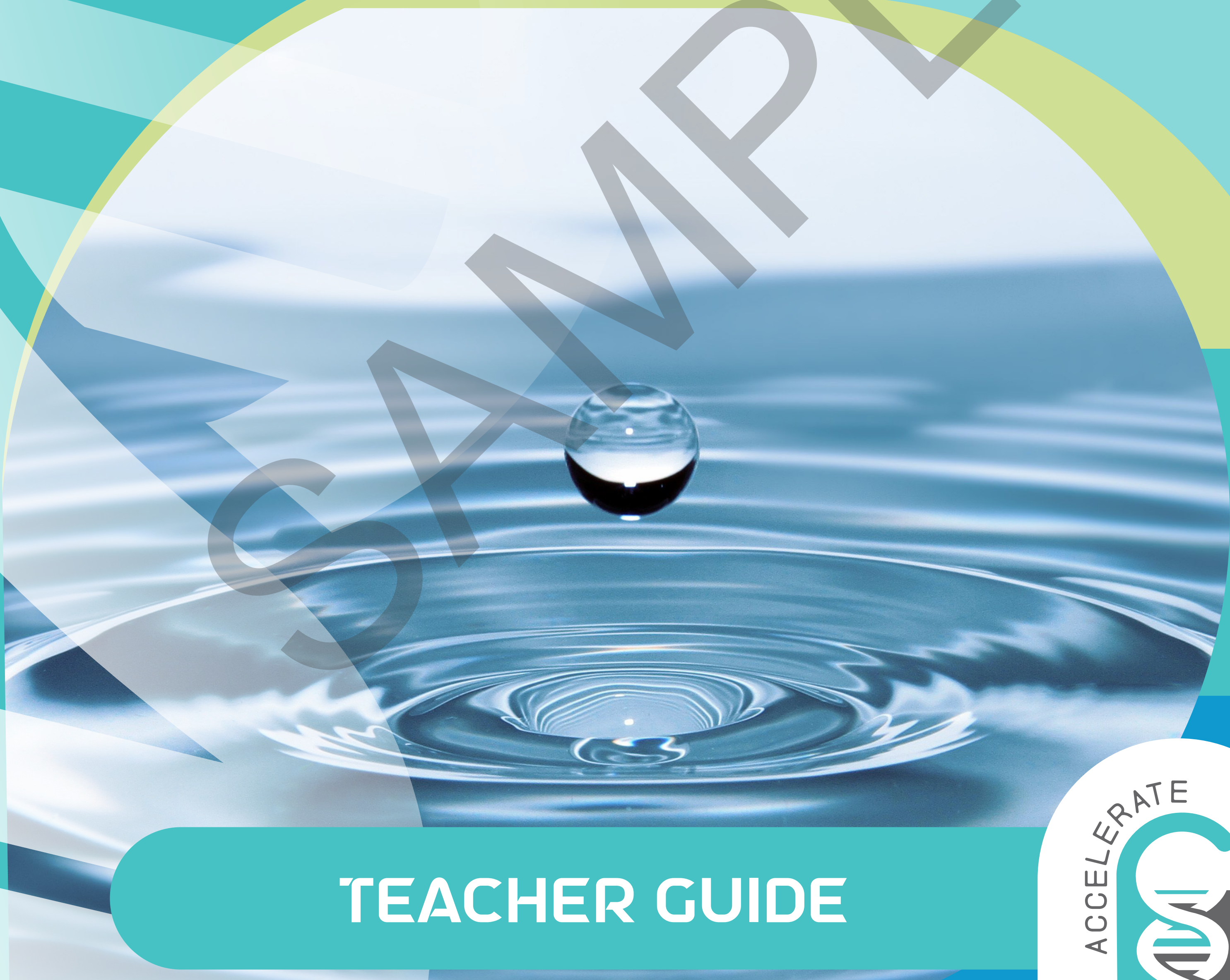
WATER: WEIRD AND WONDERFUL



TEACHER GUIDE

ACCELERATE

PLANNING

Here's a suggested schedule for this kit! The activities should be completed in order, but you can choose when the lessons take place over time.

