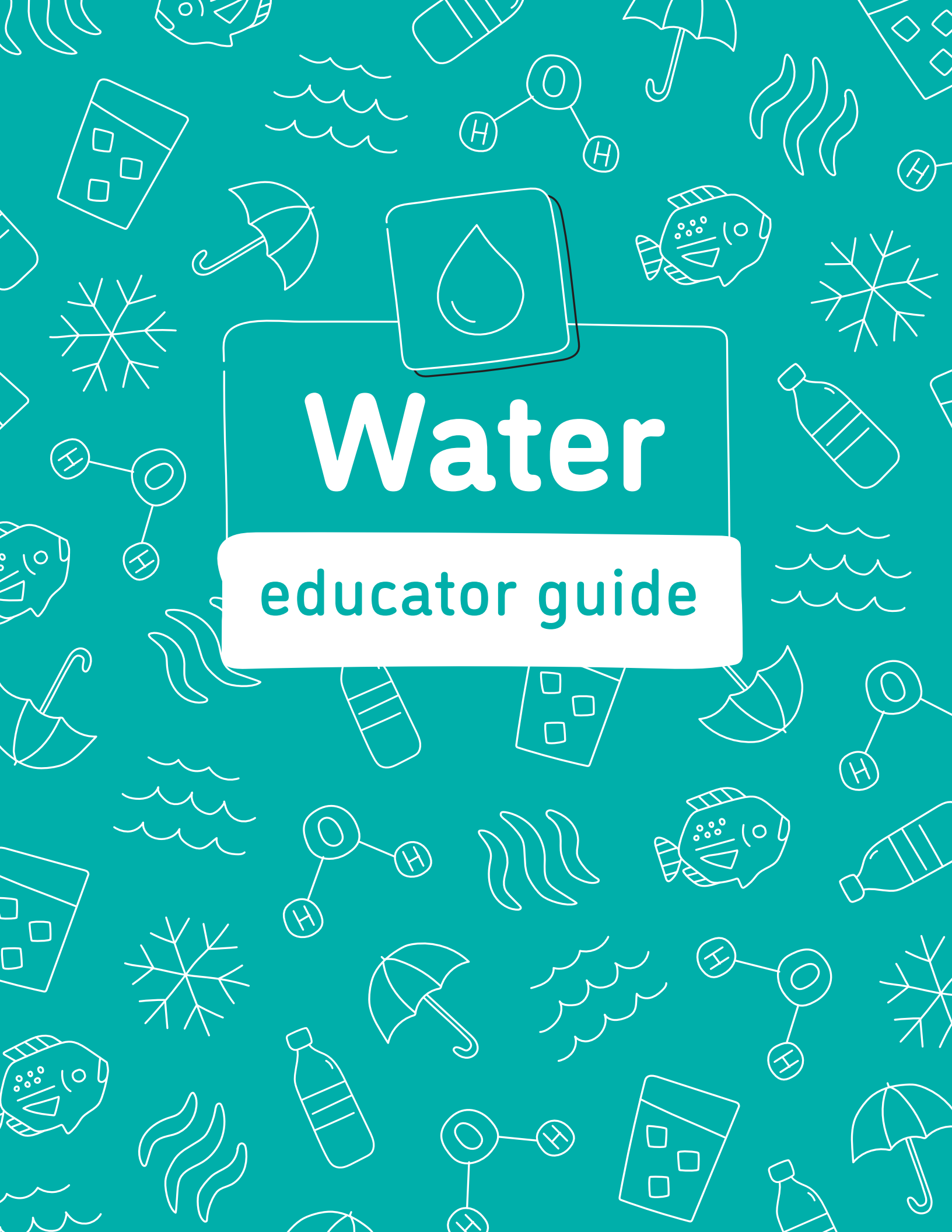

# Water

## educator guide

# WELCOME TO THE WATER Educator Guide!

In this Educator Guide, you'll find Grade Banded Learning Standards aligning to each of the activities. You will also find a QR Code linking you to COSI Connects, an online universe of science through videos, activities and so much more! COSI Connects also includes a section called Community Connects, a digital hub for online and in-person resources from museums, cultural institutions, and other nonprofits.

**COSI Connects**

For additional resources, including book recommendations, and video instructions for completing each of the activities inside your box be sure to check out **cosi.org/connects/kits/**.

