LESSON 1

Name: ___________________________ School: _________________________________

WATER: EVERY DROP COUNTS

MATERIALS: Empty gallon jug, measuring spoons (1 tbsp, 1 tsp), 1 cup measuring cup
(If you don't have these, just visualize!)

PROCEDURE

1. Play the "*Water Trivia Game*"
2. Do the "*Global Fresh Water*" Demonstration
3. Watch "Edme's Long Walk for Water" (optional)
4. Complete the "*Personal Water Use Audit" Worksheet*

WATER TRIVIA GAME – **Do your best to answer each question accurately in each box**. The answers are at the end of this lesson (don't peek until you're done!)

1. What percent of the earth's water is available for people to use (drink, clean, etc.)?	2. What percentage of people in the world lack access to safe drinking water?	3. What is the total amount of water (in gallons) consumed per day by the average American?	4. What percentage of the adult human body is comprised of water?
5. What activity accounts for the highest water use worldwide? Agriculture, Industry, or Domestic?	6. What percentage of income does the average U.S. Citizen spend on drinking water?	7. What percentage of income does the average Honduran from Tegucigalpa spend on drinking water?	8. Approximately how many people in developing countries die each year from water-related disease?
9. How many gallons of water does it take to produce one pound of corn?	10. How many gallons of water does it take to produce one pound of beef?	11. Of all the earth's water, how much is ocean or seas?	12. How much water drops with an inch of rain on one acre of ground?

GLOBAL FRESH WATER DEMONSTRATION

1. Fill a gallon jug with water.
2. Take out 2.5 percent (3 tablespoons plus 1 teaspoon) and place it in a clear container to represent the amount of fresh water on Earth.
3. Of this amount, remove 70 percent (2 tablespoons) to represent the amount of water trapped in glaciers or too deep in the ground to realistically be recovered. **The remainder-less than 1 percent of the Earth's total water supply-is left to support human needs for agriculture, drinking and washing as well as for lakes, rivers, and fresh water ecosystems!**

LESSON 1

ASSESSMENT REFLECTION QUESTIONS

1. What happens when people do not have enough water to meet their basic needs?

2. Given that there is a fixed amount of fresh water on the planet, what will happen to the distribution of water resources as global population grows?

(Optional if you have Internet/Youtube):

Edme's Long Walk for Water (https://www.youtube.com/watch?v=1Mem3z-1404)

https://water.org/our-impact/all-stories/ (https://water.org/our-impact/all-stories/)

WATER TRIVIA **ANSWERS:**

1.) 0.03% The earth has an abundance of water, but unfortunately, only a small percentage is even usable by humans. The other 99.7 percent is in the oceans, soils, icecaps, and floating in the atmosphere.	2.) 11% An estimated 790 million people without access to an improved water supply.	3.) 80-100 According to USGS estimates, each person in the United States uses about 80-100 gallons of fresh water per day. On a monthly basis nationwide, Americans use 3.9 trillion gallons of water.	4.) 50-65% Up to 60% of the human adult body is water. The brain and heart are composed of 73% water, and the lungs are about 83% water. The skin contains 64% water, muscles and kidneys are 79%, and even the bones are watery: 31%.
5.) Agriculture, 65-70% In most regions of the world, over 70 percent of freshwater is used for agriculture. By 2050, feeding a planet of 9 billion people will require an estimated 50 percent increase in agricultural production.	6.) 0.05% The United States has good infrastructure for treating and supplying fresh water.	7.) 25% Potable water coverage is poor with around 40% of the city's residents without access to piped water supply thus relying on more costly water trucks and bottled water.	8.) 3.4 million people, mostly children, die annually from water-related diseases. Most of these illnesses and deaths can be prevented through simple, inexpensive measures.
9.) 127 A high-yielding corn crop uses about 600,000 gallons of water per acre. An acre of corn releases approximately 4,000 gallons of water a day in evaporation. Corn uses nearly 3,000 gallons of water for each bushel of yield.	10.) 2,500 The total amount of water needed – to produce one pound of beef is 1,799 gallons of water; one pound of pork takes 576 gallons of water.	11.) 97% The ocean holds about 97 percent of the Earth's water; the remaining three percent is distributed in many different places, including glaciers and ice, below the ground, in rivers and lakes, and in the atmosphere.	12.) 27,154 gallons, which weighs 113 tons!

