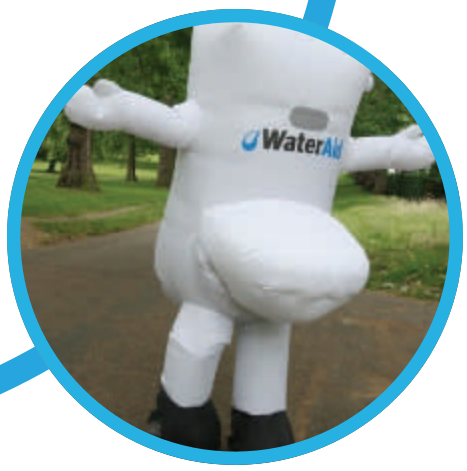
WaterAid Water Wise Module 4
Grades 3—6

Physics of flushes and flows



National Science Education Standards
Levels K-4
Understanding about science and technology (Science and Technology Standards)
Personal health (Science in Personal and Social Perspectives)
Position and motion of objects (Physical Science Standards
Levels 5-8
Abilities of technological design (Science and Technology Standards)
Personal health (Science in Personal and Social Perspectives)
Motions and forces (Physical Science Standards)

Physics of flushes and flows

It was a successful trip to the toilet. Now that you're done, it's time to empty the bowl. Lucky for you, you live in a society that has flush toilets. Okay, so press down on the lever. Whoosh. Several gallons of clean water flow from the tank into the bowl. Next, the siphon effect sucks the bowl clean. With the waste on its way, the bowl water level returns to its pre-flush height.

Over 150 years ago, inventors came up with our basic siphon system for flushing toilets. You've used this simple technology all your life, but did you ever wonder how it worked? Well, you're about to find out. In this activity, you'll construct a model of a flush toilet that uses a siphon system. By exploring this model, you'll understand how it maintains the bowl's water level and when flushed, produces a discharge of the tank water rapid enough to carry the waste away!

Materials

- ⇒ Small paper cup (cannot be plastic)
- ⇒ 2 drinking straws (with bendable elbow)
- ⇒ Scissors
- ⇒ Sharp pencil
- ⇒ Tape
- ⇒ Waterproof clay
- ⇒ Cup with tap water

Steps

1. Use the point of a pencil to punch a hole near the bottom of a paper cup. Make sure the hole has a diameter large enough to fit a drinking straw. CAUTION: Sharp objects can be hazardous.
2. Use the scissors to carefully shorten both ends of a drinking straw, leaving only a 1" (2.5 cm) segment of straight straw that extends from both directions of the bendable elbow.
3. For the second straw, identify the "mouth end" of this bendable tube. Use scissors to further shorten this end so that only about 1" (2.5 cm) of straight straw extends from the bendable elbow.
4. Insert the short end of the second straw into either end of the straw that was prepared in step 2. Take your time. Once the straw segment is inserted, make sure that air flows through the entire "pipe" without leaking at the joint. If necessary, wrap a piece of tape around the connection.
5. Place two bends in the pipe forming an "S" shape.
6. Insert the shorter end into the cup's punched hole. Use waterproof modeling clay to seal this connection. Make sure that the top of the straw pipe is about 2/3 the height of the cup (see photo).
7. Over a bowl or sink, fill the cup halfway with water. As you add the water, observe the level of water in the attached straw.
8. When you are ready to model a flush, add more water so that the cup's level rises above the height of the attached straw. What happens?

Physics of flushes and flows: Questions

Name:

1. In your own words, describe a siphon.

2. What did the paper cup in your model represent?

3. What part of your set-up represented the water that is stored in the toilet tank?

4. How did the flush begin and what happened when the water level surpassed the height of the upper straw bend?

5. Does the height of the upper bend in the straw affect the operation of the toilet? Explain.

Sanitation and toilet facts

⇒ **2.6 billion people** in the world do not have access to a toilet, this is almost two fifths of the world's population. (WHO/UNICEF)
⇒ Older toilets use at least **nine liters of water** a flush; a low-flush model uses as little as three liters.
⇒ In the developing world, about **90% of sewage is discharged untreated** into rivers, polluting them and affecting plants, animals and humans.
Find out more water facts and download more worksheets at www.wateraidamerica.org/education.

Teacher notes

This activity offers students the opportunity to observe the basic physics of a siphon toilet flush. By modeling this system, students can better understand the nature of fluids and the siphon effect. In addition, it offers insight into the technological simplicity of design and function.

If you think students may struggle with this activity, consider punching the holes prior to the classroom period. In addition, you may need to assemble the two-straw system. Don't forget to remind students of the safety hazards associated with pointed objects and to be careful if you decide to have them punch holes into the cups. Remember, the cups must be paper! Plastic cups will crack as they produce an unsafe and unrealistic material for punching.

Answers

1. A siphon is a tube in which liquid flows from a higher level to a lower level.

2. The toilet bowl.

3. The tap water within the cup represented the water stored in a toilet tank.

4. The flush began as water was poured into the modified cup. Once the water level in the cup rose above the upper bend in the straw, the siphon effect took over. Water then flowed out of the cup and through the straw, until the cup had emptied.

5. Yes. If the height is too low, then the siphon flush will occur before sufficient water volume has entered the bowl. If the height is too high, then the bowl will overflow before the siphon flush will initiate.

WaterAid transforms lives by improving access to safe water, hygiene and sanitation in the world's poorest communities.

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