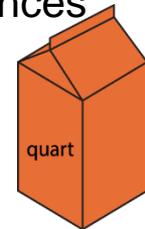
amount a container can hold



cup – amount in one single milk serving in cafeteria, 8 fluid ounces



pint (pt.) – regular drinking glass, 16 fluid ounces



quart (qt.) – very large drink, common size for milk at store, 32 fluid ounces



gallon (g.) – large container of milk in store, large can of paint, 128 fluid ounces

Measurement U.S. Customary System

Temperature

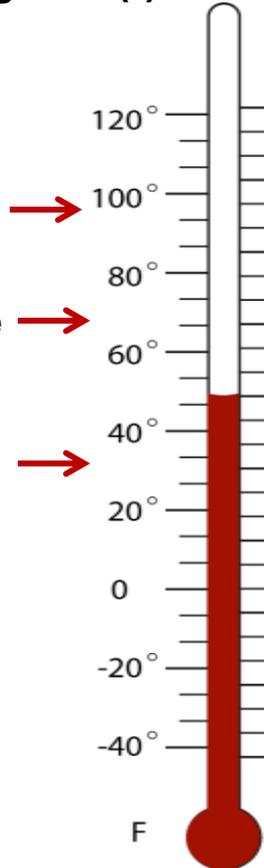
Temperature is how hot or cold it is. It is measured in degrees (°) Fahrenheit (F).

212°F water boils

98.6°F normal body temperature

68°F room temperature

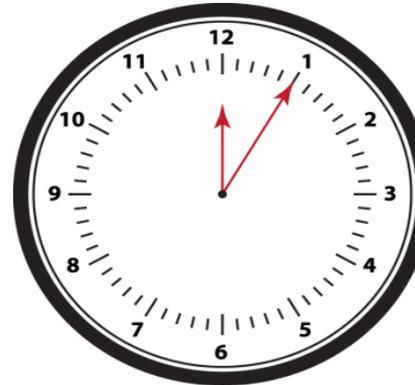
32°F water will freeze



**Fahrenheit
Thermometer**

Time

A measured period where actions and processes take place. A quantity that can be measured – clock, calendar...



12:05

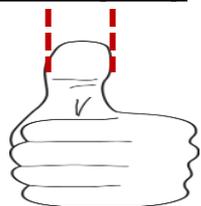
**1 minute = 60 seconds
1 hour = 60 minutes
1 day = 24 hours
1 week = 7 days
1 month = 30-31 days*
1 year = 365 days**

*February has 28 days normally, but every four years it has 29 (leap year).

Length (U.S. Customary System)

[how long something is, distance]

inch (in.)



foot (ft.)



yard (yd.)



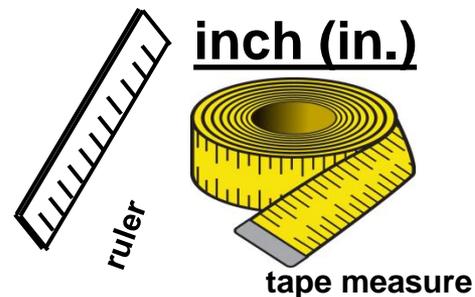
mile (mi.)

5,280 ft.

12 in. = 1 ft. 3 ft. = 1 yd.

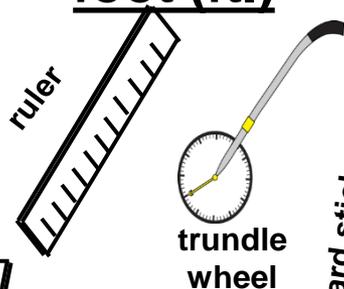
Devices (tools) to measure

inch (in.)



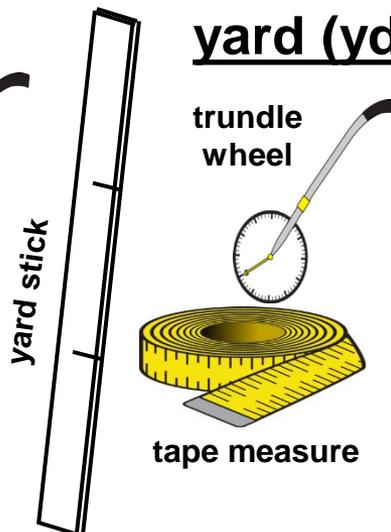
tape measure

foot (ft.)



trundle wheel

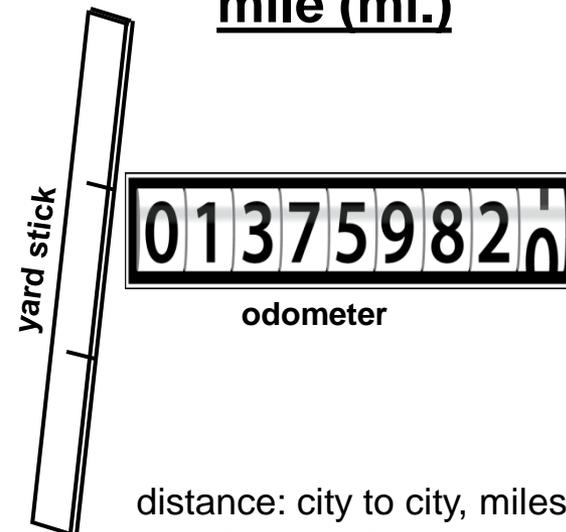
yard (yd.)



trundle wheel

tape measure

mile (mi.)



odometer

small items: pencil, book, crayon

small, medium items: room, house, baseball field

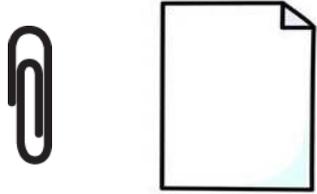
medium, big items: football, soccer fields, house, barn

distance: city to city, miles to grandparents house, airplane

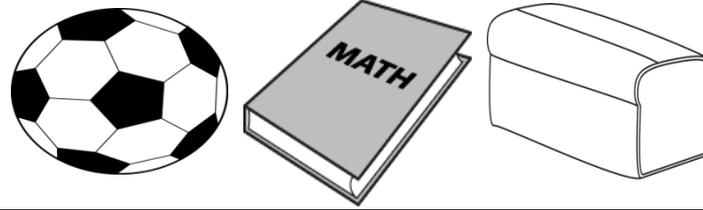
Weight (U.S. Customary System)

[how heavy something is]

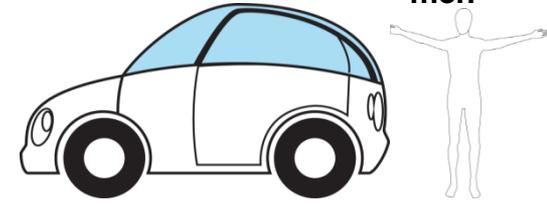
ounce (oz.)



pound (lb.)



ton (T.)



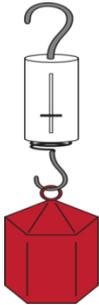
10
men

$$16 \text{ oz.} = 1 \text{ lb.}$$

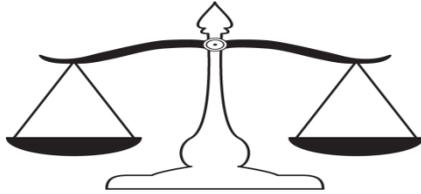
$$2000 \text{ lbs.} = 1 \text{ T.}$$

Devices (tools) to measure

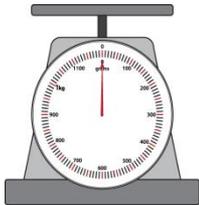
ounce (oz.)



spring
scale



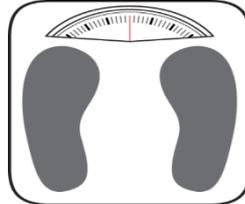
balance scale



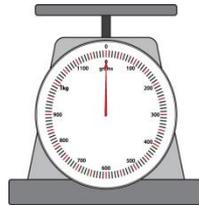
scale

small items: crayons, doll,
coins, light food

pound (lb.)

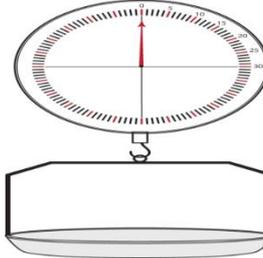


bathroom scale



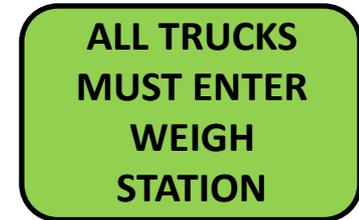
scale

medium - big items: books,
shoe, fruit, vegetables, child,
adult, animals



grocery scale

ton (T.)



truck scale

large objects: cars, trucks, large
animals, airplanes

Capacity (U.S. Customary System)

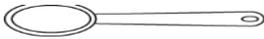
[amount a container can hold]

fluid ounce (fl. oz.)



medicine cup

2 tablespoons
1 fluid ounce

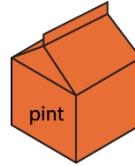


cup (c.)



8 fl. oz.

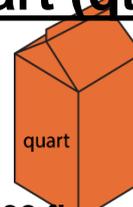
pint (pt.)



16 fl. oz.



quart (qt.)



32 fl. oz.

gallon (gal.)



128 fl. oz.

2 cups = 1 pint, 2 pints = 1 quart, 4 quarts = 1 gallon
2c. = 1 pt., 2pt. = 1 qt., 4 qt. = 1 gal.

Devices (tools) to measure

fluid ounce (fl. oz.)

liquid measuring
cup



small amounts:
recipes, medicines

cup (c.)

liquid measuring
cup



small amounts:
recipes, medicines

pint (pt.)

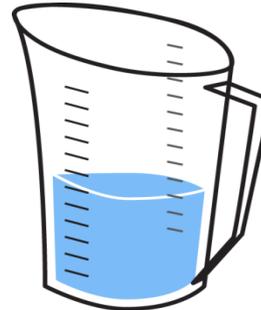
liquid measuring
cup



medium amounts:
recipes, drinks

quart (qt.)

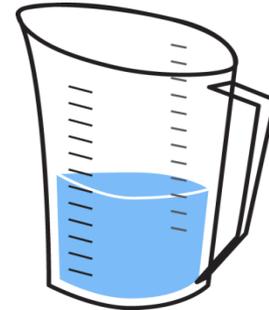
liquid measuring
cup/jar



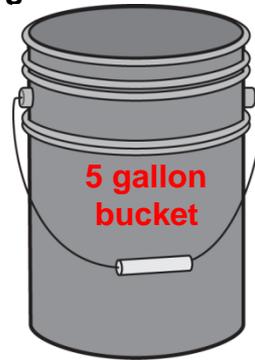
medium/large
amounts: recipes,
punches, drinks

gallon (gal.)

liquid measuring
cup/jar



large liquid amounts:
pools, tanks, fuel
containers



U.S. Customary System (length/distance)



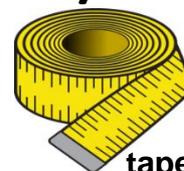
ruler



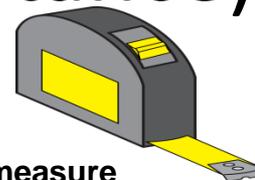
yard stick



trundle wheel



tape measure



Decide which device (tool) is BEST to measure the various lengths/distances.



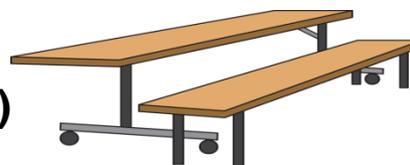
marker

2)



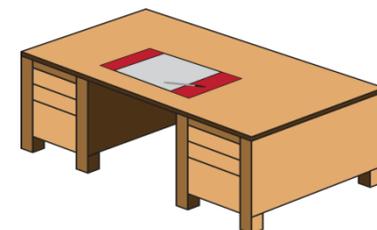
basketball

3)



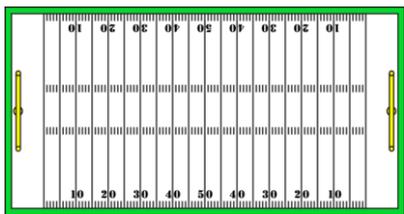
cafeteria table

4)



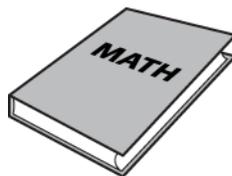
teacher's desk

5)



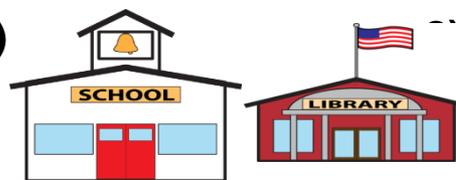
length football field

6)

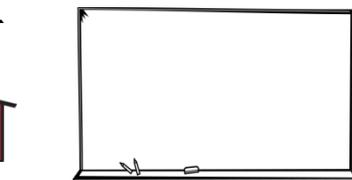


width of math book

7)

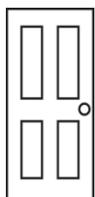


office to library



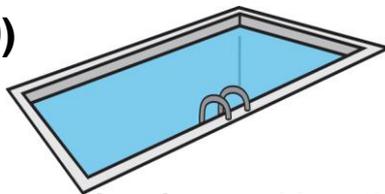
length of marker board

9)



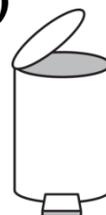
height of door

10)



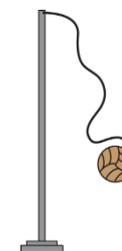
swimming pool length

11)



distance around wastebasket

12)



height of tether ball pole

Customary Conversion Table

When changing from a larger unit to a smaller unit (feet to inches), you **multiply**.

BIG > small
(multiply)

- feet to inches
- yards to feet
- miles to yards
- tons to pounds
- gallons to quarts



24 ft. = ___ in.

1 ft. = 12 in.

$24 \times 12 = 288$ in.

When changing from a smaller unit to a larger unit (inches to feet), you **divide**.

small > **Big**
(divide)

- inches to feet
- feet to yards
- yards to miles
- feet to miles
- pounds to tons
- quarts to gallons
- pints to quarts



132 pints = ___ gallons

8 pt. = 1 gal

$132 \div 8 = 16.5$ gal.

U.S. Customary Conversion

Answers on slide 90

1) 16 pt. = _____ oz.

13) 68 lb. = _____ oz.

2) 12 gal. = _____ qt.

14) 688 oz. = _____ lb.

3) 22.5 yd. = _____ ft

15) 82 ft. = _____ in.

4) 120 in. = _____ ft.

16) 888 in. = _____ ft.

5) 4250 lbs. = _____ T

17) 24 pt. = _____ gal.

6) 2.8 mi. = _____ yd.

18) 100 qt. = _____ gal.

7) 2.8 mi. = _____ ft.

19) 47 lb. = _____ oz.

8) 40 pt. = _____ gal.

20) 48 oz. = _____ lb.

9) 15 gal. = _____ qt.

21) 3 mi. = _____ ft.

10) 26 pt. = _____ qt.

22) 24 ft. = _____ in.

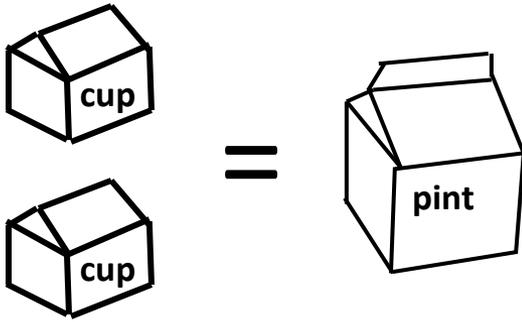
11) 10 lbs. = _____ oz.

23) 420 in. = _____ ft.

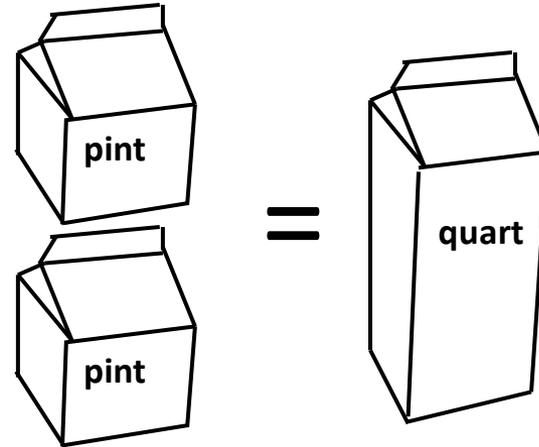
12) 480 oz. = _____ lbs.

24) 30 in. = _____ ft _____ in.

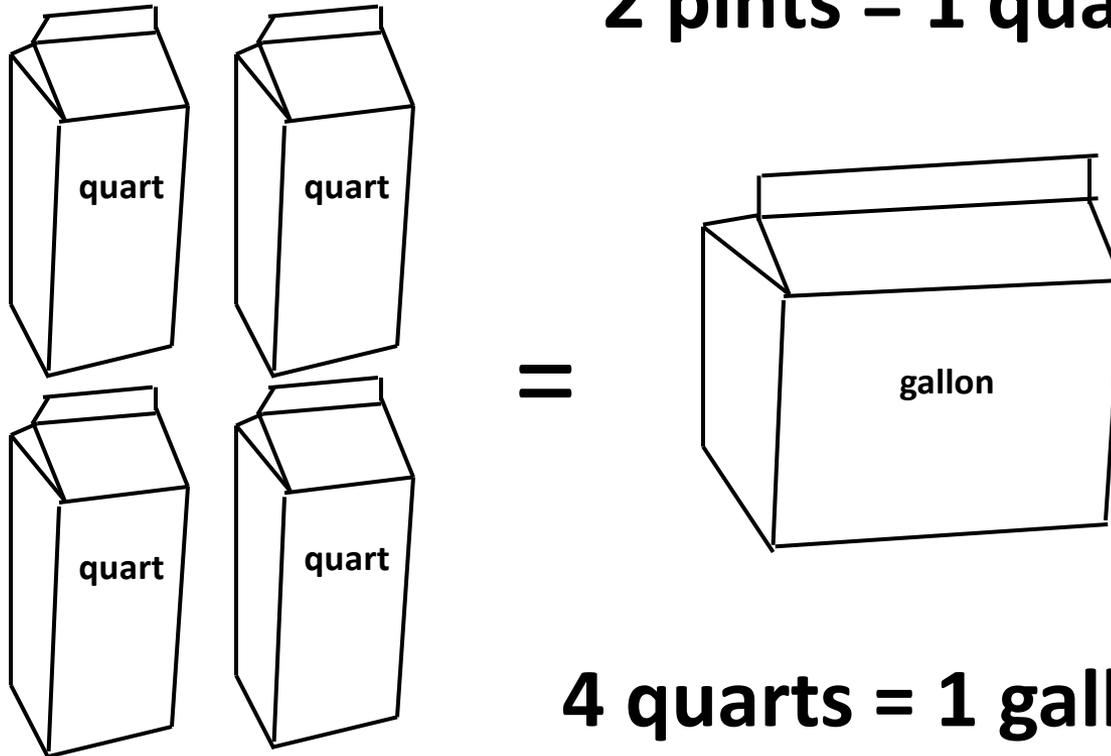
U.S. Customary (capacity)



2 cups = 1 pint



2 pints = 1 quart



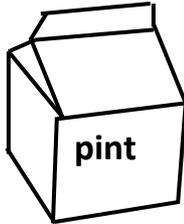
4 quarts = 1 gallon

U.S. Customary (capacity, fluid ounces)



8 fl. oz.

