

# HERON'S FOUNTAIN

## WHAT YOU'LL NEED:

- 3 water bottles with lids
- 4 feet aquarium tubing
- Hot glue gun and glue
- Water
- Optional – tub tint or food coloring

## MATERIAL PREP:

Drill a  $\frac{1}{4}$ " hole in the center of each lid. Set aside.

Cut the top third off of one of the bottles. Discard the bottom piece. Drill or melt one hole approximately  $\frac{1}{4}$ " on the side of the bottle near the cut end.

**This bottle piece (#1)**  is the top of your fountain

Drill or melt three holes approximately  $\frac{1}{4}$ " in the second bottle:

- One on the side of the second bottle, near the top
- One on the opposite side of the bottle near the bottom
- One hole in the center of the bottom of the bottle.

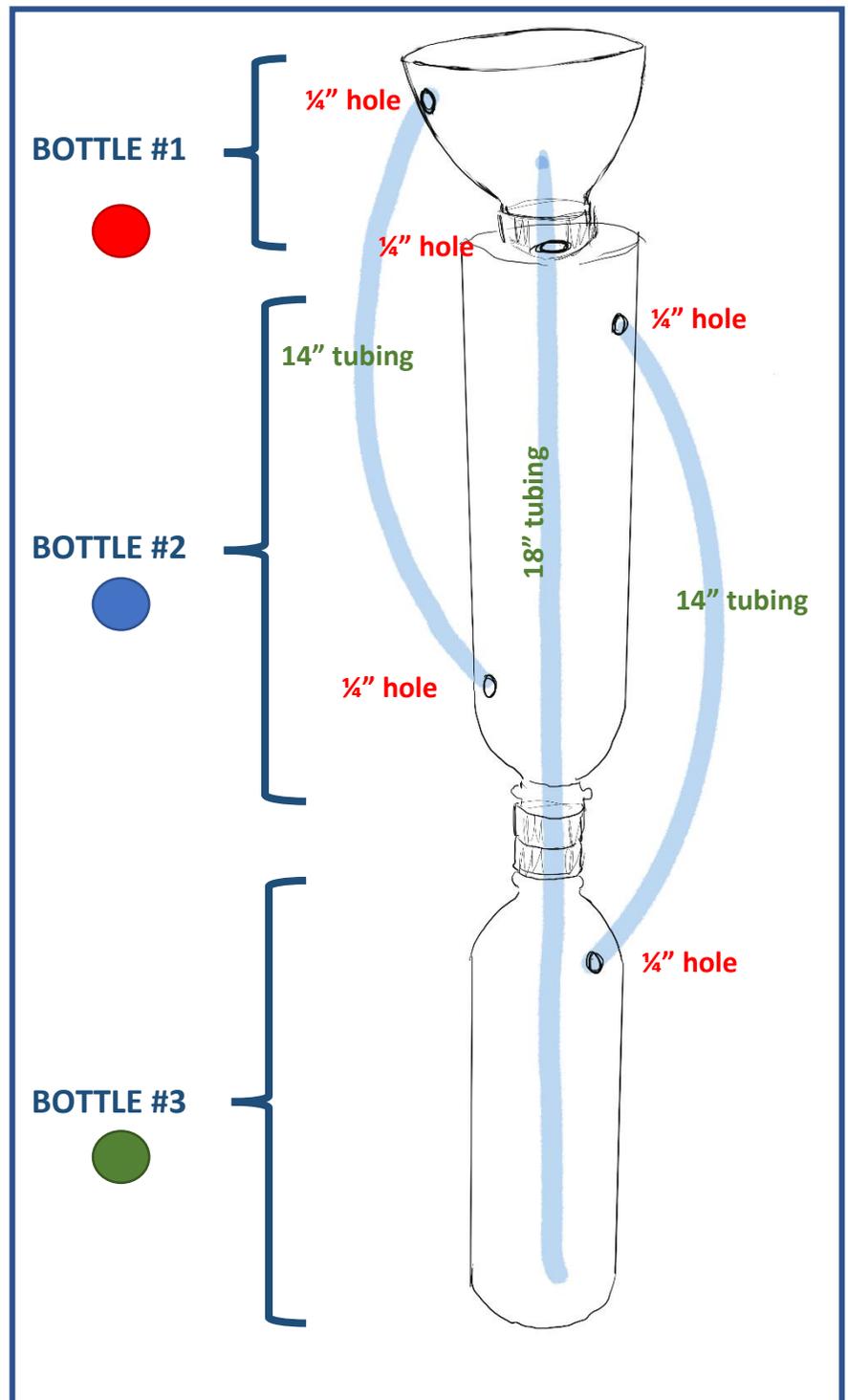
**This bottle (#2)**  is the middle of the fountain.