**For questions regarding the content inside this educator guide, please email ScienceQuestions@cosi.org.**

# Table of Contents



**Dear Educators, Parents, and Caregivers:**

**We know education is important now more than ever, and COSI stands ready to be your partner with this COSI Connects Kit. Together, we will engage, inspire, and transform our students and youth in science, technology, engineering, art, and math (STEAM) at school and at home. These activities correlate directly to Ohio's Learning Standards and Next Generation Science Standards - the same key learning goals that schools, educators, parents and caregivers use.**

In this Educator Guide, you will find the Ohio Learning Standards and Next Generation Science Standards that correspond to each of the activities in this box. You will also find interactive questions that will promote critical thinking. If you want to dig deeper into science, additional experiences are available through our free Connects digital platform, **www.cosi.org/connects**.

For additional resources, including book recommendations, and video instructions for completing each of the activities inside your box be sure to check out out **www.cosi.org/waterkitvideos.**

For questions regarding the content inside this educator guide, please email **ScienceQuestions@cosi.org**.

**Water Kit:** cosi.org/connects/kits/water-kit.php

**Resources:** cosi.org/connects/kits/water-kit-resources.php

**Connects:** www.cosi.org/connects

# Facilitating STEAM Learning with Kits

## Kits Overview

COSI Connects Kits contain carefully designed hands-on STEAM activities that support fun, engaging learning about a topic or theme. Each box comes with:

- **Supplies**: Materials for activities are in the box
- **Activity book:** This guide provides directions for setting up and completing activities, explains relevant STEAM content knowledge and skills, and offers discussion prompts to deepen the learning experience
- **Instructional videos:** Each kit has a QR code linking you to short videos demonstrating how to complete different steps of the activities. If you cannot scan the QR code, you can find the videos online at **cosi.org/connects/kits**. Click on your kit, then click the "Parent/Educator Resources" tab.

## Goals for Using Kits

At COSI, we know science is everywhere and for everyone. To reinforce this message, we've designed our kits to do so much more than just teach STEAM content knowledge. Every kit, regardless of the content or topic, also provides important non-content learning opportunities such as:

- Engaging with STEAM in fun, inspiring, and creative ways
- Making sense of scientific observations
- Seeing oneself as a capable, welcome, and valued STEAM community member
- Practicing a growth mindset by valuing effort and learning over ease and knowing
- Bonding with peers, family, and educators over shared experiences and excitement

## Techniques for Facilitating COSI Connects Kits

Decades of research show that learning is rarely as straightforward as receiving information. This is especially true when the goal is to *understand* and *apply* information, not simply recognize and repeat it. Learning and understanding requires the student to make sense of the information for themselves: Have they heard anything like that before? Does it make sense? Does it support or contradict something they already know? Is it useful or interesting enough to warrant the effort to learn and remember it?

When helping your learners accomplish the goals of using a COSI Connects kit, you'll want to ask more questions than you answer (unless they're practical or logistical questions about the directions).

Why? For a few reasons:

1) If learners have a question in mind before doing an activity, or before doing a step of the activity, they'll be primed to notice information that is useful for sense-making or question-asking.
2) This technique helps you model the process of science for your learners. Instead of assuming what they do or don't know and thus what you need to tell them, you are being curious, collecting data (their knowledge and ideas) and interpreting those data to decide how to most effectively help them.
3) This invites critical thinking: you can follow most questions with things like, "Why do you think that?" or "What did you observe during your activity that makes you think that?"
4) It shows your learners that you are interested in their experiences, and that you find them valuable and interesting to know.
5) If something isn't working, it can help you troubleshoot the issue: Did they skip a step? Use a different material? Was the reaction really fast or really subtle and they missed it?

Make sure you ask your questions with curiosity and openness: you are asking the question because you want to learn your learners' answers, not because you will try to change their minds (even if you do want to!). This will help them feel more comfortable sharing, which will deepen and sustain their conversations and learning.

| Technique | Examples of Effective Questions |
|---|---|
| **Model the scientific method before, during & after**<br>Model the scientific method before, during & after<br>Scientists work together to collect information (evidence) they can use to answer questions about how things work, why things happen, or even if/when things *will* happen!<br>They collect this evidence by learning from their peers, making observations, and conducting experiments. Additionally, scientists are never "done" learning: experiments often leave scientists with more questions than answers, which is exciting! | · What questions could we answer by doing this activity?<br>· What information could we collect to answer that question? What changes or results could we look for?<br>· What do you think will happen? Why?<br>· What information or knowledge did you use to come up with your answer?<br>· What new questions do you have? What about those questions is interesting to you? How would you collect evidence to answer your questions? |
| **Focus on ideas rather than terminology**<br>If a learner is having a hard time with a particular word or phrase (pronouncing, understanding – anything!), help them find other words to use instead. It's more important for learners to learn by making sense of ideas and practicing skills than it is for them to use terminology correctly. | · What are other words that mean the same thing?<br>· How would you explain it to a younger sibling?<br>· Can you act out the word, or draw the word?<br>· Is there a similar word that means something different, and that's making this feel confusing?<br>· How can you remember the information/skill even if you forget the specific word(s)? |

