All About Plastics

Plastics Exploration
Grades 6-8
Sorting and Identification of Plastics
Polymer Fun

Materials: (see teacher notes for more information), samples of plastics 1-6, "Characteristics of Common Plastics" information sheet, student worksheets, answer keys, 5 beakers, water, salt, corn syrup, isopropyl alcohol, vegetable oil, wooden stirring sticks
Activity Time: 2 class periods (45 – 50 min. ea.) or 1 block period
Concepts Taught: Scientific investigations, chemical and physical properties of matter
Correlations to NCSCOS: Grade 6: Math Objectives 1.03, 1.07, 4.06; Science Competency Goal 1; Grade **7:** Math Objective 4.01 Science Competency Goal 1; Grade **8:** Math Objectives 1.02, 4.01; Science Competency Goal 1, 3.01, 4.01, 4.02, 4.04, 4.05, 4.10;

Objectives:

- Students will recognize there are differences between plastics.
- Students will sort and identify plastics by their number.
- Students will investigate the physical properties of plastics and evaluate differences between those properties for each type of plastic.

For background information about plastics and plastics recycling:

- NEED Project booklet Museum of Solid Waste & Energy, pp. 22-25
- Hands on Plastics™ Background Information for Teachers http://www.teachingplastics.org/hands_on_plastics/intro_to_plastics/teachers.html
- American Plastics Council: http://www.americanplasticscouncil.org/s_apc/index.asp

Lesson:
Prior to the lesson, have students bring in various plastics from home. These should be collected by the teacher and kept aside until the day of the lesson.

PART 1:

1. Place collected plastics in a location of the classroom that is accessible by the majority of students. Students will devise a method to sort and count the plastics of each type. Students will then record and graph the results.
2. Ask students to hypothesize why there are so many different types of plastics. Have them look at their results and identify any types that are more common than others. Ask them to provide reasons for why this might be so.
3. Pass examples of plastics 1-6 around the room. Students will record observations on the Observations Worksheet about the physical properties of each plastic as they view them.

PART 2:
Students will work in cooperative groups of 3-4 to complete this part of the activity. Enough materials should be prepared so that each group has a complete set OR materials should be distributed and set up at 5 stations so that student groups can rotate through the stations.

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1. Instruct students that one of the easiest ways to classify plastics is by their densities. Density is the amount of mass an object or substance has divided by the volume of that object or substance. Each type of plastic has a specific density range, and by observing what a plastic does when placed in various liquids (float vs. sink), density ranges can be determined for identification of plastic types. This technique is used to sort plastics during the recycling process.
2. Review safety procedures for working with chemicals and equipment.
3. Distribute materials and worksheets to students.
4. Students will then follow the flow chart to perform density tests on all plastic samples using the following liquid substances: Water (Density=1.0 g/mL), Salt Water -1200g salt per 1 L of water - (D= 1.2 g/mL), Corn Syrup (D= 1.36 g/mL), Isopropyl Alcohol (D=0.94 g/mL), Vegetable Oil (D=0.90 g/mL). Students will use their observations and the density range values given on the Characteristics of Common Plastics information sheet to identify the plastics and fill-in the shaded boxes on the flow chart worksheet with the appropriate plastics number as they complete the tests.
5. Students will answer questions using the information they have gained during the experiment.

Extensions:

- Plastic Type # 7(Other) is used to categorize any plastic that does not fit into one of the other types (1-6). It is often a multi-layer plastic made by combining two or more of the other plastic types.
- Provide students with several different samples of Plastics #7.
- Have them try different variations of the density tests to find out if each of the #7 samples produce the same results. For example, did each #7 sample float in water? Sink? What about in the isopropyl alcohol?
- Ask students to try to provide a density range value for Plastic #7.

