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Enduring Understandings:

- Nothing disappears; matter can change form but it can be neither created nor destroyed.

NYS Standards: Elementary standards for math, science and technology:

Standard 1 (Analysis, inquiry and design):

- M1.1c Apply mathematical skills to describe the natural world
- M3.1a Use appropriate scientific tools, such as metric rulers, spring scale, pan balance, to solve problems about the natural world
- S2.3b Record observations accurately and concisely.

Standard 4 (Science)

- 3.2a Matter exists in three states: solid, liquid, gas. 5.1c The force of gravity pulls objects toward the center of Earth.
- 3.2c Changes in the properties or materials of objects can be observed and described..

This lesson builds on students' knowledge of the law of conservation of mass, which is a critical concept in ecology (among other sciences). It also allows them to practice their scientific thinking skills and to weigh materials, also very important in science.

Setting: School and Schoolyard

Duration: 50 minutes - 1 hour

Materials you will need:

Data sheet for each student (attached)

Pencils

This lesson is broken into stations:

Station 1 (optional if you do not have a precise scale) :

Digital scale or balance (whichever will weigh small amounts of weight)

Orange slices of the same size and weight

Apple slices of the same size and weight

Station 2:

A kitchen scale (also called a platform scale).

Two cups of frozen water

Two cups of liquid water

Station 3:

Spring scale (available for less than \$10)

Plastic bags

Ruler and Egg carton

Can of soup and a book
Magazine and bar of soap
Station 4:
Bathroom scale
Cups for each student
Potable water

Setting up the lesson:

1. One to two days before the lesson slice the apple and orange into equal slices. Take a few of the slices and place them in plastic bags so that they stay hydrated. There are a few options for drying the other slices. If it is a sunny day, you can simply leave them in the sun on a paper towel or paper plate. Be sure to keep it safe from animals that may want to steal the fruit! If you have a food dehydrator or laboratory oven, you can leave the slices to dry there. If you have or would like to make a solar oven, that works nicely as well (go to <http://www.solarnow.org/pizzabx.htm> for directions on making a pizza box solar oven). Lastly, you can place them in a conventional oven at 140°F for 4-12 hours.
2. Several hours or a day before, place exactly two cups of water in the freezer.
3. Just before the lesson, prepare the materials for each station.
4. If possible, find a parent or other adult to supervise each stations.

Lesson

1. Tell the students that today they are going to learn some important tools and techniques that many scientists use. They will be asked to weigh items using different scales, and they will want to be sure to take their time, measure the items accurately and write down all their scientific data. They will also be asked to make predictions, which is an important part of some scientific research.
2. Give each student a data sheet, pencil and assign groups to stations. Each station will take about 10 minutes. The student data sheet gives directions for each station.
3. Here is some extra information that can be used by the facilitator of each station and/or as a wrap-up discussion with the class:
 - a. Station 1 demonstrates an important technique used by many ecologists. They often want to measure the dry mass of leaves, soil, plants, and other objects in the natural world in order to understand more about food webs and other ecological processes. This station also builds on students' knowledge of evaporation.
 - b. Station 2 demonstrates the law of conservation of mass. Eventhough the ice is larger, that does not mean it is heavier. It simply expanded, but did not gain any weight as it changed from liquid to gas.
 - c. Station 3 demonstrates the importance of collecting scientific data, and using that data as evidence to answer the question. Scientists go to great lengths to as objective and critical as possible in their work. One way they do this is to make sure that the data they collect always takes precedence over how they feel or assume. Tell the students that while they may think, for example, that a bar of soap is heavier than a magazine – they can only really know if they weigh the two items.
 - d. Station 4 builds on students systems thinking skills and also demonstrates the law of conversation of mass. The water, of course, has weight. And when that water is added to their body, they will also gain the exact amount of weight. However, most of that water will also leave their body eventually and enter another system (like the wastewater treatment plant or the atmosphere).

Station 1 Digital Scale: *How much water is in this apple?*



When I dry the apple, most of the water will evaporate from the apple and enter the air. So the weight of the apple minus the weight of the dried apple will tell me how much water is in the apple. Of course, it is best to weigh the apple, dry the same apple, then weigh it again. But that takes time. I started with two slices of the same weight and placed one in a plastic bag and dried the other.

Apple slice's weight: _____
 Dried apple slice's weight: _____
 Amount of water in the apple slice: _____

Which has more water, an apple or an orange?
 Orange slice's weight: _____
 Dried orange slice's weight: _____
 Amount of water in the orange slice: _____

Station 2 Kitchen scale: *Does liquid water and frozen water weigh the same?*

I took 4 cups of water, and froze half of the water (I froze two cups)



Will they weigh the same amount? _____ If not, which will be heavier?

Weight of the frozen water: _____

Weight of the liquid water: _____



Station 3 Spring scale: *What we feel may not be what is real!*



Predict which item is heavier. Take one item. Hold it in one hand (palm face up) for one second. Pass it to the next person. Take the second item and hold it in the same hand for one second. Pass this item to the next person. Circle the item you think it heavier. Then, weigh the two items to test your prediction. Write down the weight if each item. Now move on to the second set of items!

Ruler: _____
 Eggcarton: _____

Can of soup: _____
 Book: _____

Magazine: _____
 Bar of soap: _____

Station 4 Bathroom scale: *Does your weight change when you drink water?*



Weigh yourself and write down your weight: _____

Drink 2 full cups of water. Will you be heavier, lighter, or the same? _____

Weigh yourself after you drink the water: _____
 What happened? How much did the water that you drank weigh?

