



This guide accompanies
[*Science Sustainability Sleuths Day 4*](#)

PRIOR TO TEACHING



Subject

Aqueducts



Program Length

45 minutes – 1 hour



Program Objective

Put your engineer cap on as you design, build, and test your own aqueduct maze to learn how we transport water.



Next Generation Science Standards

3-ESS2-2: Obtain and combine information to describe climates in different regions of the world.

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.

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.

4-ESS3-1: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

4-PS3-1: Use evidence to construct an explanation relating the speed of an object to the energy of that object.

5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

5-ESS2-2: Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.



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

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

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.

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.



What I Need Today

empty toilet tubes, paper towel tubes, or wrapping paper tubes

scissors

cardboard

construction paper

tape

toy train tracks (optional)

marble or other small spherical object



Vocabulary

Aqueduct – A system that carries water from one place to another. Aqueducts can help water travel underground (through a tunnel or pipe), at ground level (through a canal), or above the ground (over a bridge).

Engineer – A person who uses physics, math, and chemistry to figure out the best way to solve problems by creating new things or improving a product.

Force – A push or a pull on an object.

Gravity – An invisible force that pulls objects toward each other. Your gravitational force is pulling on the Earth and the Earth's gravitational force is pulling on you. But, because the Earth has a much larger mass than you do, gravity pulls you down toward the Earth's center, keeping your feet on the ground.



Instructor Prep

In advance, send students a list of the materials needed for today's lesson.



PROCEDURE



What We'll Learn

Engineers build aqueducts to bring clean, fresh water from places where it rains or snows to places where people live in more arid environments, like Southern California.



What Will Happen?

Scientists ask questions and make predictions before they start investigating. Have your students hypothesize: how many twists, turns, or loops can you create in your home-made aqueduct maze through which your "water" will travel?

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3+

What to Do



REVIEW - DAY 3: SOURCES OF WATER

Have your students show off their completed topographic maps. Today you're going to learn how the water gets from the highest mountains in California to those of us who live in places where we don't get a lot of precipitation.



VIDEO - FROM THE MOUNTAINS TO YOUR TAP

To start learning about aqueducts, first watch

[*From the Mountains to Your Tap*](#):

<https://vimeo.com/496450842/9789664caf>





EXPERIMENT - ENGINEER AN AQUEDUCT

1) Gather your supplies. You will be creating a ramp, so think creatively about what materials you already have that you can use. Just make sure you have a small, spherical object, such as a marble, so you can test your ramp.

2) Aqueducts are structures designed by engineers to move water from one place to another. To build your own aqueduct, start by cutting the cardboard rolls in half lengthwise to make a semi-circle bowl shape.



Fun Fact: Much of the water in Southern California starts out as snow high in the mountains. When it melts, it travels down a series of rivers and streams, through aqueducts created by engineers, and into pipes – that lead right to your faucet!

3) Create a long ramp by taping several cardboard tubes together. You can also try bending flat pieces of cardboard or rolling construction paper and adding them to your tubes. Do you have any toy car or train tracks you could try using in your ramp? Be creative and experiment with different materials.

4) Lay your ramp flat on the ground. Then place the marble at one end and watch what happens.

5) Did your marble move? Did it travel all the way down the length of your ramp? It probably didn't because, just like aqueducts, ramps use gravity to pull objects such as marbles or water downhill. To create your "hill", try taping one end of the ramp to a wall, the top of a table, or a stack of books.

6) Place your marble at the high end of your ramp and let it go. What happens this time?



Fun Fact: When you release the marble, the act of you letting it go gives it an initial push (also called an action or a force). As the force of gravity pulls it down the ramp, it gains speed.

