

Units and Measurements

Preparation

Grade Level: K-3

Group Size: 20-30

Time: 45-60 Minutes

Presenters: 3-5

Objectives

This lesson will enable students to:

- Define and identify various units of measurements.
- Measure using standard and non-standard units.
- Compare weights using a balance.
- Use measurement in their daily lives (such as in cooking, shopping, home repair, etc.)

Standards

This lesson aligns with the following National Science Content Standards:



- Unifying Concepts and Processes in Science, K-12
- Science as Inquiry, K-4
- Physical Science, K-4

Material

- Paper clips
- Ruler
- Yardstick
- Pens, markers to measure
- Height poster
- Feather
- Balance
- Stone or rock
- Chips and popcorn
- Marbles
- Marshmallows
- Beans
- Split peas
- Rock - approximately the size of a tennis ball
- Tennis ball
- Mixing spoon
- Trail mix ingredients (see recipe)
- Measuring cups and spoons
- Large bowl
- *How Long Is It?* handout (Appendix A)
- *Which is Heavier?* handout (Appendix B)
- *Basic Trail Mix Recipe* handout (Appendix C)

Preparation

Set up three stations with the materials and equipment needed for each station.

Print copies of the worksheets and recipes for each student.

Introduction

Today we are going to discuss weights and measurements. Raise your hand if you know how much you weigh. How did you weigh yourself?

Q: What does the word weight mean?

A: Weight is a measuring word--we weigh things to find out how heavy or light they are. We measure our weight in pounds.

Q: Do you know how tall you are? How can you find out how tall you are?

A: We measure height in feet and inches using rulers, tape measures, and other tools.

Feet, inches and pounds are called "units of measurement."

History of Measurement

Have a brief discussion on how people have used parts of their bodies to measure distances, such as feet or hands.

Hundreds of years ago, people counted steps to measure how long something was, and they used hands with thumb and fingers outspread to see how tall something was. Today horses are still measured in "hands." A Shetland pony may measure only 10 hands while a Thoroughbred can be as tall as 17 1/2 hands.

Problem

Q: What would happen if two different farmers measured the same field using giant steps?

A: The farmer with longer legs and bigger feet would take fewer steps than the farmer with short legs and small feet would take to measure the same length.

To help them comprehend this, have two students of very different heights step off the length or perimeter of the classroom, each taking steps as big as they can, while the other students count. Another method is to have all of the students line up against a wall and walk heel to toe for a specific number of steps.

King Henry I of England wanted everyone to measure the same, so he declared that a "yard" would now be the distance from the tip of HIS nose to the end of HIS thumb. This distance divided into three equal parts became the standard "foot" and the standard foot was divided into twelve equal parts to become the standard "inch." *Use a yardstick to help illustrate this distance.*

The English system of measurement began using feet and yards and miles (1,760 yards) as units of measurement as well as pints, quarts, and gallons; bushels and pecks; and ounces, pounds, and tons.

One of the problems with the English measurements was that everyone has to memorize all the different names for the units and the amounts of sub-units in each unit. For example, there are 8 ounces in 1 cup, 2 cups in 1 pint, 2 pints in 1 quart, and 4 quarts in 1 gallon.

Metric System

Depending on time and the lesson objectives, have a brief discussion on the metric system.

Some people in France thought of another way to measure distance. They decided not to use feet and yards. They used a part of the distance around the earth as a way to measure. They invented the meter, which could be divided into 100 equal parts called centimeters or 1000 equal parts called millimeters. And one kilometer is the same as 1000 meters.

The new way of measuring was called the "metric" system. The other types of measurements in the metric system—for weight, quantities, and temperature—were also based on a decimal system with units, which are multiples of ten, which makes them much easier to calculate and are more precise.

The metric system uses prefixes such as cent, dec, and mil in all types of measurements—length, weight, and volume—to indicate the division or multiplication factor.

Today, all but a few countries use the metric system for measuring. In America, we use both. Over 100 years ago, the leaders passed a law allowing people to use the metric system, but they didn't have to. Most people liked the old way of using feet and inches and yards, so they did not change. However, even in America, the metric system is preferred for science and technology.

Introduction Summary

Q: What types of things can you measure at school and in your home?

A:

SCHOOL

desk
teacher's desk
blackboard
pencil
marker
book

HOME

bed
TV
shoe
cooking quantities
family members
favorite toy
glove

We are now going to break into three groups where you will take different measurements. Be sure to take a pencil with you to record your measurements.