=

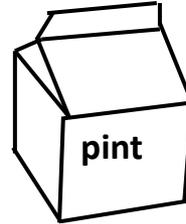


16 fl. oz.



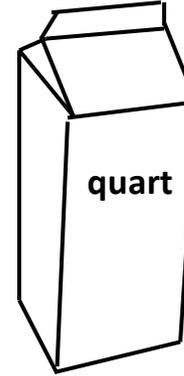
8 fl. oz.

2 cups = 1 pint

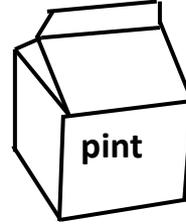


16 fl. oz.

=

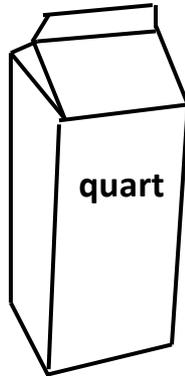


32 fl. oz.

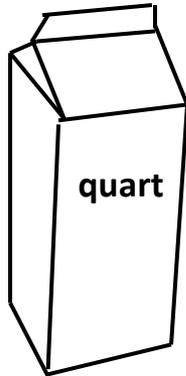


16 fl. oz.

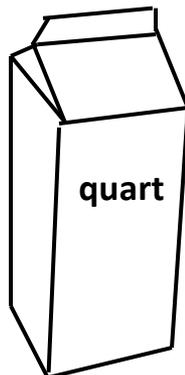
2 pints = 1 quart



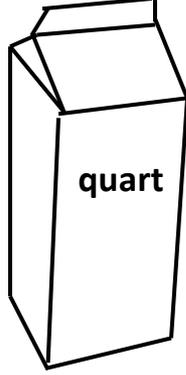
32 fl. oz.



32 fl. oz.

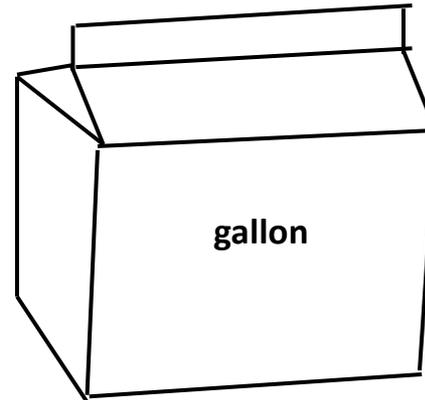


32 fl. oz.



32 fl. oz.

=



128 fl. oz.

4 quarts = 1 gallon

Common Kitchen Measures

Liquid Measure Equivalents

1 tbsp.	1/2 fl. oz.	3 tsp.	15 mL
1/4 c.	2 fl. oz.	4 tbsp.	60 mL
1/3 c.	3 fl. oz.	5 tbsp.	80 mL
1/2 c.	4 fl. oz.	8 tbsp.	120 mL
2/3 c.	5 fl. oz.	10 tbsp.	160 mL
3/4 c.	6 fl. oz.	12 tbsp.	180 mL
1 c.	8 fl. oz.	16 tbsp.	240 mL
2 c.	16 fl. oz.	32 tbsp.	480 mL
4 c.	32 fl. oz.	64 tbsp.	960 mL
4 c.	1 qt.		
1 gal.	128 fl. oz.		3840 mL

Dry Measure Equivalents

1 oz.	1	28.35 g
2 oz.	1	55 g
3 oz.	1	85 g
4 oz.	1/4 lb.	125 g
8 oz.	1/2 lb.	250 g
12 oz.	3/4 lb.	375 g
16 oz.	1 lb.	450 g
32 oz.	2 lb.	900 g
1 kg	2.2 lb.	1000g

Miscellaneous Measurements

dash/pinch	< 1/8 tsp.
splash	1-5 drops
scant	just barely, slightly less than
heaping	filled over the top
level	even with top, filled & leveled with a straight edge

Common Kitchen Measures

1 gallon

4 quarts

8 pints

16 cups

128 fl. ounces

1 quart

2 pints

4 cups

32 fl. oz.

1 pint

2 cups

16 fl. oz.

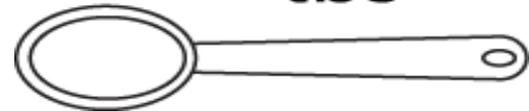
480 mL

1 cup

8 fl. oz.

240 mL

tbs



tsp



1 tablespoon

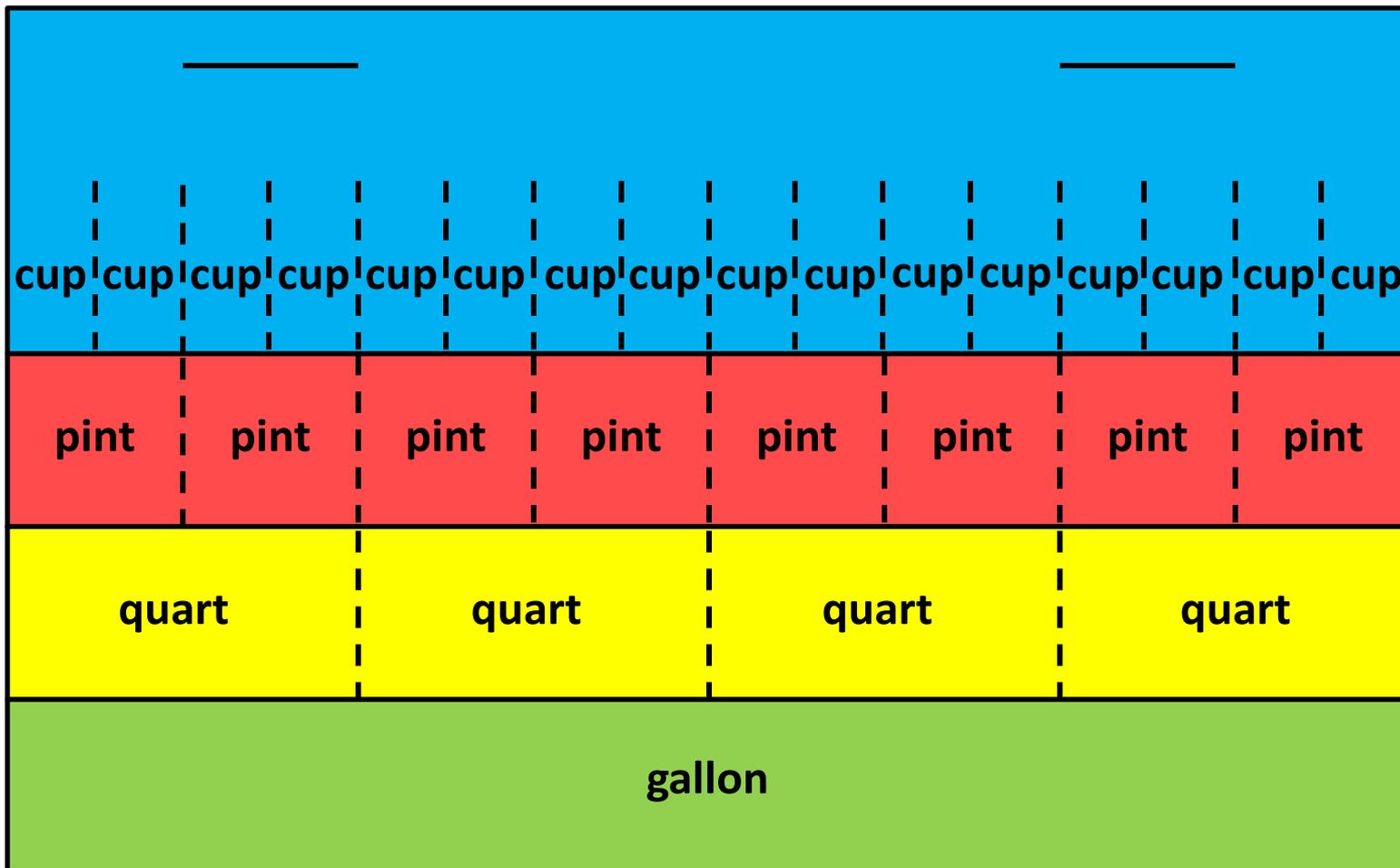
3 teaspoons

1/2 fl. oz.

15 mL

Capacity Gallon Model Mnemonic #1

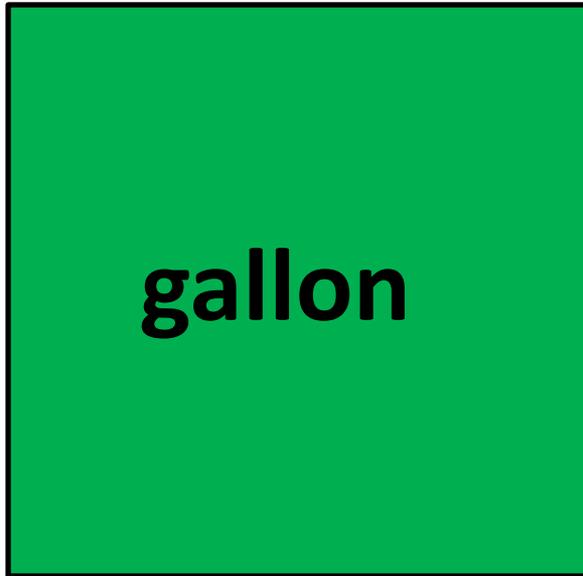
2 cups = 1 pint, 2 pints = 1 quart, 4 quarts = 1 gallon



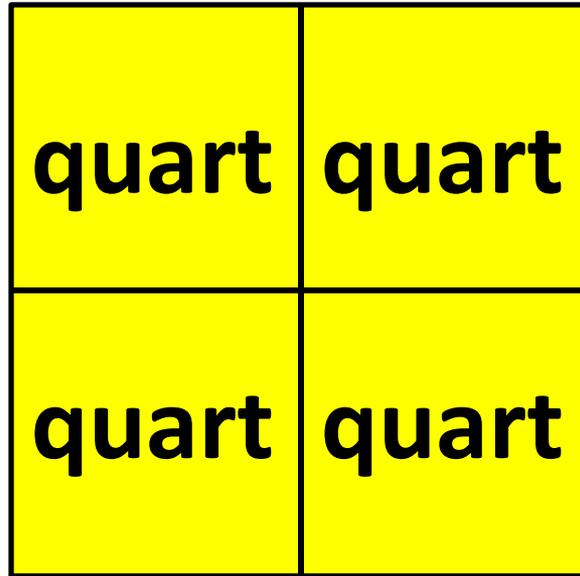
Using four different colored sheets of construction paper, cut one sheet 2"x 8" and make cuts every 1/2" to represent a cup. Then cut a second piece 3"x 8" and make a cut every 1" to represent a pint. Cut a third piece 4"x 8" and make a cut every 2" to represent a quart. Cut the final piece 5"x 8" to represent gallon and make no cuts. Stack the pieces accordingly and put two staples as shown at the top. This gives a simple aide to help remember the basics of capacity in the U.S. Customary system .

Capacity Gallon Model Mnemonic #2

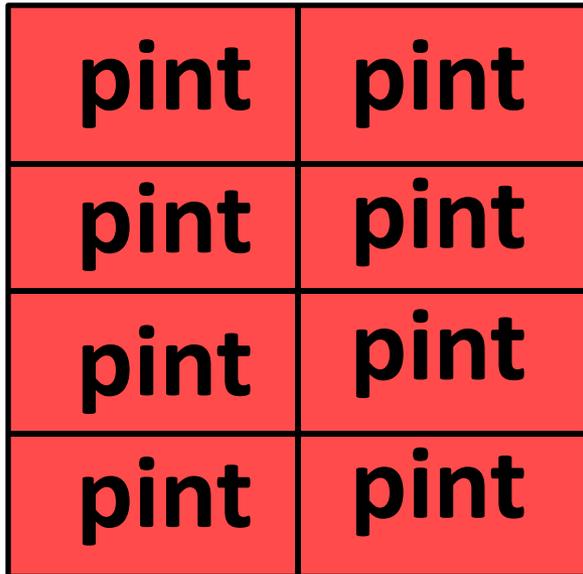
2 cups = 1 pint, 2 pints = 1 quart, 4 quarts = 1 gallon



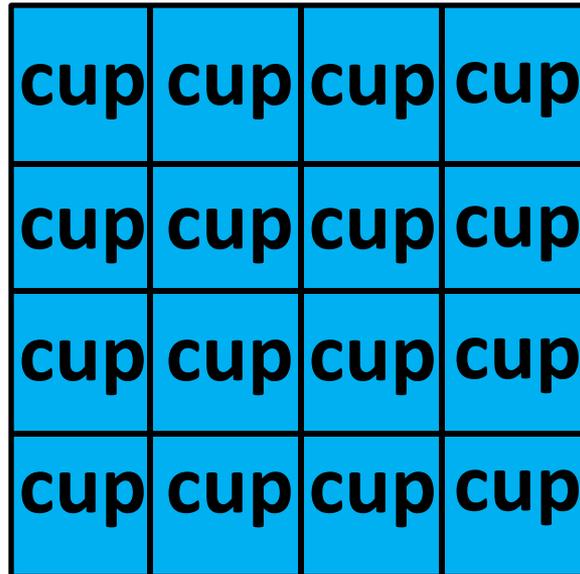
8x8



4x4



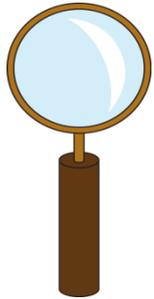
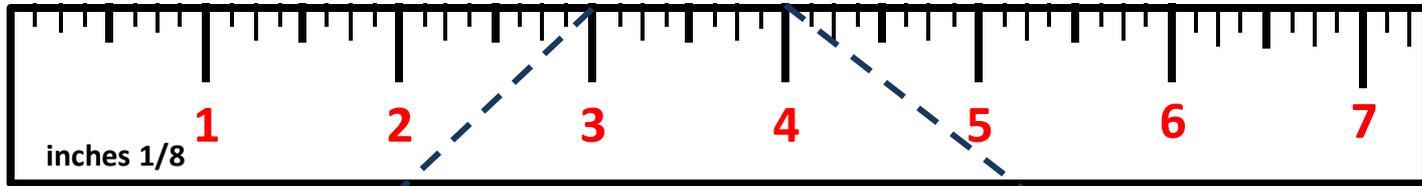
2x4



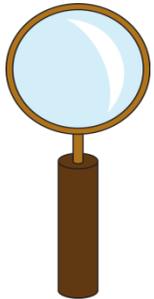
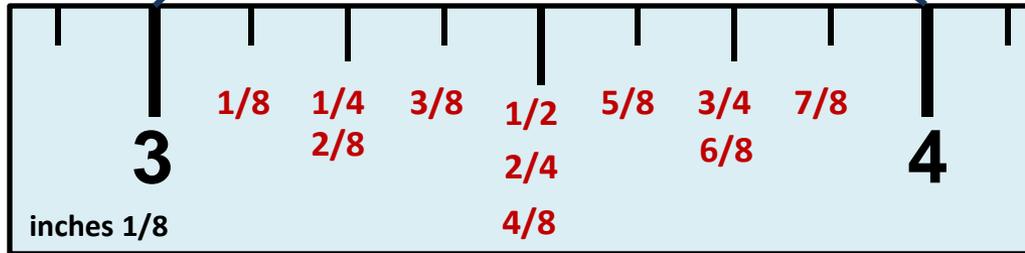
2x2

Another model for capacity in the U.S. Customary System is to take four different colors of construction paper. Cut one piece 8 inches by 8 inches (8x8) and label gallon. Next, take a second sheet and cut 8x8 but also cut into four pieces which are 4x4 and label quart. Continue with piece three by cutting into eight 2x4 pieces with a label of pint. Lastly, cut the last piece into 16 equal 2x2 pieces which are labeled cup. By placing various pieces on top of one another, this gives a visual representation that 2 cups = 1 pint, 2 pints = 1 quart and so on.

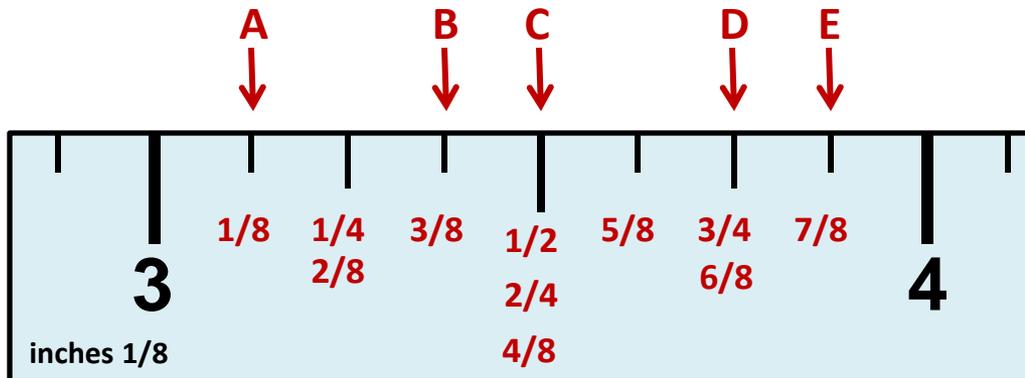
U.S. Customary (inch ruler)



magnified inch



magnified inch



Point A is at $3 \frac{1}{8}$ in.

Point B is at $3 \frac{3}{8}$ in.

Point C is at $3 \frac{1}{2}$ * in.

Point D is at $3 \frac{3}{4}$ * in.

Point E is at $3 \frac{7}{8}$ in.

* These lengths have been reported in lowest terms. $3 \frac{4}{8}$ is the same as $3 \frac{1}{2}$, and $3 \frac{6}{8}$ is the same as $3 \frac{3}{4}$ in.

Demonstration - Capacity

A productive way to introduce students to U.S. Customary Capacity is to take time initially and give a demonstration of the various units – cup, pint, quart, gallon. Your children probably know the term “cup” but you might show and explain that there are a number of items called a cup. There is a coffee cup, tea cup, various size cups and mugs, however, point out by showing a measuring cup and explain that is a “standard” for measuring recipes. One cup is the same on all capacity measuring tools. One cup in California is the same as one cup in New Jersey if using a standard measuring container.

Demonstrate by filling the measuring “cup” and pour it into the standard one pint container. You may ask if the pint is filled up – to which the kids will answer no. Someone or yourself may answer that it is $\frac{1}{2}$ full. Fill up the cup again and pour the rest into the pint container. They can see that it is now full and that 2 cups equals 1 pint. Continue on by filling the pint and pouring it into the quart container and so on. Even though this is time consuming, it will pay off in that children can relate to $2 \text{ cups} = 1 \text{ pint}$, $2 \text{ pints} = 1 \text{ quart}$, $4 \text{ quarts} = 1 \text{ gallon}$.

You may want to show the students several posters related to capacity which are available with this measurement book. Post them around the room and discuss them from time to time. Talk about the abbreviations for the capacity units: cup (c.), pint (pt.), quart (qt.) and gallon (gal.). Also, over time ask them to relate common items that are about a cup, pint, quart, or gallon. Explain that in liquid capacity fluid ounces (fl. oz.) is different from ounces (oz.) in weight measure. Gradually they will relate that a cup is smallest and 8 fl. oz., a pint is 16 fl. oz. and a can of soda is somewhere between a cup and pint. They will also take note that the quart of milk is still fairly common in many households. Lastly, the gallon is not as common but children will be more comfortable with how much bigger it is than a quart. Even though the gallon is heard by them when their parents fill the automobiles gas tank, it is hard to relate as you don't see the fluid going into the tank and how much space it occupies.

