

Vignette #1 – Sinking and Floating

A fourth grade class has recently started a unit on sinking and floating. So far, students have brainstormed objects they have observed in their everyday lives that sink and float, and have shared their ideas as to why. Possible reasons they came up with include the mass of the object, how much air is in the object, and the size of the object. The purpose of this lesson is for students to identify why some objects sink and why others float.

The teacher had asked students to bring in small objects from home that they could use for this investigation. Students have brought in a wide variety of objects, including rulers (plastic and wood), coins, wooden blocks, Lego's, golf tees, pencils, pens, balls (baseball, tennis ball, golf ball), and even plastic dolls. The teacher asks students to first write in their notebooks predictions of whether each object will sink or float in a tub of water. Next, they test their predictions. Students record the mass and size of each object and whether it floats or sinks in data tables they create in their science notebooks. The groups then place their data on chart paper, which they hang on the wall behind their tables. A sample data table is shown below:

Object	Mass (g)	Shape	Sink or Float?
Plastic ruler	42g	Long and skinny	Sink
Pencil eraser	13g	Small	Sink
Troll doll	243g	Medium	Float at first then sinks when water gets in
Penny	16g	Small	Sink
Charm bracelet	478g	Medium long and skinny	Sink
Wooden block	146 g	Small cube	Float
Toothpick	5 g	Small and pointy	Float

After the students have finished collecting data, the teacher leads a whole class discussion about their data and why things sink or float. For example:

Student 1: I noticed that when I placed the plastic cup on top of the water it floated, but if water gets inside the cup, it sinks.

Teacher: So what conclusion can you make from your evidence?

Student 1: I think air has something to do with it.

Teacher: Air has something to do with sinking or floating.

Student 2: I don't think so.

Teacher: Tell us why you disagree.

Student 2: We talked the other day about how big heavy boats float, and big boats are filled up with lots of cargo and stuff so there's less air in them but they still float. So I don't think air has anything to do with it.

Teacher: Okay, so air doesn't matter. Yes or No?

Some students in class nod their heads to indicate "Yes" and others shake their heads "No."

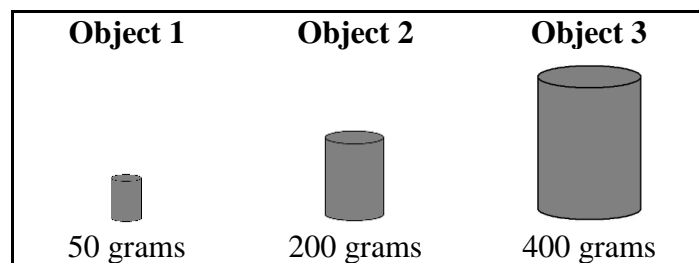
Teacher: So what about the size of the boat?
Student 2: The boat is big and the cup is small, and both float.
Teacher: So is size an important factor in determining if things float or not?
Students: No.
Teacher: Okay, how about mass?
Student 3: I think that it doesn't have to do with mass.
Student 4: I don't think so...
Student 3: [Interrupting Student 4] Like a penny is not that heavy but it sinks.
Teacher: So you think that...
Student 5: Mass doesn't matter.
Teacher: So you think mass is not a factor as to whether or not it sinks?
Student 3: The penny is light and it still sinks.
Teacher: So you're saying mass has nothing to do with it. We can throw mass right out the window.

The lesson ends with the teacher summarizing the class discussion. The teacher tells students, "Today we investigated what factors determine whether an object sinks or floats. Some of you have already made some conclusions about why things sink and others are still thinking about your data. Tomorrow we'll try putting our objects in a different liquid – salt water – to see how that affects things."

Vignette #2 – Sinking and Floating

A fourth grade class has recently started a unit on sinking and floating. In a previous lesson, students were asked to brainstorm about what makes objects float or sink. Ideas volunteered by students included the mass of the object, how much air is in the object, and the size of the object.

The purpose of this lesson is for students to learn that mass alone does not determine whether an object sinks or floats. The teacher starts by saying, “At the beginning of this unit, you shared lots of factors that you think determine whether objects sink or float. Many of you thought the mass of the object was important. Let’s find out whether the mass of an object determines whether an object sinks or floats. To start, I’ll do a demonstration.” The teacher shows students the three objects pictured below.