ACTIVITY INFORMATION	SECTION (S)	TIME REQUIRED	DAY/ LESSON
ACTIVITY 1: WHAT WATER CAN DO Get hands-on with water and observe its interesting characteristics. Time required: 1 h	☐ Water Will Wow You ☐ What's up With Water?	60 minutes	Day 1
ACTIVITY 2: CLING AND CLIMB Explore adhesion, water's ability to stick to surfaces. Time required: 2 h 30 min	☐ Tiny Pieces of Matter	30 minutes	Day 2
	☐ Water's Polar Structure	60 minutes	Day 3
	☐ Sticking to the Sides ☐ Sh		Day 4
ACTIVITY 3: KEEP IT TOGETHER Learn how water can also stick to i property of cohesion			

Total time: 9+ hours

activity 1

WHAT WATER CAN DO

We all know water is important: nothing can live without it, and most of Earth's surface is covered by it. But students seldom wonder why water is so important. In this kit, your student will explore water's unique properties and find out what causes them.

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WATER WILL WOW YOU

CONTENT

To start, your student will perform a short set of four hands-on experiments. For each one of these three quick investigations, they should predict what they think will happen, then observe and record the result, all in terms of the properties, or characteristics, of water.

• For each experiment, we've provided a summary of what your student will do, what property they will observe, and how you can help.
• Avoid telling them the demonstrated property; they will explore these further throughout the other activities.
• Focus on the fun and exciting surprises water has in store for them, and ensure they make predictions before doing the actions so they can see how reality compares to their previous ideas.

☑ PREPARATION AND SUPERVISION

- The experiments are rather short, and you can easily do them all within an hour.
- It may be helpful to gather all the materials for all the experiments before starting; keeping the kit box on hand should work fine.

MULTIPLE AGES AND ABILITIES:

While we've only included materials for one student to do these experiments, there are several opportunities to show other students or get them involved. The experiments are short but exciting; with a bit of dramatic flair, they might even be spun as magic tricks for an audience of family members. Experiments 2 and 4 are especially easy for little hands and don't involve any food coloring, if you'd like to offer younger students a less-messy way to get involved.

Experiment 1

• **Property demonstrated: Adhesion**
• What the student will do: Dip a piece of filter paper in colored water on a watch glass.
• What the student should see: The colored water travels up the paper.
• How to help: Food coloring can stain fabrics and porous surfaces, so clean up spills right away. Assist your student with using scissors if needed. Help them measure the piece of filter paper, but reassure them that the exact size is not important. Experiment 1 may be the first time your student has used a pipet; remind them to squeeze the bulb before they place the tip under the water level, and then relax the squeeze. Be sure to keep the rest of the filter paper because you will need it in Activity 2.

THINK ABOUT IT!

Question: Explain why the saying "opposites attract" is important in science, using at least two examples.
Answer: The student should mention electricity, magnets, batteries, or pushes and pulls.
How to Help: *You can direct them back to the diagram with the water molecules, magnets, and battery to remind them of the similarities.*

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Capillary Comparison
• Your student will perform a short experiment in which they compare water adhesion in a capillary tube to its adhesion to filter paper.
• Essentially, they will mimic the action of a fountain pen by loading the capillary tube with water and using it to "write" on the filter paper.
• The colored water is more attracted the filter paper than the capillary tube, so it empties out of the tube onto the paper, resulting in an inking effect.

THINK ABOUT IT!

Question 1: Explain two ways in which adhesion allowed you to write the message.
Answer: Adhesion caused water to climb up the inside of the capillary tube, and it caused water to spread through the filter paper.
How to Help: *You can guide your student to this answer by asking them how the water got into the tube, and how it got out.*

Question 2: Which material – the tube or the paper – is water more attracted to? How do you know?
Answer: Gravity certainly is a factor, but it appears that water is more attracted to the filter paper, because if it wasn't, it would stay in the capillary tube when it touched the paper.

