Explore It!

SCIENCE INVESTIGATIONS
IN OUT-OF-SCHOOL PROGRAMS

Sinking & Floating

EDC CENTER FOR Science Education

Sinking & Floating

WHAT FLOATS AND WHAT SINKS?

EXPLORATION 1

In this exploration, your team will investigate whether certain familiar objects sink or float in water. First, you will make predictions about which items will sink or float, and then you will test to see whether your predictions were correct.

Discovery Question

**Of the items you have been given,
can you predict which will sink and which will float?**

WHAT TO DO

PART 1 Predicting

1. Look at the objects your program leader has given you. For each one, predict whether it will sink or float in water.
2. On the *Will It Float or Sink?* chart provided, give your prediction and write the reason you think your prediction is correct.

PART 2 Testing

1. Fill the paint bucket about half full of water.
2. Place each item in the water to see whether it sinks or floats.
3. Fill in the result in the last column of the *Will It Float or Sink?* chart.

WHAT TO THINK ABOUT

- What properties of the object may cause it to sink or float?
- For those objects that floated, what were they made of? What was their shape?
- For those objects that sunk, what were they made of? What was their shape?
- Were there other properties that the two groups of objects had in common? Were there other properties that were very different?

WHAT FLOATS AND WHAT SINKS?

EXPLORATION 1

EXPLORERS' SHEET 1

WILL IT FLOAT OR SINK?

For each object you look at, predict whether it will sink or float in water in the third column. Then write the reason for your prediction in the next box. Finally, test each object to see whether it sinks or floats, and write that result in the final box.

Object	Type of Material	Prediction: Sink or Float?	Reason(s) for Your Prediction	Actual: Sink or Float?

WHAT FLOATS AND WHAT SINKS?

EXPLORATION 1

MATERIALS

For Each Team

- 1 paint bucket*, partially filled with water
- 1 "Sink-and-Float" collection, which may contain some or all the following (you may also use alternative items):
  - apple
  - potato
  - metal paper clip
  - modeling clay (oil based)
  - plastic spoon
  - Styrofoam meat tray
  - Styrofoam cup
  - cork (available in hardware stores; you can also use corks from wine bottles)
  - piece of a half-gallon milk carton*, cut into squares 4 inches x 4 inches
  - drinking straw
  - empty can
  - piece of 2-liter soda bottle, cut into squares or strips
  - ice cubes
  - string
  - wooden ball
  - glass marble
  - plastic bead
  - high-bounce ball[1]
- 1 Explorers' Sheet, including the *Will It Float or Sink?* chart

Shared

- newspaper or sponges (for cleanup)

For the Program Leader

- 1 GladWare Mini Round container with lid* (alternative: 1 35-mm plastic film canister with lid)
- modeling clay (2 ounces or a 2-inch cube)
- 1 apple (or similar fruit or vegetable that floats)
- 1 large bucket (3–5-gallon size)

Additional information is available under Special Notes About Materials (page xv) for those materials noted with an asterisk (*).

[1] If you are using the balls and beads, it enhances the explorations if all of them have the same or similar diameters.

PREPARING FOR THE EXPLORATION

- For each team, **gather a "Sink-and-Float" collection of objects**, such as those suggested in the Materials list. You can add or substitute items that seem appropriate. The collections should contain items that sink (for example, stones), items that float well (for example, corks or hollow balls), and items that either sink or float (for example, cans or containers). The collection should include some items that will defy the children's expectations with regard to floating or sinking, such as candles, fruits, and certain plastic balls and beads.
- If you do not have a water supply in your room, gather empty 1-gallon milk jugs (about one per two teams) and fill them with lukewarm tap water before the children arrive. Also have on hand a 3- to 5-gallon bucket to dispose of the water after the children have finished working for the day.
- **Prepare for the demonstration that you will do during the Introducing the Exploration segment:** Fill a GladWare Mini Round container (or film canister) half full of clay, replace the lid (Figure 1), and test to see whether it will float. While testing, adjust the amount of clay so that the container hovers just below the surface of the water (Figure 2). Keep this container for the demonstration.

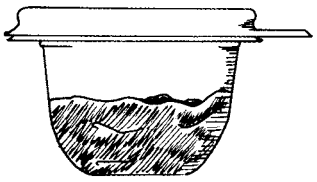

Figure 1
Container filled halfway with clay.

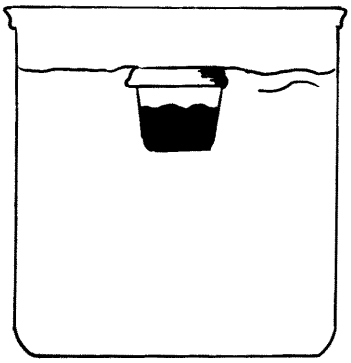

Figure 2
Container hovering just below the surface of the water.

