2nd Grade Science Action:
BUOYANCY

Parent Volunteer Notes for Grade 2 Buoyancy Lab

- Usually done mid-to-late January
- Reserve Auditorium (check dates of concerts; music teachers often schedule extra rehearsals during lunch, which will prohibit use of auditorium)
- Request 5 tables
    - 1 table for each Activity, 1-4
    - 1 table for Introduction/Demonstration
- Request use of Janitorial Closet across from the Auditorium
- Request 1 large rolling trash bin.
- Use towels/rags versus paper towels for water spillage
    - Recommendation: bring 1 beach towel & 1-2 hand towels per activity table
    - In 2018, we purchased disposable plastic table cloths for each table - - you may wish to place beach towels on the tables instead, and set up the materials on top of those
- For Activity 2, we recommend purchasing the pre-cut foil sheets OR ripping the foil ahead of time (1 sheet per student)
- Salt Water for Activity 3 – Use 4 ½ cups of salt in 1 gallon of water (This will make the real golf ball float)
- Bring a measuring cup from home to measure the sale for Activity 3.
- Purchase fresh Craisins every year.
- Leftover Lentils can be used year after year.
- You'll need two (2) 2L bottles of 7Up per class, plus 1-2 extra bottles
- Bring a strainer from home to use for Activity #4.
- Use personal bowling ball and basketball (or any 2 balls that are similar in size, but are different weights)
- Need 3 large clear plastic bins for: Introduction, Activity 1, and Activity 2
- The intro takes about 10 minutes, and each station takes about 9 minutes
- At the first station, have students write their name on their Data Sheet, and then put the Data Sheet and their pencil on the stage steps
    - For the last minute of each station, the parent volunteers help the students fill in their Data Sheets
    - Note: The Data Sheets will get soaked and ruined on the tables…and placing them on the floor didn't help to keep them dry

OBJECTIVES: Students will:

1. Understand the concept of displacement.
2. Learn that the density of an object will affect its buoyancy.
3. Explore the impact (on buoyancy) of changing the density of the medium by comparing the buoyancy of objects in fresh water vs. salt water.
4. Learn that buoyancy may be increased through the use of floatation.

MATERIALS:

For Introduction:

- Large cylindrical vase
- 2 Golf balls (1 regular and 1 plastic)
- 2 Forks (1 metal and 1 plastic)
- 1 Bowling Ball (could also use a heavy Bocce ball)
- 1 Basketball (if using Bocce ball, then replace basketball with a rubber ball about the size of the Bocce ball)
- 1 Balloon
- 1 Large Clear Bin (Big enough to fit both Bowling Ball and Basketball)
- 1 Kool-Aid packet
- 5 Sugar packets (real sugar – not artificial sweetener)
- 2 small plastic water bottles
    - 1 bottle of water will have water inside
    - 1 bottle of water will have 1 packet of Kool-Aid plus 5 sugar packets
- 1 can of Coke
- 1 can of seltzer

Note for Parent Volunteers: During this lab you may notice air bubbles on the objects. The air bubbles will help the objects float. Gently tap the objects to release any air bubbles. (This is an example of flotation, discussed in Activity #4.)

PROCEDURE

Introduction (full group):

Today in Science Action we're going to do some experiments on BUOYANCY. What is buoyancy? (Accept all answers.) *Buoyancy is the force that causes objects to float – it makes objects feel lighter in water than they do in air.*

Show the students an inflated balloon and the water-filled cylindrical vase and ask: *What will happen when I put this balloon in the water?* (It floats)
*What is really happening? The **buoyant force** of the water pushes up on the balloon to make it float. The buoyant force pushing up is greater than the weight of the balloon pushing down, and so the balloon floats!*

1. **Displacement:**

*We have another big word to learn today. What is **displacement**?* (Accept all answers.) *Two things cannot occupy the same place at the same time - if they try, one or both of them will be displaced.*

Ask for two volunteers and have the children come up and try to occupy the same place at the same time. *Can they do it? No because two things cannot be in the same place at the same time - one or both of them will be displaced.*

Demonstrate how displacement affects buoyancy:

Let's see how displacement works & find out how displacement affects buoyancy. (Use the inflated balloon/water-filled cylindrical vase again.) *What happens when we try to push the balloon under the water? The water rises - see, it is displaced. The balloon pushed the water out of the way, and the water had no place to go but up around the sides of the balloon. We easily see this by observing the water level rise along the sides of the cylindrical vase. When an object rests upon or sinks into water it pushes water out of the way. The water will resist being pushed by pushing back on the object - trying to move the object back out of the water. The more water the object moves out of the way (or displaces) the stronger the push back (or the greater the buoyant force) will be.*
(Show this by pushing balloon farther into the vase and letting go.)

