

Relational Causality and Drinking From a Straw

RECAST ACTIVITY

What causes the liquid to rise in a straw when you drink from it? Ask the students to draw a model of their ideas.

Then do the demonstration. Select three students to participate in a mini-competition.

Explain,

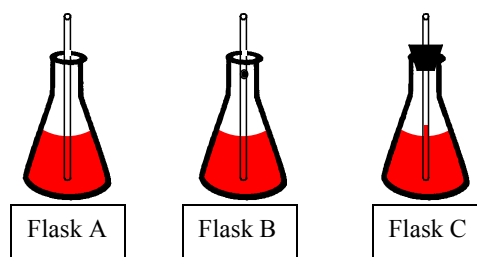
“Here I have three clean flasks and straws with juice in them. Let’s see who can drink the juice from their straw the fastest! There are some differences between the flasks that we’ll discuss later. For the student drinking from Flask C, you’ll notice something around the stopper; that’s just a little petroleum jelly.

“When I say ‘go,’ you are going to put your lips to the straw and begin drinking continuously. Once you have sealed your lips around the straw do not take them off or open them for air. Just breathe through your nose and drink as fast as you can. The student with Flask C should hold the stopper in place gently but not push down on it.

“Ready, Set, Go!”

[The student drinking from A should finish first. The student drinking from B often cannot remove much liquid at all and often says something like, “there’s a hole in my straw—no fair!” Ask why that would matter, what is going on? The student drinking from C can only get a little liquid to come up the straw. The students often laugh or are puzzled at the outcome. Ask each student to tell the class what it was like to drink from the straw and to explain why he or she is laughing.]

Discuss the modifications to the flasks/straws and have the students figure out why this matters. They cannot create an air pressure differential in flasks B and C. Why not?



PREPARATION

Materials (per group unless otherwise indicated)

- 3 Erlenmeyer flasks, 250 ml
- Juice (a color that is easy to see such as grape, cranberry, or orange juice), 450 ml
- Petroleum jelly, 1 jar per class
- Pin, 1 per class
- 1 Single-holed rubber stopper (size #6½)
- 3 Straws (chosen to fit tightly through the size #6½ stopper hole)

Prep Steps

1. Label the Erlenmeyer flasks, A, B and C.
2. Fill the Erlenmeyer flasks to the 150 ml line with juice.
3. Place a straw in Flask A.
4. Make a small non-obvious hole so that when the straw is in the flask, the hole will be just below the top of the flask. Place the straw in Flask B.
5. Insert a straw through the hole of the stopper. Place petroleum jelly around the hole to make an airtight seal between the straw and the stopper. Place the stopper into Flask C. If the seal is not airtight, place petroleum jelly around the stopper to seal it.

RECAST ACTIVITY ANALYSIS

What makes this work as a RECAST activity?

Students typically bring simple linear causal models to drinking from a straw that are centered on their own initiative or agency. “I suck and the liquid comes up.” In order to shift students to a relational causal model where a difference in air pressure accounts for the outcome, we need to help them realize the role of ambient air pressure.

The **A flask** works because they lower the air pressure on the end of the system where their lips are (including the lips, mouth, and lungs in the system) and the relatively higher air pressure pushed the liquid up the straw.

With the **B flask**, they cannot lower the pressure on this side of the straw because it is replaced by more air. **Flasks A and B** alone are not enough to make this a RECAST activity though because students can keep their linear model and just say, “I couldn’t suck hard enough.”

When they drink from **Flask C**, they can remove a little liquid. Since no more air can enter the flask, the air already in the flask spreads out in the available space thus lowering the pressure so that the pressure is in equilibrium with the lowered pressure on the mouth end. **Flask C** focuses students’ attention on the role of the surrounding air pressure and the part that this air pressure plays in the pressure differential.