You might want students to bring in a container from home that meets one of the four main capacity units. Also, a wonderful homework assignment is to have children make notes of containers at home that are in the kitchen or garage that meet the cup, pint, quart and gallon measure. As noted, the demonstration takes time, but it will pay dividends if you have them prepare recipes or do some of the “hands on” activities in the book.

“Hands On” (U.S. Customary)

[length/width]

Activity 1 (inch)

- Material: inch/foot ruler, 36/72 inch tape, yardstick, classroom objects that can be measured

item	estimate	actual measure	difference
paper clip	_____ in.	_____ in.	_____ in.
crayon	_____ in.	_____ in.	_____ in.
pencil	_____ in.	_____ in.	_____ in.
math book	_____ in.	_____ in.	_____ in.
board eraser	_____ in.	_____ in.	_____ in.
sheet of paper	_____ in.	_____ in.	_____ in.
desk length	_____ in.	_____ in.	_____ in.
desk width	_____ in.	_____ in.	_____ in.
_____	_____ in.	_____ in.	_____ in.
_____	_____ in.	_____ in.	_____ in.

“Hands On” (U.S. Customary)

[length/width]

Activity 2 (nearest foot)

- Material: foot ruler, yard stick, 6-8 foot tapes, items/objects in classroom to measure

item	estimate	actual measure	difference
length of desk	_____ ft.	_____ ft.	_____ ft.
width of desk	_____ ft.	_____ ft.	_____ ft.
height of door	_____ ft.	_____ ft.	_____ ft.
width of door	_____ ft.	_____ ft.	_____ ft.
length marker board	_____ ft.	_____ ft.	_____ ft.
width marker board	_____ ft.	_____ ft.	_____ ft.
length of room	_____ ft.	_____ ft.	_____ ft.
width of room	_____ ft.	_____ ft.	_____ ft.
volunteer student ht.	_____ ft.	_____ ft.	_____ ft.
_____	_____ ft.	_____ ft.	_____ ft.
_____	_____ ft.	_____ ft.	_____ ft.

“Hands On” (U.S. Customary)

[length/width]

Activity 3 (feet, inches)

- Material: foot ruler, yard stick, 6-8 foot tapes, items/objects in classroom to measure

item	estimate	actual measure	difference
length of desk	____ ft. ____ in.	____ ft. ____ in.	____ ft. ____ in.
width of desk	____ ft. ____ in.	____ ft. ____ in.	____ ft. ____ in.
height of door	____ ft. ____ in.	____ ft. ____ in.	____ ft. ____ in.
width of door	____ ft. ____ in.	____ ft. ____ in.	____ ft. ____ in.
length marker board	____ ft. ____ in.	____ ft. ____ in.	____ ft. ____ in.
width marker board	____ ft. ____ in.	____ ft. ____ in.	____ ft. ____ in.
length of room	____ ft. ____ in.	____ ft. ____ in.	____ ft. ____ in.
width of room	____ ft. ____ in.	____ ft. ____ in.	____ ft. ____ in.
volunteer student ht.	____ ft. ____ in.	____ ft. ____ in.	____ ft. ____ in.
_____	____ ft. ____ in.	____ ft. ____ in.	____ ft. ____ in.
_____	____ ft. ____ in.	____ ft. ____ in.	____ ft. ____ in.

“Hands On” (U.S. Customary)

[My Personal Record]

Activity 4 (inches)

Name _____

- Material: inch/foot ruler, 36/72 inch tape, yardstick

item	estimate	actual measure
my height	_____ in.	_____ in.
around head (hat size)	_____ in.	_____ in.
around neck (collar size)	_____ in.	_____ in.
shoulder to wrist (sleeve length)	_____ in.	_____ in.
waist (belt size)	_____ in.	_____ in.
fingertip to fingertip	_____ in.	_____ in.
around wrist	_____ in.	_____ in.
around ankle	_____ in.	_____ in.
hand span (little finger to thumb stretched)	_____ in.	_____ in.
my choice _____	_____ in.	_____ in.

“Hands On” (U.S. Customary) [capacity]

Activity 5 (fluid ounces, cups, pints, quarts, gallons)

- Material: Measuring cups, beakers, etc., 9 jars, cans, cartons, labeled A thru I not to exceed a gallon in size. Have students estimate how many fluid ounces or a cup, pint, etc. and then measure using your capacity tools.

- 1 cup = 8 fluid ounces
- 2 pints = 1 quart (32 fl. oz.)
- 2 cups = 1 pint (16 fl. oz.)
- 4 quarts = 1 gallon (128 fl. oz.)

Item	estimate	actual measure	difference
Container A	_____	_____	_____
Container B	_____	_____	_____
Container C	_____	_____	_____
Container D	_____	_____	_____
Container E	_____	_____	_____
Container F	_____	_____	_____
Container G	_____	_____	_____
Container H	_____	_____	_____
Container I	_____	_____	_____

Which container holds the least amount? _____

Which container holds the greatest amount? _____

“Hands On”(U.S. Customary)

[capacity] Orange Surprise

Activity 6 (Recipes)

- 2 qt. milk
- 2 qt. water
- 4 cans orange juice concentrate (48 oz.)
- 4 c. sugar
- 8 tsp. vanilla
- 8 trays of ice cubes

Blend in blender until ice is chopped. It should make adequate liquid for class of 20+ students.

Chocolate Chip Cookies

- 1 c. margarine
- 1 c. white sugar
- 1 c. brown sugar
- 2 eggs
- 2 c. oatmeal
- 2 c. flour
- 1 tsp. soda
- 1 tsp. salt
- 1 c. chocolate chips

Cream the margarine and sugars together. Add eggs and beat until light and fluffy. In a separate large bowl combine the dry ingredients except for the chocolate chips. Add the dry ingredients a little at a time to the creamed mixture until all is very well mixed. Then stir in the chocolate chips. Place on cookie sheets a teaspoon full at a time and bake at 350° for about 10 minutes. Will make about 6 dozen cookies.

Jello Cookies

- 4 c. flour, sifted
- 1 ½ c. butter
- 1 c. sugar
- 1 tsp. baking powder
- 1 package of Jello
- 1 egg
- 1 tsp. vanilla

Sift the flour with the baking soda. Cream the butter and slowly add sugar and Jello. Cream after each addition until smooth. Force through a cookie press onto an ungreased baking sheet. Bake at 400° for about 12 minutes. Will make about 5 dozen cookies.

“Hands On” (U.S. Customary)

[weight]

Activity 7 (ounces)

- Material: Use balance scale, spring scale.

Item/object	estimate	actual weight	difference
pencil	_____ OZ.	_____ OZ.	_____ OZ.
crayon	_____ OZ.	_____ OZ.	_____ OZ.
box of crayons	_____ OZ.	_____ OZ.	_____ OZ.
marker	_____ OZ.	_____ OZ.	_____ OZ.
writing journal	_____ OZ.	_____ OZ.	_____ OZ.
scissors	_____ OZ.	_____ OZ.	_____ OZ.
watch	_____ OZ.	_____ OZ.	_____ OZ.
board eraser	_____ OZ.	_____ OZ.	_____ OZ.
computer mouse	_____ OZ.	_____ OZ.	_____ OZ.
_____	_____ OZ.	_____ OZ.	_____ OZ.
_____	_____ OZ.	_____ OZ.	_____ OZ.

“Hands On” (U.S. Customary)

[weight]

Activity 8 (pounds)

- Material: Use spring scale, bathroom scale, grocery scale.

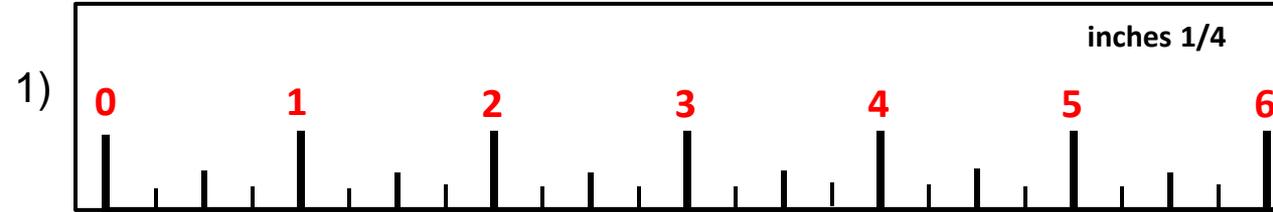
Item/object	estimate	actual weight	difference
small can fruit/veg.	____ lb. ____ oz.	____ lb. ____ oz.	____ lb. ____ oz.
large can fruit/veg.	____ lb. ____ oz.	____ lb. ____ oz.	____ lb. ____ oz.
liter of water	____ lb. ____ oz.	____ lb. ____ oz.	____ lb. ____ oz.
dictionary	____ lb. ____ oz.	____ lb. ____ oz.	____ lb. ____ oz.
math book	____ lb. ____ oz.	____ lb. ____ oz.	____ lb. ____ oz.
telephone book	____ lb. ____ oz.	____ lb. ____ oz.	____ lb. ____ oz.
small chair	____ lb. ____ oz.	____ lb. ____ oz.	____ lb. ____ oz.
globe	____ lb. ____ oz.	____ lb. ____ oz.	____ lb. ____ oz.
volunteer student	____ lb. ____ oz.	____ lb. ____ oz.	____ lb. ____ oz.
_____	____ lb. ____ oz.	____ lb. ____ oz.	____ lb. ____ oz.
_____	____ lb. ____ oz.	____ lb. ____ oz.	____ lb. ____ oz.

“Hands On” (U.S. Customary)

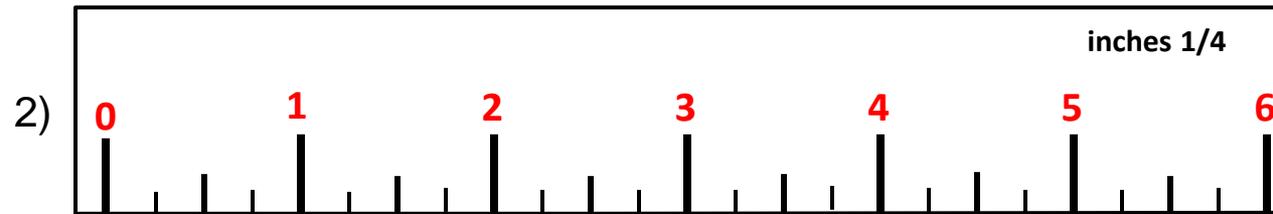
[length/width]

Activity 9 (nearest inch)

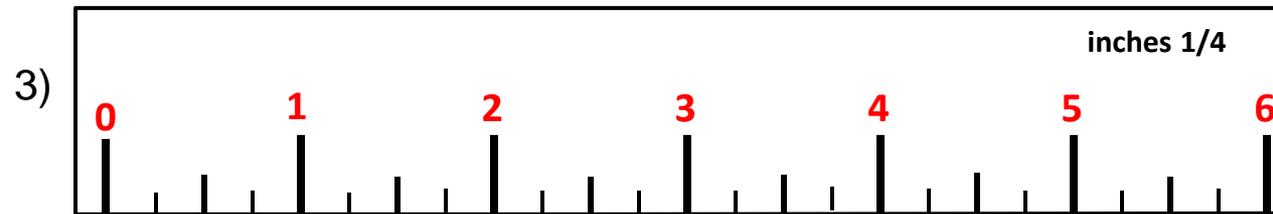
- Material: use the 6 inch ruler to measure the lines & objects to the nearest inch.
Note: the edge of the ruler is NOT always zero (o). Always begin at ZERO.



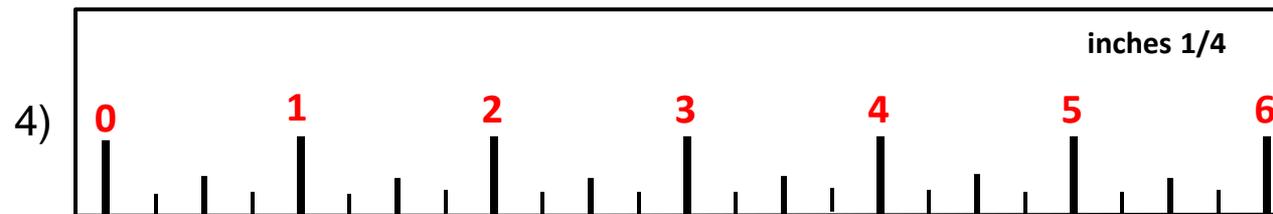
_____ in.



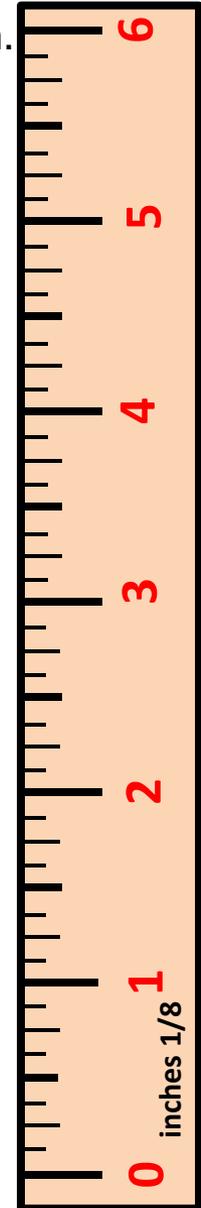
_____ in.



_____ in.



_____ in.



_____ in.

Rulers not to scale

5)

“Hands On” (U.S. Customary System)

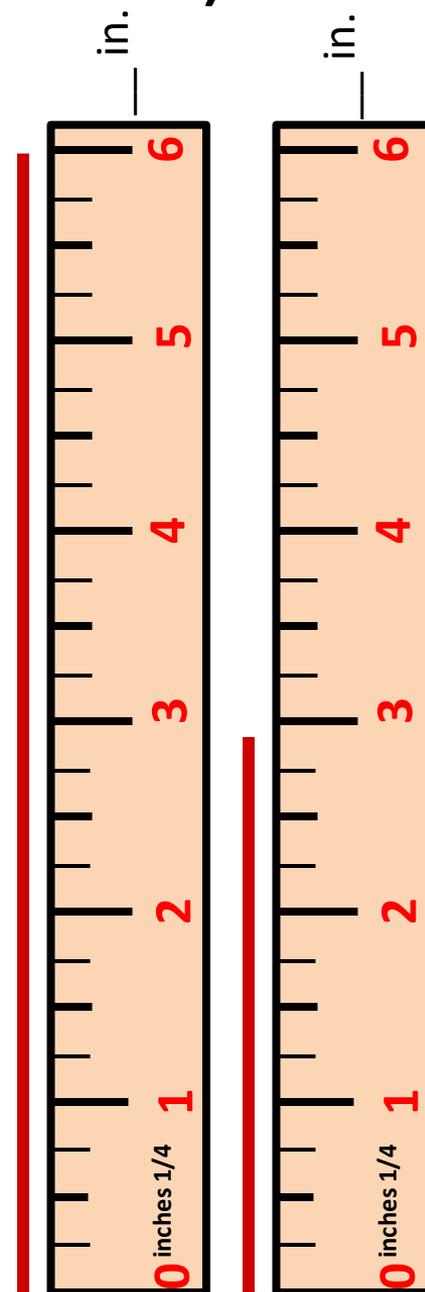
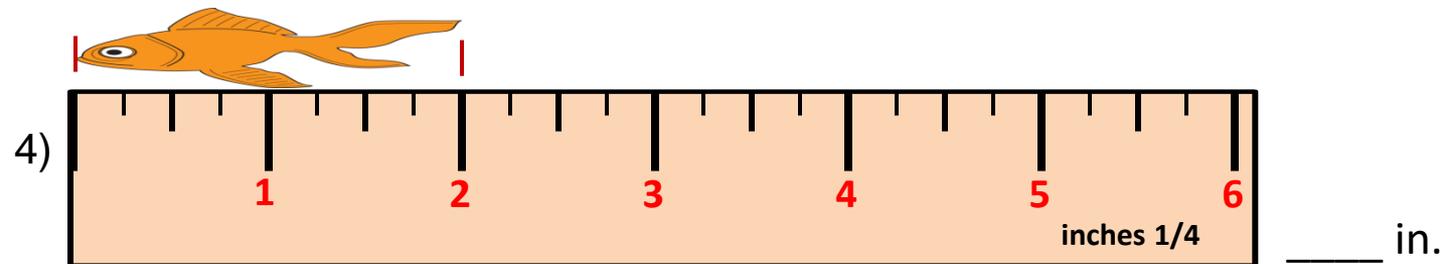
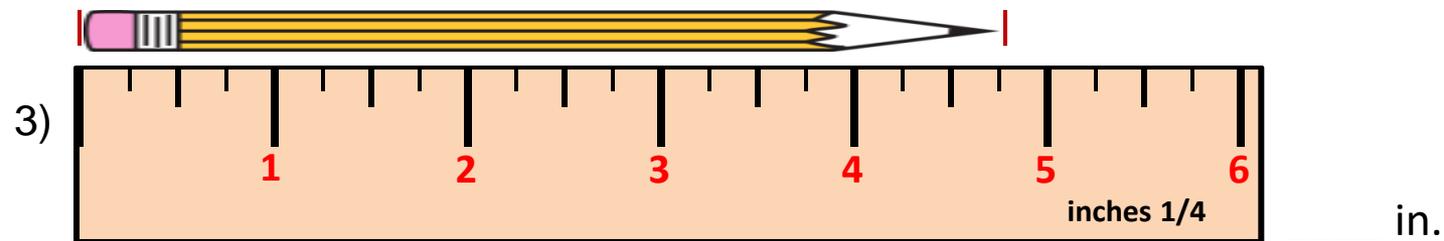
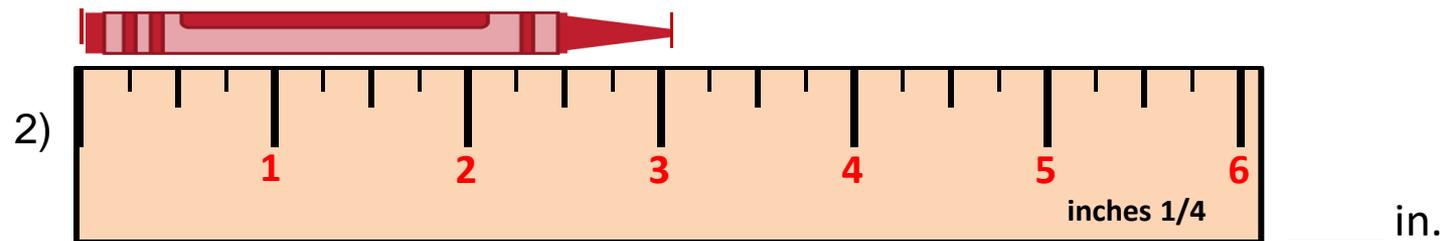
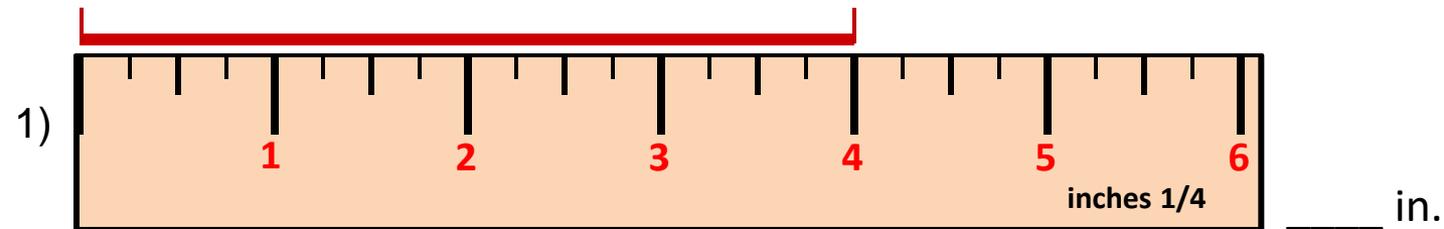
Activity 10 (nearest inch)

[length/width]

- Material: use the 6 inch ruler to measure the lines & objects to the nearest inch.