COMPLETE THE WATER AUDIT TODAY!!

LESSON 1

Personal Water Use Audit

Keep track of how many times you do each activity in 1 day. Keep a running tally throughout the day and then calculate your total times and gallons used at the end of the day.

Activity	Tally times doing activity	Total number	Estimated Water Use (multiply total number by the amount listed to get total gallons)
Washed hands			0.1 gallons = ________ gallons
Showered (regular showerhead)			30 gallons = ________ gallons
Showered (low-flow showerhead)			15 gallons = ________ gallons
Tub bath			20 gallons = ________ gallons
Brushed teeth			0.2 gallons = ________ gallons
Drank a glass of water			0.008 gallons = ________ gallons
Boiled pot of water for cooking			0.25 gallons = ________ gallons
Flushed toilet (conventional toilet)			5 gallons = ________ gallons
Flushed toilet (ultra-low flush toilet)			1.6 gallons = ________ gallons
Washed a load of dishes in dishwasher			15 gallons = ________ gallons
Washed a load of dishes in sink (not running the tap)			10 gallons = ________ gallons
Washed load of laundry in conventional machine			40 gallons = ________ gallons
Washed load of laundry in high efficiency washer			25 gallons = ________ gallons
Washed a car			15 gallons = ________ gallons
Other activity:			
Other activity:			
Other activity:			
Total daily gallons			

LESSON 2

BRAIN HEMISPHERE HAT

Target age group: ages 8-13

Time needed: at least 20 minutes for assembly (allow 30 minutes for younger students) plus any additional time you want to spend on coloring and/or labeling

What you will need:

• copies of the following pattern pages printed onto heavyweight paper (card stock) if possible (if card stock is not available, go ahead and use regular paper--the hat just won't be quite as durable)

• clear tape

• white glue or glue stick if you want to avoid too much tape on the hat

NOTES:

• If you use white glue, I recommend using clothespins or paper clips to hold the joints while they dry. If you use glue sticks I highly recommend using glue sticks intended for adults, not "school glue." Glue labeled as "washable" or "school glue" tends to be wimpy and doesn't stick nearly as well as regular glue. But if school glue is all you've got, you can probably make it work. It will just take longer for the joints to dry. (For the seam down the middle, most people choose to use tape.)

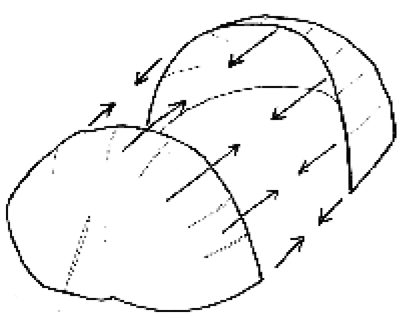
• There are both labeled and unlabeled patterns provided so that your students can do their own labeling, if you wish. With the labeled patterns, you may still want your students to color code the lobes, or trace over the words with markers or crayons. Do all coloring and labeling before you assemble the hats.

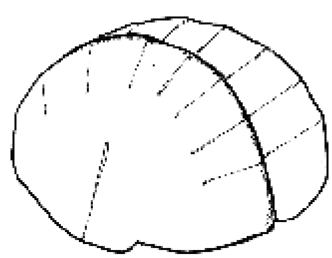
• Though two sizes are provided, the hat is designed to be as "one-size-fits-all" as possible. (It's amazing how similar head sizes are in comparison to shoe or shirt sizes.) The size of the hat can be made a little smaller by overlapping the hemispheres slightly more before taping them together. If necessary, the folds can also be overlapped, as well. Another way you could shrink the size would be to use the size reduction button on a copier and copy at about 95%.