| | |
|---|---|
| **Help learners see themselves as scientists by challenging negative misconceptions**<br><br>Importantly, "science" is a *process*, not a product - science is not simply a collection of information or facts. Science is a process of asking questions, making observations to collect information, and thinking carefully to make sense of the information.<br><br>The goal of science is not to "prove" that a certain idea is "right," or to get "the correct result" from doing an experiment. If an experiment produces an outcome that suggests a scientist's idea was wrong, that's great because there is something new to be learned!<br><br>A "good" scientist is not somebody who is already very smart, works all by themselves without any help, and never makes mistakes. A "good" scientist is curious, collaborative, and learns from their mistakes. | · What does the word "science" mean to you?<br>· Do you think science is interesting? Fun? Exciting? Scary? Boring? Why?<br>· How do we use science to learn about things?<br>· How does science help us understand things?<br>· How do you use science to understand things?<br>· What does the word "scientist" mean to you?<br>· What does a scientist do?<br>· What makes somebody a "good scientist" or "good at science"?<br>· Do you think you can be a scientist?<br>· How are you like a scientist every day?<br>· What attributes make you a good scientist?<br>· Why do you think it's more important for a scientist to learn from mistakes than to never make mistakes?<br>· Have you ever made a mistake that helped you learn something really useful? |
| **Invite sense-making and peer discussion**<br><br>It's great for learners to have questions because that means they're curious, and they have the opportunity to learn something new! Ask your learners to share what kit activity information and experiences they're curious or confused about and want to understand better. Ask other learners in your group to share how they figured something out.<br><br>This is especially helpful when you have learners who want to work more quickly than others: capitalize on their energy and help them engage more deeply! | · Was any part of the kit activity surprising, strange, or even counterintuitive to what you expected?<br>· Why do you think that was surprising/strange/counterintuitive – what made you think that something else would happen?<br>· Did any part of the kit activity not make sense?<br>· Did you see or try anything in the kit activity that helped something make sense?<br>· Do you have any other information or experiences from before the kit activity that helped something make sense? |
| **Explore real-world connections**<br><br>Learners are more likely to value the effort required to learn or complete a task if they believe the results will provide something useful and relevant. Personal connections can also help learners see themselves as capable STEAM community members and practitioners. | · Is this something you've ever wondered about?<br>· Would a friend or family member find this interesting?<br>· How could you use something you learned from this activity in your own life?<br>· How could you use something you learned from this activity to help someone else? |
| **Reflect on progress and experiences**<br><br>At the end of each activity, or even after a step within an activity, ask your learners questions that help them see things like:<br>· They learned a new fact or skill<br>· They had a fun/cool/interesting experience<br>· They overcame an obstacle and achieved success<br>· They are scientists and they're doing science<br>· They changed their mind with new information<br>· They turned a "mistake" into a learning opportunity<br>· They wondered new and interesting questions | · What is the most interesting thing you learned?<br>· Was anything confusing at first, but now you understand it better?<br>· Was anything frustrating at first, but it helped you learn something?<br>· Why was it confusing at first? How did you get to understand it better?<br>· What is something you learned that you want to tell a friend or family member?<br>· What is something you learned that you want to use in your everyday life? |

# Kit Accessibility Tips

This is an additional resource to support the success of learners. Below are tips and tools from COSI's accessibility experts that can be used when adapting for learners.

## Fine Motor Adaptations

- Get creative! When completing a movement required activity, think of different ways to accomplish it, like moving an object by attaching it to a wheelchair.
- If an object is too small to handle, swap for similar but larger objects, like switching a bouncy ball for a basketball. You can also attach the smaller object to a larger one to make it easier to hold.
- Use hand over hand to support students when completing fine motor tasks.
- For the writing portions, provide notepaper to give extra space for writing.

## Blind and Low Vision Adaptations

- Use puffy paint on the activity book images to create additional tactile images.
- Use manipulatives (objects) for students to touch when explaining how something works to help students process what is happening.
- Use the camera on a phone or tablet to magnify the words and images in the activity book.

## Deaf Adaptations

- Utilize COSI's demonstration videos with closed captioning when completing an activity.
- Visually demonstrate the activity steps.

## Cognitive Adaptations

- Break the activity into smaller steps to make processing easier.
- For harder to understand concepts use manipulatives (objects) to explain or relate to a practical process.
- Model the steps for the child to follow and complete at the same time.
- Ask leading questions to help students problem solve. For example: "How could you change the shape of the wings to make it fly better?"

