Try This at Home Science:
Tinfoil Boats

Activity Overview:
Discover how density and surface area can help float your tinfoil boat, or sink your experiment.

Materials:
- Tinfoil
- Sink or bath tub with drain plug
- Pennies or marbles
- Towels

Try this!
1. Tear a sheet of tinfoil from the roll and fashion it into a boat-like shape.
2. Fill the sink half full of water, and have towels handy for any spills.
3. Place your boat into the water and observe.
4. Did it float? If so, proceed to Step 5. If not, reform your boat into a shape that may float better. If needed, get a new piece of tinfoil and repeat Steps 1-4.
5. Place pennies or marbles into the boat one at a time and count them as they are added.
6. Continue to add and count pennies until the boat *begins* to sink below the surface. Record the number of pennies in the boat.
7. Continue to add and count pennies until the boat *almost* takes on water. Record the number of pennies in the boat.
8. Continue to add and count pennies until the boat *begins* to take on water. Record the number of pennies in the boat.
9. Continue to add and count pennies until the boat *completely sinks*. Record the number of pennies in the boat.
10. Choose a variable to change in your boat design from the ***Now Try…*** Section and repeat the experiment. Compare results between the two experiments and hypothesize "why".

What's happening?
Tinfoil floats due to its density, or how close molecules are within a substance or object. A denser object has many molecules clustered together, where a less dense object would have more space between the molecules. For example, two sheets of tinfoil the same size are placed in water and both float, but what happens when we crumple one up into a ball? The crumpled ball will sink because it now has a greater density than before. Even though it has the same mass, the molecules of tin foil are now closer together, making it denser than the water, causing it to sink.

How does this relate to boat building and stability?

There are many different types of boats and ships on the water, and some, like cruise ships seems to be getting larger and larger. So how do they stay afloat? The same way as our tinfoil boats do. They utilize a greater surface area to displace the surrounding water, and the high sides of the ship keep the water from entering the hull, or inside, of the ship.

When the tinfoil is fashioned into a boat-like shape with raised edges, the sides prevent water from covering the tinfoil completely thus sinking the flat piece of tinfoil. However, the overall design of the boat can alter the results as well. If the boat has shallow sides, or the keel (the stabilizing center of the ship) is too shallow or skinny for the vessel then it will not keep the vessel from capsizing, or overturning, in heavy waves. Larger ships utilize ballast in addition to the keel to add weight to the bottom of the vessel to prevent capsizing.

The distribution of mass on the vessel also matters as seen in the experiment. If all of the weight is in one place then the vessel becomes unstable and is more susceptible to the waves. This is why mass needs to be evenly distributed across the vessel, and why there is a max stacking height on cargo ships and why cruise ships can only be so tall before needing to be built longer.

Now try…

- Use multiple pieces of stacked tinfoil to make your boat. Can it hold the same amount of pennies? If not, what variable can be changed to increase the number of pennies the boat can hold?
- Create two boats of equal size and shape. Add and count pennies to both boats in the following ways; place pennies evenly throughout the boat bottom, stack the pennies in a single pile in the bottom of the boat. What did you notice? Why would the results be different?
- Add waves to your water by dropping a ball into the water and observe. Did your boat sink? What could you add to your design to stabilize the boat when interacting with waves?
- Try different keel designs and test their effectiveness.

Additional Information

Watch a how-to video for this experiment here: https://www.youtube.com/watch?v=pK-iPwtW4W8