Note: the edge of this ruler is zero (0). Always begin measuring at ZERO.

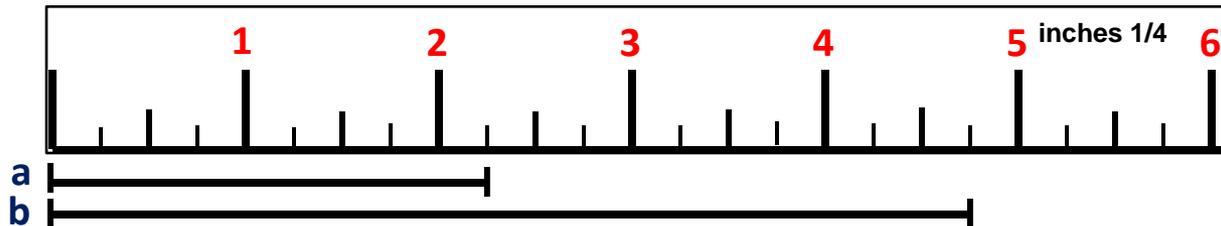
Rulers not to scale



U.S. Customary Ruler Workshop -- inch

1) Line a = _____ in.

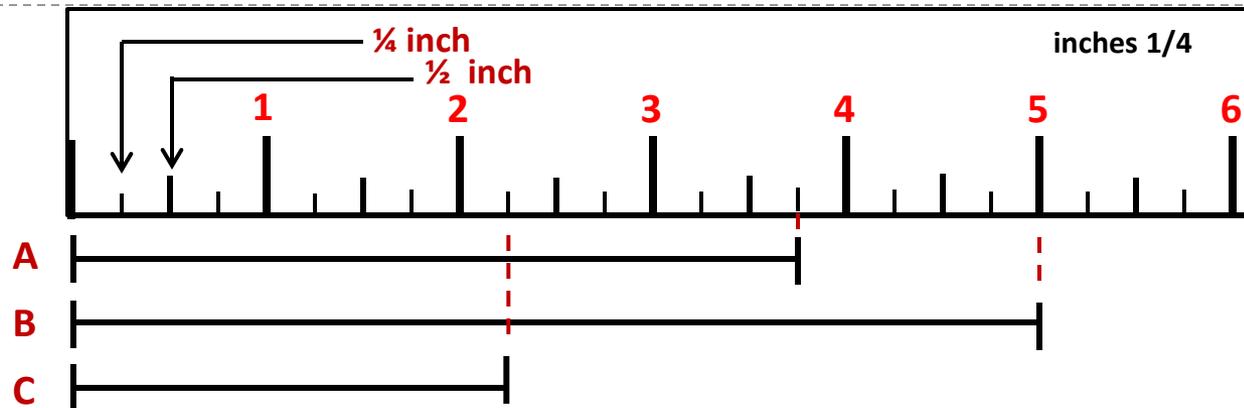
2) Line b = _____ in.



3) How long is line A? _____

4) How long is line B? _____

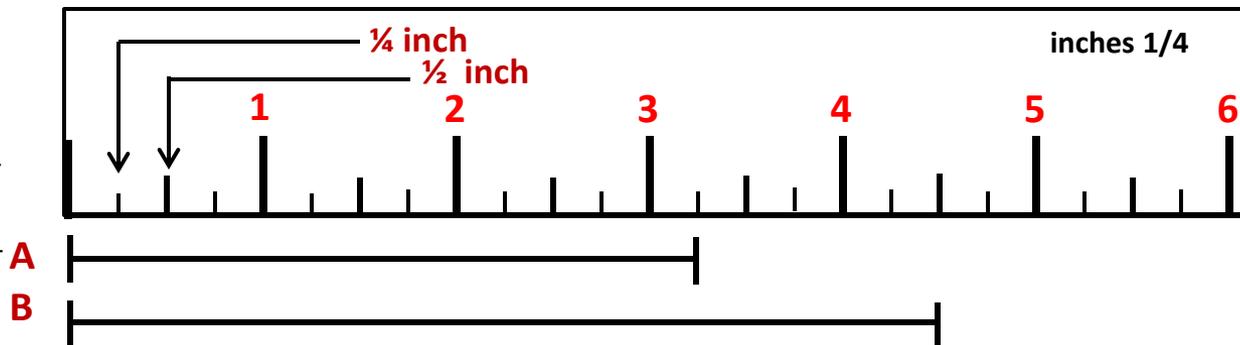
5) How long is line C? _____



6) **BRR** The perimeter of a rectangle is 32 cm. Its length is 10 cm. What is its width? _____

7) How long is line A? _____

8) How long is line B? _____



9) **BRR** The area and perimeter of a square that is 9 cm on each side is? A=____, P=_____

U.S. Customary Measurement
(Choose the best unit of Length)

- 1) Length of a board eraser
 - a) inches
 - b) feet
 - c) yards
 - d) miles
- 2) Length of the classroom
 - a) inches
 - b) feet
 - c) pounds
 - d) miles
- 3) Length of your reading book
 - a) inches
 - b) feet
 - c) yards
 - d) miles
- 4) Length of your foot
 - a) inches
 - b) feet
 - c) yards
 - d) miles
- 5) Length of a cafeteria
 - a) inches
 - b) ounces
 - c) yards
 - d) miles
- 6) Length of the library
 - a) inches
 - b) feet
 - c) yards
 - d) miles
- 7) Length of soccer field
 - a) inches
 - b) feet
 - c) yards
 - d) miles
- 8) Length of your notebook
 - a) inches
 - b) feet
 - c) yards
 - d) miles
- 9) Length of a pencil
 - a) inches
 - b) feet
 - c) yards
 - d) miles
- 10) Length of the chalkboard
 - a) inches
 - b) feet
 - c) fluid ounces
 - d) miles
- 11) Distance from LA to New York
 - a) inches
 - b) feet
 - c) yards
 - d) miles
- 12) Height of your classroom
 - a) inches
 - b) feet
 - c) yards
 - d) miles

U.S. Customary Measurement
(Choose the best unit of Weight)

- 1) How heavy a chalkboard eraser is:
a) ounces
b) pounds
c) tons
- 2) The weight of a classmate:
a) ounces
b) pounds
c) tons
- 3) How much a box of crayons weighs:
a) ounces
b) pounds
c) tons
- 4) The weight of a truck:
a) ounces
b) pounds
c) tons
- 5) How heavy a large watermelon is:
a) ounces
b) pounds
c) tons
- 6) The weight of your teacher's desk:
a) ounces
b) pounds
c) tons
- 7) How much a magic marker weighs:
a) ounces
b) pounds
c) tons
- 8) The weight of the principal's automobile:
a) ounces
b) pounds
c) tons
- 9) How heavy a student desk is:
a) ounces
b) pounds
c) tons
- 10) The weight of a can of soup.
a) ounces
b) pounds
c) tons
- 11) How much a dozen pencils weigh:
a) ounces
b) pounds
c) tons
- 12) The weight of all of the students in sixth grade:
a) ounces
b) pounds
c) tons

Non Standard Units (U.S. Customary)

[length/width – shorter objects]

Activity #1 (paper clips, crayons, straws, pennies, snap cubes, square tiles, other _____)

- Material: Circle what unit you will use and measure the objects after first estimating their length or width.

item	estimate	actual measure	difference
reading book	_____	_____	_____
scissors	_____	_____	_____
pencil	_____	_____	_____
math book	_____	_____	_____
board eraser	_____	_____	_____
sheet of paper	_____	_____	_____
desk length	_____	_____	_____
desk width	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Non Standard Units (U.S. Customary)

[length/width – mid to large objects]

Activity #2 (straws, foot pattern, pencil, yarn, other: _____)

- Material: Circle what unit you will use and measure the objects after first estimating their length or width.

Item	estimate	actual measure	difference
desk (length)	_____	_____	_____
desk (width)	_____	_____	_____
desk (height)	_____	_____	_____
teacher desk (length)	_____	_____	_____
teacher desk (width)	_____	_____	_____
teacher desk (height)	_____	_____	_____
marker board (length)	_____	_____	_____
classroom (length)	_____	_____	_____
classroom (width)	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Non Standard Units (U.S. Customary)

[length/width – mid to large objects]

Activity #3 (straws, foot pattern, pencil, yarn, other: _____)

- Material: Lay out 9 strips of masking taped in an area of the classroom. Make them for 2-3 feet up to about 8-9 feet in length. Label them A through I. Circle which unit you are using to measure and begin.

Item	estimate	actual measure	difference
Tape A	_____	_____	_____
Tape B	_____	_____	_____
Tape C	_____	_____	_____
Tape D	_____	_____	_____
Tape E	_____	_____	_____
Tape F	_____	_____	_____
Tape G	_____	_____	_____
Tape H	_____	_____	_____
Tape I	_____	_____	_____

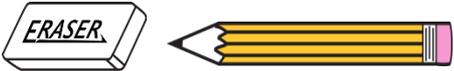
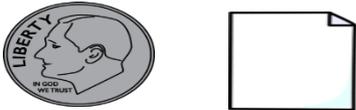
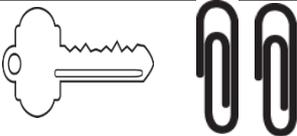
Which tape is the shortest? _____

Which tape is the longest? _____

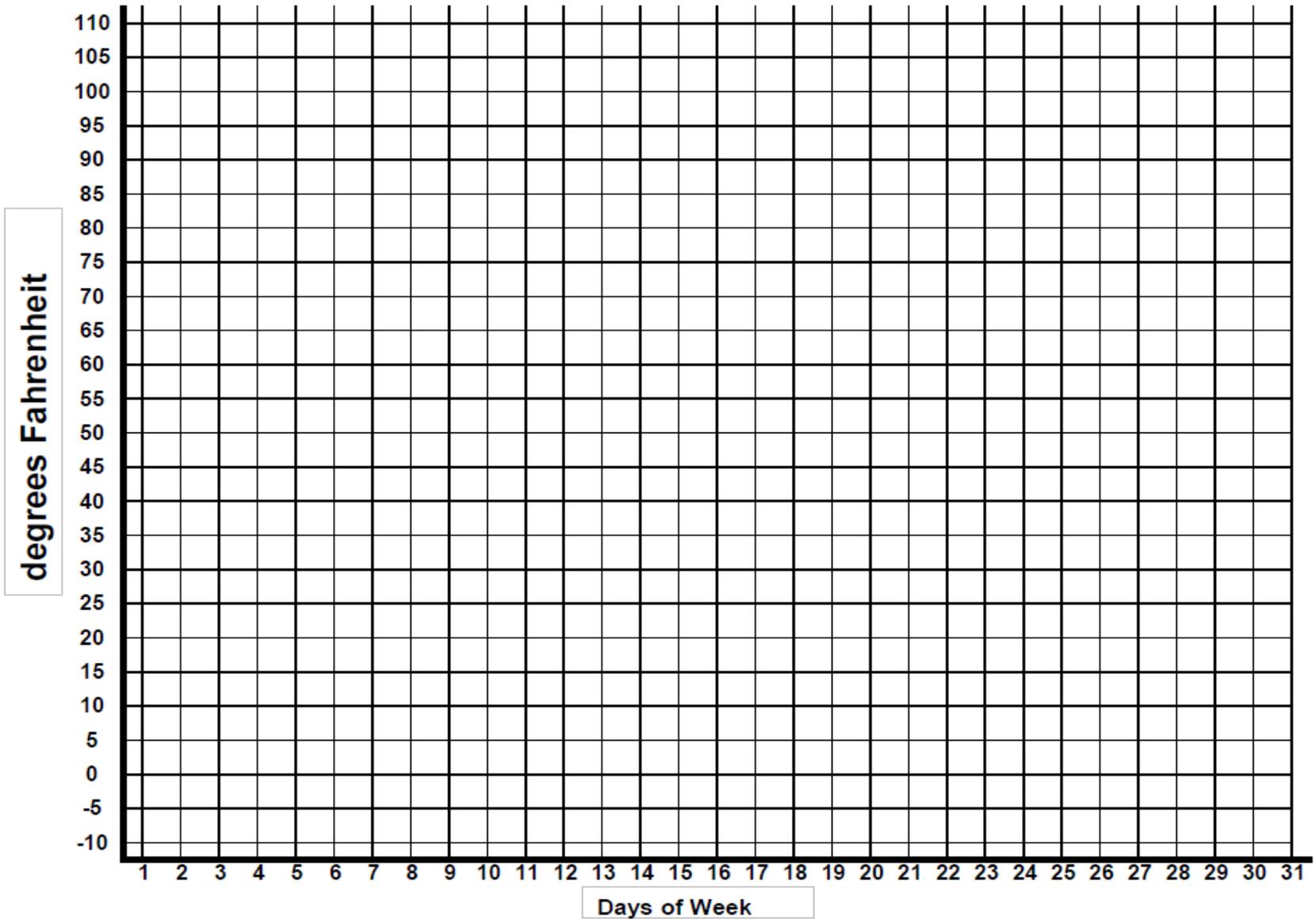
Non Standard Units (U.S. Customary)

[weight, smaller objects]

Activity #4 (common classroom objects, guess which item is **heavier**, then weigh with the pan balance or balance scale. Place one item (or set) on the left side and other item on right side of pan balance or balance scale. Ask how you know which is heavier or lighter, etc.)

Items	Guess which is heavier	Weigh which is heavier
	eraser, pencil	eraser, pencil
	dime, sheet of paper	dime, sheet of paper
	scissors, math book	scissors, math book
	crayon, pen	crayon, pen
	key, 2 paper clips	key, 2 paper clips
	2 quarters, 3 pennies	2 quarters, 3 pennies

Month _____



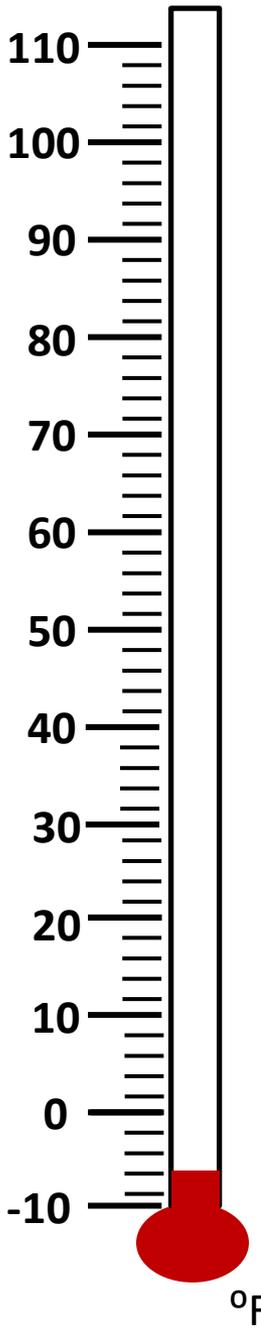
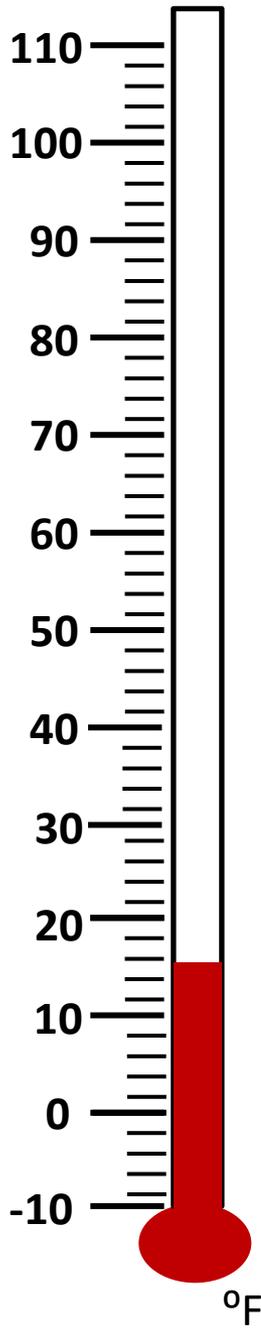
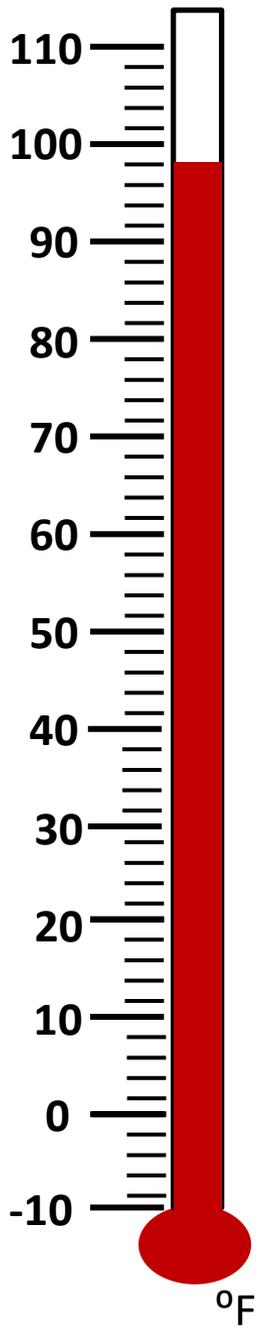
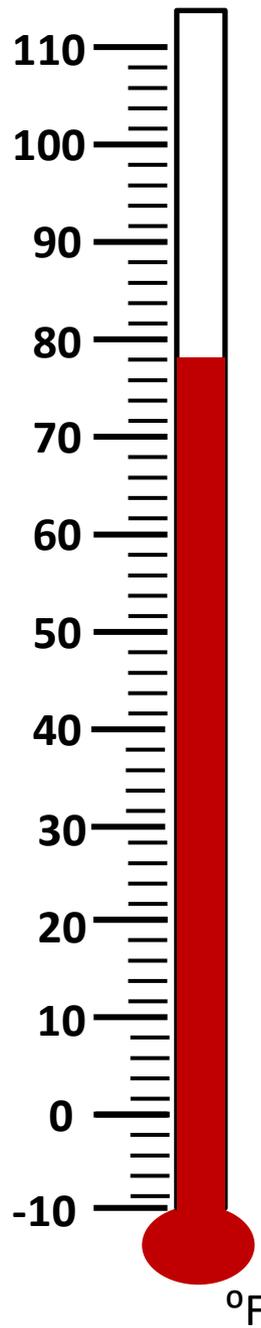
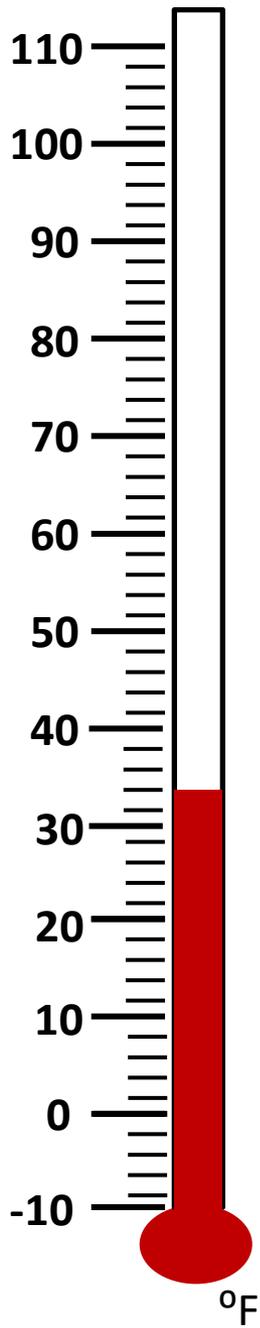
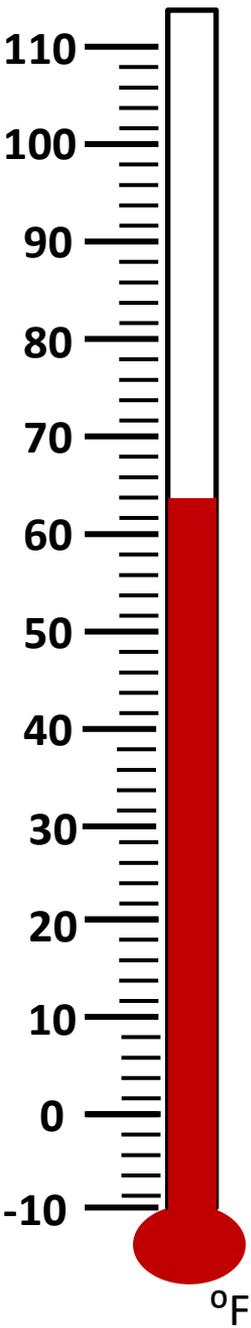
Weekly Chart, Week of _____ to _____

degrees Fahrenheit



Days of Week

Find the temperature on the Fahrenheit thermometers



A History of Measurement (Customary Measure)

People have needed tools to measure for hundreds of years. Besides needing a system to determine how many animals they had, they needed tools to measure the passing of time, ways to measure how long something was, and how many or how much something will hold.