Question 3: The process you used to write a message is similar to the way an average pen works. They both depend on gravity to allow ink (which is mostly water) to flow downward. Most pens also allow some air to flow into the barrel to help "push" the ink out. How is this related to the capillary tube "pen" you made? How could you stop the "ink flow" in a full capillary tube?
Answer: The capillary "pen" should have only worked at an angle. When held too horizontally, gravity would not allow the water to run out of the tube. When held too vertically, it would rush out quickly. If you want to stop the flow, you can cover the open end of the capillary tube with a finger.

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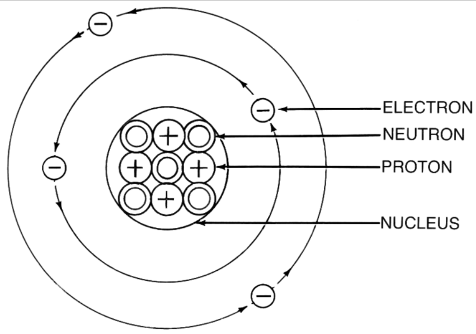
SHOW WHAT YOU KNOW

Question 1: Next to the diagram of an atom, label the following terms: electron, proton, neutron, nucleus.
Answer: Please see the diagram. Refer your student back to the text as needed.



• The dishwashing liquid is explained as having molecules with a polar part and nonpolar part.
o While not provided to the student, the name for this type of molecule is amphoteric.
o Amphoteric substances attract both polar and nonpolar substances, allowing for them to mix when they normally couldn't.
o A biology connection to this is the phospholipids that make up the double-layer cell membrane.

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SHOW WHAT YOU KNOW

Notes
• This is a performance assessment that may seem a bit more demanding than other assessments.
• It asks students to practice their content knowledge and their ability to apply it to other situations.
• The questions require critical thinking and reasoning, and your student may require some support. For example, you can help them take each question step by step and make sure they understand each step before moving on to the next.

Question 1
Imagine that you are trying to identify a mystery substance. Here's what you know:
- It's a clear liquid.
- You measured a sample of it and it had a mass of 15.5 g and a volume of 19 mL.
- It dissolves in water with a little bit of stirring.
Which of these substances is most likely the mystery substance? Support your choice with evidence and explain how you used that evidence to decide.
- Benzene: nonpolar, density 0.9 g/mL
- Ammonia: very polar, density 0.8 g/mL
- Kerosene: nonpolar, density 0.8 g/mL
- Pentanol: slightly polar, density 0.8 g/mL
- Diethyl ether: slightly polar, density 0.7 g/mL
Answer: The identity of the mystery substance should have the same density and polarity (based on solubility). The evidence points to a density of (15.5g/19mL) = 0.8 g/mL and a polarity of slightly polar because it takes a little stirring to dissolve in water. The best match for these properties is pentanol.

Question 2a: One common demonstration of density and dissolving is a density column (you can make one using the extensions in Activity 7). Imagine you have assembled such a density column with several layers. What will happen if you pour a bit of salt into the top? Why?
Answer: Oil is on the top, so salt would just stay there and not dissolve. Eventually, it might sink down because of its higher density, but it would take a long time.

Question 2b: What will happen if you drop in a building brick that has a density of 1.2 g/mL? Why?
Answer: The brick would stay suspended where the density of what's above it is lower than 1.2 g/mL and the density of what's below it is greater than 1.2 g/mL. The point in the column where this is true is the boundary between the dish soap and maple syrup.

Question 2c: What will happen if you use a long pair of tweezers to drop a piece of plastic on the bottom with a density of 0.2 g/mL? Why?
Answer: The density is lower than all of the liquids, so it would rise or float to the top.

ACCELERATE

SCIENCE UNLOCKED

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Kit	SU-WTRWRD
Instructions	IN-WTRWRDT
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