Measuring Lengths

When measuring lengths, there are a variety of tools that can be used.

Q. What would you use to measure the length of your paper?

A. A ruler, or a small tape measure.

Q. What about the height of this room?

A. A longer tape measure.

Q. How would you measure the distance from school to your home?

A. A car odometer, a bicycle cyclometer.

Measuring longer lengths or distances requires different tools. We generally use a longer tape measure or another method for distances over a couple of feet.

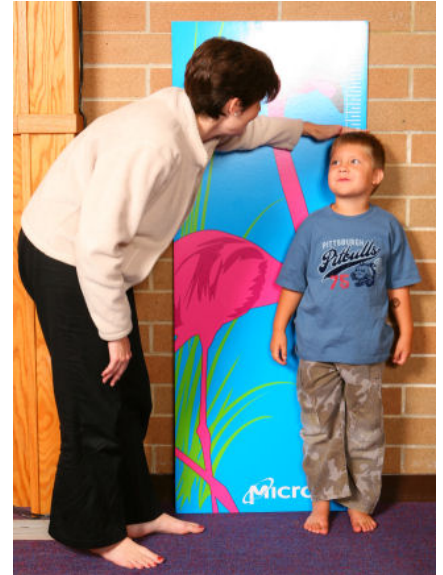
Q. What would happen if we used a paper clip or ruler for measuring long distances?

A. Inaccuracies, mistakes, frustration.

We are giving each of you a handout for you to record some measurements. As soon as you have it, put your name on the line marked NAME. Then we will take and record some measurements.

Pass out the worksheet.

Measure each child's height. When we measure your height, we will identify it on the wall chart, and you will record it—in feet and inches—on the line marked HEIGHT.



Now we will measure various objects—such as a book, a pencil, a desk, or your hand—but instead of using a yardstick or a measuring tape with inches and feet, we will be using paper clips as our standard unit. After you measure each object, write the name of the object in the line provided and its length in number of paper clips next to it. Measure as many different items as you can in the time allowed.

Show the handout and point to the areas you are talking about. Point out that the paper clips are approximately one inch long.

Measuring Weights

Call a child up to the front and have him or her hold a rock or similar object in one hand and a tennis ball in the other.

Q: Which is heavier—rock or the tennis ball?

A. The rock.

Q: How do you know which is heavier?

A: Looking at them, past experience, size.

Now we are going to use a "balance" to compare the weight of different items. A balance is an instrument used to weigh objects or to compare weights of objects. Each side has a pan that weighs the very same as the pan on the other side.

You can see how the "beam" is level and motionless when both sides are equal in weight.

Put identical objects on either side of the balance—one at a time—to demonstrate this concept.



When we put different objects in the pans, the beam will tip as the heavier object pulls down. By adding weights of some sort to the lighter side until the beam is level again, we can determine how much heavier one object is than the other.

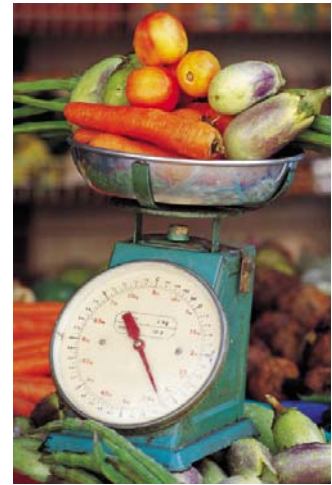
Put popcorn or some other item in a cup on one side, and corn chips or some slightly heavier item in a cup on the other. Then add beans to the lighter side until the weights are equal and the beam is balanced.

Q: In this case the cereal is_____ beans heavier than the popcorn.

Now we will compare the weights of some other objects. Can you guess which one will be heavier just by looking? Can you guess how many beans it will take to balance the scales?
Compare various objects such as those listed below, giving students a chance to guess and to add beans to the lighter side.

- Feather and rock
- Eraser and chalk
- Two different books
- Pencil and pen

Most of the scales that we use to weigh objects don't have a balance beam with two pans to compare objects. They are made so that when a person or object is placed on the scale, either a needle will move around a system of marks—like on the scales you see at the grocery store—or the system of marks moves around until the correct weight is shown next to a stationary line—like the bathroom scale.