Many early units for measuring length related to human body parts. The cubit was the length of a man's forearm or the distance from the tip of the elbow to the end of his middle finger. The early Egyptians and Greeks used the cubit on a regular basis for measuring length. Most times this was useful because it was convenient, available, and couldn't be misplaced. However, it was not a fixed standard and varied with the person doing the measuring.

Even though the cubit is not used today, many customary standards originated in the same way. Our foot-rule started out as the length of a man's foot. Later, the use of fingers, hands, and legs became prevalent in measuring various other units. Essentially, what is now the inch originated with the width of a man's thumb or the length of the forefinger from the tip to the first joint. Later, 12 times that length made a foot and three times the length of a foot was called a yard. Using a human component, the yard was the length from the tip of the nose to the outstretched fingertip.

In sailing, two times the distance of a yard was known as a fathom which was the same distance across a man's outstretched arms. Also, the outstretched distance from thumb to the tip of the little finger was called a span and used for measuring smaller lengths. Additionally, half a span or the measure across a hand was called a hand and was also used for quick measures of smaller distances.

The need to measure how heavy various items are was extremely important in business and trade. Among the first people, the Babylonians made important contributions in weighing objects through the use of a balance. Instead of comparing the two objects, they compared the weight of an item with a set

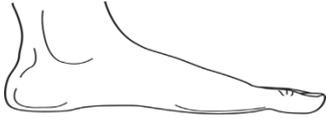
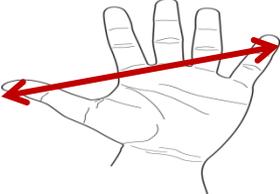
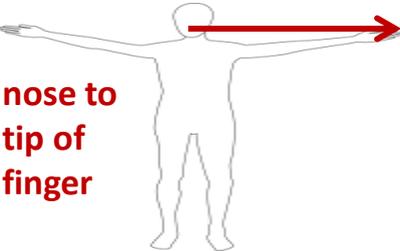
standard of stones which were kept strictly for that purpose. Later, the Greeks and Egyptians used the wheat seed as the smallest unit of weight. Arabs contributed to the weighing of precious stones as well as silver and gold by using a small bean known as a karob. This became the origin of the word carat which all jewelers use today to measure the weight of precious metals and gemstones.

Through trade between many nations, the various methods of measuring distance and weight gradually became intermingled. The Romans assisted in spreading knowledge of measurement because of their influence and power throughout Europe and Asia. Roman soldiers kept track of distance by counting their pace, which was the distance covered from the heel of one foot to the heel of the same foot when it next touches the ground. Around the fifth century AD, the power and influence of the Roman Empire had declined and most of Europe fell into what is known as the Dark Ages. Little if any progress with standardizing measurement took place over the next seven centuries.

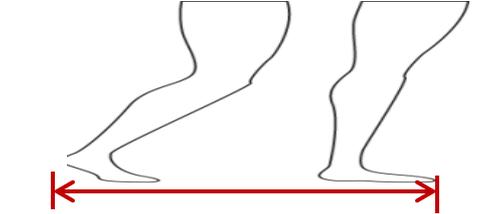
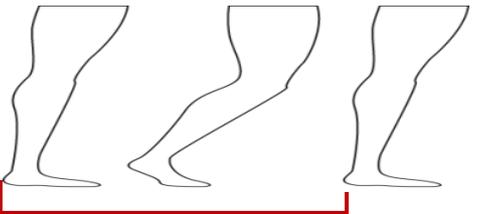
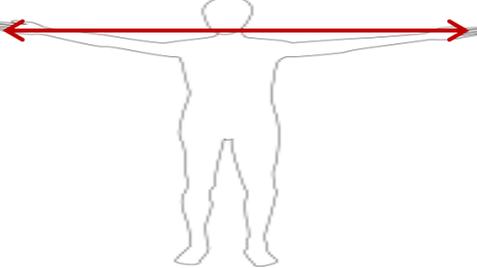
In the 12th Century, King Henry I of England decreed that a yard should be the distance from the tip of his nose to the end of his thumb but the length was later standardized by King Richard I when he had uniform metal rods distributed throughout the country which became known as the “kings iron yard.” Later, the furlong was established as 220 yards which led Queen Elizabeth I to decree that the mile would be 5280 feet which made the mile exactly 8 furlongs (1760 yards) and helped link a relationship between these measures. In the United States, U.S. Customary units are still used today for much common measurement. The military, most all manufacturing companies, the U.S. government, and virtually all scientific ventures use the metric system. However, for the most part, the U.S. remains the only industrialized nation that hasn't made the metric system compulsory.

Historical Measure

With a partner and using the older historic measures and customary measuring devices (ruler, tape, etc.) see what your measurements currently are:

Name	Picture	Measure
foot		__ in.
hand		__ in.
span		__ in.
cubit	 <p data-bbox="807 982 1137 1019">elbow to tip of finger</p>	__ in.
yard	 <p data-bbox="774 1162 890 1282">nose to tip of finger</p>	__ in.

Historical Measure

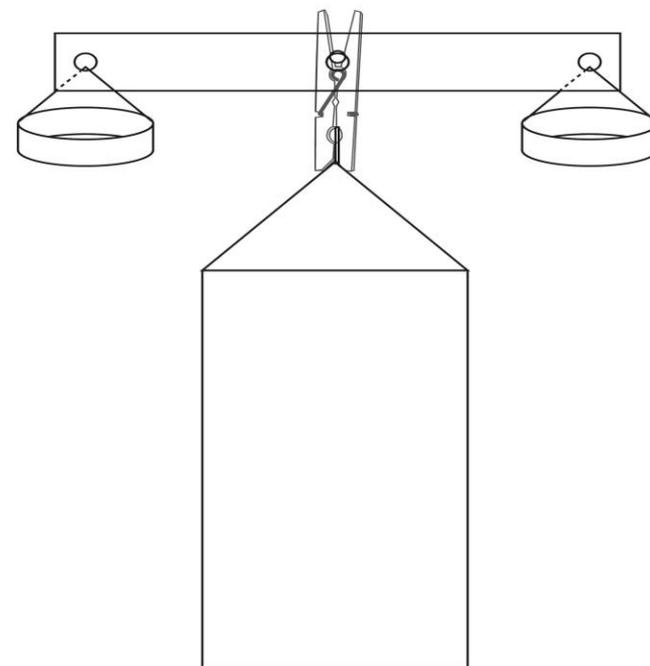
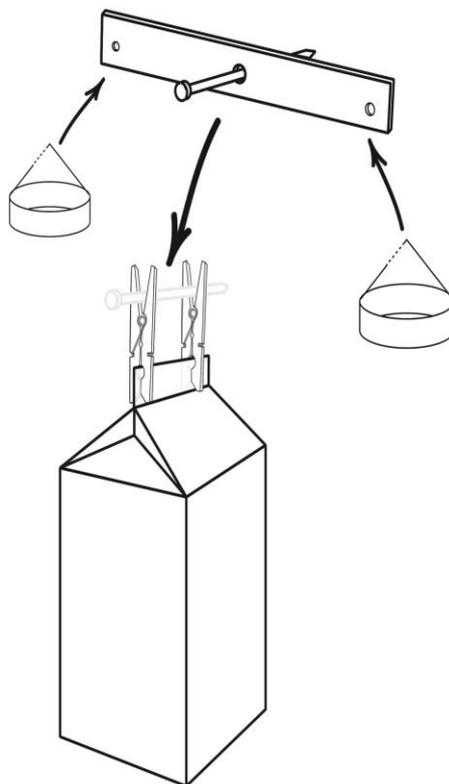
Name	Picture	Measure
pace	 A diagram showing two legs in profile, one in front of the other. A red double-headed arrow is drawn below the feet, extending from the heel of the front foot to the heel of the back foot.	— in.
Roman pace	 A diagram showing three legs in profile, one in front of the other. A red double-headed arrow is drawn below the feet, extending from the heel of the first foot to the heel of the third foot.	— in.
fathom	 A diagram of a human figure with arms extended horizontally to the sides. A red double-headed arrow is drawn above the arms, extending from the tip of the left hand to the tip of the right hand.	— in.

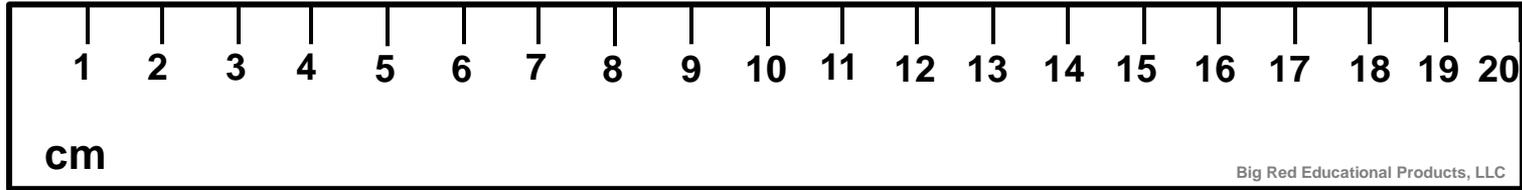
Milk Carton Balance

A simple scale made with a base of a milk carton works extremely well and is quite accurate to measure smaller objects.

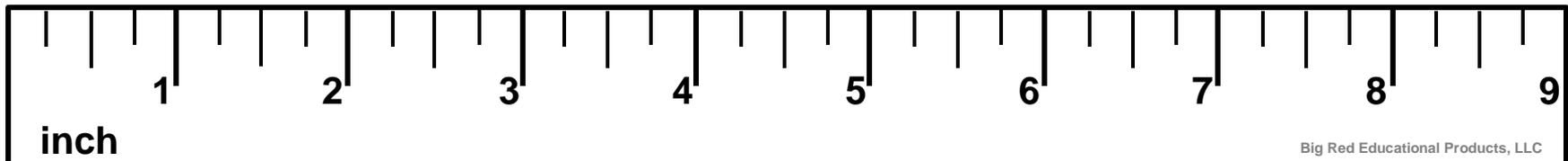
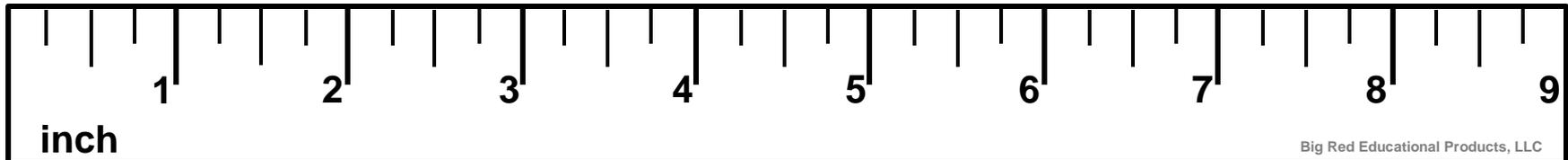
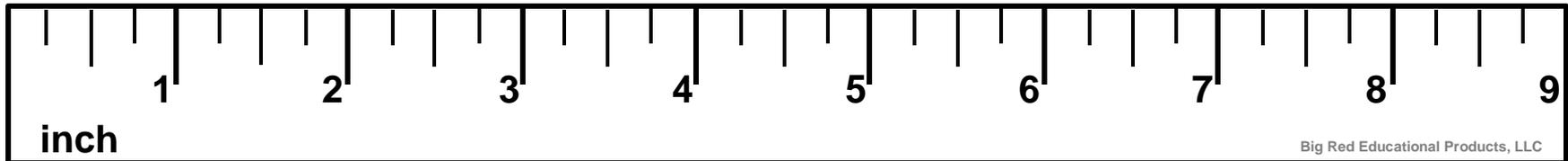
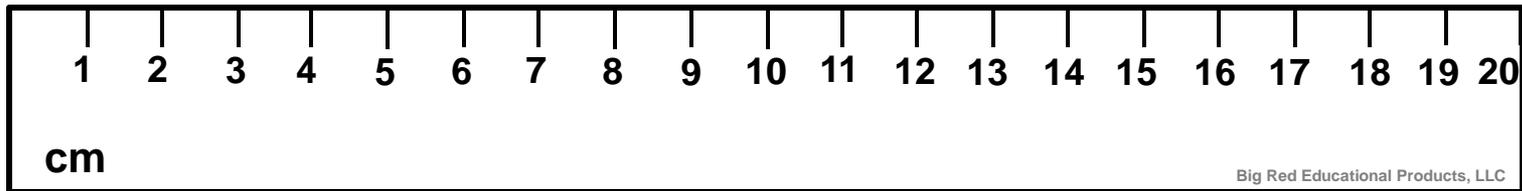
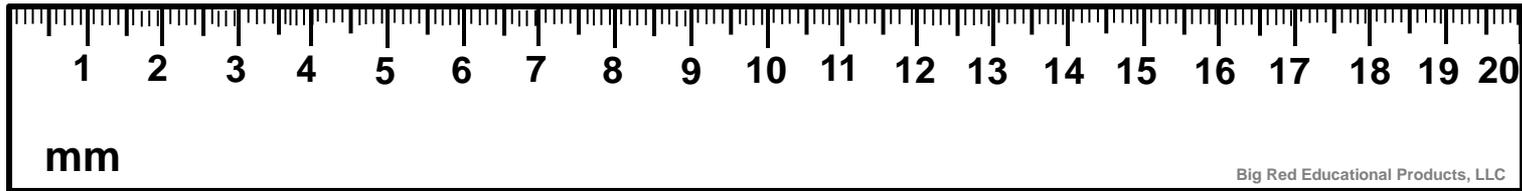
Materials Needed & Instructions

1. Half-gallon milk carton
2. Fill carton with sand or water and tape the top so it doesn't spill.
3. 2 clothespins
4. Nail or heavy paper clip
5. Ruler or piece of wood about 12" long. (paint stirrer will also work)
6. Drill holes in ruler/wood at center and at each end.
7. Place nail through center hole in ruler and the holes in each clothespin.
8. Use an 8 ounce cup connected with string to use as pans to put weights and objects into for measuring.
9. Make sure balance is horizontal to ground before weighing objects. If balance is tilted to one side, simply place a paper clip on light side to balance.
10. Place object to weight in one pan and weights gradually into the other pan until the scale balances.