ENGINEER AN AQUEDUCT



1. START BY CUTTING THE CARDBOARD ROLLS IN HALF LENGTHWISE TO MAKE A SEMI-CIRCLE BOWL SHAPE.

2. WITH A LOT OF WATER IN SOUTHERN CALIFORNIA COMES OUT OF THE MOUNTAINS. WHEN IT RAINS, IT TRAVELS DOWN A SERIES OF RIVERS AND STREAMS, THROUGH AQUEDUCTS CREATED BY ENGINEERS, AND INTO PIPES – THAT LEAD RIGHT TO YOUR FAUCET!

ENGINEER AN AQUEDUCT



3. CREATE A LONG RAMP BY TAPING SEVERAL CARDBOARD TUBES TOGETHER. YOU CAN ALSO TRY BENDING FLAT PIECES OF CARDBOARD OR ROLLING CONSTRUCTION PAPER AND ADDING THEM TO YOUR TUBES. DO YOU HAVE ANY TOY CAR OR TRAIN TRACKS YOU COULD TRY USING ON YOUR RAMP? BE CREATIVE AND EXPERIMENT WITH DIFFERENT MATERIALS.

ENGINEER AN AQUEDUCT



4. LAY YOUR RAMP FLAT ON THE GROUND. THEN PLACE THE MARBLE AT ONE END AND WATCH WHAT HAPPENS.

5. DID YOUR MARBLE MOVE? DID IT TRAVEL ALL THE WAY DOWN THE LENGTH OF YOUR RAMP? IT PROBABLY DIDN'T BECAUSE, JUST LIKE AQUEDUCTS, RAMP USE GRAVITY TO PULL OBJECTS SUCH AS MARBLES OR WATER DOWNHILL.

6. TO CREATE YOUR "HILL", TRY TAPING ONE END OF THE RAMP TO A WALL, THE TOP OF A TABLE, OR A STACK OF BOOKS.

ENGINEER AN AQUEDUCT



7. PLACE YOUR MARBLE AT THE HIGH END OF YOUR RAMP AND LET IT GO. WHAT HAPPENS THIS TIME?

8. WHEN YOU RELEASE THE MARBLE, THE ACT OF YOU LETTING IT GO GIVES IT AN INITIAL PUSH (ALSO CALLED AN ACTION OR A FORCE). AS THE FORCE OF GRAVITY PULLS IT DOWN THE RAMP, IT GAINS SPEED.

ENGINEER AN AQUEDUCT



9. TRY MAKING MORE "HILLS" TO YOUR RAMP BY PUTTING OBJECTS UNDER PARTS OF THE RAMP. CAN YOU CREATE A LONG, TWISTY, HILLS-CRAFTER-STYLE RAMP FOR YOUR MARBLE?

10. AQUEDUCTS CAN TRANSPORT WATER OVER LONG DISTANCES, MOVING THE WATER THROUG THROUGHS OR TUNNELS, WORKING THEIR WAY UNDERGROUND, AND EVEN USING PIPES!



7) Try adding more “hills” to your ramp by putting objects under part of the ramp. Can you create a long, twisty, roller coaster-like ride for your marble?



Fun Fact: Aqueducts can transport water over long distances, making the water travel through straight or twisty channels, winding their way underground, and even going uphill.



VIDEO - GROUNDWATER REPLENISHMENT

Next week, you will have a special live presentation from an educator with Discovery Cube, where they will show you how to do the activity and answer questions you might have about the topic. To help prepare, watch this [film from Los Angeles Department of Water and Power](https://vimeo.com/372940709), about their groundwater replenishment project: <https://vimeo.com/372940709>

What questions do your students want to ask our educator next week? Please send a list of questions to educationemail@discoverycube.org.



CONCLUSION

What I Discovered

To earn a portion of the Go With The Flow badge, have your students reflect on what they discovered. We would love to see pictures of their aqueduct models. Please email pictures to educationemail@discoverycube.org.

For Next Week

Have your students gather these supplies:

2 clear cups

spoon

straw

cereal or granola

milk or milk substitute

smashed banana, yogurt, or applesauce

cinnamon

food coloring or colored sugar

