Grade Level	Content Area	Course Title *(For 9-12 Samples Only)*	Unit Title
Grade 8	Science		Introduction to Scientific Measurement and Testing

Length of Unit	Time of Year Taught	Expected Prior Knowledge
5 Days	Fall	Basic knowledge of English measurement system

Unit Description To provide a positive science experiences to introduce students to fundamental concept of measurement.

Standards: Arizona **Strand:** 1 Inquiry Process **Concept** 2 Scientific Testing **PO 4.** Perform measurements using appropriate scientific tools (e.g., balances, microscopes, probes, micrometers).	"Key Learning Points" Understand fundamental concepts of measurement through student learning activities. 1. Students will demonstrate the need for a standard system of measurement. 2. Students will demonstrate a clear understanding of the metric system in comparison to the English system. 3. Students will demonstrate the ability to use the appropriate tools to make scientific measurements using the metric system. 4. Students will enhance their observation skills by quantifying what they are observing. Students will make observations and measurements (uses instruments as appropriate).
Summative Assessment *In addition to the description, include a copy of the summative assessment in the application package.*	Culminating Activity Divide the class in teams of 4 students and organize the following 4 work stations for each of the following measurements: Weight - several scales and things to weigh (pencil, eraser, textbook, water bottle) Length and area - meter sticks and metric rulers and items to measure (pieces of string - length, desktop – area) Volume - several graduated cylinders beakers and other glassware to show how the same amount of water looks in the different flasks and beakers. Temperature – thermometer to measure temperature in bowl of ice, area near a window, area near the return duct, heating pad. Students will record findings in science journal. Students will compare findings with 2 other students and discuss why measurements in weight, length, area, and temperature might be different or the same. Students will record comparative findings in science journal.
Scoring for Summative Assessment *In addition to the description, include a copy of the answer key and scoring rubric (if applicable) for the summative assessment in the application package.*	Students "Science Friday Activity" will be scored using a rubric and Science Journal Rubric. Mastery is set at 80%. Students must receive at least 96 points out of 120 possible to achieve mastery.
Materials/Resources Needed *Include all items for the entire unit.*	Metric Rulers, Metric Balances, Graduated Cylinders, Thermometers **Homemade Balance:** plastic ruler with holes (x20), ten to twenty paper clips (x20), two 3-5 oz. plastic or paper cups (x20), 10-20 pennies (x20), 5-10 nickels (x20), masking tape, scissors and/or 1-hole punch, Objects to be weighed (eraser, 1 ft.length of nylon cord, large nail, piece of sponge, seashell, piece of black chalk), Weight data sheet, "standard" scientific balance, 2-5 lab stands with clamps to support balances **Body:** Tape measures (various lengths, metal and cloth), Yardsticks and other measuring sticks, machinist's rule, calipers, nylon cord (fathom, yard), handouts about units of measure (4 sheets), poster board or blackboard to record results, marker(s) **Rice:** 10-lb. bag of rice, two large plastic buckets, 1/8 cup and 4 cup measures **Misc:** Pencils, scissors **Homemade Bulb Thermometer:** A glass jar or bottle with a water-tight lid, a drill or a hammer and a large nail, some putty (silly putty, plumbers putty, caulk or chewing gum), a drinking straw, some food coloring