## Speech Adaptations

- Have students present in alternate ways, like with drawings or by demonstrating what they did.

# Standards Alignment and Extension Questions

The following pages will include Ohio Learning Standards and Next Generation Science Standards that are aligned with each activity in the kit. In addition to these standards, you will find extension questions to scale up or scale down the content of each activity according to your students' abilities or grade level. These extension questions are arranged in grade level bands of Kindergarten – Second Grade, Third – Fifth Grade, and Sixth – Eighth Grade. Each set of these questions are also aligned with both Ohio Learning Standards and Next Generation Science Standards.

Throughout the kit activities, your students will find opportunities to write down their scientific findings and connect to digital learning resources through COSI Connects. This will allow them to fulfill the Ohio English Language Arts, Technology, and Digital Literacy Learning standards listed below.

### Kindergarten – 2nd Grade

- K-2.ICT.3.b.: Use visuals found in digital learning tools and resources to clarify and add to knowledge.
- W.K.2: Use a combination of drawing, dictating, and writing to compose informative/ explanatory texts that name what is being written about and supply some information about the topic.
- W.1.8: With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.
- W.2.8: Recall information from experiences or gather information from provided sources to answer a question.
- K-2.ST.2.a.: Communicate and collaborate using several digital methods.

### Third Grade – Fifth Grade

- 3-5.ICT.1.a.: With guidance, identify and use digital learning tools or resources to support planning, implementing and reflecting upon a defined task.
- W.3-5.10: Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
- 3-5.ICT.4.d.: Produce and publish information appropriate for a target audience using digital learning tools and resources.

### Sixth Grade – Eighth Grade

- 6-8.ICT.4.b.: Select and use a variety of media formats to communicate information to a target audience.

COSIconnects learning lunchbox

# Water

## ACTIVITY 1: Float Your Boat

Design the best boat and see if it can float! Can you add cargo to your boat?

### Ohio Learning Standards

**1st Grade Science 1.PS.1:** Properties of objects and materials can change.

**2nd Grade Science 2.PS.1:** Forces change the motion of an object.

**3rd Grade Science 3.PS.1:** All objects and substances in the natural world are composed of matter.

### Next Generation Science Standards

**2-PS1-3:** Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.

**K-PS2-1:** Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

GRADES K–2

### Extended Learning Questions:

1) What do you notice about the shape of your boat? Is it small or large? Round or flat? How does its shape impact its ability to float?
2) Have all students place their boats in a row. (If not in a group, make a few different boats). What do you notice about the boats? Are they the same or different? Can you line them up from smallest to largest?
3) Push your boat around on the floor, pretending it is a car. Then, push it around in a bowl of water. Does it move the same or differently?
4) Place your finger in the middle of your boat. Push just a little. Do you feel the water pushing back up? Push down slowly until your boat is submerged. What happened? Did it sink quickly or slowly? Now try the same thing with a differently shaped boat. Does it sink the same or differently?

### Ohio Learning Standards:

**1st Grade Science 1.PS.2:** Objects can be moved in a variety of ways, such as straight, zigzag, circular and back and forth.

**2nd Grade Science 2.PS.1:** Forces change the motion of an object.

### Next Generation Science Standards:

**K-PS2-1:** Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

COSIconnects learning lunchbox

# Water

## ACTIVITY 1: Float Your Boat

Design the best boat and see if it can float! Can you add cargo to your boat?

GRADES 3–5

### Extended Learning Questions:

1) Place your hand in the water near your boat and wave it back and forth. How does your boat react to the waves generated by your hand? Compare what happens with small waves (low amplitude) to what happens with large waves (high amplitude). Is there a point where your boat can no longer stay floating?
2) Collect small objects like pennies or beads. Place them in your boat one by one. Spread them out across the boat. Is there a point where the boat begins to sink? Try to find how much weight your boat can hold by experimenting with placing these objects in the boat.
3) Dry your boat off to try the experiment above again. This time, predict what will happen if you place all the objects on one side of the boat rather than spreading them out. Now, test it out. Did the boat sink faster or slower? Did it sink differently?
4) Crumple up one of your aluminum foil boats. What happens when you put it back on the water? Does it sink or float? Why?

### Ohio Learning Standards:

**5th Grade Science 5.PS.2:** The amount of change in movement of an object is based on the mass of the object and the amount of force exerted.

**4th Grade Science 4.PS.2:** Energy can be transferred from one location to another or can be transformed from one form to another.

### Next Generation Science Standards:

**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.

**4-PS4-1:** Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

COSIconnects learning lunchbox

# Water

## ACTIVITY 1: Float Your Boat

Design the best boat and see if it can float! Can you add cargo to your boat?