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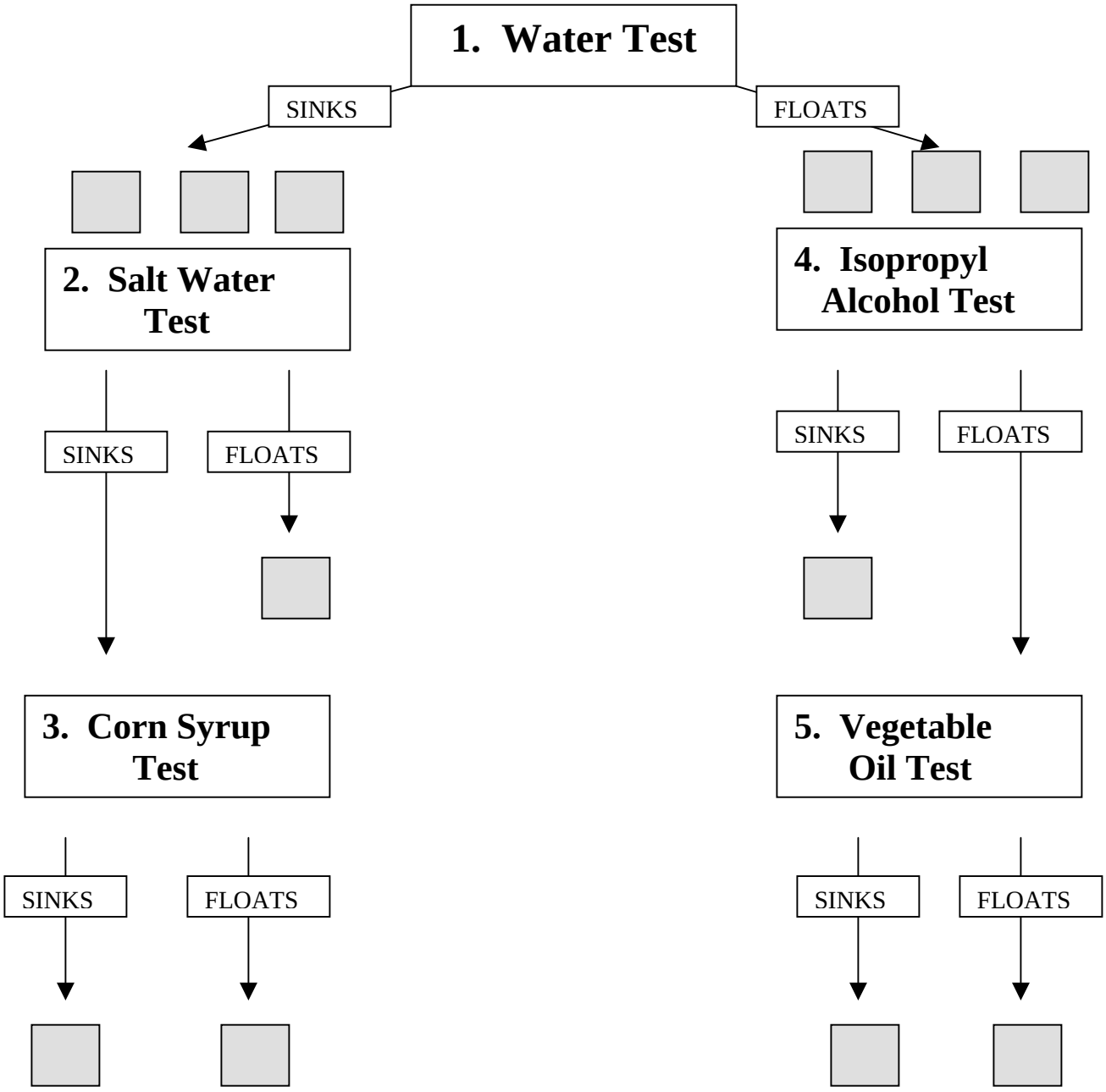
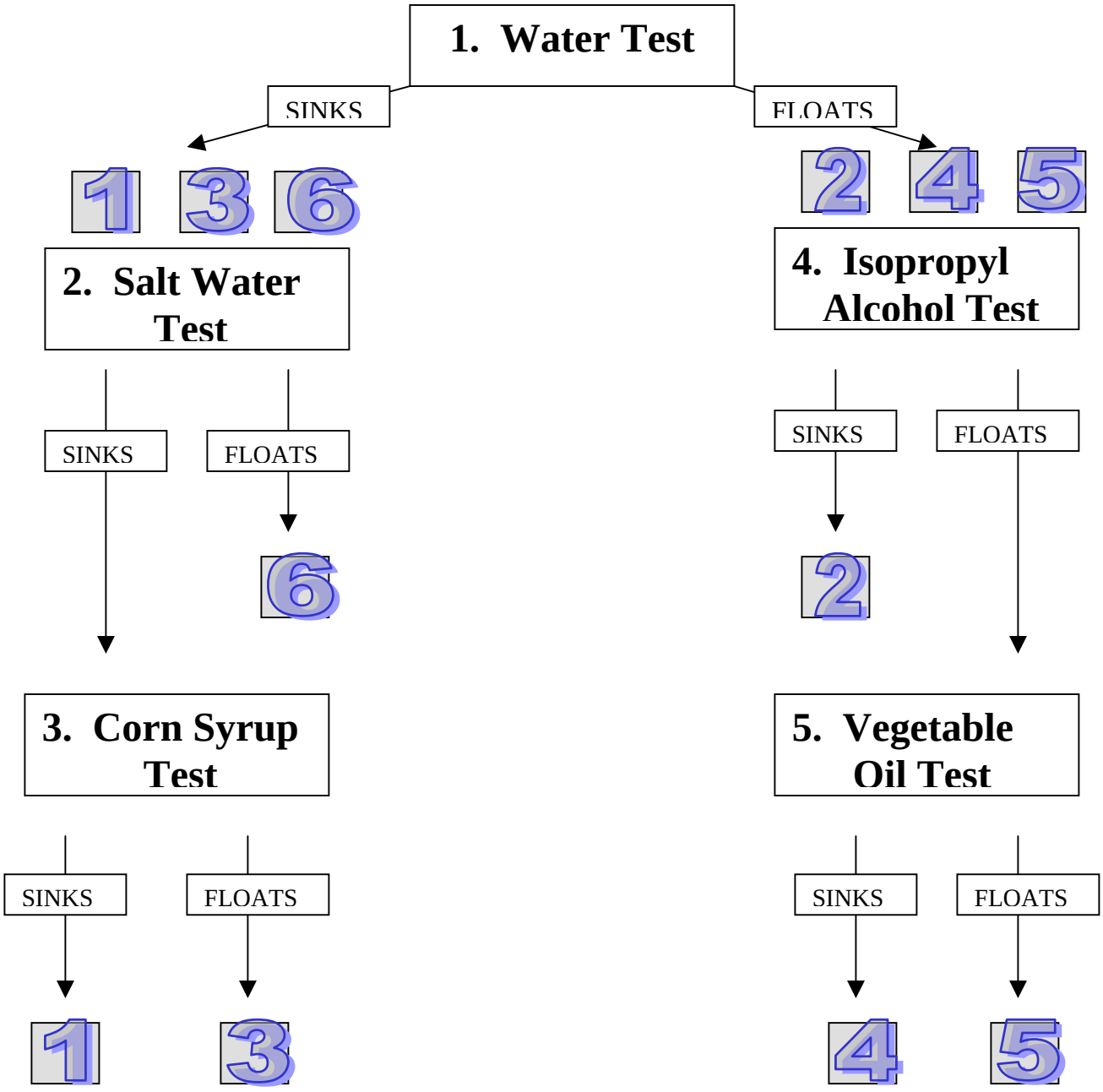
Follow the flow chart, performing each test as numbered in order. Please note that you will <u>NOT</u> use all 6 plastic samples for each test. After completing each test, determine which plastics (of the ones used for that particular test) sink and which float. Then record the answers in the appropriate shaded boxes or continue on to the next test.