• If you are doing this project with a class, you might want to have two or three pre-assembled hats for the students to try on before assembling their own. Make one standard size, one smaller, and maybe one even smaller if you have young students. Students who find that the smaller hats fit better will know to make adjustments during assembly.

How to assemble:

Cut out both hemispheres. Then snip in on the "V" lines. Don't snip on the dashed lines, just the solid lines. Then pull the "flaps" you have created over to their dashed lines and secure with glue or tape. After you have pulled all the flaps over to their dashed lines, it should then take on a half-round shape. To put these two halves together, simply choose one side to overlap just slightly onto the other (1/8" or less is enough, but use more if you are trying to shrink the size of the hat). Secure with tape. (If you don't want the tape to show, put the tape on the inside of the hat.)





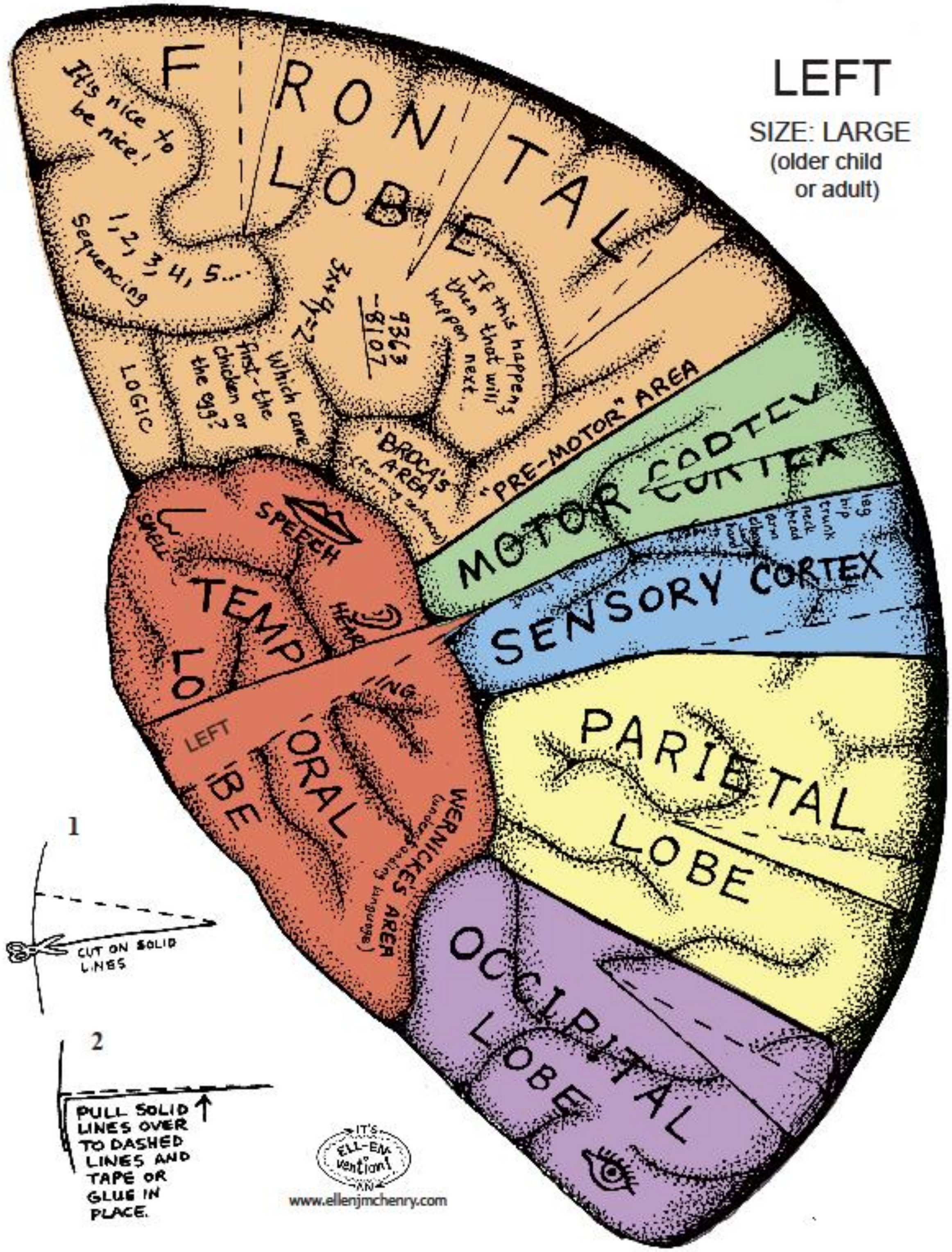
IT'S ELL-EN-vention! AN

www.ellenjmchenry.com

LESSON 2

LEFT

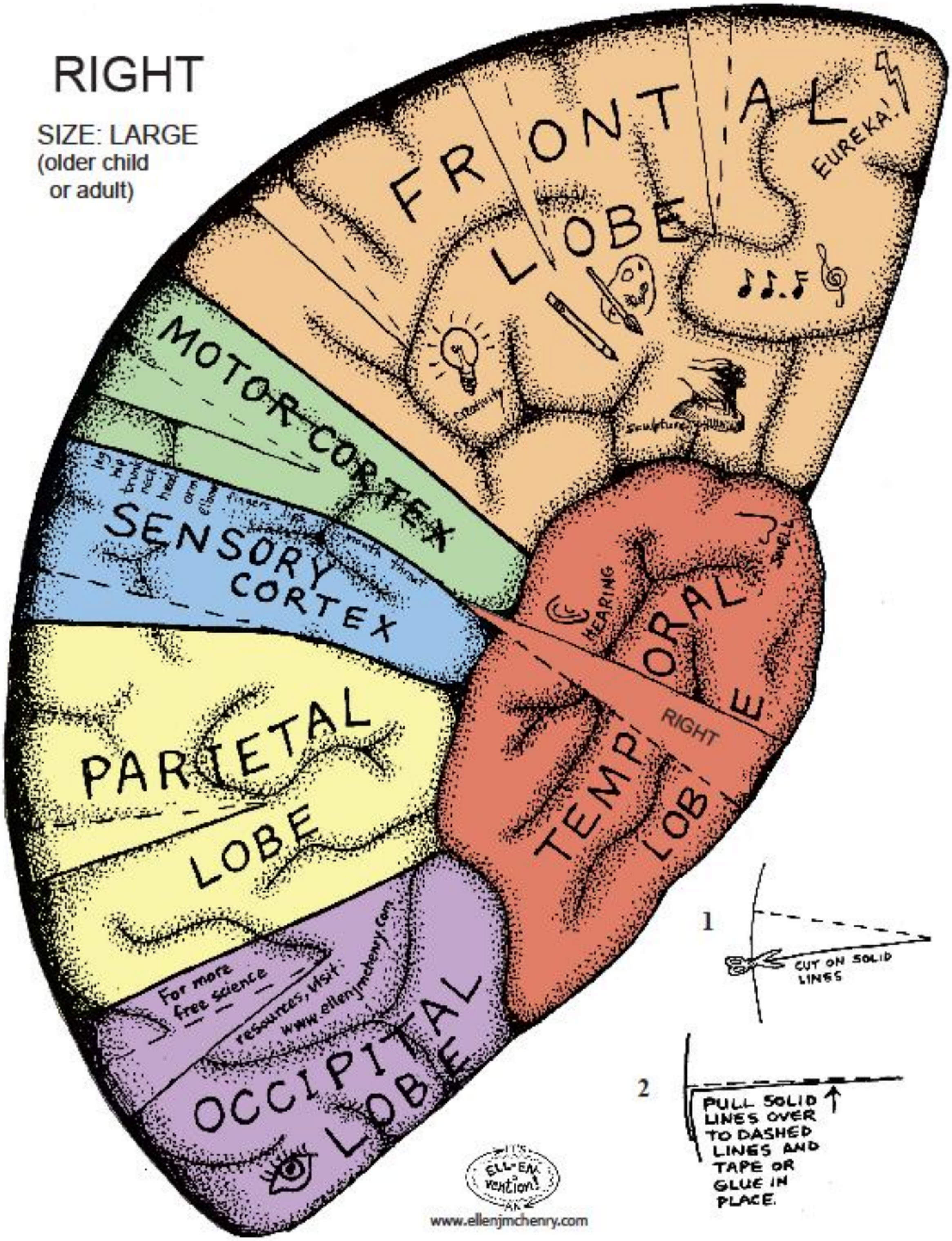
SIZE: LARGE
(older child
or adult)