GRADES 6–8

### Extended Learning Questions:

1) Place your finger in the center of your boat and begin to push down. When does your boat sink? Why? What are two forces that are pushing or pulling the boat downwards? What is one force that is pushing the boat upwards? When are those forces balanced? (Hint – an object will change its motion when forces are unbalanced).
2) Make a new boat that will float on water. Test it to be sure. Use a ruler and a scale to estimate the density of your boat. You'll first need to find the mass and the volume. Be sure to include the "air space" in your volume estimate. Use the density equation to calculate the density:

$$density = \frac{mass}{volume}$$

Now, crumple the boat into a tiny ball. Calculate the density again. To find the volume, you may want to use the equation for the volume of a sphere:

$$volume = \frac{4}{3}\pi r^3$$

Calculate the density using the same density equation, but with the new volume. Now, put the ball into the water. Does it sink or float? What is different about the two densities? How does that impact whether it sinks or floats?
3) Place your hand in the water and wave it back and forth a few times. Watch the waves. Can you use a ruler to estimate the amplitude (the height) of the wave? Watch as the wave runs into the side of the bowl or container. Does it bounce off the side and start moving backwards (reflect)? Now, place your boat back in the water. What happens to your boat when a wave reflects off the side of the container?

### Ohio Learning Standards:

**8th Grade Science 8.PS.1:** Objects can experience a force due to an external field such as magnetic, electrostatic, or gravitational fields.

**7th Grade Science 7.PS.4:** Energy can be transferred through a variety of ways.

**6th Grade Mathematics 6.G.1.** Solve real-world and mathematical problems involving area, surface area, and volume.

### Next Generation Science Standards:

**MS-PS4-2 Waves and their Applications in Technologies for Information Transfer:** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

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# Water

## ACTIVITY 2 : Water Striders

Have you ever seen a water strider? These insects walk on water. Learn how they do it. Can you use what you learned about surface tension to make a paperclip float?

### Ohio Learning Standards

**2nd Grade Science 2.PS.1:** Forces change the motion of an object.

**4th Grade Science 4.LS.1:** Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.

**High School Chemistry C.PM.6:** Intermolecular forces of attraction.

### Next Generation Science Standards

**K-ESS3-1:** Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.

**K-ESS3-3:** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment

**3-LS4-4:** Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

**5-PS1-1:** Develop a model to describe that matter is made of particles too small to be seen.

GRADES K–2

### Extended Learning Questions:

1) Find three items in the room to test to see whether or not they can float. Make sure they are things that can safely get wet! You may want to try a small piece of fabric, a crayon, a piece of paper, or a balloon. Make a prediction for each one: will it sink or float? Then, test it out!
2) When you get a paperclip to float, look carefully at it without touching it. What do you notice? Draw a picture of your paperclip floating on the water.

### Ohio Learning Standards:

**Kindergarten Science K.PS.1:** Objects and materials can be sorted and described by their properties.

**K – 2nd Grade Technology K-2. DT.4.b.:** Identify and discuss functional aspects of everyday objects.

### Next Generation Science Standards:

**2-PS1-1:** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

**K-2-ETS1-2:** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

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# Water

## ACTIVITY 2 : Water Striders

Have you ever seen a water strider? These insects walk on water. Learn how they do it. Can you use what you learned about surface tension to make a paperclip float?

GRADES 3–5

### Extended Learning Questions:

1) Is the paperclip a solid, liquid, or gas? How about the water in your container? How do you know?
2) In the activity, you got a solid to float on water. Are there any liquids that could float on water?
3) Brainstorm a list of materials around you that might float on water. Choose the three that you believe will work the best. Place them on the water's surface. What materials are the best for staying afloat? Why do some materials perform better than others?
4) What direction does an object move when it sinks? What force causes an object to sink? Explain.

### Ohio Learning Standards:

**Third Grade Science 3.PS.2:** Matter exists in different states, each of which has different properties.

**3rd – 5th Grade Technology 3-5.DT.2.b:** Plan and implement a design process: identify a problem, think about ways to solve the problem, develop possible solutions, test and evaluate solution(s), present a possible solution, and redesign to improve the solution.

**5th Grade Science 5.PS.1:** The amount of change in movement of an object is based on the mass of the object and the amount of force exerted.

### Next Generation Science Standards:

**3-5-ETS1-3:** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

**5-PS2-1:** Support an argument that the gravitational force exerted by Earth on objects is directed down.

GRADES 6–8

### Extended Learning Questions:

1) Changing the surface tension in a pond or stream is bad for water striders. We often think of soap as not being harmful, but in the case of water striders it is very dangerous. In what other ways might adding soap, oil, or other pollutants to a waterway have a negative impact on the environment? What can humans do to address these concerns?
2) A force is a push or a pull. When you are standing, the floor is putting a force upward on your feet while gravity is pulling you toward the earth. Look online or in your activity guide to see what a water strider looks like. Draw a picture of a water strider (the animal) standing on water. Where do you think there are forces on the water strider? Draw each force on the water strider. What direction is each force?