ANSWER KEY


1. Water Test
SINKS
FLOATS
1 3 6
2 4 5
2. Salt Water Test
4. Isopropyl Alcohol Test
SINKS
FLOATS
SINKS
FLOATS
6
2
3. Corn Syrup Test
5. Vegetable Oil Test
SINKS
FLOATS
SINKS
FLOATS
1
3
4
5

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Name_____

Observations Worksheet

Plastics Type (#)	Observations
1 PETE	
2 HDPE	
3 PVC	
4 LDPE	
5 PP	
6 PS	

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Name_____

Application & Conclusion Questions

1. A lifeguard sees a young child fall into the neighborhood pool. There are 6 plastic life preservers labeled 1, 2, 3, 4, 5, and 6. If the labels identify the type of plastic each is made of, which three would be the best to grab to save the child? Why?

2. A ship carrying empty milk jugs down the Mississippi River has a spill, and the jugs go overboard. What will happen to the jugs when they hit the water?

3. What do you think would happen to the jugs when they reach the salt waters of the Gulf of Mexico? Explain your answer.

4.A local water park has a new ride called the Slime Flume. The slime used in the ride has a density of 1.15 g/mL. What type(s) of plastic would be best to use for making the floats for the ride?

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Application & Conclusion Questions

ANSWER KEY

1. A lifeguard sees a young child fall into the neighborhood pool. There are 6 plastic life preservers labeled 1, 2, 3, 4, 5, and 6. If the labels identify the type of plastic each is made of, which three would be the best to grab to save the child? Why?

The life preservers made from plastics 2, 4, and 5 would be best since they float when placed in water.

2. A ship carrying empty milk jugs down the Mississippi River has a spill, and the jugs go overboard. What will happen to the jugs when they hit the water?

The jugs will float. Milk jugs are made from HDPE (plastic #2) which floats when placed in water.

3. What do you think would happen to the jugs when they reach the salt waters of the Gulf of Mexico? Explain your answer.

The jugs would still float. The density range of HDPE is 0.95 – 0.97g/mL. The density of salt water is 1.20 g/mL. Therefore, the HDPE is less dense and will float on the more dense salt water.