2. **Density:**

*The **density** of an object impacts its buoyancy. What is density?* (How tightly packed an object is …so the more air an object has the less dense it is.)

Demonstrate how density affects the buoyancy of various objects in water:
2 golf balls (one regular and one plastic).
2 balls (one heavy and one light but similar in size; for example, bowling ball & basketball, OR bocce ball and rubber ball)
2 forks (one metal and one plastic)

I have 2 golf balls, a regular one and a toy plastic one. What will happen when I drop both of them into the water? (Demonstrate) *Which one sank and which one floated? Why did the regular golf ball sink?* (It's more dense and "heavy" compared to the water.) *Why did the plastic golf ball float?* (It's light and filled with air so it's less dense and "light" compared to the water - just like the balloon.)

I have a bowling ball and a basketball. What will happen when I drop both of them into the water? (Demonstrate) *Which one sank and which one floated? Why did the bowling ball sink?* (It's more dense and "heavy" compared to water.) *Why did the basketball float?* (It's light and filled with air so it's less dense and "light" compared to water – just like the balloon.)

I have a metal fork and a plastic fork. What will happen when I drop both of them into the water? (Demonstrate) *Which one sank and which one floated? Why did the metal fork sink?* (It's more dense and "heavy" compared to water.) *Why did the plastic fork float?* (It's light and filled with air so it's less dense and "light" compared to water – just like the balloon.)

So in these examples, even though they look the same, the two objects differ in what they are made of and their densities are different, and that affects their ability to float in water.

Demonstrate how density affects the buoyancy of various liquids in water:
What else has different densities? Liquids can also have different densities. The same ideas apply: if a liquid is more dense than water it will sink, but if it is less dense than water it will float! Let's look at some common drinks.

Water and Kool-Aid: *Here we have two bottles - they each have the same volume of liquid in them. One is full of water, and the other is full of Kool-Aid. What will happen when I drop them into the water?* (Demonstrate) *Which one sank and which one floated? Why did the Kool-Aid sink?* (It's more dense and "heavy" compared to the water because the Kool-Aid contains sugar, which is heavier than water.)

Coke and Diet Coke: *Here we have cans of Coke and Diet Coke - they each have the same volume of liquid in them. One is full of Coke, and the other is full of Diet Coke. What will happen when I drop them into the water?* (Demonstrate) *Which one sank and which one floated? Why did the Coke sink?* (It's more dense and "heavy" compared to the water because the Coke contains sugar, which is heavier than water.)

<u>Summary</u>:

So we have now demonstrated displacement, and how it occurs when an object (a balloon) is placed in a medium (like water).

We have also observed that:

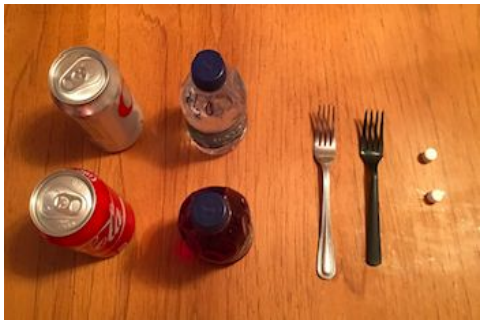
- *solid objects, and liquids, can have different densities*
- *density affects an object's buoyancy*

Today you will get to do your own experiments with buoyancy and further explore the effects of displacement and density on buoyancy.

3 Rules:

1. *Always listen to the parent volunteers and your teachers.*
2. *Nothing from Science Action should go in your mouth.*
3. *Have fun!*

Break up into groups. Have children with long sleeves roll up their sleeves.



Activity #1: Displacement

Materials:

- 1 red grease pencil
- 1 fish tank or large clear plastic tub
- 1 gallon filled with fresh water
- 1 clear plastic bowl (for parent volunteer to do demo)
- 1 bowl filled with mini ceramic weights
- 6 clear plastic bins (1 per student in group)
- 6 clear plastic specimen cups (1 per student in group)
- 6 clear plastic specimen half-cups (1 per student in group)

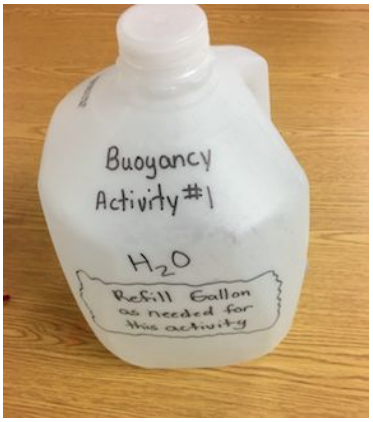
Advance Preparation:

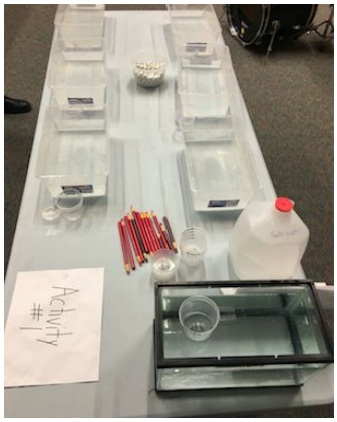
1. Parent Volunteer Only – Prefill the fish tank or large clear plastic tub for the lead parent volunteer.
2. Parent Volunteer ONLY – Prefill the small clear plastic bins that students will use during the activity. Fill them to the natural "line" in the container so kids have a reference point.
3. Parent Volunteer – mark the water line on the large tub with a grease pencil

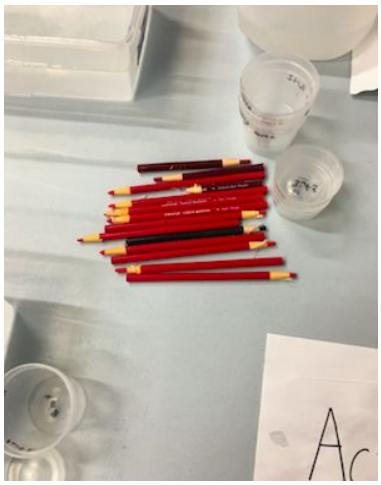
Procedure:

1. *Two objects cannot occupy the same space at the same time.*
2. *In buoyancy this causes **displacement**.*
3. *Will something happen to the water when we add objects to the water container? Let's do some experiments to find out.*
4. Parent Volunteer ONLY – Take a plastic bowl and float it on the water.
5. Parent Volunteer ONLY – Carefully push the bowl into the water.
6. Ask students to come up and carefully push the cup into water.
7. Ask the students, "*Can you feel the force required to displace the water?*
8. Ask the students, "*Does the water level change as you apply this force?*
9. Parent Volunteer ONLY – *Now add some weights to the cup.*
10. Ask students, "*Do you see the water level rise?"*
11. Ask students, "*Why does this happen?*"
12. Explain to students: (*When the weights are added to the cup, the combination becomes heavier, and more dense. This allows it to overcome more of the buoyant force, and so it sinks down further, displacing more water. As the water is displaced, it has nowhere in the container to go but "up" and we see this as a rising water level.)*
13. *Remember, two things cannot occupy the same place at the same time – if they try, one or both of them will undergo **displacement**.*
14. Parent Volunteer ONLY – Provide each student with an empty clean/dry specimen cup.
15. Ask the students, "*Will the empty specimen cup float in your clear plastic bin?* (Parent discusses with students about making predictions. Yes, it will float.)
16. Ask the students to place the empty specimen cup into the plastic bin and observe.

17. Discuss the observations with the students.
18. Parent Volunteer ONLY – Distribute 12 mini ceramic weights to each child.
19. Ask the students, "*Do you think the specimen cup will still float if you add the 12 mini ceramic weights?*"
20. Ask the students, "*What happened?*" (It floats)
21. Discuss the results.
22. Parent Volunteer ONLY – Provide each student with an empty clean/dry specimen cup that has been cut horizontally to half its original height.
23. Show the students both halves of this specimen cup so that they can see that this cup was identical to the first specimen cup.
24. *Now let's look at this specimen cup – what's the difference about this cup?* (It is only half the height of the first specimen cup.)
25. Ask the students, "*Do you think that it will still float if we place 12 mini ceramic weights in this one?*"
26. Ask students to place the half cut specimen cut into the clear plastic bin and slowly add the 12 mini ceramic weights into it.
27. Ask the students, "*What happened?*" (It sinks).
28. Ask the students, "*Why did the half cut specimen cup sink while the full size specimen cup floated?*" (As the water in the container is displaced, it rises up the sides of the container <u>and</u> the specimen cup. The water only has to be displaced a little bit, causing a small rise in the water level, for it to pour over the edges of the half cut specimen cup and sink it. Now this cup has weights and water in it whereas before it only had weights and air. It now weighs more than an equivalent volume of water, and so it sinks!)
29. **Note:** Help students complete Data Sheet.