### Ohio Learning Standards:

**6th - 8th Grade Technology 6-8.DT.1.b:** Analyze how tools, materials and processes are used to alter the natural and human-designed worlds.

**8th Grade Science 8.PS.1:** Objects can experience a force due to an external field such as magnetic, electrostatic, or gravitational fields.

### Next Generation Science Standards:

**MS-ESS3-4:** Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

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# Water

## ACTIVITY 3 : Fish Frenzy

Make your own fish that "swim" with the help of surface tension!

### Ohio Learning Standards

**2nd Grade Science 2.PS.1:** Forces change the motion of an object.

**4th Grade Science 4.LS.1:** Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.

### Next Generation Science Standards

**K-ESS3-1:** Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.

**K-ESS3-3:** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment

**3-LS4-4:** Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

**5-PS1-1:** Develop a model to describe that matter is made of particles too small to be seen.

GRADES K–2

### Extended Learning Questions:

1) Will a bigger fish move further? Replace the water in your bowl with clean water. With the other two pieces of craft foam, cut out two more fish. Make one fish bigger than your first fish, and one fish smaller. Follow the steps to make the bigger fish swim across. Use a ruler to measure the distance it traveled. With a new dish and new water, follow the steps to make the smaller fish swim across. Use a ruler to measure the distance it traveled. Which fish travels the furthest?
2) Look at pictures of different fish. Fish might be big, small, long, short, round, or skinny. Some are different colors. Some have different shapes. Draw three different fish on your paper. Explain to someone what makes them different.

### Ohio Learning Standards:

**1st Grade Science 1.PS.2:** Objects can be moved in a variety of ways, such as straight, zigzag, circular and back and forth.

**K – 2nd Grade Technology K-2. DT.2.b.:** Demonstrate the ability to follow a simple design process: identify a problem, think about ways to solve the problem, develop possible solutions, and share and evaluate solutions with others.

### Next Generation Science Standards:

**K-PS2-2:** Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

**K-2-ETS1-3:** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.


# Water

## ACTIVITY 3 : Fish Frenzy

Make your own fish that "swim" with the help of surface tension!

GRADES 3–5

### Extended Learning Questions:

1) Replace the water in your bowl with clean water. Place your fish in the bowl with the tail at one edge. Predict what will happen when you dip your cotton swab in dish soap and touch it into the water somewhere next to your fish. Test what happens. Repeat this activity two more times, changing the placement of the cotton swab each time. Be sure to use a clean bowl of water each time. Does your fish move differently depending on where you place the cotton swab? Why or why not?
2) Cut out two more fish of different sizes and shapes. Predict: which will move the fastest? Which will move the furthest? Replace the water in your bowl with clean water and place all three fish in the bowl. Dip your cotton swab in dish soap and touch it, one after the next, into each fish's notch. What patterns of movement do you see in your fish? Which one moves fastest? Which one moves furthest? Do they all move in the same direction?

### Ohio Learning Standards:

**5th Grade Science 5.PS.1:** The amount of change in movement of an object is based on the mass of the object and the amount of force exerted.

### Next Generation Science Standards:

**3-PS2-2:** Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

GRADES 6–8

### Extended Learning Questions:

1) When does your fish have kinetic energy? How do you know?
2) What do you think would happen if you used a different liquid in place of water for this activity? Why?
3) Your fish is moving away from the soap because of the Marangoni effect. Read the description of the Marangoni effect on page 11 of the activity guide. Explain it in your own words.

### Ohio Learning Standards:

**7th Grade Science 7.PS.4:** Energy can be transferred through a variety of ways.

**6th – 8th Grade ELA L.6-8.6** Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression. (I believe this ties in well with the 3rd question)

### Next Generation Science Standards:

**MS-PS3-5:** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

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# Water

## ACTIVITY 4 : What's a Watershed?

Learn all about watersheds and their own impact on the environment as you build your own watershed model.