4.A local water park has a new ride called the Slime Flume. The slime used in the ride has a density of 1.15 g/mL. What type(s) of plastic would be best to use for making the floats for the ride?

Plastics 2, 4, 5, and 6 could all be used to make the floats since they all have density ranges less than the density of the slime.

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Characteristics of Common Plastics

Plastic Type	Name	Properties	Density Range	Common Uses
	Polyethylene Terephthalate	Tough, rigid, shatter-resistant, softens if heated	1.38-1.39 g/mL	Soda, water, juice, and cooking oil bottles
	High Density Polyethylene	Semi-rigid, tough, flexible	0.95-0.97 g/mL	Milk and water jugs, bleach bottles
	Polyvinyl Chloride	Strong, semi-rigid, glossy	1.16-1.35 g/mL	Detergent bottles, shampoo bottles, shrink wrap, pipes
	Low Density Polyethylene	Flexible, not crinkly, moisture-proof	0.92-0.94g/mL	Garbage bags, sandwich bags, 6-pack rings
	Polypropylene	Non-glossy, semi-rigid	0.90-0.91 g/mL	Yogurt cups, margarine tubs, screw-on lids/caps
	Polystyrene	Often brittle, sometimes glossy, often has strong chemical reactions	1.05-1.07 g/mL	Styrofoam, egg cartons, packing pellets, take-out containers

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Polymer Fun

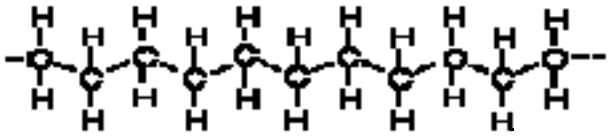
Materials Needed: water, glue, Borax, food coloring, plastic cups, wooden stirring sticks, plastic sandwich bags
Correlations to NCSCOS: Grade 6: Science Competency Goal 1, Science Competency Goal 2; **Grade 7:** Science Competency Goal 1, Science Competency Goal 2; **Grade 8:** Science Competency Goal 1, Science Competency Goal 2, Science Competency Goal 4 (especially 4.01, 4.02, 4.05, 4.06, 4.07, 4.10)

Objectives:

- Students will understand that plastics are polymers.
- Students will model plastic polymer formation.
- Students will create a polymer substance.

Lesson:
PART 1:

Plastics are made of polymers. A polymer (poly = many) is a chemical substance created when multiple basic units known as monomers (mono=one,single) are joined together to form complex molecular structures. Most plastics are hydrocarbon polymers which means they are constructed of mainly hydrogen and carbon atoms.



polyethylene

For more detailed background information:
http://www.americanplasticscouncil.org/s_apc/sec.asp?TRACKID=&CID=309&DID=919

Activity:
Have students stand together in an area of the room where there is open space and enough room to spread out. Each student in the classroom will act as a monomer. Then have students link arms to create one long polymer chain. See if they can come up with ways to create more complex structures by forming more linkages.
For a seated activity option: have students make paper chains or link paper clips into chains.

PART 2: Polymer Slime

Recipe: (to make one portion of slime – prepare enough materials for each student to make their own individual portion)

30 mL glue-water solution
10 mL Borax – water solution
2 drops food coloring

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To make glue-water solution
500 mL water : 500 mL glue

To make Borax – water solution
60 mL Borax powder dissolved in 1000 mL water

Directions:

Pour glue-water solution in plastic cup.
Put 2 drops of food coloring. Stir with wooden stirring stick.
Pour Borax – water solution into mixture. Begin stirring immediately.
Mixture should begin to thicken. Keep stirring until formation of a semi-solid. Final substance should have the consistency of Silly Putty™.
Store in plastic sandwich bag. Keep in refrigerator when not in use.

Have students reflect on the slime-making process by recording their experience in their science journals or science notebooks. They should describe the ingredients used and the steps they took. They should also write a brief description of their final product.

Then have them answer the following question:
Q: How does this explain and model polymer formation?
A: A polymer (slime) is a complex molecular structure made from combining simpler molecular structures (water, glue, and Borax) together.

Extension:
Plastic polymers are very important; plastic is used in hundreds of ways in our daily life.

1. Have students keep a log for one day that lists everything they do or use that involves plastic. Include use of products that are made of plastic and/or have plastic parts. (Example: brushing teeth – toothbrush and toothpaste tube are made of plastic, riding to school – vehicle parts are made of plastic, CD player – cord is covered in plastic, etc.)

2. Have students research one of the following areas where plastics are being widely used in new and innovative ways to improve life:

Medicine & Health	Industrial Safety	Packaging
Automotives	Building Materials	Clothing