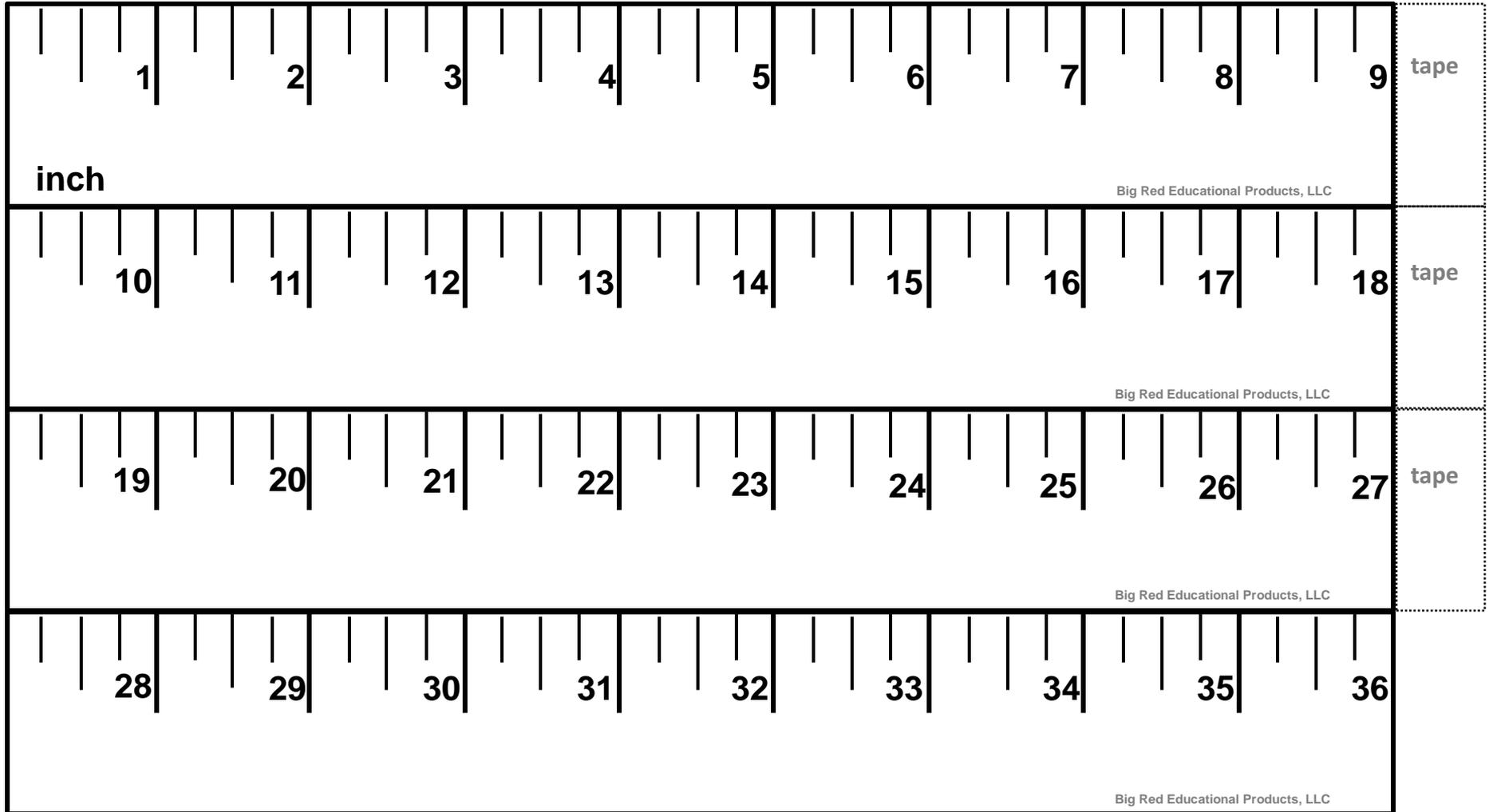


**Centimeter,
millimeter & inch
rulers**



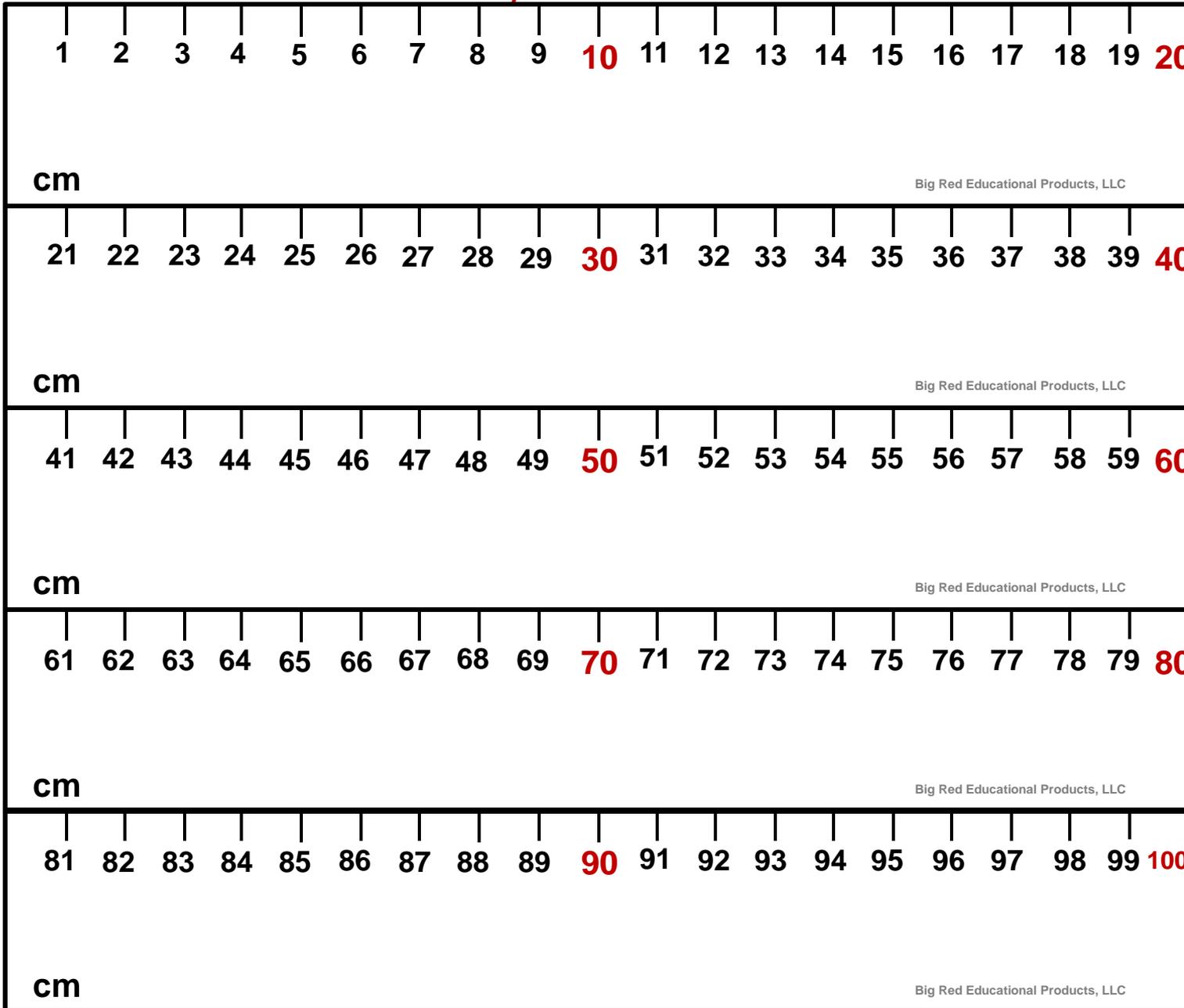
When printing rulers: If printing in PDF, select print on actual size NOT to fit. Printing in PowerPoint will keep rulers close to scale.

Make your own yard stick



When printing rulers: If printing in PDF, select print on actual size NOT to fit. Printing in PowerPoint will keep rulers close to scale.

Make your own meter stick



tape

tape

tape

tape

When printing rulers: If printing in PDF, select print on actual size NOT to fit. Printing in PowerPoint will keep rulers close to scale.

Make your own meter stick (with millimeters)

The image shows a template for a 100 cm meter stick, divided into five 20 cm segments. Each segment is labeled 'mm/cm' and 'tape'. The segments are numbered 1 through 100, with every 10th millimeter (10, 20, 30, 40, 50, 60, 70, 80, 90, 100) highlighted in red. The text 'Big Red Educational Products, LLC' is printed at the bottom of each segment.

Segment	Start (mm)	End (mm)	Labels
1	0	20	mm/cm, tape
2	20	40	mm/cm, tape
3	40	60	mm/cm, tape
4	60	80	mm/cm, tape
5	80	100	mm/cm, tape

1. Liter measures the property of:

- a. mass
- b. length
- c. volume
- d. temperature

2. Meter measures the property of:

- a. mass
- b. length
- c. volume
- d. temperature

3. A scientist would use what term to measure capacity?

- a. gram
- b. meter
- c. liter
- d. centimeter

4. Milli means:

- a. 0.001
- b. 0.01
- c. 0.1
- d. 1000

5. Kilo means:

- a. 0.001
- b. 0.01
- c. 100
- d. 1000

6. Centi means:

- a. 0.001
- b. 0.01
- c. 0.1
- d. 100

7. 45 g = _____ kg

- a. 0.045 kg
- b. 0.45 kg
- c. 4.5 kg
- d. 450 kg

8. 15 liters = _____ mL

- a. 0.015 mL
- b. 0.15 mL
- c. 150 mL
- d. 15,000 mL

9. 62.5 milligrams = _____ g

- a. 62500 g
- b. 625 g
- c. 6.25 g
- d. 0.0625 g

10. 85 cm = _____ mm

- a. 0.085 mm
- b. 8.5 mm
- c. 850 mm
- d. 8500 mm

11. 82 kg. = _____ g

- a. 8.2 g
- b. 820 g
- c. 8200 g
- d. 82,000 g

12. An 18 wheeler would be best measured in:

- a. milligrams
- b. grams
- c. kilograms
- d. kilometers

Metric Pretest (continued)

13. 75 g = _____ mg
- 75000 mg
 - 7500 mg
 - 750 mg
 - 0.75 mg
14. A soda has a capacity of 250 mL. How many sodas are needed to have exactly 1 L?
- 2
 - 3
 - 4
 - none of the above
15. Which is best measured in grams?
- car
 - child
 - cow
 - calculator
16. Which is best measured in milligrams?
- sack of grain
 - chest of drawers
 - a lady bug
 - microwave oven
17. To measure the mass of an object, you would use a _____.
- meter stick
 - balance scale
 - thermometer
 - graduated cylinder
18. To measure the volume of a container, you would use a _____.
- Meter stick
 - Balance scale
 - Thermometer
 - Graduated cylinder
19. To measure the length of a table, you would use a _____.
- ruler
 - thermometer
 - clock
 - spring scale
20. The most logical length of a pencil might be _____.
- 18 mm
 - 18 cm
 - 18 m
 - 18 km
21. The most logical width of a AAA battery might be _____.
- 8 mm
 - 8 cm
 - 8 m
 - 8 km
22. The most logical mass for a grown man might be _____.
- 85 mg
 - 85 g
 - 85 kg
 - 85 t

Metric Pretest (continued)

23. If you purchase a large plastic soda bottle, the most logical capacity would be _____.

- a. 2 L
- b. 2 kL
- c. 2 mL
- d. 2 g

24. The temperature in the classroom would be about _____ °C.

- a. 100° C
- b. 68° C
- c. 20°C
- d. 0°C

Choose the best metric unit to measure the various items and places described.

25. Length of a soccer field. _____

26. Mass of an adult cow. _____

27. Length of a marker. _____

28. Capacity of a coffee cup. _____

29. Mass of a pencil. _____

30. Capacity of the local swimming pool. _____

31. Distance from LA to San Diego. _____

32. Thickness of a writing pad. _____

U.S. Customary Pretest

Answers on slide 92

Choose the best answer for the following multiple choice questions.

- One pound is equal to:
 - 3 ft.
 - 10 m
 - 12 in.
 - 16 oz.
- The measure of weight in U.S. Customary System is:
 - lbs.
 - kg
 - g
 - in.
- A measure of length in the U.S. Customary System is:
 - meter
 - centimeter
 - mile
 - kilometer
- The most reasonable length of a classroom is:
 - 30 m
 - 30 yds.
 - 30 ft.
 - 30 in.
- The most reasonable temperature of your classroom is:
 - 110°F
 - 68°F
 - 32°F
 - 3°F

Circle the **best** unit to measure the various items and places described.

- Length of a soccer field. _____ yard, inch
- Weight of a full grown horse. _____ pound, ounce
- Length of a pencil. _____ inch, feet
- Amount of coffee in a cup. _____ fl. ounces, gallon
- Weight of a box of crayons. _____ ounce, ton
- Capacity of the local swimming pool. _____ gallon, pint
- Distance from LA to San Diego. _____ mile, yard
- Thickness of a box of crayons. _____ inch, yard
- How tall you are? _____ inch, yard
- Length of a classroom. _____ feet, mile
- Amount of water in a bucket. _____ cup, quart

Fill-in the blank with the correct measure.

- 1 yard _____ in.
- 3 yards _____ ft.
- 2 gallon _____ pt.
- 4 quarts _____ c.

U.S. Customary Pretest (continued)

21. 5 yards _____ in.

22. 4 tons _____ lbs.

23. 8 fl. ounces _____ pt.

24. 12 yards _____ ft.

25. 12 cups _____ fl. oz.

26. 96 inches _____ ft.

27. 3 gallons _____ qt.

28. 3 pints _____ c.

29. 4 gallons _____ pt.

30. 2 miles _____ ft.

34. About how many quarts would a medium milk carton hold? _____ qts.

35. In the space below, without a ruler, draw a line segment that you estimate is 4 inches long.

Answer the final questions by using common sense and/or estimation.

31. About how much would a 1 year old baby weight? _____ lbs.

32. About how long is your classroom's marker board? _____ ft.

33. About what temperature would water freeze on the Fahrenheit Scale? _____ °F

Metric Conversion Answers

1) $356 \text{ m} = 35600 \text{ cm}$

2) $3 \text{ km} = 3000 \text{ m}$

3) $16.35 \text{ kg} = 16350 \text{ g}$

4) $14.2 \text{ L} = 14200 \text{ mL}$

5) $0.165 \text{ g} = 165 \text{ mg}$

6) $17 \text{ m} = 1700 \text{ cm}$

7) $7\text{L} = 7000 \text{ mL}$

8) $4.1 \text{ km} = 4100 \text{ m}$

9) $7.5 \text{ L} = 7500 \text{ mL}$

10) $43 \text{ cm} = 430 \text{ mm}$

11) $50 \text{ kg} = 50000\text{g}$

12) $900 \text{ cm} = 9 \text{ m}$

13) $12000 \text{ mL} = 12 \text{ L}$

14) $900 \text{ m} = 0.9 \text{ km}$

15) $250 \text{ g} = 2.5 \text{ hg}$

16) $25 \text{ mm} = 2.5 \text{ cm}$

17) $15.4 \text{ L} = 15400 \text{ mL}$

18) $235 \text{ mL} = 0.235 \text{ L}$

19) $5.6 \text{ kg} = 5600 \text{ g}$

20) $2000 \text{ mg} = 2 \text{ g}$

21) $6.3 \text{ cm} = 63 \text{ mm}$

22) $5.6 \text{ m} = 560 \text{ cm}$

23) $1220 \text{ cL} = 12.2 \text{ L}$

24) $12.25 \text{ kg} = 1225 \text{ dag}$

U.S. Customary ANSWERS

1) 16 pt. = 256 fl. oz.

2) 12 gal. = 48 qt.

3) 22.5 yd. = 67.5 ft

4) 120 in. = 10 ft.

5) 4250 lbs. = 2.125 T

6) 2.8 mi. = 4928 yd.

7) 2.8 mi. = 14784 ft.

8) 40 pt. = 5 gal.

9) 15 gal. = 60 qt.

10) 26 pt. = 13 qt.

11) 10 lbs. = 160 oz.

12) 480 oz. = 30 lbs.

13) 68 lb. = 1088 oz.

14) 688 oz. = 43 lb.

15) 82 ft. = 984 in.

16) 888 in. = 74 ft.

17) 24 pt. = 3 gal.

18) 100 qt. = 25 gal.

19) 47 lb. = 752 oz.

20) 48 oz. = 3 lb.

21) 3 mi. = 15840 ft.

22) 24 ft. = 288 in.

23) 420 in. = 35 ft.

24) 30 in. = 2 ft. 6 in.

Metric Pretest -- Answers

1. C
2. B
3. C
4. A
5. D
6. B
7. A
8. D
9. D
10. C
11. D
12. C
13. A
14. C
15. D
16. C
17. B
18. D
19. A
20. B
21. A
22. C
23. A
24. C
25. meter
26. kilogram
27. centimeter or millimeter
28. milliliter
29. gram
30. liter or kiloliter
31. kilometer
32. millimeter

U.S. Customary Pretest -- Answers

1. D
2. A
3. C
4. C
5. B
6. yard
7. pound
8. inch
9. fluid ounces
10. ounce
11. gallon
12. mile
13. inch
14. inch
15. feet
16. quart
17. 36 in.
18. 9 ft.
19. 16 pt.
20. 16 c.
21. 180 in.
22. 8000 lbs.
23. $\frac{1}{2}$ pt.
24. 36 ft.
25. 96 fl. oz.
26. 8 ft.
27. 12 qt.
28. 6 c.
29. 32 pt.
30. 10,560 ft.
31. Around 20 lbs. + or - 5
32. 12-20 ft. dep. on room
33. 32°F, + or - 5
34. 1 qt., + or - 1-2
35. Look at, around 1 inch + or -.

Meter Trundle Wheel

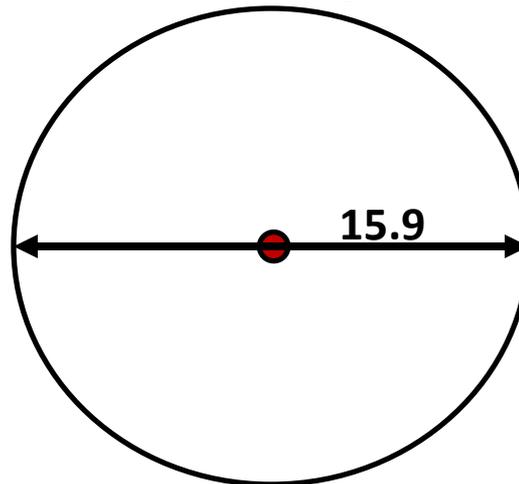
The trundle wheel probably came into operation during the building of the pyramids. The trundle wheel relies on the fact that a circle with a known circumference can be used as a ruler. The circumference is the distance around any circle.

Materials:

- ¼ inch cardboard, thin plywood, or foam board (any one will work)
- stick (about as long as a meter stick, yard stick – same thickness)
- brass fasteners, small lag bolt and nut
- marker
- compass

1. Firmly stick the pin end of the compass into the cardboard and set the compass length for 15.9 cm. Swing the pencil end around on the cardboard outlining a circle. 15.9 cm.
2. Carefully, with scissors or with a blade, cut out the circle. With a dark marker, make one straight line connecting the center to one edge of the circle.