### Ohio Learning Standards

**1st Grade Science 1.ESS.2:** Water on Earth is present in many forms.

**2nd Grade Science 2.LS.1:** Living things cause changes on Earth.

**4th Grade Science 4.ESS.1:** Earth's surface has specific characteristics and landforms that can be identified.

**4th Grade Science 4.ESS.3:** The surface of Earth changes due to erosion and deposition.

**4th Grade Science 4.LS.1:** Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.

### Next Generation Science Standards

**K-ESS3-1:** Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.

**2-ESS2-2:** Develop a model to represent the shapes and kinds of land and bodies of water in an area.

**3-LS4-4:** Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

**MS-LS2-2:** Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

GRADES K–2

### Extended Learning Questions:

1) As a class, make three model watersheds. On the first one, use blue and red markers (or watercolor paint) to color the ridges. On the second one, use blue and yellow markers (or watercolor paint) to color the ridges. On the third one, use yellow and red markers (or watercolor paint) to color the ridges. Predict: what colors will you see after you spray each of these with water? Use the spray bottle to wet each model. Were your predictions correct? Did any of the colors surprise you?
2) Ask an adult what they do to help take care of the watershed. If they aren't sure, work together to look up one or two ways that people help watersheds.
3) Sometimes, water can change the shape of the land. Build a model of this in a sandbox: build up a mountain of sand, then pour water down the mountain. How did the sand change? Ask an adult how people might prevent water from changing the shape of the land. Can you do that on your sand model?
4) Can you change the way water moves in your watershed model? How? Try it out. Why would humans want to change the way water moves in real life?

### Ohio Learning Standards:

**1st Grade Science 1.LS.1:** Living things have basic needs, which are met by obtaining materials from the physical environment.

**2nd Grade Science 2.LS.1:** Living things cause changes on Earth.

### Next Generation Science Standards:

**K-ESS2-2:** Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.

**2-ESS2-1:** Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.


# Water

## ACTIVITY 4 : What's a Watershed?

Learn all about watersheds and their own impact on the environment as you build your own watershed model.

GRADES 3–5

### Extended Learning Questions:

1) Ask an adult what they do to help take care of the watershed. If they aren't sure, work together to look up one or two ways that people help watersheds.
2) How does the movement of water in a watershed contribute to erosion? Use your watershed model to support your answer.
3) What changes could you make to your watershed to alter the direction and/or movement of water? How would these changes impact real watersheds? What types of changes do humans make to change the direction or movement of water? Why would humans want to change the way water moves?
4) Make another watershed model that is a work of art. You might want to draw something on the paper before crumpling it up. Choose your colors of markers (or watercolor paint) carefully, knowing they will mix together. Once you've sprayed it with water and let it dry, name your work of art!

### Ohio Learning Standards:

**4th Grade Science 4.ESS.3:** The surface of Earth changes due to erosion and deposition.

**4th Grade Science 4.ESS.1:** Earth's surface has specific characteristics and landforms that can be identified.

### Next Generation Science Standards:

**4-ESS2-1:** Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

**4-ESS3-2:** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.


# Water

## ACTIVITY 4 : What's a Watershed?

Learn all about watersheds and their own impact on the environment as you build your own watershed model.

GRADES 6–8

### Extended Learning Questions:

1) How do the pollutants in your watershed impact the waterways? How would they impact wildlife living in the watershed? Support your argument using your watershed model and additional research.
2) What happens to the molecules of water as it dries on your watershed model? Where do they go? In a real-world watershed, how would the water get back to the watershed after drying? Use your watershed model to explain the water cycle. How is the force of gravity involved? What about energy from the Sun?
3) Make a work of art in the same way you made your watershed model. You may want to first draw on paper with ink pen. Then, crumple it up and use markers or watercolor paint to color the ridges. Then, spray it with water and allow it to dry. When it is dry, you can flatten it and frame it, or leave it as a 3-dimensional watershed. What will you name your work of art?

### Ohio Learning Standards:

**7th Grade Science 7.LS.2:** In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors.

**7th Grade Science 7.ESS.1:** The hydrologic cycle illustrates the changing states of water as it moves through the lithosphere, biosphere, hydrosphere and atmosphere.

### Next Generation Science Standards:

**MS-LS2-4:** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

**MS-ESS2-4:** Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

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# Water

## ACTIVITY 5 : Aquatic Debris

Learn about the impact that aquatic debris has on our waterways. Then, build your own water filter to remove debris from a sample of water.

### Ohio Learning Standards

**1st Grade Science 1.ESS.2:** Water on Earth is present in many forms.

**2nd Grade Science 2.LS.1:** Living things cause changes on Earth.

**4th Grade Science 4.LS.1:** Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.

**7th Grade Science 7.LS.2:** In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors.

### Next Generation Science Standards

**K-ESS3-1:** Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.

**K-ESS3-3:** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment

GRADES K–2

### Extended Learning Questions:

1) Try a very simple filter – a coffee filter. Coffee filters have tiny holes in them that allow water to get through. Pour some 'polluted' water through the coffee filter. Watch as you pour it through. Then, look at what is left in the filter. What do you notice? Did it work? Why or why not?
2) Compare the water filter you built to another water filter (such as an inexpensive Brita filter). Filter the same dirty water through both filters. Which one works best?
3) With an adult's permission, find two additional types of materials to use in your water filter. Test each material out in place of dirt or gravel. Which one works the best? How do you know?