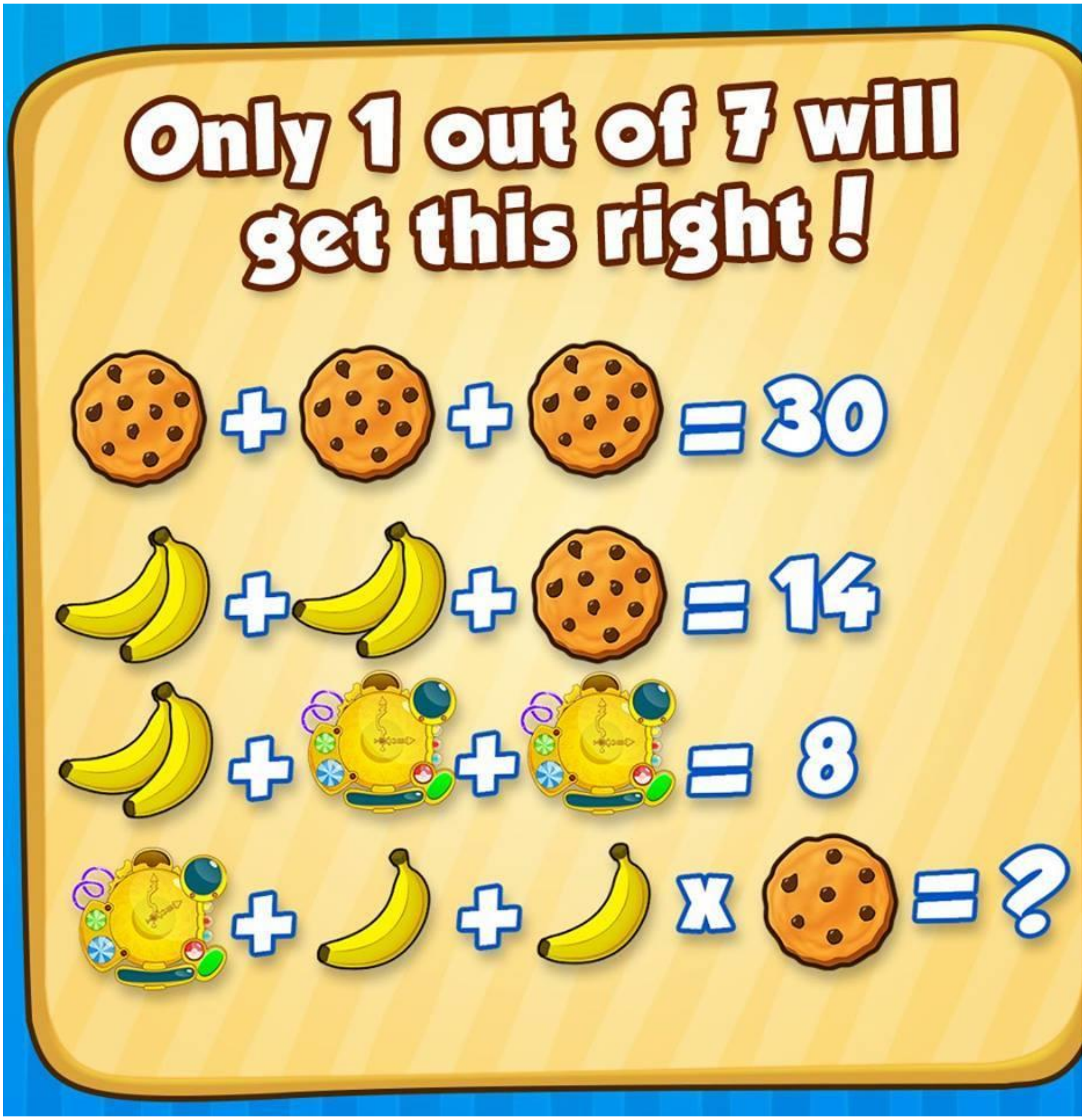
LESSON 2

RIGHT

SIZE: LARGE
(older child
or adult)



