HISTORY OF MEASUREMENT ACTIVITY

Invitation

In this workshop (experiment) you will be measuring things, keeping in mind the following questions:

1. What are some things we measure in our daily lives?
2. Does everyone in the world measure things exactly the same way?
3. What are some ways that we measure things?
4. Does it matter if that measurement can be reproduced? Why?

So the idea of measurement is fundamental to our society. What if you were in a society that did not have an established system of measurement? It would be pretty difficult to exchange goods.

Exploration

Make groups.

You are a society with no system of measurement. You want to give every family in your tribe an equal amount of potatoes, an equal amount of cloth, and an equal amount of wine. Come up with a way to make equal portions for each of these items. You will create a system of measurement that your society will use. When you finish we will share these with the class. You have 10 minutes.

Concept Introduction

1. How did you measure your cloth? Let each group share.

So you are measuring length….

2. Measuring body parts was a common measure of length. Why? (Most everyone had those parts easily accessible)

3. The earliest well documented measure of length was the Egyptian cubit. It was defined as the length of the forearm from the elbow to the tip of the middle finger. So this was an easy measurement, but was it accurate? Why not? What would you want to do to make it consistent?

They made their measure more consistent by establishing a standard, a unit of measure that all other measurements can be based off of. Theirs was called the royal master cubit and was made of black marble. It was divided into 28 approximately finger width digits, which were themselves divided into fractional parts. This was the first known standard measure of length.

4. What are some ways you measured the potatoes? Let groups share.
5. There was more than one way you could measure potatoes. Which systems used the weight of the potatoes?

6. Did anyone use mass?

7. Does anyone know the difference between weight and mass? *Mass measures the amount of matter that an object has. Weight is a measure of the amount of pull that gravity has on that mass. Most of us are probably used to measuring things in weight, but scientists usually find mass a better way to measure, because mass stays the same even if gravitational pull changes.*

8. Can you think of anywhere there might be a different pull? How about the moon? *People weigh less on the moon, but their mass stays the same. All that changes is gravitational pull.*

9. Were there any that used volume?

Weight was probably first measured by just comparing the weights of any two given objects. The Babylonians were believed to be the first to have a specific set of stones they polished and used as weight standards. Later Egyptians and Greeks used wheat seeds as the smallest unit of weight. It worked pretty well because wheat seeds are relatively uniform. One standard of weight you may be familiar with is the carat. It was actually based on the seed of the carob bean. The Arabs used this to weigh precious metals and stones.

10. How did you measure the wine? **Let the groups share.**

11. Did anyone use weight/mass? How about volume?

12. How would you measure the volume of a container?

Early Babylonian and Egyptian societies would fill a container with seeds and then count the seeds as a measure of the volume of the container.

13. Now, imagine that you had to trade with someone using a different system. (You can actually have students split into new groups and trade using the system their group had established.) What difficulties might you encounter?

14. So it would be preferable if everyone used the same system of measure?

15. Do we all have the same system of measure today?

16. What are two systems of measurement that we use in the US today? *English system and the SI or International System of Measurement*

Most people in the US are pretty familiar with the **English system:** Yard, foot, and inch standardized by King Edward I of England in 13th Century. For yard he measured tip of his nose
to thumb. (Yard originally Saxon word “grid” meaning circumference of waist. Saxon kings wore a sash around with waist used for measure.) For more check out NASA website. US brought their version of the English system with early immigrants. Our gallon is actually not the Standard English gallon, but an early form, the “wine gallon.”

The metric system or SI was established in France beginning in the 1790’s. In trying to establish a universal system of measure, they defined the meter. Does anyone know how they decided what a meter should be? It was defined as one ten-millionth of the distance from the North Pole to the equator in the meridian running through Dunkirk in France and Barcelona in Spain.

An insightful thing that the Academy did was to use length to create measures for volume and mass. They felt that all basic units of the system should be related to each other.

17. What is the basic measure of fluid volume? 

**Liter** How is it defined? 

*One decimeter cubed* (0.1 m³)

18. What is the basic unit for mass? 

*Originally gram—* one cubic cm (.01 m³) of water at its temperature of maximum density (4°C). Now kilogram—1000 g or 10 cubic cm of water at its temperature of maximum density (4°C)

Another helpful part of this system of measure was that everything was done is a base 10 system so that conversion would be easy. Take a look at your chart. Prefixes were placed on the unit to determine how many times it should be multiplied (or divided) by 10. For example 1000 m is one km. Because our number system is base 10 all you have to do is change the decimal place. This was much easier than converting with the Roman base 12 system.

19. Using your chart, how would you convert meters to centimeters? 

*Move the decimal to the left two spaces.*

The General Conference on Weights and Measures met in 1960. In addition to basic units for length (m), volume (l), and mass (g), they defined units for time (s), electrical current (ampere), thermodynamic temperature (Kelvin), amount of substance (mole), and luminous intensity (candela).

**Application**

Now that we have the developed the metric system, we have a systematic way of measuring things around us. With this system, will all measurements be consistent? 

*Lead into Errors lab.*

**Web Resources:**

http://standards.Nasa.gov/history_metric.pdf  “A Brief History of Measurement Systems” based on a publication by the National Institute of Standards and Technology

http://www.ex.ac.uk/cimt/dictunit/dictunit.htm  “A Dictionary of Units and Conversions”—a great resource!