	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5
Instruction and Timeline	Teacher Directed Introduction to Key Learning Points (5 min) Student activity – Scientific Measurement in Daily Life (10 min) Teacher Directed discussion of "Body Parts" as historical origin of common length measurements. Include how "foot" became a measure of length. Ask, "Is the use of a king's foot a good method to measure? Why? What would happen in our world if we used the president's foot as the guide for measuring?" Compare using two different students' feet as a measurement guide. Have a tall and short student compare size of shoe. Use to measure various items.(15 min) Student activity "Body Parts" (15 min) Read the story *How Big Is a Foot?* In this story, the king orders a bed to be made for the queen's birthday. He measures how big it should be using his foot. The apprentice makes the bed using his smaller foot. The bed is too small and the king throws the apprentice into jail. The apprentice comes up with a plan and is able to make the bed the correct size. Have students discuss what they would tell the king about what he did. Finish the story and have the students follow up with a	Teacher Directed Review of Key Learning Points (5min) Introduction: No two human beings look exactly alike. Not even identical twins. But how about raccoons? Or goldfish? How hard is it for us to tell individuals apart? How hard is it for *them* to tell individuals apart? Actually, we know, based on an enormous amount of empirical data, that there is lots of variation in nature, and we can see it if we look hard enough. Give each student a peanut to study carefully. Ask them not to mark their peanuts in any way. Have students sketch their peanuts or describe them in writing in their journals. After a few minutes, put all the peanuts together in a bag, mix them up, pour them out. Ask them to find their own peanut. Lead students in a follow-up discussion. The following activities explore the variation among peanuts in two ways--the actual variation in length of different peanuts, and the variation in measurements that *different* people get when they measure the *same* peanuts. Give each student 15-20 peanuts and a ruler. Ask the students to measure and record the maximum length of each peanut, to the nearest millimeter. The maximum length may lie along a diagonal. And there will be	Teacher Directed Review of Key Learning Points (5min) Demonstration of units of weight – ounces/pounds, grams/kilograms (10 min) Demonstration of comparing paperclips to grams on a scientific balance (15 minutes) Prepare students to build a homemade balance Student activity build and use homemade balance (35 min) Teacher Directed closure (5 min)	Teacher Directed Review of Key Learning Points and Lesson 3 (5min) Teacher introduction of measurement of temperature (20 min) *Key Vocabulary* 1. Bulb Thermometer- The common glass thermometer you probably grew up with. The thermometer contains some type of fluid, generally mercury. Bulb thermometers rely on the simple principle that **a liquid changes its volume relative to its temperature**. 2. Fahrenheit The Fahrenheit scale records the freezing point of water at 32° F and the boiling point of water at 212° F (at sea level). The temperature is usually reported in degrees Fahrenheit in newspapers, on the radio, and on television. 3. Celsius The Celsius scale is based on the freezing point of water at 0° C and boiling point of water at 100° C (at sea level). The Celsius thermometer is usually used by scientists. Discussion of different devices found around the students' homes whose purpose is to either **detect or measure changes in temperature**. Examples: • The thermometer in the backyard tells you how hot or cold it is outside. • The meat and candy thermometers in the –	Teacher Directed Review of Key Learning Points (5 min) Teacher directed set-up of culminating activity (10 min) Review procedures for science Friday activities Review each science work station Review science journal requirements Review grading rubric

	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5
	journal entry explaining what they learned from the first activity and the story as well as what they need in order to measure. Tell them to include personal experiences of using a ruler or some other tool. Teacher Directed Overview of metric system (5 min) Discuss appropriate standards - demonstrate rulers and tape measures that don't agree, show metal machinist's rule and prevision calipers; talk about standard meters kept in Paris and at National Institute of Standards and Technology in the U.S. Student Activity – English vs Metric measurement (20 min) Student Activity – What measuring tool? (10 min) Teacher Directed – Closure (5 min)	parallax problems, depending on where the student places the ruler with respect to the peanut. Once the students have gathered their data, ask them to find the following: ***mean***: Add up their individual measurements and divide by the number of peanuts. This will give them the average size of the peanuts in their sample. ***median***: Arrange their measurements from shortest to longest, and then find the length of the middle peanut. ***mode***: Record the most common length in their sample. In some cases there may not be a mode--i.e., all the peanuts are different lengths. In other cases there might be more than one mode. ***range***: Find the shortest and longest peanuts in their samples.		kitchen measure food temperatures. • The thermometer in the thermostat tells the AC when to turn on and off. • The thermometer in the oven lets it keep a set temperature (hot). • The thermometer in the refrigerator lets it keep a set temperature (cold). • The fever thermometer in the medicine cabinet measures temperature accurately over a very small range. Prepare students to make one Homemade bulb thermometer per table team.	