- Spread out newspaper or plastic sheets to protect the tables from water.
- Make one copy of the Explorers' Sheet for each team, including the *Will It Float or Sink?* chart. However, wait to pass them out until after you have explained the task at hand.

***NOTE**: Some of the materials used in this exploration can be recycled for use in later explorations.*

WHAT FLOATS AND WHAT SINKS?

EXPLORATION 1

Introducing the Exploration

Begin by asking the children what happens when they jump into a swimming pool. Do they float or sink? (Although most people float, there are some who do have a hard time staying afloat.)

Have they ever used Pool Noodles or inflated toys to keep themselves afloat? Also, ask them why very large ships that travel the ocean, and boats on ponds or lakes, stay afloat even though they are very heavy.

Tell the children that during this project they will be trying to figure out what makes some things float and other things sink. Show the children the materials they will be using. Read them, and then discuss, the Discovery Question on the Explorers' Sheet.

Exploratory Demonstration

1. Hold up an apple and ask the children whether they think it will sink or float in water. If some children have had experience with bobbing for apples, they may immediately say that it will float. Others may think that because it is a solid and heavy object, it should sink. Let everyone express his or her opinion, but do not reveal the answer at this point.
2. Hold up the GladWare Mini Round or film canister that is half full of clay. Let the children look inside and feel the weight if they want to.
3. Ask whether they think this item will sink or float. Again, let the children express their opinions.
4. Carefully drop the apple and the canister into a bucket of water and watch what they do.

Sink and Float Chart

After they have watched your demonstration and expressed their initial reactions, put away the materials and post a sheet of chart paper with the title *What Makes Things Sink and Float?* Divide the chart into two columns headed *Sink* and *Float*. Then ask the children to think about what they just observed and about all the other things they have seen sinking and floating. Have them try to say what it is that makes some things sink and other things float.

As they call out their ideas, write down anything they say that fits into either column.[2]

After a few minutes, or when they run out of ideas, congratulate the children on their ideas and tell them that over the next few sessions, they will all be engaging in a scientific exploration to see which of their ideas actually fit with the experiences they are about to have. Tell them also that, like scientists, their task from now on is to try to find the patterns that explain why some things sink and other things float.

2 Do not edit or select what they say beyond making a shorthand version, and do not worry if some entries contradict others—all the more fodder for debate as the process continues.

Then hold up a copy of the *Will It Float or Sink?* chart and point out how each column should be filled in. Tell the children that you want them, in their teams, to write their predictions on the chart. Tell them to try to agree among themselves on what will happen to each item, but that if they cannot agree, to make a note of that fact.

Finally, before you let the children start, tell them that they will be working with water, so they need to be especially careful not to get their clothes wet, particularly if it is cold outside when the children leave this activity. Form teams, assign roles, hand out the Explorers' Sheet to each team, and have the materials manager from each team (see Teamwork on page xii of the Overview) collect the materials for the activity (minus the water).

LEADING THE EXPLORATION

PART 1

Give the children 5 to 10 minutes to look at the objects in the Sink-and-Float collection and to write their predictions on the *Will It Float or Sink?* chart. Walk among them as they do this to help them figure out what the objects are called and to keep them on task. As soon as they begin to lose focus and start playing irrelevant games with the objects, call the whole group together to report out.

On chart paper, make a large version of the *Will It Float or Sink?* chart and ask the group what they predicted for each item. For most items, there will be agreement about whether the item sinks or floats. Differences may arise in the reasoning, however, so try to capture this (in shorthand) in the "Reasons" column. When you have been through most of the items in this way (covering at least one item made from each major material: wood, metal, clay, plastic, and so on), tell the children that it is now time to find out what really happens. Invite the materials managers to collect the water so that the teams can test the objects.

PART 2

As the teams start to experiment with the materials, walk among them, asking what they are finding out. Especially ask whether their findings are different from their predictions and, if so, how they can explain that. Ask whether they still hold to the reason or explanation they gave initially. If the children have not already done this, have them fill in the "Type of Material" column.

When all the teams have had enough time to test all the items, call the whole group together again to share results. It is a good idea to move the children well away from the bottles and water so that you have their full attention during the group discussion.[3]

[3] Because water is involved, try to establish a routine for cleanup. Have a specific child in each team take on the role of dumping the water out. Another can wipe the table dry.

WHAT FLOATS AND WHAT SINKS?
EXPLORATION 1

LEADING THE DISCUSSION

Throughout this discussion, display and refer to the large *What Makes Things Sink and Float?* chart. Add ideas to it when appropriate. Use it as a conversation starter if you see obvious disparities between what is on the chart and the experiences the children are now reporting.[4]

Ask whether they can see any properties that are shared by all the sinkers or all the floaters. If they continue to list only individual items and materials, ask what the effect or importance is of each of the following attributes:

- **Weight**: Do only light things float? Did they find that some heavy things floated?
- **Size**: Did the size of the object make a difference in whether it floated or not? For instance, did larger pieces of a meat tray float?
- **Shape/Design**: Do hollow things float?
- **Material**: Wood and some plastic materials floated. Did any of the metal materials float?
- **Air**: Do some materials float because they have air trapped inside?