Q. Can you name some places where we might find a scale? What would you weigh there and why?

A. Possible responses:

- Grocery store scale—to weigh fruits, vegetable, and bulk items such as candy or nuts to know how much they will cost
- Airport scale—to weigh luggage to make sure you haven't exceeded your weight limit and to help place luggage on the plane to keep a balanced load
- Bathroom scale at home—to weigh yourself to see if you have gained or lost weight
- Doctor's scale at office—to weigh children to make sure they are growing properly and to weigh adults to make sure they are not gaining or losing too much weight
- Truck weigh-station—to weigh the weight of trailer load to make sure it doesn't exceed the limit for the roads and to make sure the weight is balanced on each tire
- Post office—to weigh packages and letters to know how much postage they require

Measuring Quantities

We are going to look at different types of measuring tools that people use in their homes to measure quantities when they are cooking:

- Dry measuring cups
- Liquid measuring cups
- Measuring spoons

Let the students practice measuring beans using the different measuring cups and spoons. Help them understand the concept of a cup, $\frac{1}{2}$ cup, $\frac{1}{4}$ cup, $\frac{1}{3}$ cup, a teaspoon, a tablespoon, etc. Show how two $\frac{1}{2}$ cups make a full cup and how 4 cups make a quart, etc.

Now we are going to practice measuring by following a recipe to make us all a treat. First we will all wash and dry our hands. Then we will measure out all the ingredients, mix them together, and then eat up our delicious results. You can each have a copy of the recipe to take home and make a treat for your family.



Basic Trail Mix Recipe

Give each student a copy of the recipe.

Have each student in the group choose one of the following ingredients and combine them in a bowl. (If there are six students there will be six different ingredients, eight students - eight ingredients.)

$\frac{1}{4}$ c Multi Grain Cheerios/cereal

$\frac{1}{4}$ c Mini Pretzels

2 T Dried Cranberries

3 T Banana Chips

2 T M&M Candies

2 T White Chocolate Chips

2 T Other Ingredient (soy nuts, etc)

$\frac{1}{4}$ c Granola

$\frac{1}{4}$ c Raisins

$\frac{1}{4}$ c Dried Chopped Apricots

2 T Dried Fruit Mix

2 T Chocolate Chips

2 T Sunflower Seeds

Conclusion

After all have gathered back together, ask the following questions and call on various students for the answers.

Q: In what country did our system of measurement begin?

A: England.

Q: What country developed the metric system?

A: France.

Q: What system is the metric system based on?

A: Decimal – units of 10.

Q: Why do we have a standard system of measurement?

A: Standardization, because feet and hand sizes are different.

Q: How many units of measurements was your desk? Your shoe?

A: Answers will vary.

Q: Which was heavier—the chips or the popcorn (or some other objects put on the balance)?

A: Answers will vary.

Q: How many $\frac{1}{2}$ cups does it take to make 1 cup? How many $\frac{1}{4}$ cups?

A: Two, Four.

Q: What did you like doing today?

A: Answers will vary



How long is it? Measuring Length

Name: _____

My height: _____ feet _____ inches

Write the name of object

Write the length of the object

#1 _____

_____ paperclips

#2 _____

_____ paperclips

#3 _____

_____ paperclips

#4 _____

_____ paperclips

#5 _____

_____ paperclips

#6 _____

_____ paperclips

Circle the longest item.

Place a star next to the shortest item.



Which is heavier? Measuring Weights

Name: _____



1. Which is heavier - a pencil or a pen? _____
2. How many paper clips does it take to equal the weight of the marker? _____
3. How many small marbles does it take to equal the weight of 1 big marble? _____
4. Which is the lightest: 1 cup of marshmallows or 1 cup of cereal? _____
5. Which is the heaviest: 1 cup of popcorn or 1 cup of marbles? _____
6. Which is the lightest: 1 cup of split peas or 1 cup of beans? _____
7. Which is the heaviest: 1 cup of _____ or 1 cup of _____? _____
8. Out of all of the items, which is the heaviest? _____
9. Out of all of the items, which is the lightest? _____

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| $\frac{1}{4}$ c | Mini Pretzels | $\frac{1}{4}$ c | Raisins |
| 2 T | Dried Cranberries | $\frac{1}{4}$ c | Dried Chopped Apricots |
| 3 T | Banana Chips | 2 T | Dried Fruit Mix |
| 2 T | M&M Candies | 2 T | Chocolate Chips |
| 2 T | White Chocolate Chips | 2 T | Sunflower Seeds |
| 2 T | Other Ingredient (soy nuts, etc) | | |
| 3 T | Unsalted nuts, peanuts, cashews, or almonds | | |

Mix and portion out into muffin papers, small bags or cups.

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