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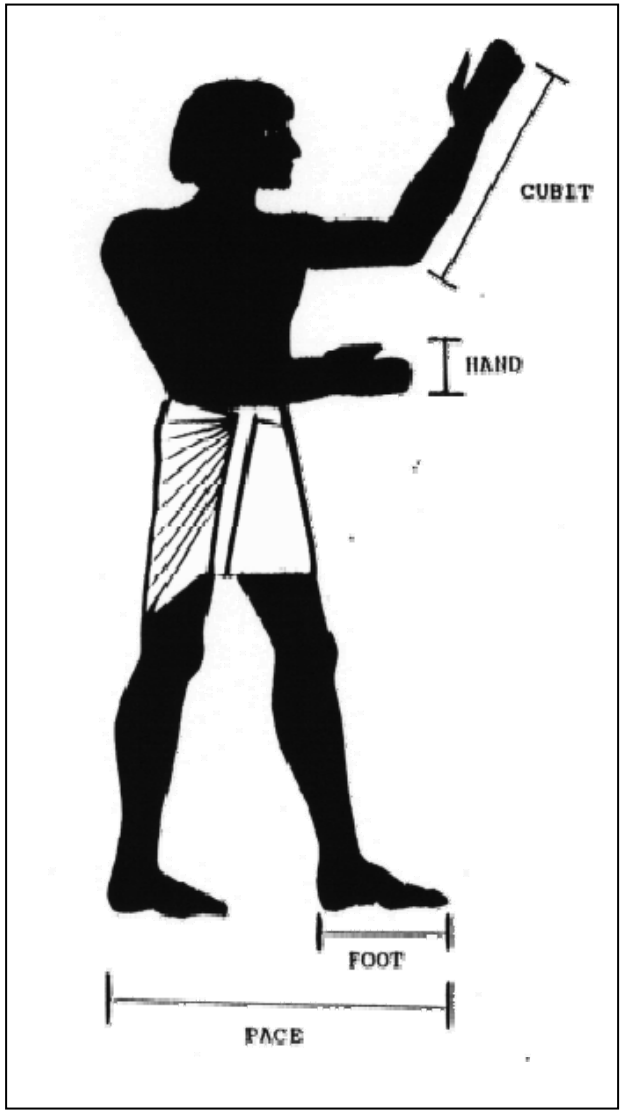
Student Activities and Timeline	Students will work in teams to brainstorm & record measurements in students' daily lives (10 min.) Students will estimate their own inch, foot, and yard, using Body Parts worksheet and compare results with 3 other students. (15 min) Journal Entry- students will explain what they learned from the first activity and the story as well as what they need in order to measure. Students will review differences in body-part measurements with a partner Students will discuss what happens with no, lose, or inconsistent standards? Student Activity – English vs Metric measurement worksheet (20 min) Student Activity – Which measuring tool? Students will determine which metric measuring tool to use for various objects (10 min)	Students will sketch their peanuts or describe them in writing in their journals. Students will measure and record the maximum length of each peanut, to the nearest millimeter. Students will find the mode, median, range and mean using the data taken from measuring their peanuts.	Students will build a "Homemade Balance Measuring Weight" (30-45 min.) • Build a simple balance from ruler, paper clips, and paper cups. • Use balance to compare weights; discuss relative and absolute measurements. • Students choose a standard unit (penny, nickel, or paper clip), and use their balance to weigh 6 common small objects (eraser, length of cord, nail, sponge, seashell, piece of chalk), and record results on a worksheet. • Convert weight measurements to grams using weight of their "standard" on a scientific balance; compare weights of same objects and discuss accuracy and precision. • Estimate large quantity using balance scale – number of rice grains in large container	Students will build a "Homemade Bulb thermometer" (20 min): 1. **Drill or punch a hole in the lid of your jar.** The hole should be as close to the diameter of the straw as you can get. 2. **Insert the end of the straw into the hole, and then seal around the hole** with your silly putty both on the inside and the outside of the lid. When you get done, it should look something like this: 3. **Fill your jar with cold water**. 4. **Add dark food coloring** to make it easier to see the water rise and fall in the straw. 5. **Place the lid on the jar** 6. **Place the jar in the sink, plug the sink and run hot water** into the sink until the sink is about half full. Students will write observations in their journals. Students will use the information just learned about the Fahrenheit scale thermometer and use a Fahrenheit thermometer to answer questions.	Students are divided into teams of 4 students. Each student team will spend 15 minutes at each of the following work stations for each of the following measurement activities: **Weight** – student will use scales to measure and record the weight of a pencil, eraser, textbook, and water bottle **Length and area** - students will use meter sticks and metric rulers to measure items for length and area pieces of string - length, desktop – area **Volume** – students will use several graduated cylinders beakers and other glassware to observe and record how the same amount of water looks in the different flasks and beakers. **Temperature** – Students will use 4 thermometers to measure and record the temperature in a bowl of ice, an area near a window, an area near the return duct, heating pad. Students will record findings in science journal. Students will compare findings with 2 other students and discuss why measurements in weight, length, area, and temperature might be different or the same. Students will record comparative findings in science journal.



Body Parts as Measurement Student Activity

Name:

INCH Originally was the length of three barley grains placed end to end. Distance from tip of thumb to first knuckle, or from first to second knuckle on index finger. My INCH = _____ INCHES
FOOT Length of foot from longest toe to heel My FOOT = _____ INCHES
YARD Distance from tip of nose to end of thumb with arm outstretched (cloth merchants, King Henry I) My YARD = _____ INCHES
HAND Width of one hand, including the thumb (height of horses) My HAND = _____ INCHES
CUBIT Length from point of bent elbow to middle fingertip (Egyptian pyramids, Noah's ark) My CUBIT = _____ INCHES
BRACCIO Italian for "an arm's length" (Da Vinci's parachute) My BRACCIO = _____INCHES
FATHOM From the Anglo-Saxon word for "embrace," it was the length of rope held between two hands with the arms outstretched. (sailors) My FATHOM = _____ INCHES
PACE Length of a single step. In Roman times one pace was a double step, and our MILE came from the Latin mille passuum, meaning 1000 paces. My PACE = _____ INCHES