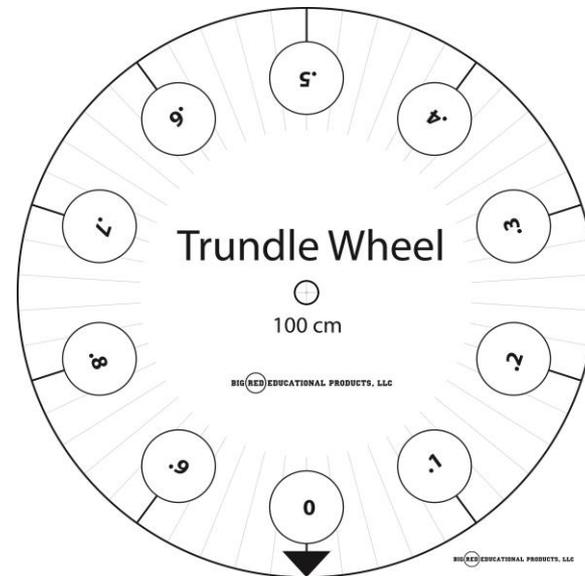
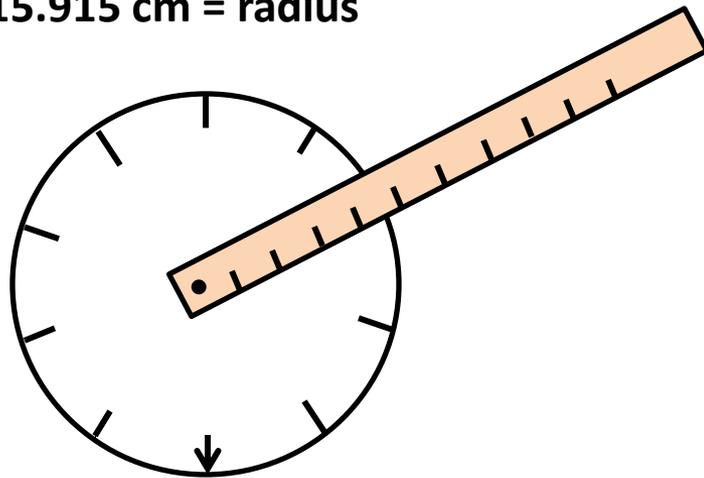
diameter
31.83 cm.
radius 15.9 cm



circumference
1 meter (100 cm)

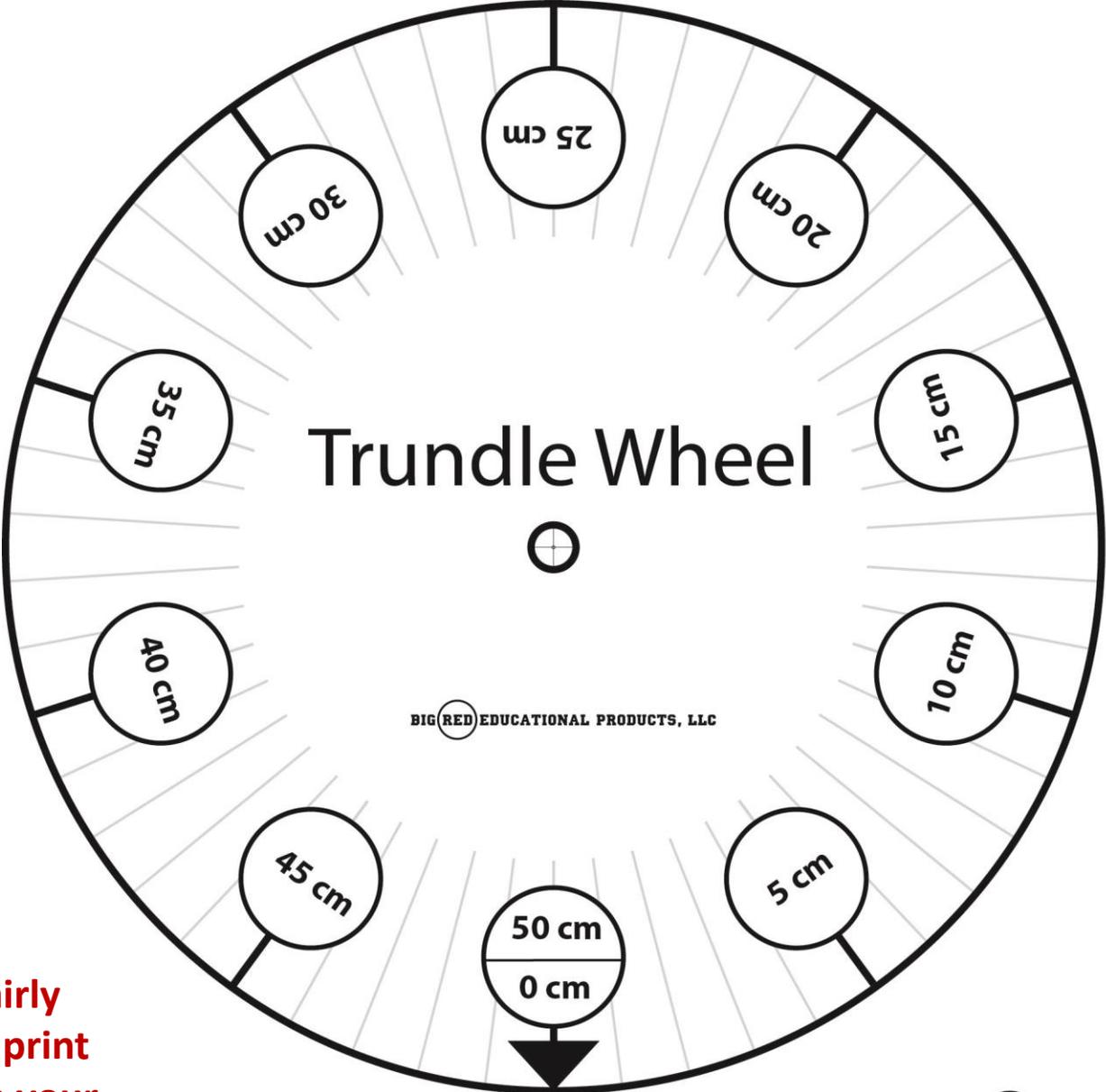
3. To the center of the circle in the compass pin hole, fasten one end of the meter stick or the cardboard strip with a brass fastener.
4. Practice measuring the size of the blackboard, the length of the room, the distance to first base on the kickball field, the height of students in the class. Compare the measurements with those gotten from laying down meter sticks.

15.915 cm = radius



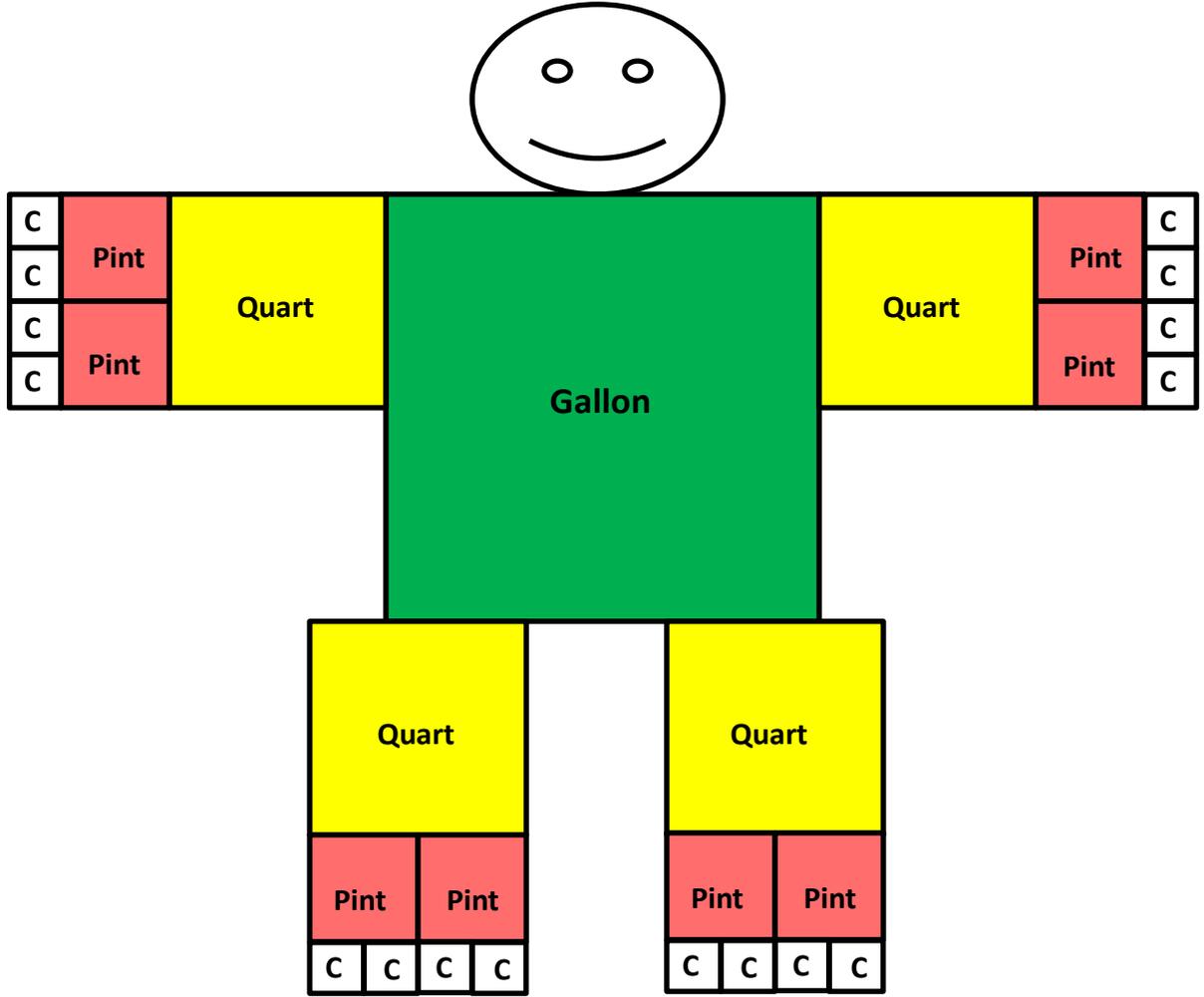
Copy our measured circle to use as an accurate measure for a meter trundle wheel or place a protractor with the center hole in the base over the center of the hole. Mark every 36 degrees. Use a meter or yard stick to make the marks as shown in the diagram above. Use a permanent magic marker to draw each line and number

50 centimeter trundle wheel



This wheel is fairly accurate if you print actual size with your printer.

Gallon Guy



Homemade Thermometer Activity

Try this homemade thermometer activity and show kids how easy it is to find out the temperature by using water -- not mercury, the poisonous metal most thermometers are made with.

Materials:

Soft drink bottle or jar with a lid

Water

Rubbing alcohol

Food coloring

Clear drinking straw

Modeling clay

Index card

Tape

Pen or pencil

Optional: actual thermometer to create a number scale

How to Make a Homemade Thermometer:

Step 1: Fill a small soft drink bottle about 3/4 full with half water and half rubbing alcohol. Add food coloring.

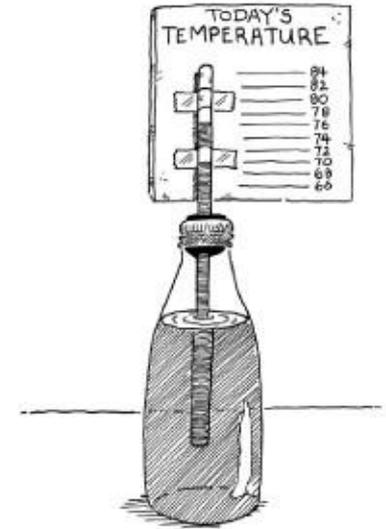
Step 2: Put a clear drinking straw in the bottle so that the straw goes halfway down into the bottle. Use modeling clay to seal the top of the bottle and hold the straw in place.

Step 3: Tape an index card to the straw. You will use the card as a scale. Make a mark on the card to show where the water level is. *Optional: using your actual thermometer, read the temperature and mark that on your index card.*

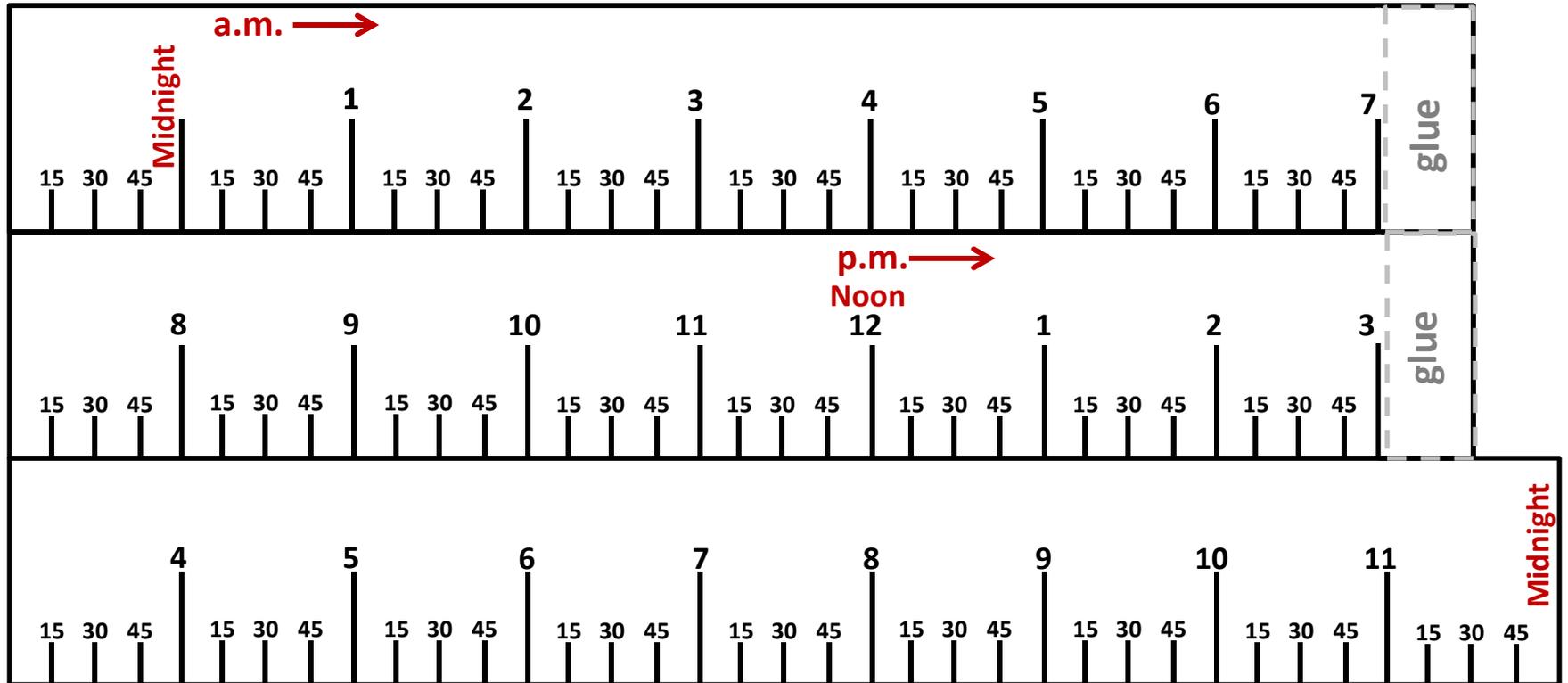
Now move your thermometer to a sunny place. Does the water rise? Mark the index card to show the new water level. (You may want to mark it with an 'S' so you'll know which mark is which.)

Check your thermometer at different times of the day to see how the temperature varies.

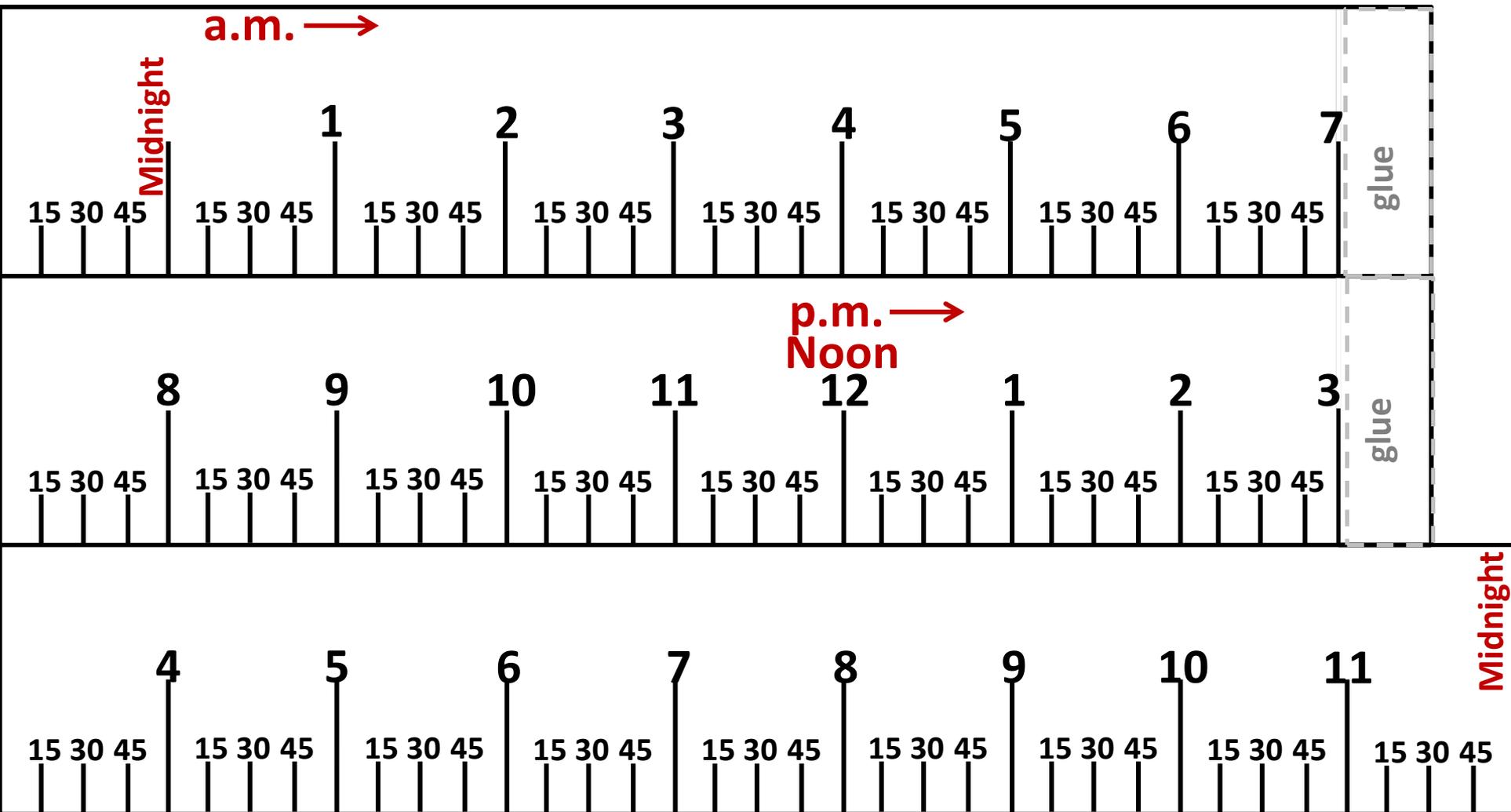
You can also compare it with the weather section of your local newspaper to see if your readings match the "official" temperature.



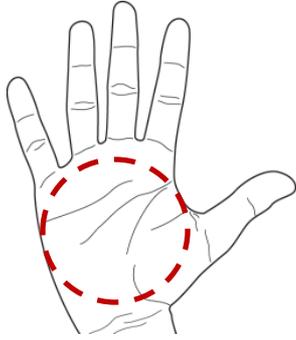
Individual time line



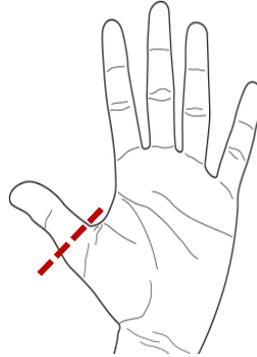
poster time line



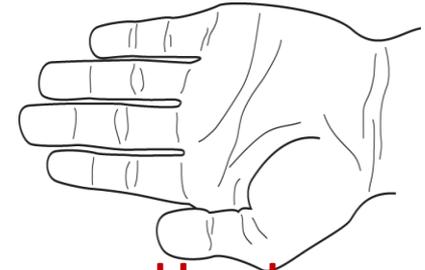
Hand Serving Sizes



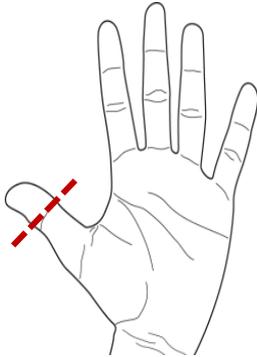
**palm,
3 ounces meat**



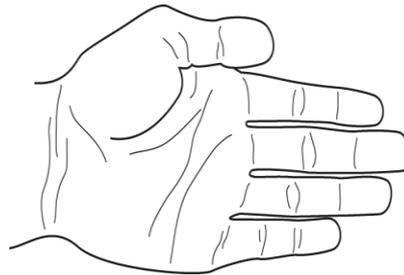
**thumb,
1 ounce cheese**



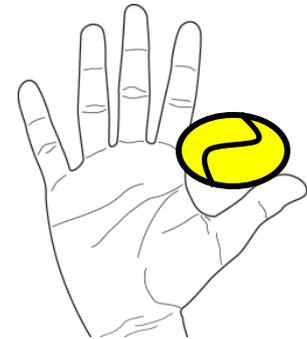
**fist, cupped hand
1 cup**



**thumb tip,
1 teaspoon**



**handful,
1-2 oz. snack food**



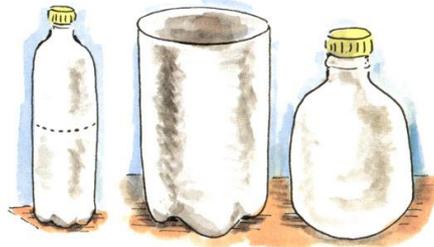
**tennis ball,
1 serving fruit**

water clock (clepsydra)

Many ancient civilizations used different devices to make a water clock. The Romans used different vessels to make what they called a “clepsydra” or water clock. You can make a water clock using some modern articles found in our everyday world.

