

Plastic Density Lab



Objective: Learn about different plastic polymers and what they are used for, then test the density of these materials. Relate this to marine debris by determining which materials could end up floating in the ocean and which would sink to the bottom, if disposed of improperly.

Materials needed:

- Containers full of water – individual cups/jars at each table so students can work in groups.
- An object made from each plastic resin code 1-6, cut up into small pieces. Most plastic objects have the recycling triangle with a number inside letting you know the type of plastic it is made of. It is helpful to try to choose objects that are different colors, or to color objects with a permanent marker if they are the same color. This helps distinguish which piece is which polymer once they are all cut up. You can use a hole punch or scissors to create the small pieces.

Some examples for each code:

1 – PETE (Polyethylene terephthalate) – water bottles, soda bottles, iced coffee cup lids, berry containers

2 – HDPE (High Density Polyethylene) – milk jugs, detergent bottles, grocery bags

3 – PVC (Polyvinyl Chloride) – old credit or debit cards, white PVC pipe (although this is harder to cut into small pieces)

4 – LDPE (Low Density Polyethylene) – dairy container lids, bread bags

5 – PP (Polypropylene) – sour cream or yogurt containers, some iced coffee cups

6 –PS (Polystyrene) – there are two forms of this plastic, it is usually a good comparison to have both:

- PS foam, “Styrofoam” – take out containers, insulated coffee cups, some egg cartons
- Solid PS – some hot coffee cup lids or clear, hard, brittle take out containers (sometimes used for baked goods)

7 – This code refers to “All other plastic”, there are too many options to include here, but you can add additional polymers if they are of interest.

Experiment:

Fill each container with water (tap water is fine if you don't have seawater, you can talk about the density difference between the two during the question section).

As you pass out a few pieces of each polymer to each group, list the resin code and polymer type on the board and talk about some common items that are made of that polymer (or share an infographic from links below).

Have the class define density.

After each group has some pieces of each polymer, have them hypothesize which polymers will float and which will sink based on comparing the pieces in their hand and what they know about the items made of each plastic.

Then have them work together to test which types float and sink and record their results.

Discuss as a class the questions below (this can be modified based on the age group):

- Talk about any discrepancies between groups – did some groups have a polymer that sank, while it floated for other groups? What could cause this? Have them retest this polymer. Sometimes a bubble stuck to a piece or the surface tension may make it float when it should sink (this is especially true of some solid PS). They will have to mix or submerge each piece for accurate results.
- Were their hypotheses correct? Were some polymers easier to predict than others?
- Did they notice a difference in how quickly some sank? Why might this happen?
- Does the size of the piece matter? Does the shape of the piece matter?
- What happens to the density if you add air to the material? (Use PS as an example)
- Would the results change if the experiment was done in seawater or freshwater?

Final discussion:

- Bring the topic back to marine debris.
- Based on what you know now, what polymers and objects could end up floating in the ocean if disposed of improperly?
- Where could the others end up?
- What are some impacts of these plastics ending up floating in the ocean or sitting on the bottom?
- What can individuals do to help prevent this? Which objects are things that could be avoided and replaced by a reusable option instead?

Key:

Density – the mass per unit volume of a substance (how compact something is)

Actual density of each plastic, you can list these on the board after the experiment:

- PVC 1.3 – 1.45 g/ml
- PETE 1.38 – 1.39 g/ml
- PS (solid) 1.04 – 1.07 g/ml
- HDPE 0.95 – 0.97 g/ml
- LDPE 0.92 – 0.94 g/ml
- PP 0.89 – 0.91 g/ml
- PS (foam) <0.05 g/ml

Density of fresh water = 1.0 g/ml

Density of seawater = approx. 1.03 g/ml

Some links to learn more about the different types of plastic with infographics about plastic types:

- <https://plasticoceans.org/7-types-of-plastic/>
- <https://www.brownrecycling.co.uk/news-advice/plastic-recycling-codes-article-infographic/>