SUGGESTED ACTIVITIES

(*Observing and Measuring Matter*)

From *Invitations to Science Inquiry 2nd Edition* by Tik L. Liem:

Activity	Page Number	Concept
• The funny water	122	Density
• The different clay sticks	126	Density
• Is the crown made of pure clay?	127	Density
• Can you make clay float?	128	Density

From *NSF/IERI Science IDEAS Project*:

Activity	Page Number	Concept
• A density dilemma	See following pages	Density
• Rainbow straws	" " "	Density
• Float the egg	" " "	Density
• Coke and Candy	" " "	Density
• Sum of the parts	" " "	Mass
• Measuring mass	" " "	Mass

From *Harcourt Science* Teacher's Ed. Unit E: (For ALL grade levels)

Activity	Page Number	Concept
• Physical properties	E4-5 (3rd grade text)	Qualitative Obs.
• What's that taste	E9 (3rd grade text)	Qualitative Obs.
• Measuring mass and volume	E20-21 (3rd grade text)	Mass and Volume
• Density	E10-11 (4th grade text)	Mass and Density
• Measuring volume	E13 (4th grade text)	Volume
• Using physical properties	E4-5 (5th grade text)	Quantitative Obs.

THE FUNNY WATER

A. Question: *What does it take to float?*

B. Materials Needed:

1. Two identical beakers, two identical watch glasses
2. One small and one large candle
3. Alcohol (methyl, ethyl, or isopropyl)

C: Procedure:

1. Fill beaker A about ¾ full of water and beaker B with the same amount of alcohol and cover them with the with glasses (do not reveal to students that the liquids are different).
2. Show the students the two candles: drop the smaller candle into beaker A and the larger one into beaker B.
3. Ask: "Why does one candle float and the other sink?" and "What will the candles do if they are placed in the opposite beakers?"
4. Drop the large candle in beaker A and the small one in beaker B.
5. See what happens.

D: Anticipated Results:

The students should expect to see, that despite the size of the candle, both will float in the water. When the candles are placed in the alcohol each will sink, despite their size.

E: Thought Questions for Class Discussion:

1. Why does the candle float in beaker A?
2. Why does the candle sink in beaker B?
3. What does sinking or floating depend on?

F: Explanation:

The alcohol has a lower density than water. This is why the candle sank in the alcohol and stayed afloat in water. Some students may suggest that it sank in beaker B because it is larger or longer than the other piece that stayed afloat. But then, after switching the pieces of candle around, the larger candle stays afloat in the water and the smaller one sinks in beaker B. This most likely will give students a clue, that the liquid in beaker B is some kind of "funny water." This liquid may be methyl, ethyl or isopropyl alcohol. All of these have a density of around 0.76 whereas, the density of water is 1. That of wax is 0.85.

Density is defined as the ratio of mass and volume of a substance. It is scientifically represented as D= M/V in which D= Density, M= Mass and V= Volume. Whether something sinks or floats depends on the relative density of the object compared to that of the liquid into which it is submerged. Any object that has a density between that of water (1) and that of alcohol (0.76) may be used for this demonstration.

THE DIFFERENT CLAY STICKS

A. Question: *Does floating depend on an object's weight?*

B. Materials Needed:

1. Molding clay and a short wooden stick
2. A technical or equal arm balance
3. Two transparent beakers (glass or plastic)

C: Procedure:

1. Wrap just enough clay around a short wooden stick, so that it would just barely float in water.
2. Place this on one pan of the equal arm balance and weigh off the same mass of clay on the other pan.
3. Roll a cylinder out of this mass of clay. You are now ready for the inquiry demonstration.
4. Show the students the two beakers filled with water and the two clay cylinders (to be placed in water).
5. Show them that they weigh exactly the same, by placing them on each pan of the equal arm balance.
6. Now drop them in the two beakers with water.

D: Anticipated Results:

The students will see that one of the clay cylinders sinks and the other floats.

E: Thought Questions for Class Discussion:

1. Why does one clay cylinder sink and why does the other float?
2. What property is the same for both sticks?
3. What property does it depend on whether an object sinks or floats in a certain liquid?
4. What force is holding the floating object afloat?

F: Explanation:

Although the mass of the two clay cylinders are equal, the volume is definitely not the same. This is because one contains a wooden stick inside. And this is the one that floats. Since the density may be calculated from D= M/V, it can be seen that the density of the floating cylinder is smaller than the one that sinks. The force that holds up the floating cylinder is the buoyant force, which is the mass of the displaced liquid (water in this case). If the mass of the displaced water is the same as the mass of the object, it will float. If the former is less than the mass, the object sinks.

IS THE CROWN MADE OF PURE CLAY?

