Dynamic Fluids activity

Purpose: The purpose of this activity is to determine the velocity of water out of a hole in a bottle in two different ways to see how use of the equation of continuity compares to using projectile equations.

1) Choose a 2 L bottle and find the hole in the side of the bottle near the bottom. Find the area of the hole as best you can. Assuming the hole is a circle is a good start.

2) Find a region on the body of the bottle that is (or is nearly) uniform in cross sectional area for several vertical centimeters. Find the cross sectional area as best you can.

3) Fill the bottle to the top of the section of bottle that is the same cross sectional area. **When transporting the bottle from the sink it is very helpful to keep the cap on the bottle**. Try to spill as little as possible out of the hole.

4) Determine the flow rate of water out of the hole in 2 different ways. 1) determine the velocity of the water down the side of the bottle as water leaves the hole in the side; 2) determine the volume of water that leaves the hole each second. HINT: You must do this for fairly small increments of time and distance down the side of the bottle. If you do this in two separate trials, you should start and stop with the top of the water at the same heights each time. YOU WILL NEED TO KNOW WHAT THE HEIGHT OF THE WATER AT THE START AND FINISH WHEN YOU COMPLETED THIS STEP SO WRITE IT DOWN.

5) Use your determinations of the flow rate to determine the velocity of the water out of the hole in the side of the bottle.

6) Determine where the stream of water should land using projectile equations. You will need to make appropriate measurements to complete this step.

7) Refill the bottle so that the water is at just above the midpoint of the starting and final heights from step 4. Tighten the cap.

8) Set up the bottle so the water will leave the bottle through the hole in the side and fall to the floor below. Cover the hole firmly with a finger. Remove the cap. Uncover the hole for a brief moment. Be careful to mark the location that the water reaches when it first hits the ground.

9) Make the appropriate measurements, then calculate the velocity of water that would be required for the water to hit at that location.

10) Compare the velocity of the water using each of the two methods and determine the percent difference between the two.

11) Determine at least two factors that could have caused either of your calculations of the velocity of the water out of the hole to be inaccurate.