### Ohio Learning Standards:

**Kindergarten Science K.PS.1:** Objects and materials can be sorted and described by their properties.

**1st Grade Science 1.LS.2:** Living things survive only in environments that meet their needs.

### Next Generation Science Standards:

**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.

**K-ESS3-3:** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.


# Water

## ACTIVITY 5 : Aquatic Debris

Learn about the impact that aquatic debris has on our waterways. Then, build your own water filter to remove debris from a sample of water.

GRADES 3–5

### Extended Learning Questions:

1) Your challenge is to make a water filter that works even better! Brainstorm a list of materials at home that you could use in your water filter instead of dirt and gravel. Choose two materials from the list and test them using your water filter. Which material performed better? Why do you think that is?
2) Compare the water filter you built to another water filter (such as an inexpensive Brita filter). Filter the same dirty water through both filters. Which one works best? Now, make a guess at what is inside the Brita filter. Write down what you think is inside and why. As a group, open one up to see what is inside. Was it what you expected? Were you surprised?
3) Sometimes, when people go camping, they have to bring filters to clean the water for drinking. Water in streams might look clean, but there are invisible creatures called microbes living in the water that can make people sick. Get some water from a nearby lake, river, pond, or stream. Back in the classroom, pour it into a shallow dish and look at it. Do you see anything in it? How does it smell? Now, look at the water under a microscope. What do you see? Optional: pour the water into an aquarium in the classroom. Add more (tap) water and an aquatic plant. Watch it for the next month or two. Each day, monitor the water level and check for anything that looks alive. Look at a drop of water under the microscope every week. What do you notice?

### Ohio Learning Standards:

**3rd – 5th Grade Technology 3-5. DT.2.b.:** Plan and implement a design process: identify a problem, think about ways to solve the problem, develop possible solutions, test and evaluate solution(s), present a possible solution, and redesign to improve the solution.

### Next Generation Science Standards:

**3-5-ETS1-2:** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.


# Water

## ACTIVITY 5 : Aquatic Debris

Learn about the impact that aquatic debris has on our waterways. Then, build your own water filter to remove debris from a sample of water.

GRADES 6–8

### Extended Learning Questions:

1) Brainstorm a list of ways to monitor and reduce litter on the beach. Choose one idea from your list and write out benefits and limitations of the idea. What requirements would your idea take to be done in real life? Research current beach cleanup efforts. How does your idea compare to what is currently being done?
2) As a group, find and attend a locally organized litter clean-up in your area. Groups often organize these in local parks and near waterways.
3) Sometimes, when people go camping, they have to bring filters to clean the water for drinking. Water in streams might look clean, but there are tiny creatures called microbes living in the water that can make people sick. Get some water from a nearby lake, river, pond, or stream. Back in the classroom, pour it into a shallow dish and look at it. Do you see anything in it? Now, look at the water under a microscope. What do you see? Draw any microbes you see on a piece of paper. Use the internet or a textbook to try to identify the microbes living in your water.

### Ohio Learning Standards:

**6th – 8th Grade Technology**
**6-8.DT.1.b.:** Analyze how tools, materials and processes are used to alter the natural and human-designed worlds.

### Next Generation Science Standards:

**MS-ESS3-3:** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

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# Glossary:

**Aquatic debris —** Trash that ends up in waterways.

**Buoyant Force —** An upward force that a liquid exerts on an object in the liquid.

**Density —** The amount of mass compared to volume of an object or substance.

**Gravity —** An invisible force that pulls objects toward each other. On Earth, gravity is a force that pulls objects toward the center of the Earth.

**Hydrologist —** A scientist who studies water. Hydrologists use science to solve water-related problems in our society.

**Hydrophobic —** Something that repels water

**Impermeable surfaces —** Ground surfaces that do not allow liquids and gases to pass through.

**Marangoni Effect —** When water moves away from areas of lower surface tension toward areas of higher surface tension

**Mass —** The amount of matter in an object.

**Permeable surfaces —** Ground surfaces that allow liquids and gases to pass through.

**Pollutants —** Harmful substances that are introduced into the environment.

**Runoff —** Excess water that flows across roads, parking lots, farmland, etc.

**Surface tension —** A barrier that holds a material (like water) together. It is caused by forces between molecules of the material.

**Volume —** The amount of space an object takes up

**Wastewater treatment plant —** A place that cleans the water that comes from drains and sewers

**Watershed —** The land around bodies of water