A. Question: *Can the formula D= M/V help us solve object identity problems?*

B. Materials Needed:

1. Molding clay
2. Some sawdust or woodchips
3. A graduated cylinder or beaker
4. An equal arm or technical balance

C: Procedure:

1. Make "impure" clay by mixing some sawdust or wood chips in the clay.
2. Now make an intricate shape (like a crown) out of the "impure" clay, and ask: "How can I find out whether the crown is made of pure clay or not?" You may also tell the story of the King, his crown, and Archimedes).
3. Weigh pure clay on the balance of the same mass as that of the crown. Form the clay into a ball.
4. Determine the volume of the crown and the pure clay by immersing them one by one in the graduated beaker. Read off the water level before and after immersion and calculate the difference.

D: Anticipated Results:

The impure clay crown will displace more water than the ball of pure clay.

E: Thought Questions for Class Discussion:

1. If the crown and the clay ball were to displace the same amount of water, what may we conclude about the crown?
2. If the crown is made of impure clay, how would the two volumes differ?
3. Why does the ball need to be of the same mass as the crown?
4. What property are we actually determining of the crown?
5. What property is determined by immersing the object in water.
6. How did Archimedes determine the density of the King's crown?
7. Is density a specific characteristic of a substance?

F: Explanation:

The King suspected that his crown maker had cheated him (by mixing in copper with gold to make his crown). Therefore, he summoned Archimedes to check whether his crown was made of pure gold or not. To do this, Archimedes made use of the definition of density (D=M/V). He weighed out pure gold so that its mass would be the same as that of the crown. Then he determined the volume of the crown and the mass of the pure gold by immersing each in water. If the crown were made of pure gold, the density of both objects should be the same, thus also the volume of the displaced water. If the volume of the crown came to be larger than that of the pure gold mass, then the crown would have been made of impure gold.

CAN YOU MAKE CLAY FLOAT?

A. Question: *How can we make an object float?*

B. Materials Needed:

1. A lump of modeling clay.
2. A large beaker or transparent container.

C: Procedure:

1. Make a ball of clay with a diameter of about 5cm.
2. Fill the beaker half way with water and mark off the water level.
3. Ask students: “Will clay float or sink in water?” Plunge the clay ball in the water, mark off the water level and take it back out.
4. Transform the same ball of clay into a small boat (make sure it is watertight), and let it float on the water.
5. Draw students’ attention to the water level with the floating clay boat on the water.

D: Anticipated Results:

Students should observe the clay boat float, but not the clay ball.

E: Thought Questions for Class Discussion:

1. Was the clay ball heavier than the clay boat?
2. Which of the two displaced more water?
3. What is the volume of the displaced water equal to?
4. What is the weight of the displaced water equal ?
5. Would we be able to float iron or lead this same way?

F: Explanation:

The clay ball and clay boat were of the same weight, because the boat was made of the same mass of clay that the ball was made of. Mass is conserved and no clay has been taken away or added, the mass and thus the weight are the same. The boat however, displaced more water because of its shape. The volume of this displaced water is equal to the volume of the submerged part of the boat or ball, whereas the weight of the displaced water is equal to the buoyant force, which is the force upward. This is equal to the mass of the clay boat when floating, but less than the mass of the clay ball (this is why the ball sinks.)

A DENSITY DILEMMA

KEY OPENING QUESTION: Which liquids are more dense?

MATERIALS: 4 cups containing the following liquids:
One of Vegetable Oil
One of Corn Syrup
One of Blue Shampoo
One of Soy Sauce
7 Small Plastic Portion Cups (1.25 oz)

PROCEDURE:

1. Layer 2 liquids in 6 of the Small Plastic Portion cups (1/4 to ½ inch layers) in the following combinations:
   1) oil/shampoo
   2) corn syrup/shampoo
   3) soy sauce/shampoo
   4) oil/corn syrup
   5) oil/soy sauce
   6) soy sauce/corn syrup

2. Based on what you know about density. Predict which liquid will sink to the bottom.

3. Line up the cups to determine the order of the four liquids (least dense to most dense)
   - Which liquid is always on top?
   - Which liquid is always on the bottom?

4. Predict how the 4 liquids will layer when poured in the same container.

5. Experiment to find out by pouring combination one (oil/shampoo) and combination six (soy sauce/corn syrup) into the remaining Small Plastic Portion cup.

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RAINBOW STRAWS

KEY OPENING QUESTION: Which Solution Is The Most Dense?