Throughout this discussion, keep referring to the *What Makes Things Sink and Float?* chart. Keep asking whether their earlier explanations still hold up in light of new experiences or new thinking. Ask whether there are any ideas on that list that should be removed or any new ones that should be added.

At this time you could introduce the word *buoyancy*. You can tell the children that another way of describing objects that float is to say that they have buoyancy. This term has a special scientific definition, but during this project it will be used to describe how objects float in liquids such as water.

Save the large *What Makes Things Sink and Float?* and *Will It Float or Sink?* charts to refer to in the subsequent explorations.

4 Most children know that wood floats and that heavy metal objects (generally) sink. The candle, the apple (or other fruit or vegetable), the string, and the container with clay may have surprised some children, but it is in their reasoning about *why* these things sink or float that the children reveal most about their naive thinking on the topic. Your task is to get the children's ideas out into the open so that they and you can challenge them to compare their thinking with the evidence and experiences they are now having. So, ask the children what it is about each item that made it sink or float.

WHAT FLOATS AND WHAT SINKS?

EXPLORATION 1

RATIONALE

The goal of this exploration is to get the children's ideas about sinking and floating out into the open. By making predictions about particular objects and then testing them, and by making general statements that try to explain *why* things sink or float, children quickly become aware that this is not the simple problem they may have thought it was.

SCIENCE/TECHNOLOGY BACKGROUND

Two common naive conceptions about sinking and floating are that heavy things sink and that things containing air float. However, if you think about the ocean liner Titanic and the iceberg that sent it to the bottom of the ocean, you can see that it is not quite as simple as that.

First, as massive as the *Titanic* was, an iceberg is a great deal heavier! So it was the lighter of the two that sank, not the heavier. When it was floating, the *Titanic* did have a lot of "air" inside. After a hole was punched in the hull and the ship filled up with water (replacing the air), it sank. This reinforces the idea that it is air that keeps things afloat and leads some people to conclude that an iceberg must have air in it, too. The reasoning is something like this: If things that have air in them float, then things that float must have air in them.

In fact, icebergs have no appreciable amounts of air inside them, and even if they had none at all, they would still float very well. They float because they are made of fresh water (frozen), which is less dense (see the following section) than the salt water they float in. A submarine, by contrast, has plenty of air inside and can both sink and float.

So, neither weight nor air is a very helpful way of thinking about sinking and floating. It is better to pay attention to (1) the kind of material an item is made from—in particular, the *density* of that material, and (2) the overall shape (or design) of the object.

Density

In science, the weight per given volume for a material is called *density*. For example, a one-inch cube of a certain material might weigh 2 ounces. A one-inch cube of a different material might weight 3 ounces. The latter material has a greater density than the former. It is not intended that you talk to the children specifically about density during this project. The connection of density to buoyancy is this:

If you have a solid block of material—with no spaces or fancy shapes involved—then the density of the material (mass/unit volume) compared with the density of water is what determines whether it will sink or float in water. Simply saying that an object is heavier or lighter is not sufficient as an explanation for why things sink or float. Comparison of materials has to be in terms of a ratio. If the density of a material is greater than the density of water, it will sink. If a material's density is less than that of water, it will float.

However, when materials are made into shapes like boats, these statements do not apply. Some boats made with wood will float even if they are filled with water. Some boats made from metal will float, if they have not taken on water. And even without using the term *density* or trying to explain it, children can still generally understand that some materials are "heavier" or "lighter" than others *for a given volume*, even if they are not thinking precisely about what that means.

This confirms one half of what the children will have discovered, that light materials (with densities less than the density of water), such as Styrofoam, will float no matter what their shape, the number of holes in them, or how much water they are filled with. A wooden ship full of water may not float the right way up, but it will float. And any young swimmer will confirm that Styrofoam flotation devices will not sink. When pushed under the water, they will come rocketing back to the surface and float there.

Density, however, does not resolve the problem of the heavy materials (whose density is greater than the density of water), which require a more complicated explanation. Lumps of metal, concrete blocks, and stones usually sink, but each material can be made to float if formed into certain shapes and positioned in the water in particular ways. The children will investigate this phenomenon in Exploration 2.

Observing Progress

This first exploration is an opportunity to get children to reveal their thinking about why objects sink or float. They may not be able to give careful explanations, and their descriptions of the materials' properties may be very vague. The challenge for you is to help them make repeated attempts to come up with clearer responses even if they are not scientifically correct. Part of the goal of these explorations is to provide opportunities to witness certain kinds of events with objects in water and attempt to find words to explain what happened. In this first exploration, take note of how and what kind of explanations are put forth. In the last two explorations, you will compare children's responses at that point to their responses in this first activity.