Drill or melt one hole in the third bottle:

- One on the side of the bottle near the bottom

**This bottle (#3)**  is the bottom of the fountain.

Cut the tubing into: two 14" pieces, one 20" piece



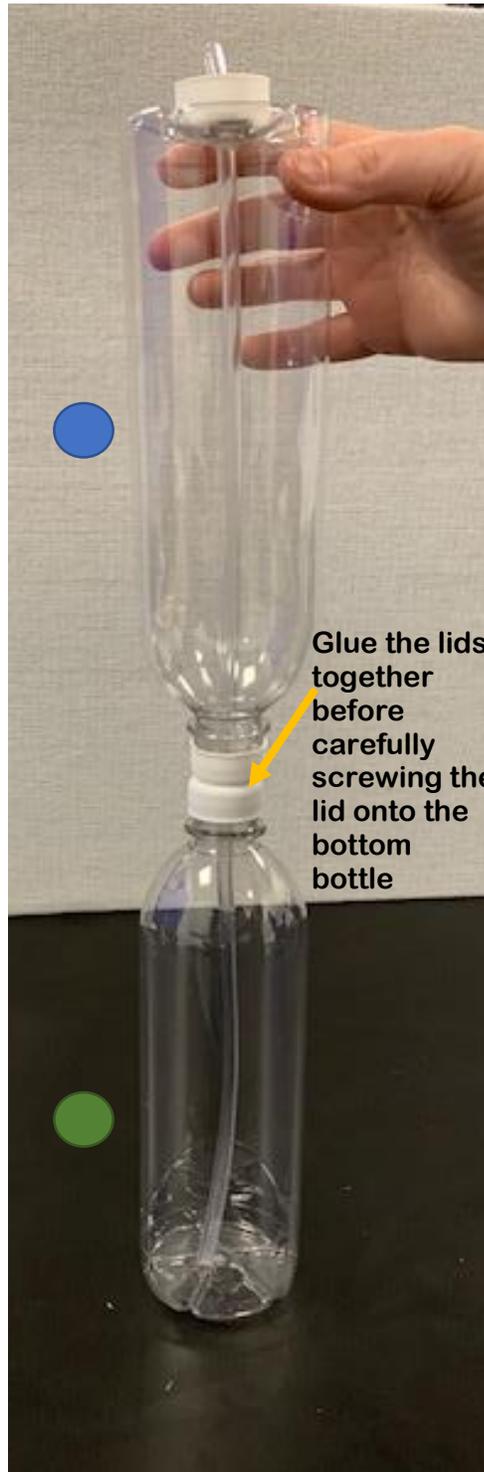
## FOUNTAIN CONSTRUCTION:

1. Thread the long piece of tubing (20") through the hole in the center bottom of bottle #2 and out through the top of the bottle.
2. Put two lids together with the tops facing each other and continue threading the tubing through both lids. Screw one lid onto bottle #2 ●.
3. Continue threading the tubing into the bottle #3 ● until it is about an inch from the bottom of the bottle. Glue the two lids together and



carefully screw the lid onto the bottom bottle (#3) ●.

4. Flip the remaining lid upside down on the bottom of bottle #2 ● and thread the tubing thru the hole in the center. Glue the cap securely to the bottom of bottle #2 ●.
5. Carefully screw the lid onto bottle piece (#1) ● Leave  $\frac{1}{4}$  -  $\frac{1}{2}$ " length of hose extending into the top bottle, cutting off any excess.



Glue the lids together before carefully screwing the lid onto the bottom bottle



Leave  $\frac{1}{4}$  -  $\frac{1}{2}$ " length of hose extending into the top bottle. Cut off any excess.

6. Cut the both ends of the 14" pieces of tubing at an angle. This will make steps 7 and 8 easier.



7. Thread one of the pieces of tubing into the upper side hole of the middle bottle (#2) and thread the other end into the side hole on the bottom bottle (#3) ●.

8. Thread the remaining tubing into the bottom side hole on middle bottle (#2) ● and thread the other end into the upper side hole in the top bottle piece. (#1) ●

9. Once the tubes are in place. Use hot glue or another appropriate sealant to secure the hoses to the bottle, so that there are no leaks around the hoses.

10. Double check that the connections around the caps are well secured and add additional glue where needed to prevent any leakage.



## ADDING WATER

- **Optional:** color the water with food coloring or tub tint tablets.
- Pour water into the funnel at the top until the bottom bottle fills and the side tubes starts sucking water into the middle bottle.
- Carefully turn up the fountain upside down, draining excess from the funnel and letting the water in the bottom bottle move up to prime the middle bottle. You may need to squeeze the bottom bottle to start the siphon. Once the water stops leaving the bottom bottle flip the fountain back over and set it down right side up.
- Add a small amount of water to the top funnel (#1) ● (Optional: use water of a different color). What happens?
- Once that process has refilled the water in bottom bottle (#3) ●, you can repeat the procedure.
- What happens if you squeeze either bottle, increasing or decreasing the pressure?

- Using a syringe on the hoses, find out what happens when you inject air or water into the system, or suction it out.

## WHAT'S GOING ON

The fountain you just built is known as a Heron's Fountain, named after the Greek inventor, Heron of Alexandria. A Heron's Fountain is a hydraulic machine that shows how potential energy can provide power, using water and gravity, and air and compression to create a water spout.

To start the fountain, the top bottle (#1) ● should be open to the air and holding no water. The middle bottle (#2) ● should be filled with water, and the bottom bottle (#3) ● filled with water to the bottom of the straw. The bottom bottle needs to have water filled up to the bottom of the straw because otherwise air can get into the straw and flow backwards into the upper container which will impede the flow of the water.

As additional water is poured into the top funnel, gravity pulls it down into the bottom bottle. The air filling the bottom bottle is displaced by the denser water flowing into it. The displaced air rises up through the tube connecting the bottom and middle containers. This air increases the pressure in the middle bottle, which displaces the water that was previously occupying space. Because the pressure in the middle bottle is greater than atmospheric pressure, water will flow up the tube and form a fountain. The flow of water will stop once the middle bottle is empty of water.