

Why Do They Float & Sink?

INTRODUCTION: To help students understand the concept of floating and sinking using solutions of different density. Students in grades 5 and 6 may need more help with these questions than students in grades 7 and 8. Students will be introduced to the concept of density in terms of floating and sinking of plastic pellets. The Density Table will be used as a reference. Please note that you will be using *flexible PVC* and *solid PS*. *Rigid PVC* has a density of 1.36 –1.40 g/mL; *Foam PS* would be less than 1.00 g/ml.

MATERIALS: Activity sheets for each student and the flow chart.

Three Teacher demonstrations

Let students have time to predict and write answers before each.

- Place a cork and a penny in a cup of water.
- Place all six plastic pellets in 70% isopropyl alcohol.
- Place all six plastic pellets in concentrated calcium chloride solution.

DENSITY TABLE	
Substance	Density (g/mL)
Water	1.00
1-PETE	1.38-1.39
2-HDPE	0.95-0.96
3-PVC	1.16-1.35
4-LDPE	0.92-0.94
5-PP	0.90-0.91
6-PS	1.05-1.07

Explanation of Lab Activity:

Students will be placing all six recycled resins into water to watch them float or sink. The three that float in water are less than 1.00 g/mL and these are: HDPE, LDPE, and PP. See the Density Table for actual numbers. Plastics will vary in density when they are manufactured so there is a range of densities for each kind of plastic. Pure metals have an exact density and not a range.

When the three floaters are placed in 70% isopropyl alcohol, one plastic, PP will float since it is less dense than the alcohol solution that has a density of about 0.88 g/mL. By adding water (a more dense liquid) to the alcohol solution, the new solution will become more dense to about 0.94 g/mL. The next separation is when HDPE still sinks in the solution but LDPE floats.

On the other side of the flow chart, the sinkers in water will be added to a very concentrated calcium chloride solution. All three resins will float since they are less dense than the 1.40 g/mL solution of calcium chloride. As water (1.00 g/mL) is added to the dense solution, the new solution becomes less dense and the first resin to sink will be PETE, the most dense of the six. The second test solution has even more water added. The solution for test #2 is about 1.12 g/mL so that PVC sinks and PS stays floating.

Teacher Answer Sheet – Why Do They Float and Sink?

Answers to Teacher demonstrations:

- A. Cork will float; Penny will sink
- B. All will sink
- C. All will float

Answers to Explanation Questions:

- D. More dense objects will sink
- E. The penny will sink

Answers to Why Do They Float? Questions 1-7 on page 2 of student activity sheet:

1. Using your notes, place the letters of the three least dense pellets here: **(M, Z, X)**
2. Rank these three pellets from the least dense to the most dense based on your observations.
Least dense M, middle density Z, most dense X
3. Predict which letter from question 2 is which plastic.
Letter M is PP #5, Letter Z is LDPE #4, Letter X is HDPE #2
4. Now rank those resins that are more dense than water in order from the least dense to the most. **(W, P, Y)**
5. Using your notes from the flow chart and the density chart of plastics match the plastics with the letter of the resins.
Letter W is PS #6, Letter P is PVC #3, Letter Y is PETE #1
6. The plastics names are listed below:
PETE - polyethylene terephthalate
HDPE - high-density polyethylene
PVC - polyvinyl chloride
LDPE - low-density polyethylene
PP - polypropylene
PS - polystyrene
7. Why do all the names have the prefix “poly” in them?
Plastics are made out of polymers, or long-chain molecules. Poly means “many”, referring to many repeating units.

Answers to Evaluation Questions on page 2 of student activity sheet:

1. A ship carrying plastic pellets has a spill in the port of Chicago on Lake Michigan. All the containers are labeled “RECYCLED PLASTIC # 3”. What will you see on or in the water around the ship? Explain.
Lake Michigan is a fresh water port so #3 plastic is PVC; it sinks in fresh water.
2. Would it make any difference if the ship were in New York or Los Angeles? Explain.
Yes, it makes a difference because these are salt water ports. Ocean water is about 3.5% salt. Salt water is more dense than tap water. The question now is what is the density of salt water compared to the plastic pellets? Students will need time to experiment to find the answer.

Student Activity Sheet - Why Do They Float and Sink? (page 1 of 3)

Your Mission: You have just completed the task of identifying the pellets for a plastic factory. You have taken extensive notes on the pellets sinking and floating in the three liquids. Your job is to analyze the data and determine which plastic resin pellet is which plastic.

Purpose: To match the plastic resin pellets with the correct plastic name and symbol.

Your Predictions for teacher demonstrations:

A. Predict what will happen when a cork and a penny are dropped into a cup of water.

Prediction: _____

B. Predict what will happen when all 6 plastic pellets are dropped into 70% isopropyl alcohol.

Prediction: _____

C. Predict what will happen when all 6 plastic pellets are dropped into saturated calcium chloride solution.

Prediction: _____

Explanation:

- Water has a density of 1.00 gram/mL therefore those objects with a density of less than 1.00 gram/mL will float in water.
- 70% isopropyl alcohol has a density of about 0.88 g/mL therefore those pellets with a density of less than 0.88 g/mL will float in alcohol.
- One can conclude that objects that are less dense than the liquid they are placed into will float.

D. What is true about objects that are more dense than the liquid they are placed in?

E. The calcium chloride solution has a density of about 1.40g/mL. The density of a penny is about 8.00 g/mL. If you placed a penny that sinks in water into the calcium chloride solution, what will happen?

Student Activity Sheet - Why Do They Float and Sink? (page 2 of 3)

1. Place the letters of the three least dense pellets here:

_____, _____, _____

2. Rank these three pellets in question #1, from least dense to most dense based on your observations. **HINT:** 70% alcohol has a density of 0.88 g/mL and when water is added to the solution, the density of the new solution gets greater since water has a greater density (1.00 g/mL). *Place letters in the blanks.*

DENSITY TABLE	
Substance	Density (g/mL)
Water	1.00
1-PETE	1.38-1.39
2-HDPE	0.95-0.96
3-PVC	1.16-1.35
4-LDPE	0.92-0.94
5-PP	0.90-0.91
6-PS	1.05-1.07

Least dense _____, middle density _____, most dense _____

3. Look at the density table for plastics. Predict which letter from question 2 is which plastic.

Letter _____ is PP (#5); Letter _____ is LDPE (#4); Letter _____ is HDPE (#2)

4. Now rank those resins that are more dense than water in order from the least dense to the most. **HINT:** If you add water (1.0 g/mL) to the calcium chloride solution (1.40g/mL), then the resulting solution will be less dense.

Least dense _____, middle density _____, most dense _____

5. Using your notes from the flow chart and the density table of plastics, you should be able to match the plastics with the letter of the resin.

Letter _____ is PS #6; Letter _____ is PVC #3; Letter _____ is PETE #1

6. Write out the full name of each plastic:

1. PETE: _____

2. HDPE: _____

3. PVC: _____

4. LDPE: _____

5. PP: _____

6. PS: _____

Student Activity Sheet - Why Do They Float and Sink? (page 3 of 3)

7. Why do all of the names have the prefix “poly” in them?

Evaluate: Write answer below.

1. A ship carrying plastic pellets has a spill in the port of Chicago on Lake Michigan. All the containers are labeled “RECYCLED PLASTIC # 3”. What will you see on or in the water around the ship? Explain.
2. Would it make any difference if the ship were in New York or Los Angeles? Explain.