Materials needed:

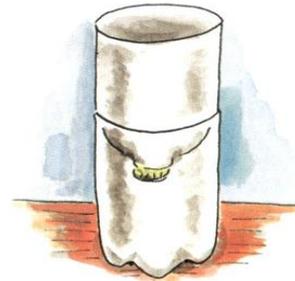
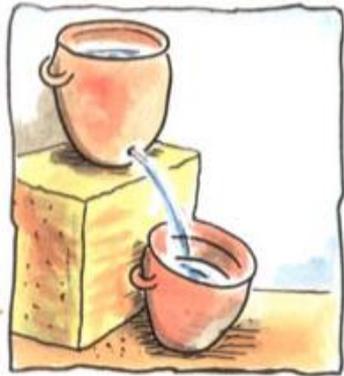
- Large plastic bottle with the top
- Scissors
- Marking pen (permanent)
- Stop watch or watch with second hand
- Thumbtack or T-pin



1. Have an adult cut the bottle in two.



2. Make a small hole in bottle top.



3. Turn the top onto the bottom.

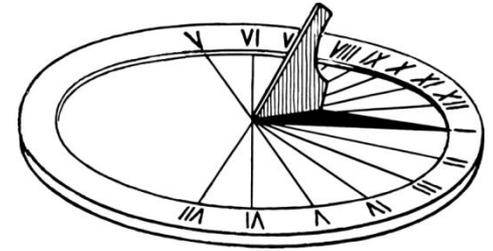


5. Mark the side in minutes – 1 min., 2 min.



4. Pour water into top. Time how much water drops through in 1, 2, 3 minute intervals.

sundial

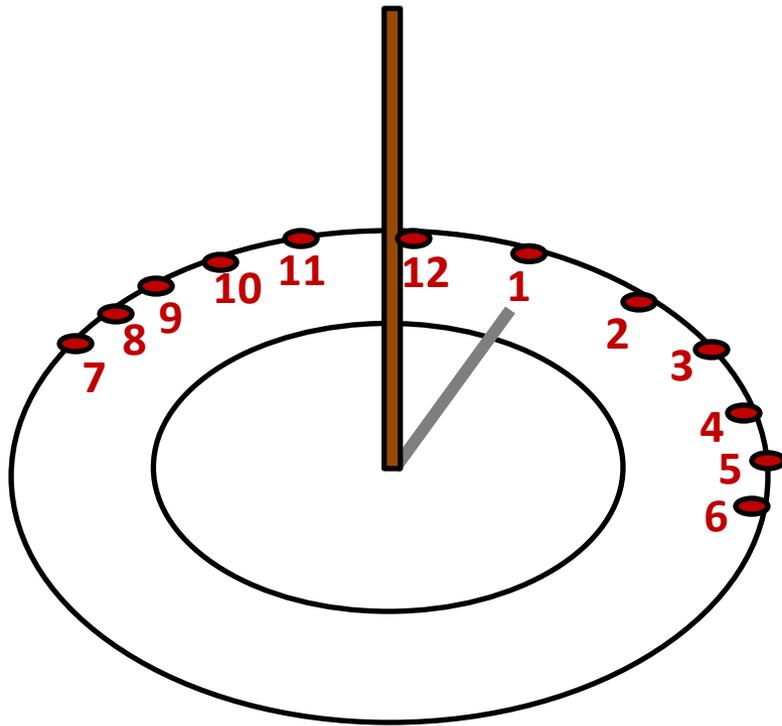


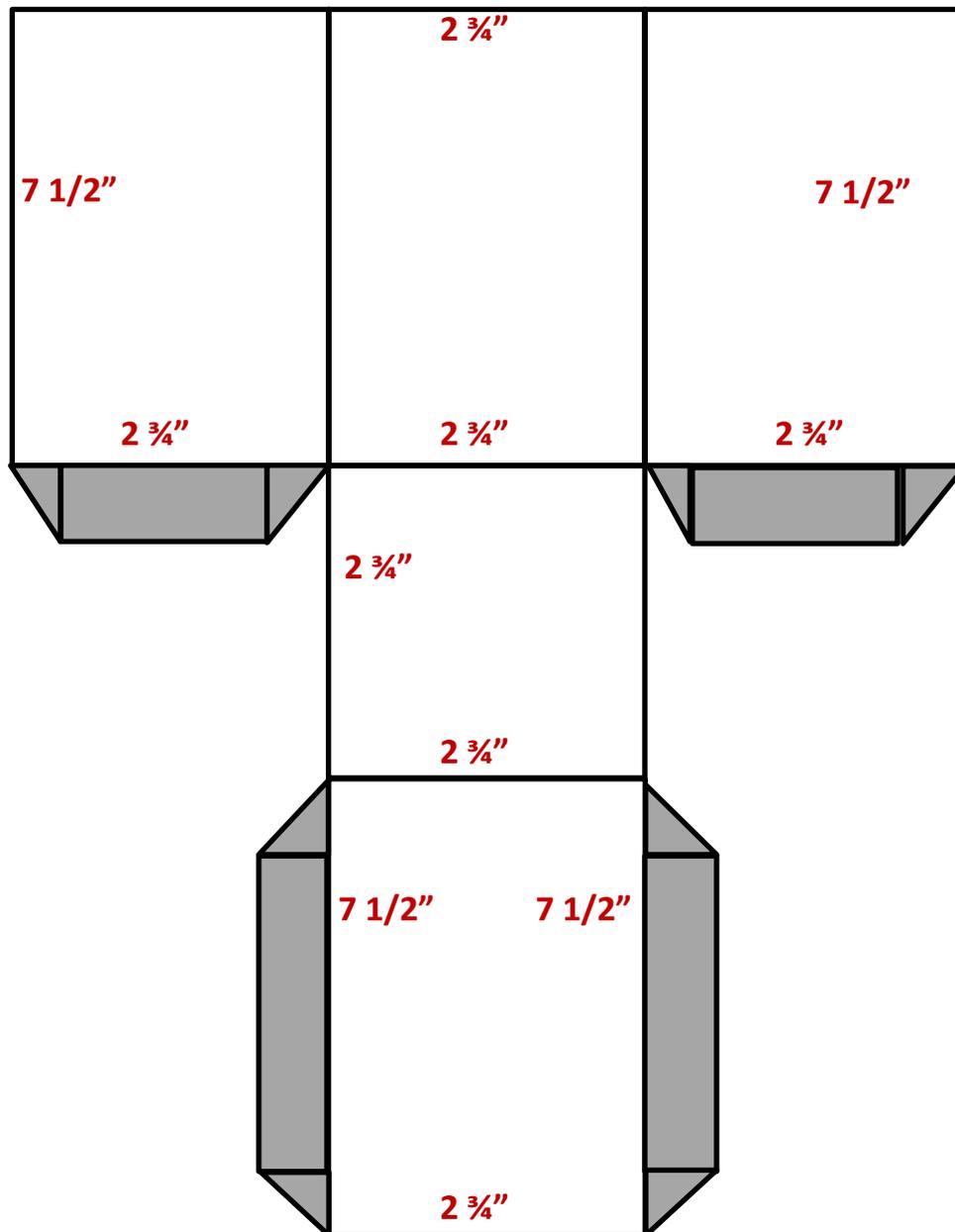
Materials needed:

- Paper plate
- Straw
- Pencil (sharp)
- Crayons or marking pen
- Duct tape
- Watch or clock
- Sunshine (open space with no shade)

Directions'

1. Punch hole in center of paper plate. (find an exact center)
2. Turn paper plate upside down and write 12 at the top edge of plate with a mark.
3. Use a ruler and draw a line from the 12 to the hole in the plate.
4. Put straw in hole and take the plate outside several minutes before noon. Put plate on ground (trace the outline of plate on cement).
5. At exactly noon turn the paper plate so the straw's shadow lines up with the line and the 12. At this point, I place 3-4 tick marks on plate and on edge of my traced circle to help align the dial in the exact spot in the future for timing.
6. Use duct tape to fasten to ground so the sundial does NOT move.
7. At exactly 1:00, mark the spot on the paper plate and write 1. Repeat this process every hour on the hour to make the sundial. Obviously starting the next day with the morning hours from 7-8 o'clock on.
8. Remember that checking the time on following days, it must be placed in exactly the same place and position.





Quart net

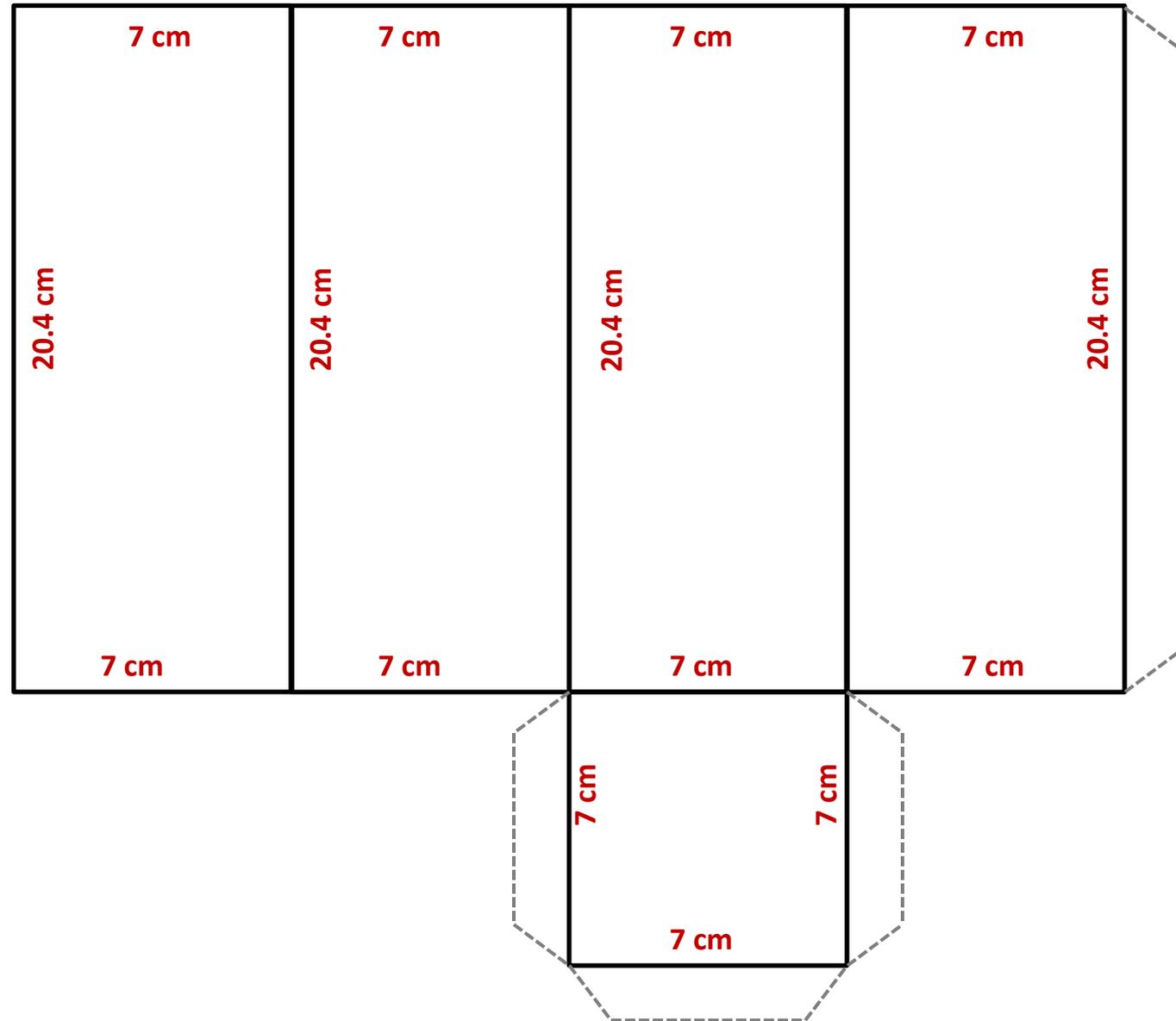
1. You can use construction paper as it is easier for children to fold rather than poster board.
2. You will want to buy 18 x 24 sized paper as it will allow students to have a little extra room to trace and cut.
3. Follow the dimensions exactly and make the tabs at least $\frac{3}{4}$ inches wide to tape or glue.
4. This will give students a quart benchmark to assist in judging capacity.

*Not drawn to scale.

Liter net*

1. You can use construction paper as it is easier for children to fold rather than poster board.
2. You will want to buy 18 x 24 sized paper as it will allow students to have a little extra room to trace and cut.
3. Follow the dimensions exactly and make the tabs at least 1 centimeters wide to tape or glue.
4. This will give students a liter benchmark to assist in judging capacity.

Hint: If you will go over the fold lines several times with a ruler and non-sharp pencil, it will make it easier and more accurate to fold.



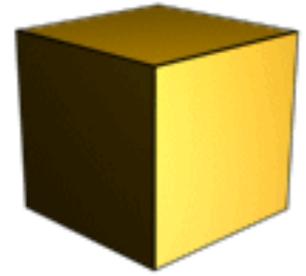
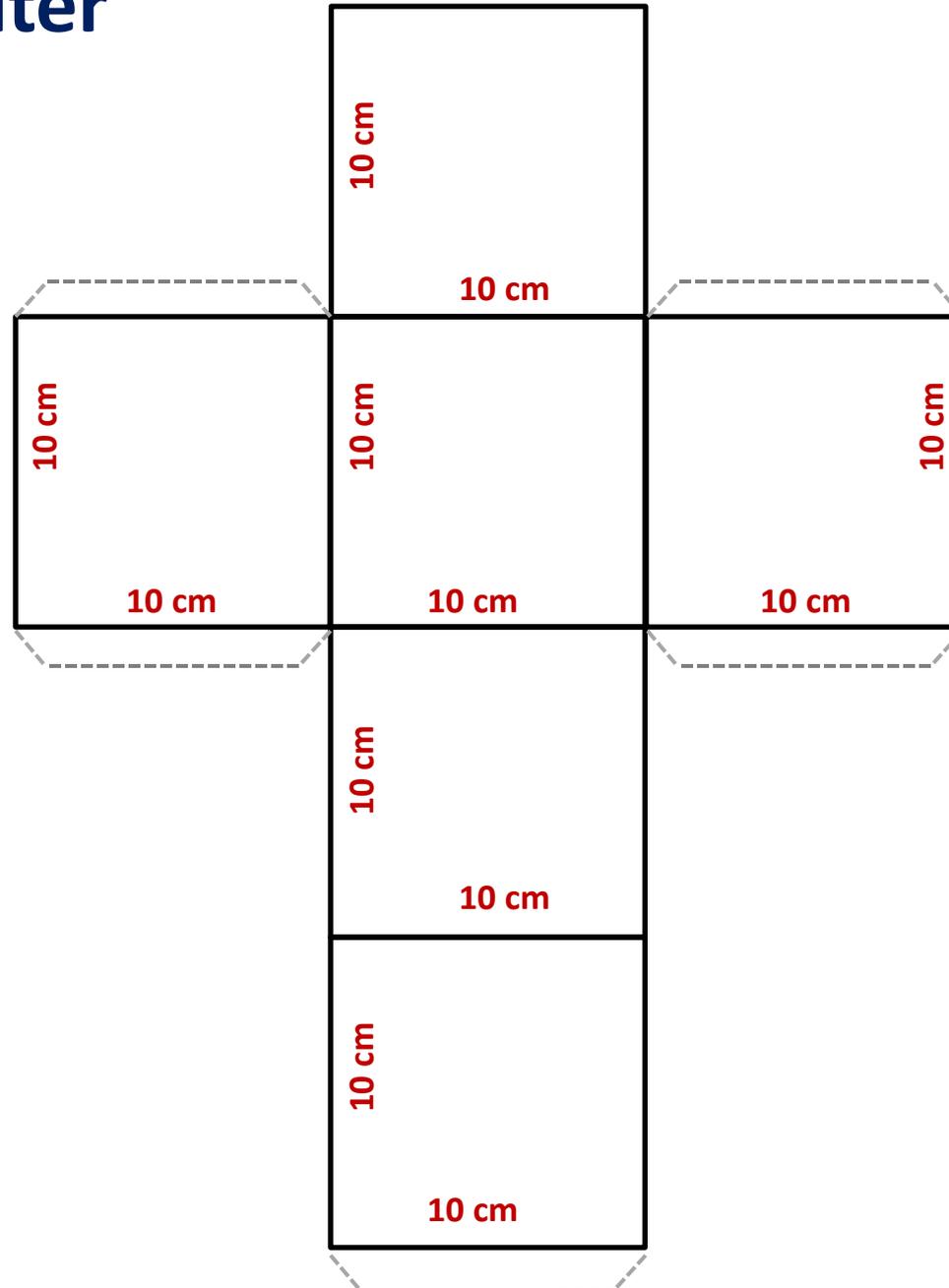
*Not drawn to scale.

1 liter

1 dm³, 1000 cm³

1. Use construction paper as it is easier for children to fold rather than poster board.
2. You will want to buy 18 x 24 sized paper. The diagram will fit but plan ahead. The side with 3 squares will be close.
3. All of the squares are 10 cm x 10 cm.
4. Follow the dimensions exactly and make the tabs at least 1 centimeter wide to tape or glue.
5. This will give students a 1000 cm³ or 1 liter of capacity to assist with that benchmark.

Hint: If you will go over the fold lines several times with a ruler and non-sharp pencil, it will make it easier and more accurate to fold.



sand timer

Materials Needed:

- watch with second hand
- very dry sand
- 2 clean, clear jars/bottles – 8-10 oz.
- scissors
- heavy paper/card stock
- hole punch
- duct tape or book binding tape



1. Find two clean, plastic bottles or jars 8-10 ounces.
2. Remove the labels.
3. Fill one of the bottles (about $\frac{3}{4}$ full) with strained, clean, dry sand.
4. Using the scissors, cut a piece of heavy paper that will cover the mouth of the jar.
5. Punch a hole in the center of the paper with a hole punch.
6. Place the paper over the mouth of the jar.
7. Position the second jar on top of the first, sand-filled jar so that the mouths of the two jars are together with the paper in between.
8. Now, tape the mouths of the jars firmly together with duct tape
9. Turn the bottles over and watch the sand fall into the lower bottle.
10. Use a watch to time one minute from the time the sand starts flowing out.
11. The moment one minute is up, turn the hourglass onto its side. The sand will stop flowing.
12. The sand in the lower bottle is the amount you need.
13. Remove the tape and dispose of the sand in the upper jar.
14. Re-tape the bottles neatly and firmly together with the sand that was left as the amount for one minute.
15. You now have a one-minute sand timer.

mass or weight

**Zip lock bags for 1 kg or 1 lb.
filled with sand or rice.**