Activity #2: Varying the Density of the Object - Aluminum Foil Boats

Materials:

- 1 large clear plastic tub for lead parent volunteer
- 1 sheet of aluminum paper for lead parent volunteer (1 sheet per group or 4 per class)
- 1 sheet of aluminum paper for each student (average = 150 sheets)
- 1 gallon of fresh water
- 6 small clear plastic bins (1 per student in group)
- 10 small clear plastic specimen cups that include the following: different colored stones, rocks, bottle caps, yarn, pennies, and mini ceramic weights.
- Empty slop bucket (to use as trash for the foil boats at the end of each group)

Advance Preparation:

1. Parent Volunteer ONLY – Prefill the large clear plastic tub for the lead parent volunteer.
2. Parent Volunteer ONLY – Prefill the small individual clear plastic bins that students will use during the activity.
3. Parent Volunteer ONLY – Organize 10 small clear plastic specimen cups in the center of the table in two rows.

Procedure:

1. Parent Volunteer ONLY – Parent takes one sheet of aluminum foil and asks, *"If I put this in the water, will it sink or float?"*
2. Parent Volunteer ONLY – Parent places the flat sheet of foil on top of the water. The flat sheet of foil floats. *Is this what you predicted?*
3. Parent Volunteer ONLY – *Will the flat sheet of foil hold anything and still float?* (Students make another prediction)
4. Parent Volunteer ONLY – Carefully place items on the flat sheet of foil and observe what happens. (Use yarn, bottle caps, pennies, stones, etc.) Add enough weight so that the boat does eventually sink. Discuss the results.
5. Ask students: *"Do you think that you could reshape the foil so that it could hold weights?"*
6. Parent Volunteer ONLY – Distribute 1 new/dry flat sheet of foil to each student.
7. Ask students to make boats out of the foil. (Each a different shape: round, oval, square, etc.)
8. Ask students to first try floating the boats to make sure they float.
9. Ask the students to predict how many weights their boats will be able to hold.
10. Have students carefully add weights to their boats and compare results.
11. Discuss with students: *Which shaped boat could hold the most weight? Why?* (The boat that displaces the greatest amount of water will be able to support the greatest amount of weight – because the more water you have displaced, the heavier the total amount of water displaced, and it is only when the boat and its contents weigh more than the weight of the water they displace that the boat sinks!)

12. **Note:** Help students complete Data Sheet.
13. Dispose of foil boats at the end of each group.

Activity #3: Varying the Density of the Medium - Salt Water

Materials

- 4 Plastic bins
  - 2 plastic containers with fresh water
  - 2 plastic containers with salt water
- 1 Popsicle stick or spoon (to stir salt water in bin)
- 2 Gallons of fresh water
- 2 Gallons of salt water
  - NOTE: Prepare salt water before lab. Use 4 ½ cups of salt in 1 gallon of water. Mix well.
- 1 boxes of salt (48 oz.)
- Measuring cup (need to bring one from home)
- 2 fresh eggs (plus a few extras, in case any break)
- Golf balls – plastic and real (about 7 of each)
- 7 Plastic eggs
- Ceramic weights

NOTE: At the end of each lab remove all mini ceramic weights from inside plastic eggs. Please wash and dry all mini ceramic weights, plastic eggs, golf balls, plastic golf balls, and the salt-water bins. If all items are not properly washed and dried, they can become damaged and unusable for the following year due to the excess salt.

Advance Preparation

1. Parent Volunteer ONLY – Prefill 2 gallons with fresh water from the janitor's closet. Use these to fill the 2 fresh water bins and place one on each short end of the table.
2. Parent Volunteer ONLY – Make salt-water mixture before lab and prefill 2 gallons. Pour into the 2 salt water bins and place one on each short end of the table.

Procedure:

What if instead of changing the density of the object in water, we change the density of the water itself?
Water found in lakes is different from water found in oceans - lakes contain fresh water and oceans contain salt water.
Do you think objects will float the same in both types of water or will they experience different buoyant forces and so behave differently?
Let's do some comparisons to see.

