

Boats (Powered by Soap!)

OVERVIEW

You will create boats out of different materials and power them briefly with a drop of soap (or wind)!

WHAT ARE WE LEARNING?

This activity can be used to learn about a variety of concepts including simple engineering, buoyancy, materials science, forces, and/or surface tension.

Materials

- Pan or bowl halfway filled with water (bigger is better)
- Dishsoap
- Q-tip or any item that can be used to place a bit of soap in water
- Scissors
- (Optional) A handheld or mechanical fan
- Materials to build boat (see below)



Image 1: Materials -but you might choose other items to make boats with

Use some or all of these materials to create your boat or boats!

- Construction paper + packing tape
- Aluminum foil
- Plastic covered paperboard, like a milk carton
- Other items that might float

Materials to create a boat mast (optional)

- Paper rolled up in tape (see instructions)
- Toothpicks
- Sections of a paper clip (may need wire cutters)
- Other small, straight, rigid objects

INSTRUCTIONS OVERVIEW

First you will make your boat(s). Depending on what materials you are using for your boat and how much you want to design them, this step can be very simple, or could take a little longer!

Next you will float your boats in water, and use a little dish soap which will break the surface tension and send them sailing! You might also explore powering your boat(s) with wind.

INSTRUCTIONS

If making a boat with paper and tape

1. Choose a shape for your boat base and cut it out! You may want to decorate your paper, or create multiple boat bases at once using different shapes. We made our shapes about 1 inch long.

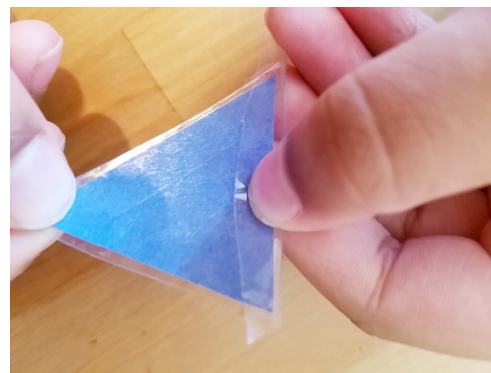


Image 2: We choose a triangle for one of our boat bases. In this image we are sealing the edges with tape, so water doesn't leak into our construction paper.

INSTRUCTIONS (CONT)

- To make the paper waterproof, place packing tape or scotch tape on both sides of the paper. You likely will need to trim the tape with scissors to keep the original boat shape. Make sure to seal the edges of the shape with extra tape so water doesn't leak into the paper (see image 2).
- A mast is a part of the boat that holds the sail up. If you would like to make a mast for your boat you have many options. You can make a mast by rolling up a small piece of paper in a piece of tape, as we show in image 3. Or you can use a piece of toothpick or a section of a paperclip (you can cut the paperclip with wire cutters).

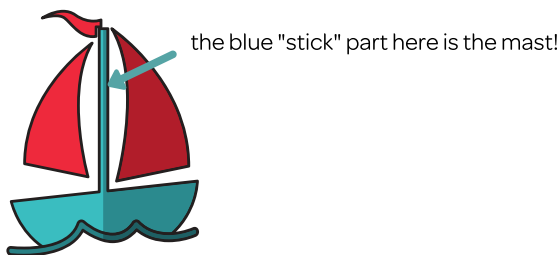


Image 3: You can make a mast by tightly rolling up a piece of paper and tightly rolling tape around it. (Make it tighter than shown here).

- Make a small hole in the base of your boat and place your mast in it! You'll want to tape the mast so it stands up, this part can be finicky so just play around with it until it stands up.
- Cut out a sail and tape it to your mast!

If you are making your boat with other materials go ahead and make your boat! Use a waterproof material and cut out small shapes from a milk carton or something plastic, or fold up aluminum foil in a boat shape, or use other creative ways to make a boat! This step can also be used to explore what floats.

- Fill your pan or bowl with water (if it is not filled already) and place your boats on the water. Do they float? See our boats in images 4 and 6!

Powering the boat

- Place a drop of dish soap on a Q-tip or similar item. Don't get any soap in the water! (See image 5)
- Put your boat on one side of your pan or dish, and then place the Q-tip behind it. What happened to your boat? Did it move forward?
- Usually you can only power the boat by soap one time, but go ahead and test if it will work a second time! If you want to repeatedly power the boat with soap, use a different water-filled dish or rinse out your dish and refill with water.

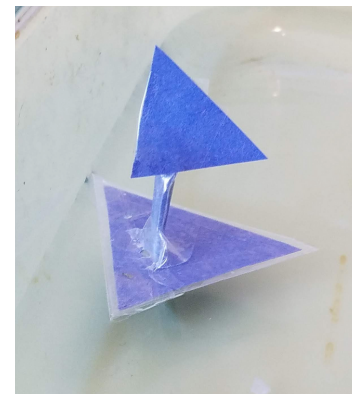


Image 4: A small boat made of construction paper covered with packing tape.

