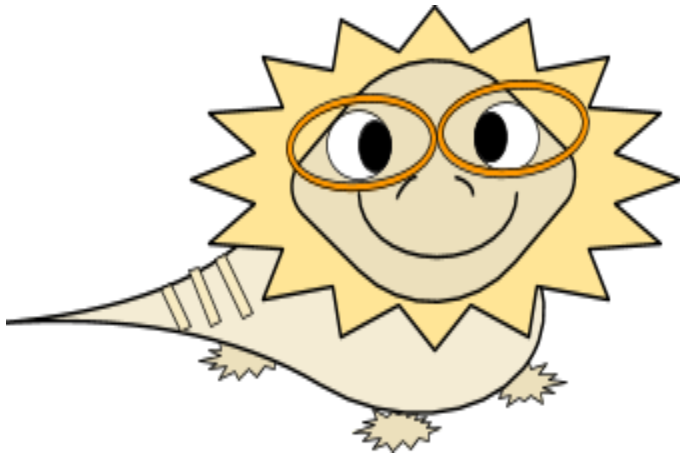


## ...Bodie's Water Bowl Struggles...

(Can we make a water fountain that doesn't need electricity?)

Meet Darwin. Darwin is a bearded dragon who loves to pose for pictures. He is also a scientist and an engineer who loves to conduct experiments and help solve problems!



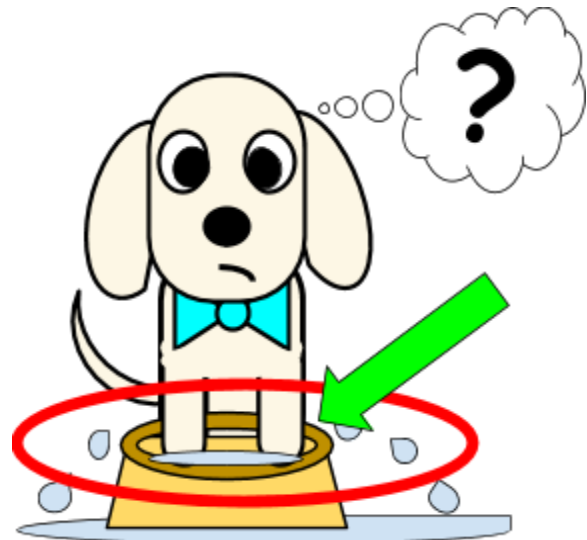
Today, Darwin had a playdate with his good friend Bodie. Bodie is an adorable, loving, and funny Golden Retriever puppy and he is always making his family laugh and smile with all his shenanigans...



Bodie's latest obsession is his water bowl which he can't seem to get enough of! As a golden retriever, Bodie really loves his water but everytime he goes to try and drink his fill, he can't seem to stop the water from "disappearing" before he can get a proper drink... (Can you figure out why?)



(Psst... I think it's because he keeps putting his paws into his water bowl and splashing all the liquid out before he can drink it...!)



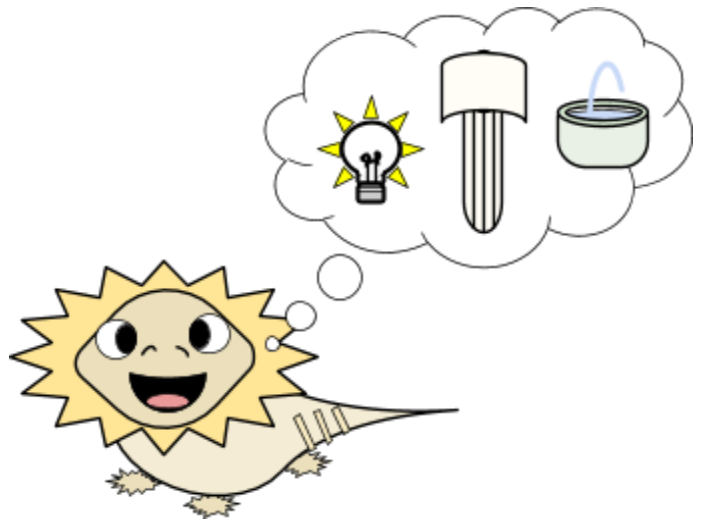
When he got home after his visit with Bodie, Darwin's engineer mind was bursting with different ideas for how he could try solving his friend's water-drinking problem. So he took out a notepad and began listing some of the criteria his new invention would need...

Bodie's Water Fountain Needs:

1. Need to keep water contained so Bodie can't spill it with his paws.
2. Need to be stable enough so fountain doesn't easily tip over and spill.
3. Need to be able to provide a (near) constant flow of water for our thirsty friend...

(Can you think of any other criteria that might be helpful to have?)