1. Have students make predictions before adding objects into the 4 plastic containers.

REAL EGGS:

2. Ask students to predict whether an egg will float or sink in fresh water? In salt water?
3. Parent Volunteer: place 1 fresh egg in the salt water and 1 fresh egg in the fresh water
4. Have students observe the results; compare and discuss the results.
5. **Note*:*** *Some objects will sink in regular water, but will float in salt water because salt water has a greater density than regular water.* (Think of it this way: In regular water the egg is more dense than the water and so it sinks. In salt water, the egg is less dense than the water and so it floats!)
6. Have students push down on floating egg in salt water to feel the buoyant force pushing back on the object.
7. **Note***: We have seen that some objects that do not float in regular water will float in salt water. Let's test out some other objects.*

GOLF BALLS:

8. Distribute 1 plastic golf ball & 1 real golf ball to each student and ask them to predict what will happen when the balls are placed in the fresh and salt water containers.
9. Have students place balls in the fresh water container and in the salt water container.
10. Observe, compare, and discuss results.

PLASTIC EGGS/WEIGHTS:

11. Distribute 1 plastic egg to each student. Ask them to place it in the fresh water and in the salt water.
12. Observe, compare, and discuss results.
13. Ask students to predict how many weights it will take to sink a plastic egg in the fresh water. And in the salt water?
14. Have students add the mini ceramic weights (approx. 2 weights at a time) into the plastic egg to determine how many weights it will take to sink the plastic egg in each type of water.
15. **Note:** Help students complete Data Sheet.

Activity #4: Increasing Buoyancy through Flotation - Dancing Craisins and Lentils

Materials:

- 7 up (2 – 2 Liter Bottles per class + 1-2 extra bottles)
- 1 Bag of Lentils
- 2 Bags of Craisins
- 7 tall clear cups
- Strainer (need to bring one from home)
- 1-2 slop buckets
- Wet wipes

Procedure:

Can an object that sinks be made to float? Let's do an experiment to find out.

1. Parent Volunteer ONLY – Distribute 1 tall clear cup to each student.
2. Parent Volunteer ONLY – Pour 7up (or other colorless soda) into a dry and clear tall cup.
3. **Note**: Point out the bubbles coming up from the bottom of the cup and explain that, "*the bubbles are carbon dioxide gas released from the liquid."*
4. Ask the students to predict what will happen when you add Craisins to the soda (7up). *"Will they sink or will they float?"*
5. Parent Volunteer ONLY – Distribute approximately 5 – 10 Craisins to each student.
6. Ask each student to predict what will happen once the Craisins are added into the 7up.
7. Ask each student to drop their Craisins into their own cup.
8. Ask students to make observations.
9. Discuss the observations. (*The Craisins first sink, then alternately rise and sink.)*
10. **Note**: If the Craisins are not alternatively rising and sinking, make sure the Craisins are fresh and gently tap on the cup to help the process.
11. **Explanation**:
    a. *The Craisins are denser than water so at first they sink to the bottom of the cup.*
    b. *As the tiny bubbles of carbon dioxide gas rise, they are attracted to the rough surface of the Craisins and so attach to the Craisins.*
    c. *Now the Craisins have a greater size, but the bubbles don't add much weight, so the overall density of the Craisins has decreased – the Craisins are bigger, but not really heavier so they rise to the top.*
    d. *Once at the top, the bubbles pop, causing the Craisins to return to being denser than the water again, and so they sink once more.*
12. When the action slows down, ask the students to predict what will happen when you add lentils to the water.
13. Parent Volunteer ONLY – Distribute approximately 5 – 10 Lentils to each student.

14. Ask each student to predict what will happen once the Lentils are added into the 7up with the Craisins.
15. Ask each student to drop their Lentils into their own cup.
16. Ask students to make observations.
17. Discuss the observations.
18. The lentils first sink and then both the Lentils and the Craisins resume alternately floating and sinking.
19. Ask the students, *"Can you think of an occasion when you have behaved like a floating Craisin?" If you have ever worn a set of inflatable floaters or an inner tube while in the water, then you have greatly increased your size with just a very small increase in weight. So your density becomes less than the density of water – and you float!*
20. Parent Volunteer ONLY – Use a strainer to pour the soda into the bucket; dump both Craisins and Lentils into the trash bin or into a separate bucket.
21. Parent Volunteer ONLY – Refill tall clear cup with 7up for each group (the straining process removes too much of the carbonation, so if you try to use the same soda again, the experiment does not work for the next group)
22. **Note:** Help students complete their Data Sheet.

Conclusion:

After students complete their Data Sheet for the last station, have them sit on the steps again to review and recap:

- *Can anyone remind us what buoyancy means?*
- *How about displacement?*
- *Can anyone tell us what density means?*
- *What is one new thing you learned about buoyancy?*
- *What surprised you during the introduction or at any of the activity tables?*
- *What was your favorite part of today's Science Action lab?*