10. Try other ways to power the boat, use a electrical fan, a paper fan, or even blow with your mouth! You can also push the boat with your hands, create waves in the water, or try other methods to create movement. Write down your observations on the companion worksheet to this activity!
11. Look at further exploration ideas below and links online to continue exploring. What materials work best for boats? Can you make other things move using soap? There is lots to explore!



Image 5: Placing a drop of dish-soap on a Q-Tip

FURTHER EXPLORATION

- Try different materials and shapes to create boats. Take notes to see what floats best, or what challenges you encounter and how to fix them.
- Use aluminum foil or other materials to create larger boats and test how much weight the boats can carry by adding pennies or other small, dense materials find links on our site for an activity like this.
- Do extra exploration on using soap to break surface tension and move floating items. Try pepper on water or "tie-dye milk" - find links on our website.

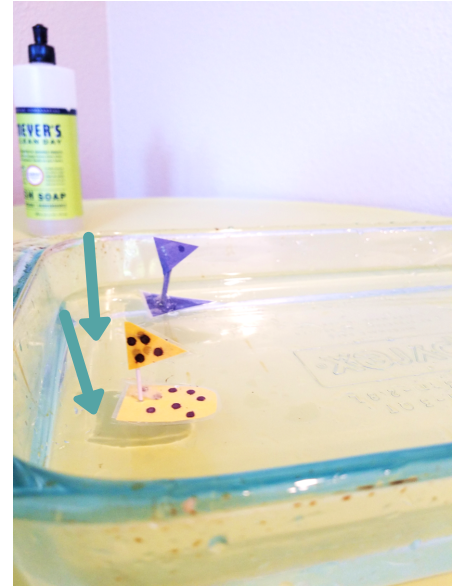


Image 6: Boats are ready to go! Dip your soap-covered toothpicks behind the boat where one of the arrows are pointing

THE SCIENCE

There's a lot of science here depending on what aspect of the activity you focused on! Here we give a brief summary of three areas and recommend continuing to investigate these ideas!

Forces and What Makes Things Float?

Items that are less dense will be more likely to float than denser objects. Young children will often discuss this in terms of objects being "heavier" or "lighter" but it's not just weight - a large heavy log might float where a tiny light penny will sink. If you have two items of different weights but the same size the heavier item is the denser item.

Items will sink in water when the forces pulling them down are heavier than the forces pushing them up. Gravity pulls objects down, but the water actually pushes up on items as well! For items that float, the upward force from the water is stronger than the downward force of gravity.

Materials Science

Materials Scientists develop and design new materials. They have a deep understanding of different materials and their properties. Testing which materials (aluminum foil? paper? cardboard?) are waterproof and can float is a great way for young students to start learning about the properties of materials!

THE SCIENCE (CONT)

How does a drop of soap power a (mini) boat?

This is about surface tension. Tiny pieces (molecules) of water or other liquids are more strongly attracted to each other at the surface of water, creating a "film" of a sort. Surface tension can help water-walking bugs stay above the surface and can trap light items at the water surface that would otherwise sink.

Soap will break most of water surface tension, causing movement and moving your boat!

THE STANDARDS:

Below are NGSS standards used in California and other states

Parts of this activity can relate to :

2nd grade standard: 2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

[Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.]

[Assessment Boundary: Assessment of quantitative measurements is limited to length.]

Third grade standard: 3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

[Clarification Statement: Examples could include unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.]



Image 7: Surface tension helps keep water striders on the surface of water.

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<https://commons.wikimedia.org/w/index.php?curid=1242390>

ADVICE FOR DOING SCIENCE WITH YOUR KIDS

- Encourage exploration and curiosity - science is about a lot more than facts and content (although these things are important too!)
- Consider writing down your child's questions and ideas during the activity. You may be able to turn these into a future research project or activity!
- You might consider getting a dedicated science journal for your child where they can keep all their thoughts and ideas and notes on their experiments.
- Do not worry about not knowing the answer to questions. Many "simple" kids science activities have very complicated, or even unknown(!) science behind them. Even scientists will often not know the answers to questions outside their field. No one knows everything! Be honest about not knowing the answer and suggest trying to figure it out together.
- Deviations from exact instructions can often be fruitful - especially if the child has been inspired and wants to try out another line of investigation.
- In many states, the science standards are called the "Next Generation Science Standards," or "NGSS." They are a little complicated to parse through but in essence they want student to learn not only content (called "disciplinary core ideas" or "DCI") but also the practices scientists and engineers use ("scientific and engineering practices" or "SEP") and also concepts that cut across all fields ("crosscutting concepts" or "CCC").