Upon seeing his list of criteria written out, Darwin was suddenly reminded of a clever invention that an ancient Greek mathematician & scientist devised and he thinks it just might be the perfect solution for Bodie's water bowl troubles...



## How to make a Hero(n)'s Fountain!!

### \*Materials:

- 3 - 16.9 fl. oz. (sturdy) plastic water bottles
  - 1 - 9" length of 3/16" **rigid** aquarium tubing (Tube A)
  - 1 - 11" length of 3/16" **rigid** aquarium tubing (Tube B)
  - 1 - 15" length of 3/16" **rigid** aquarium tubing (Tube C)
- (\*Note: Aquarium tubing can be substituted with plastic drinking straws provided they are long enough & leakproof...)
- Small clump of moldable clay - (e.g. Play-Doh) -
  - and/or some other sort of sealant - (e.g. caulk, super glue)

### \*Tools/Equipment:

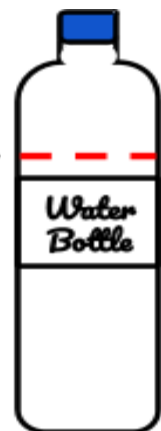
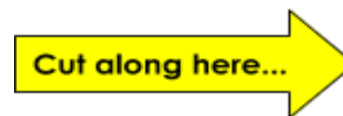
- Scissors and/or Boxcutter
- Hot Glue Gun & Glue Sticks
- Drill (hand or electric powered)
- 5/32" drill bit (drill bit needs to be just slightly smaller than tubing...)
- Scrap wood and/or other safe work surface to operate drill on

### \*Instructions:

#### Step 1 - Make drinking fountain basin (Bottle #1)

Take one plastic bottle and cut off (approximately) the top 1/3 of the bottle with scissors or boxcutter.

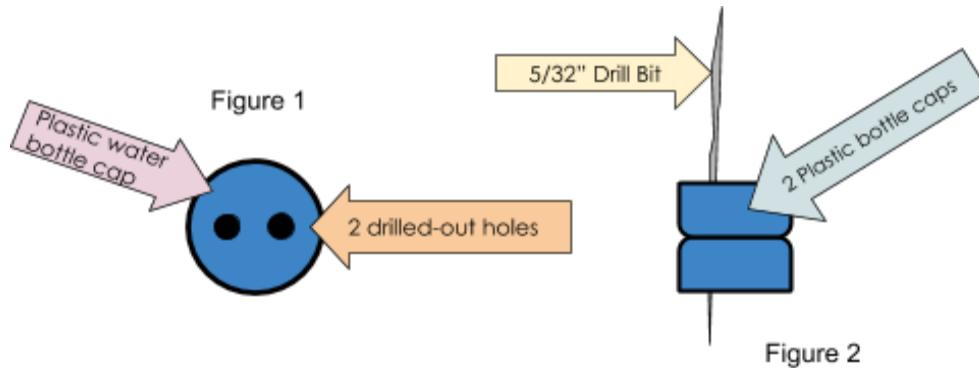
(\*This will be the part of the fountain our friend Bodie can drink out of...)



#### Step 2 - Drilling holes in plastic caps

(\*Remember to drill over a safe work surface and to always be careful when handling power tools\*)

Each plastic cap will need to have 2 equal holes drilled into them - all in the same 2 locations so that they line up. (see Figure 1)



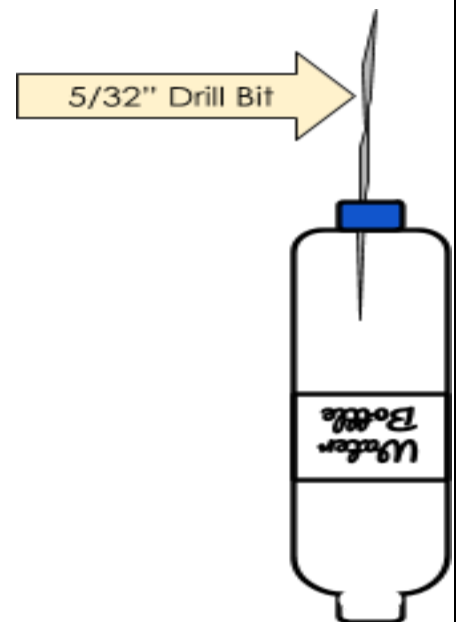
Recommendation is to drill holes in one cap first and then use it as the template/guide for hole placement in the other 2 bottle caps.

(\*Note: Bottle caps can be placed "top-to-top" as seen in Figure 2.)