MATERIALS:
straw
test tube
4 small plastic cups
large plastic cup (for discards)
food coloring (red, green, and blue)
water
table salt
3 -2L bottles

PROCEDURE:

1. Fill the 2L bottles half full with water and prepare as follows:
   - Bottle #1: no salt; add green food coloring (30-40 drops)
   - Bottle #2: 1 cup salt; add blue food coloring (30-40 drops)
   - Bottle #3: ½ cup salt; add red food coloring (30-40 drops)
2. Pour solutions into three separate test tubes.
3. Fill straw with one-inch of a solution by placing in solution, then holding finger on top of straw and lifting straw out of solution.
4. Add a second solution to the straw in the same manner: dip into second solution and lift finger off the top. The new liquid will rise into the straw. If solutions mix, then 2nd solution is less dense than the 1st.
5. Discard the mixture and begin again. Try to layer the three solutions so each layer can be seen clearly in a "rainbow" of colors.

OBSERVATIONS AND DATA:

CONCLUSIONS:

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FLOAT THE EGG

KEY OPENING QUESTION: How Can We Make An Egg Float?

BACKGROUND: Objects more dense than water will sink. The density of water is 1 g/cc. Water's density is usually increased when other substances are dissolved in it.

MATERIALS: hard-boiled egg, 250 ml beaker, water, box of salt, plastic cup, wood splint

PROCEDURE:

1. Fill the beaker to the 150 ml mark.
2. Carefully place the egg in the beaker.
3. Observe where the egg comes to a rest.
4. Pour salt into the plastic cup until it is half full.
5. Gradually add salt to the beaker, stirring to dissolve the salt.
6. Keep adding salt and stirring until you see the egg change its position in the beaker.

OBSERVATIONS AND DATA:

BEFORE Picture

Draw a picture to show where the egg went BEFORE you added the salt.

Draw a picture showing where the egg went AFTER you mixed in the salt.

AFTER Picture

Why do you think this happened?

CONCLUSION: (Answer the Problem.)

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COKE AND CANDY

KEY OPENING QUESTION: Which is denser: Coke or Diet Coke?
Snicker or Milky Way?

BACKGROUND: Objects that are denser than water will sink in water.

MATERIALS:
1 diet Coke can
1 Coke can
1 Snicker bar
1 Milky Way bar
1 large clear container
water

PROCEDURE:

1. Fill the container three-fourths with water.
2. Place the Coke can in the water. Observe its movement.
3. Place the diet Coke can in the water. Observe.
4. Take the cans out of the water.
5. Drop both candy bars into the water. Observe.

OBSERVATIONS AND DATA:
Tell what happened when each of the items were dropped into the water.

Make an inference as to why these results occurred.

CONCLUSION: Answer the problem questions.

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SUM OF THE PARTS

KEY OPENING QUESTION: Will The Sum Of Masses Of Parts Of An Item Be Equal To The Mass Of The Constructed Item?

MATERIALS: A scale
Legos or Knex
Science journal page

PROCEDURE:

1. In groups, build an object using the materials provided. Make sure your completed object can be placed on the scales to be massed out.
2. Make an estimate of its mass and record your estimate on a journal page. You may want to weigh some of the individual building pieces to help you make your estimate.
3. Place your object on the balance and find its mass. Record the object's mass in your journal. Compare the actual mass to your estimate. How close was your estimate to the actual mass?
4. Take your object apart. **DO NOT** mix up the pieces used to build the object with extra building pieces. Make an estimate of the total mass of the pieces. Record your estimate.
5. Place all of the pieces used to build the object on the balance and find their total mass. (You may need to place the pieces in a bag to weigh them. If you do, be sure to weigh the bag first so you can subtract its mass from the total mass.) Record the total mass of the pieces. Compare the actual mass to your estimate.
6. Write a mathematical equation that shows what you have learned from this activity. Write a statement that explains how the mass of the parts relates to the mass of the whole.

OBSERVATIONS AND DATA:

Explain your observations

CONCLUSION: (Answer the question)

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MEASURING MASS USING A TRIPLE BEAM BALANCE

KEY OPENING QUESTION: What Are The Masses Of Different Items?

MATERIALS: Triple beam balance
Sand
Rice
Puffed rice
Unpopped corn
Popped corn
Pencil
Marker
5 small zip-lock baggies

PROCEDURE:

1. Fill one bag with ¼ cup of sand.
2. Repeat step one with rice, puffed rice, unpopped corn, and popped corn.
3. Make sure the balance pointer is on the zero point.
4. Place the bag of sand on the balance pan.
5. Find the mass of the sand (to the nearest 0.1g).
6. Now look at the 0.1g mass column in the data table and write down the number your mass is showing in the correct box under "Mass Placement".
7. Look at the 10g mass and write down the number it is showing.
8. Look at the 100g mass and write down the number where it is located.
9. Add all the mass placements, and you will come up with your "Mass in Grams" total.
10. Record the total mass of the sand on the chart under "Mass in Grams".
11. Finish balancing each of the other items on the list and record their masses.

OBSERVATIONS AND DATA:

Fill in data table sheet.

Explain the differences in masses

CONCLUSION: (Answer the question**)**

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