WHAT'S THE ANSWER?!? LOOK CAREFULLY. IT'S NOT 17!



LESSON 4

STRAW OBOE

Two lips make sound.

From: www.exploratorium.edu

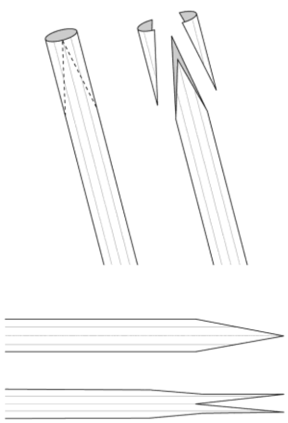
By cutting two "lips" into the flattened end of a soda straw and blowing with just the right pressure, you can make sounds resonate in the straw.

Tools and Materials

- Flexible or straight plastic soda straws (if you use straight straws, be sure not to bend them while doing this Snack, otherwise it won't work)
- Scissors
- Optional: Poster paper, tape

Assembly

1. Flatten one end of your soda straw by sticking the end in your mouth, biting down with your teeth, and pulling it out. Do this several times to make a flexible, flat-ended straw.
2. Cut equal pieces from each side of the flattened end (as shown—click to enlarge), so that the straw has two "lips" at the end.



To Do and Notice

Put the cut end of the straw in your mouth and make a seal with your lips. Blow into the straw. You'll probably have to experiment with blowing harder and softer while biting down with different amounts of pressure until you make the straw sing.

What's Going On?

The beveled "lips" you cut into the squashed end of the straw act as a reed for your instrument. When you blow into the reed and get it vibrating, you send pulses of compressed air down the straw, causing the air in the tube to start vibrating, too. Affected by the length of the tube, this vibrating air in turn affects the reed's vibrations. When the reed vibrates at just the right frequency, the air in the straw vibrates powerfully, and you hear a loud, buzzing note, sort of like an oboe.

When you blow through the straw, there is a high pressure in your mouth. As air rushes through the straw, the pressure in the straw drops. The high pressure outside the straw pushes the sides of the reed inward, closing off the flow. The pressure then builds inside the straw and pops the reed open again.

The sound from your straw oboe is an example of a phenomenon called *resonance*. Every object has a natural frequency, a tendency to vibrate at a particular rate. When you vibrate something at its natural frequency, it resonates, meaning that the vibrations build and grow more and more extreme. Other examples of resonance include a car that shudders at certain speeds, a child swinging higher and higher on a swing, and a glass shattered by the high notes of a soprano.

The straw oboe resonates when the sound waves bouncing back and forth inside make a special pattern called a standing wave. Standing waves occur when waves going one way overlap with waves going the opposite way, creating a set of peaks and valleys that seem to stand still. You can't see the standing waves in your straw, but you can hear them.

The exact note that you hear when you blow your straw oboe depends on the length of the straw. In a shorter straw, the standing wave inside the straw will be shorter, too, causing the pitch to be higher. In a longer straw, the standing wave will be longer, and the note you hear will be lower.

Going Further

There are many ways to experiment with your straw oboe:

- Slide a slightly larger straw onto the end and use it like a trombone.
- Cut finger holes into the straw with scissors and play it like a recorder.
- Snip the straw shorter and shorter with scissors to change its pitch.
- Devise a "bell" with paper and tape to make your instrument louder.
- Experiment with new ways to change the sound.

RESONANT RINGS

Here's one reason not all buildings are equal in an earthquake.