### Step 3 - Drilling holes in plastic bottle (Bottle #2)

(\*Remember to drill over a safe work surface and to always be careful when handling power tools\*)

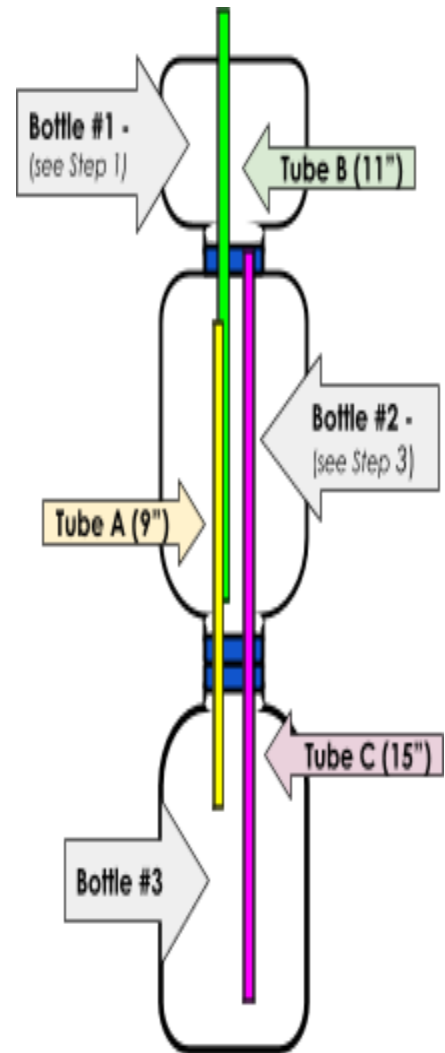
Using one of the bottle caps as a guide, drill 2 holes in the center of the bottom of one of the remaining intact bottles. (This will end up being Bottle #2 as in the diagram below. Bottle #3 won't have any additional modifications.)



### Step 4 -Connecting the Plumbing!

- Screw bottle caps back onto the bottles.
- Insert Tube B into one of the holes in cap of Bottle #1 & bottom of Bottle #2- (making sure the connection is a snug fit and reinforcing with some sort of sealant as needed) - then hot glue cap of Bottle #1 to the bottom of Bottle #2, making sure the holes are nicely aligned.
- Insert Tube A & C into the holes in caps of Bottles #2 & 3 (again, being sure to have tight fits) and then hot glue those bottle caps together.

**\*Note:** Make sure the tubing are all at the proper heights in each bottle. Having the correct heights/ratios are the key to ensuring a functional fountain!

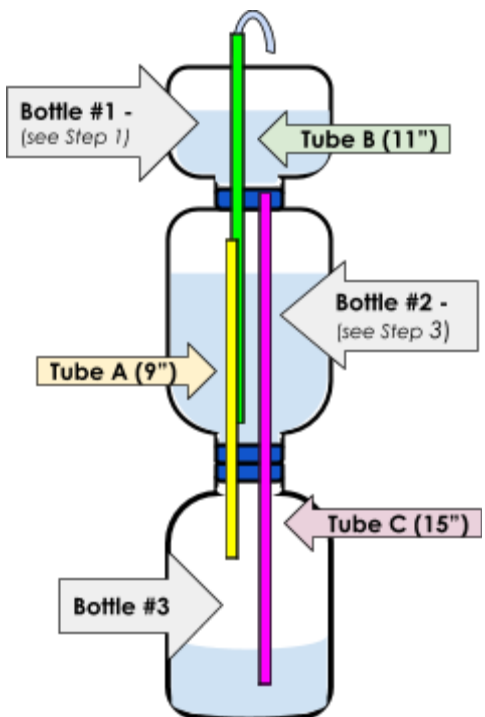


### Step 5 - Add Water, Troubleshoot, then Enjoy!

Add water to your fountain, invert the fountain in order to get Bottle #2 to fill, then revert the fountain rightside up again and add more water...



### How Does it Work? (What's the Science...?)



Pressure is the key to what makes a Hero(n)'s Fountain work. Let us follow the path of the water to see how the changes in air and water pressure allow the fountain to work.... When water goes into the fountain through the opening in Bottle #1, gravity will pull it all the way down into Bottle #3. As Bottle #3 is filled with water, this causes the air that was in it to get displaced up through Tube C into Bottle #2. And because Bottle #2 now has extra air in it, that causes the air pressure in that bottle to increase and that additional air pressure is what ultimately causes the water to get pushed back up through Tube B back into Bottle #1 which allows the whole water/air flow cycle to repeat itself all over again...

The reason it is important to keep have the tubing at the appropriate heights/ratios to each other is because this ultimately ensures that the amount of air pressure that can build up will be powerful enough to push the water from Bottle #2 back into Bottle #1 and keep the fountain flowing.