STANDARD INTERNATIONAL (SI or metric) UNITS	
METER	Defined by the French Republic in 1793 to be 1 ten-millionth of the distance from the Equator to the North Pole, as measured through Paris.
CENTIMETER	1/100 of a meter
MILLIMETER	1/10 of a centimeter
KILOMETER	1000 meters
GRAM	Weight of pure water in a cube-shaped container having each side 1 centimeter long.
KILOGRAM	1000 grams (also called KILO)
MILLILITER	Volume of pure water in a cube-shaped container having each side 1 centimeter long (also called CUBIC CENTIMETER or CC)
LITER	1000 milliliters

English Units vs Metric Equivalents

Name:

(Italicized answers)

ENGLISH UNITS	METRIC EQUIVALENTS
1 INCH	= *about 2-1/2* **CENTIMETERS**
1 FOOT = *12* **INCHES**	= *about 30* **CENTIMETERS**
1 YARD = *3* **FEET** = *36* **INCHES**	= *about 1* **METER**
1 HAND = *about 4* **INCHES**	= *about 10* **CENTIMETERS**
1 CUBIT = *about 1/2* **YARD**	= *about 46* **CENTIMETERS**
1 BRACCIO = *15 to 39* **INCHES**	= *about 1/2 to 1* **METER**
1 FATHOM = *6* **FEET**	= *about 2* **METERS**
1 MILE = *5280* **FEET**	= *about 1-1/2* **KILOMETERS**
1 OUNCE	= *about 28* **GRAMS**
1 POUND = *16* **ounces**	= *about ½* **KILOGRAM**
1 TEASPOON	= *about 5* **MILLILITERS**
1 TABLESPOON = *3* **teaspoons**	= *about 15* **MILLILITERS**
1 CUP = *16* **tablespoons**	= *about 250* **MILLILITERS**
1 QUART = *4* **cups**	= *about 1* **LITER**
1 GALLON = *4* **quarts**	= *about 4* **LITERS**

Which Measuring Tool?

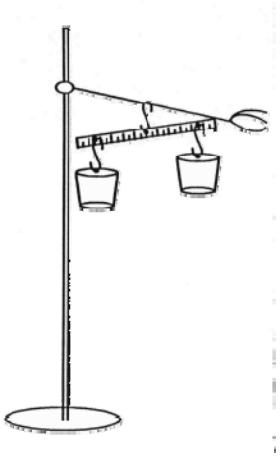
Name:

Choose a tool from the word pool that measures the terms in the last column. Give an example.

Tool	Example	Measurement
		Length
		Distance
		Weight
		Time
		Temperature
		Capacity / volume
		Mass / density

Word pool: odometer, clock, scales, ruler, beaker, thermometer, tape measure,

STUDENT'S HOMEMADE BALANCE



MATERIALS:

Stand of some kind (for hanging balance)
Ruler with holes
Paper clips to attach pieces
Paper cups
Hole puncher (for cups)
Masking tape (to ad to rulers in order to evenly balance the empty cups)

ACTIVITIES

1. Students make balance, using masking tape to ensure the empty cups actually balance and to hold the paper clips in place if the rule has slots or large holes.
2. Students order test objects according to weight, determining only the relative weight.
3. Students select a "standard" (such as a penny, a nickle, a B-B, or a paper clip) and "weigh" the test objects, recording the weights in their given units (3 pennies +/- a half penny). Precision will vary based on standard.
4. Students compare their weights with the true standard, using a precision scientific scale.

Weight Data Sheet

Name: My unit of weight is: One weighs grams.

Choose a unit of weight such as a penny

Object *Choose common classroom objects*	**Weight in my units**	**Weight in grams**
1.		
2.		
3.		
4.		
5.		
	Total weight in my units	Total weight in grams
	Average weight in my units	Average weight in grams
	Estimation of Large Quantity	
Number of grains of rice		

Science Friday Rubric

Name:	Lab Title:
Date:	Directions: *Check one box in each row to indicate the level of performance. Give each check mark the assigned number of points. Add the points in each column. Then, add across the bottom row to find the total score.*

	Points	10	9	8	7	6
	Performance Level	Excellent	Good	Average	Fair	Poor
Lab Activity:						
Followed Procedures Safely						
Correctly measured or observed						
Worked in cooperation with others						
Cleaned up work area and equipment						
Lab Report:						
Correctly recorded data in a chart or table						
Used complete sentences with correct capitalization, spelling, and punctuation						
Made thoughtful conclusions						
Applied critical thinking skills						
Journal Entry:						
Organization						
Grammar/Spelling						
Content of Entry						
Important facts demonstrating understanding						
Points		+	+	+	+	+

		=
Feedback:	TOTAL SCORE:	/120