Lesson Title: Siphons	Date: February 1, 2008
Author: Ryan Lenz	Topic: Pressure, suction, cohesion.
Grade level: 3-8	Lesson Length: 45 minutes

Overview: Students investigate the physics of suction, pressure and eventually siphons by transferring water from one bottle to another. Students also model a chain of water molecules moving through a siphon.

Objectives: Students will:

- Create a siphon
- Vary the flow rate by adjusting elevation and hose diameter
- See the real-world application of siphons in relation to aquariums
- Be introduced to the terms pressure, vacuum, suction, cohesion
- Model cohesion between water molecules

Assessment: Worksheet to be completed after lesson (attached). Ongoing assessment--students should be able to successfully siphon water from one bottle to another.

Materials	Teacher	Student (working in groups of 3-4)	Notes
	Water Food coloring Clay (for TAG extension)	10 cc syringe (blunt) 18" airline (1/8" clear hose) 2 water bottles (one full of dyed water, other empty)	This could easily be combined with the lesson on making artificial sea-water, by performing a water change after demonstrating the use of a siphon

Section/Time	Teacher Activity	Student Activity	Notes
Prep:	Fill one of each pair of water bottles with lightly dyed water. Have absorbent materials on hand.		
Engagement (5 min)	Present the students with a problem: We need to get water out of the aquarium into a drain that is 10 feet away, but we can't spill any water on the ground and we don't have a bucket. All we have is a 15-foot long hose and a drain the floor. Allow students 1-3 minutes to discuss possible ways to move the water. It is likely that at least some students will have heard of a siphon and can explain it to the class--encourage that. Tell the students that this is a real problem--we need to remove water from the aquarium to replace it with clean water. You can also use siphons to empty swimming pools, gas tanks, move water over the rim of a crater, etc.	Students discuss possible ways to move the water out of the aquarium. Hopefully some will mention the use of a siphon. Others may say pump.	Usually some students have seen a parent siphoning gas. Emphasize that we will *not* be using our mouths to create suction, out of hygiene concerns.
Guided	Distribute syringes. Ask students to experiment	Students will	Watch out

Activities (10 min)	with suction, compression. What happens when you pull on the plunger? [Create low pressure--air flows in.] What if you plug the hole of the plunger with your finger? What happens when you push on the plunger? If you plug it? [High pressure--compression, air wants to escape.] Distribute hoses. Repeat steps above--trying to demonstrate that the pressure is transmitted through the hose. Distribute first water bottle filled with dyed water. Repeat above, experimenting with suction.	experiment with the supplies, discovering the suction and compression forces that the syringe can impose.	for squirting of water!
Inquiry Instruction (5 min)	Students put materials down, listen. Instruct students of goal: be able to move water back and forth between water bottles without pouring the water. They are not allowed to suck on the end of the hose--but they are given a tool to do so (syringe). Also, everyone in the group needs to be able to perform the task.	Students put down materials and listen to instruction.	
Main Inquiry Activity (10 min)	Distribute second water bottle. Supervise activities. It is up to the teacher to determine the level of instruction desired--this lab is designed to utilize inquiry. Some students may need help creating suction with the syringe (they have a tendency to fill the syringe with air before attaching the hose). Others may need the suggestion to keep the down-hill side of the hose lower than the water level of the up-hill bottle. When students successfully complete a siphon, ask them to predict when it will stop. Also, ask them to see if they can get water to flow back the other direction without restarting the siphon (by keeping both ends under water, then lifting the lower bottle above the higher bottle) Ask students to try letting some air into the line--what happens? How else can they stop the siphon? (pinch hose, seal either bottle neck with clay)	Students experiment with different ways of moving water. They will try sucking up water 10 cc at a time and moving it that way. Encourage them to try to make a continuous flow of water. Eventually (and with some guidance) they will form a siphon. The siphon will break if the students lift the downhill leg higher than the water level of water in the upper water bottle. Students will experiment with ways to adjust the flow rate (by decreasing/increasing the difference between upper water bottle and bottom of hose)	
Kinesthetic modeling (5 min)	Ask the students what happened when air bubbles got into the tube (the siphon stops). Tell them that we will model a siphon by acting as if we are water molecules. If there is a narrow aisle in the room (consider creating one, if time allows), use it to act as a "hose". Line the students up in the "hose". Because they are water molecules, they like to stick together (just like water droplets join together when you get them close enough to	Students line up in a "J". Hold onto each other's shoulders. Transmit the pull felt, move in the direction of the pull. Students on the short end of the J will move "uphill", around the	A pulley and rope could also demonstrate this concept (a smaller weight on the short leg)

	touch). This is called "cohesion" (explore the word briefly--relate to "adhesion"--glue). They will model this by holding on to each other's shoulders/hands. Bend the line of students in a J--so that there is one end of the line longer than the other. This represents the downhill leg. The teacher and another adult (or informed student volunteer) will act as gravity, which pulls the water down. (It may be useful to diagram this on an overhead projector). Because the longer end of the leg is heavier, it pulls with more force, so the long chain of connected water molecules pulls the short chain uphill! The two volunteers pull on either end of the student-chain, but the longer end "wins" because it is heavier. Have students return to their original positions. Now introduce an "air space" in between two water molecules. Now the force of gravity will pull both legs down and the siphon "breaks". Pull on both legs of the chain, but this time the short leg also flows down. Return students to desk.	bend, and then "downhill".
Closure (5 min)	Close by asking students what they learned today. Guiding questions include: Why does the bottom leg of the hose need to be longer than the upper leg? How did you slow the flow? How did you stop the flow? Emphasize the real-world uses of siphons. It is much easier to siphon water downhill than it is to carry it in buckets. Also, emphasize that siphons take advantage of gravity--they do not work "against" gravity. They can only make water move uphill if it then flows downhill for a longer distance.	Students respond to questions.
Assessment:	Worksheet (below) can be given as homework, or as a wrap up in class.	
TAG Differentiation	Ask students to predict what would happen if a ball of clay were to seal the neck around the tube. If possible, allow students to experiment with this.	

NAME:_____________________ DATE:_______________ TEACHER:__________________

Draw a diagram of water being siphoned out of an aquarium into a bucket.

Water molecules are attracted to each other: T F

The empty container must be lower than the full container for a siphon to work: T F

A very soft hose made out of cloth (like a fire hose) would work for a siphon: T F

A siphon will stop working if too much air gets into the hose: T F

Which of the following does NOT cause a siphon to work?
A.) Air pressure
B.) Gravity
C.) Cohesion
D.) Salinity
E.) Difference in elevation

As the water level in the top bottle drops, the siphon:
A.) Speeds up
B.) Slows down
C.) Stays the same
D.) Breaks

Which of the following siphons would flow the fastest? Which one would flow the slowest?