The teacher asks students to predict whether each object will float or sink. Almost all students think Object 1 will float and Object 3 will sink; students are divided as to whether Object 2 will float or sink. The teacher asks students for their reasons. One student shares, “Because heavy things sink and light things don’t.” Many students agree. The teacher places each object in a large tank of water, and the students observe, much to their surprise, that Object 1 sinks and Objects 2 and 3 float. A discussion follows:

Teacher: You seem surprised by the results of the demonstration. Tell me why.

Student 1: I thought if an object has a lot of mass, it sinks.

Student 2: Me, too. I don’t understand why Object 1 sank, but Object 3, which was much heavier, floated.

Student 3: Maybe it was the way you placed the objects in the water that made them float or sink?

Teacher: Okay, I’ll repeat the demonstration.

The teacher does the demonstration again, being sure to place each object in the water in the exact same way. The students observe the same results.

Teacher: So can we agree now that Objects 2 and 3 float, and Object 1 sinks?

Students: Yes.

Student 4: But that can’t be right. I still think mass makes a difference. It must.

Teacher: Why do you think that?

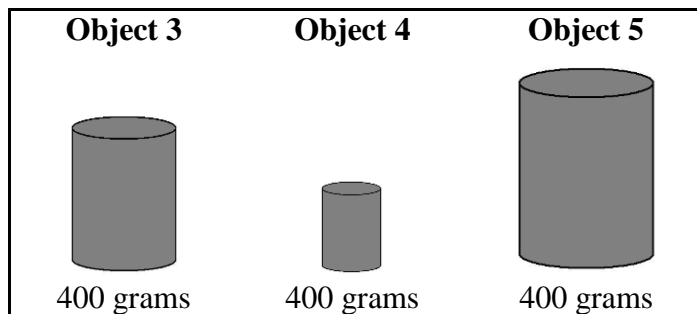
Student 4: Rocks are really heavy, and you always see them at the bottom of rivers and creeks.

Teacher: Do you think those rocks are heavier or lighter than this 400 gram object?

Student 4: I think they are probably a lot heavier.

Teacher: Okay, so maybe we need to collect some more data. This next demonstration might help. (*Addressing the whole class*) Do you think all objects with a mass of 400 grams float? Let's test two more objects that have a mass of 400 grams.

The teacher shows the class two additional objects that are pictured below next to object 3:



Teacher: Do you think they will float? Why or why not?

Many students think that the new objects will float because their mass is the same as Object 3's. Some think that the new objects will sink because 400 grams is a lot of mass. The teacher places the objects in the water, and the class observes that object 4 sinks and object 5 floats.

Teacher: So what does this experiment tell us about mass and sinking and floating?

Student 5: Mass doesn't seem to matter.

Teacher: Does everyone agree? [Many students nod their heads in agreement.]

Teacher: Who can tell me why?

Student 6: The really heavy object in the first demonstration floated, but when you tested the other two objects that also were 400 grams, one floated and one sank.

Teacher: So what does that tell us?

Student 7: If mass was the reason why things float or sink, all of the 400 gram objects would have either sank or floated, but two floated and one sank.

Teacher: It sounds like we agree that mass alone does not determine whether an object floats or sinks. Can we think of some examples from real life that support this conclusion?

Student 8: At the swimming pool, we throw in coins and dive after them. They sink to the bottom of the pool, but they aren't very heavy.

Student 9: Boats. They are really heavy, much heavier than coins, and they float.

Teacher: If it isn't mass alone, do these demonstrations raise any new ideas about what factors might affect sinking and floating?

Student 10: The size of the object

Teacher: Why do you think the size, which we call volume, might matter?

Student 10: In the first demonstration, the volumes of the objects were not all the same and we got different results—one object sank and two floated. So maybe the volume has something to do with it.

To close the lesson, the teacher says, "As a class, we are now in agreement that mass alone does not determine whether an object floats or sinks, but we need to consider in our upcoming lessons if volume is a factor that affects floating and sinking."