From: www.exploratorium.edu

This activity graphically demonstrates that objects of different sizes and stiffness tend to vibrate at different frequencies.

Tools and Materials

- Large sheet of construction paper measuring about 14 × 20 inches (35 × 50 centimeters); alternatively, use strips of construction paper ranging in size from roughly 1 x 8 in (2.5 x 25 cm) to 1 x 20 in (2.5 x 50 cm) in a variety of colors
- Sheet of cardboard that is 12 in (30 cm) long and several inches (15–20 cm) wide
- Scissors
- Tape

Assembly

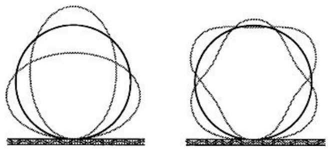
1. Cut four or five 1-in (2.5-cm) wide strips from the construction paper. The longest strip should be about 20 in (50 cm) long, and each successive strip should be about 3 in (8 cm) shorter than the preceding one.
2. Form the strips into rings by taping the two ends of each strip together.
3. Tape the rings to the cardboard sheet as shown in the image above.

To Do and Notice

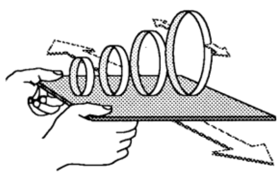
Shake the cardboard sheet back and forth. Start at very low frequencies and slowly increase the frequency of your shaking.

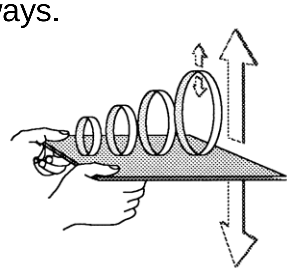
Notice that different rings vibrate strongly, or resonate, at different frequencies. The largest ring will begin to vibrate strongly first, followed by the second largest, and so on. The smallest ring starts to vibrate at the highest frequencies.

Keep shaking the cardboard faster and faster, and notice that the largest ring will begin to vibrate strongly again. Each ring will vibrate at more than one frequency, but the shape of each ring will be different for each resonant frequency. (Click to enlarge diagram below.)



The rings will also have different resonant frequencies if you shake the board up and down instead of sideways.





What's Going On?

The frequencies at which each ring vibrates most easily—its resonant frequencies—are determined by several factors, including the ring's inertia (mass) and stiffness. Stiffer objects have higher resonant frequencies, whereas more massive ones have lower resonant frequencies.

The biggest ring has the largest mass and the least stiffness, so it has the lowest resonant frequency. Put another way, the largest ring takes more time than the smaller rings to respond to an accelerating force.

During earthquakes, two buildings of different sizes may respond very differently to the earth's vibrations, depending on how well each building's resonant frequencies match the "forcing" frequencies of the earthquake. Of course, a building's stiffness—determined by the manner of construction and materials used—is just as important as a building's size.

Going Further

You can make the vibration frequency audible and more obvious by cutting a 1-in (2.5-cm) section of a plastic drinking straw, inserting a BB pellet into it, taping paper over the ends of the straw, and taping the straw to the cardboard sheet parallel to the end. As you shake the sheet, the BB will tap against the ends of the straw at the same frequency as your vibration.

Resonance in Music 𝄞♪♫♩

Resonance is an important consideration for instrument builders as most acoustic instruments use resonators, such as the strings and body of a violin, the length of tube in a flute, and the shape of a drum membrane. Violin (or harp, guitar, piano, etc.) strings have a fundamental resonant frequency directly related to the length and tension of the string. The wavelength that will create the first resonance on the string is equal to twice the length of the string. This frequency is related to the speed v of a wave traveling down the string by the equation.

<math>f = {v \over 2L}<math>

where L is the length of the string (for a string fixed at both ends). The speed of a wave through a string or wire is related to its tension T and the mass per unit length ρ:

<math>v = \sqrt {T \over \rho}<math>So the frequency is related to the properties of the string by the equation

<math>f = {\sqrt {T \over \rho} \over 2 L} = {\sqrt {T \over m / L} \over 2 L}<math>