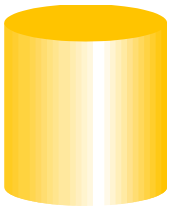
Name: _____ **Date:** _____

Why Does a Liquid Jet Form Droplets? Answers

The inkjet printer is one of the most widely-used printer types for home and office printing. The fundamental principle in the operation of inkjet printers is the tendency of a continuous stream of liquid to break apart and form droplets, just like water falling from a faucet. In this activity, we are going to explore why this happens.

1. Turn on a faucet so that just a small stream of water emerges. Describe what you see:
   Turn off the faucet when you are done.



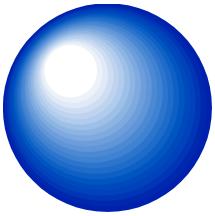
2. **Cylindrical Column:** Imagine that the water from the faucet **did not** break up, but remained in a cylindrical stream all the way down.
   Use a radius r of the cylinder is 0.75 cm and the height is 16 cm.

   a. What is volume of the water? $V = \pi r^2 h$ (Show all work.)

V = 18.3 cm^3

b. What is the surface area of the column of water? $A_C = 2\pi(r^2 + rh)$ (Show all work.)

A = 78.9 cm^2



3. **Spheres:** When a jet of water breaks up into droplets, their radii are about twice the radius of the original water column. Use a spherical radius R of 1.0 cm.

   a. What is the volume of a single spherical droplet? $V_S = \frac{4}{3}\pi R^3$ (Show all work.)

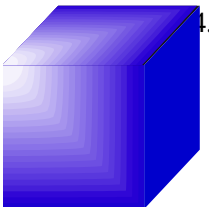
V = 4.19 cm^3

b. When water breaks into spherical droplets, the *volume* of the water does not change.
How many spherical droplets will be formed from the total volume found in # 2a? $n = \frac{V}{V_S}$ (Show all work.)

n = 4.37

c. What is the total surface area of the spherical water droplets? $A_S = n\,4\pi R^2$ (Show all work.)

A_s = 54.9 cm^2



4. **Cubes:** Why does the water form spherical droplets instead of cubical droplets? Use a cube droplet with a side length 1.0 cm.

   a. What is the volume of a single cubical droplet? $V_{Cu} = l^3$ (Show all work.)

V_{Cu}= 1 cm^3

b. How many cubical droplets would be formed from the total volume found in # 2a? $n = \frac{V}{V_{Cu}}$ (Show all work. Round to the nearest whole number.)

n = 18.3

c. What would be the total surface area of the cubical droplets? $A_{Cu} = n\ (6\ l^2)$ (Show all work.)

A_{Cu} = 110 cm^2

5. **Summary:** Fill in the table below.

Shape	Total Surface Area (cm^2)
cylindrical column	**78.9 cm^2**
spherical droplets	**54.9 cm^2**
cubical droplets	**110 cm^2**

6. **Questions:** For all three shapes, the volume used was the same. Looking at the table above, why does a liquid jet form spherical droplets? How is this related to the surface tension activities done in class?

   Surface tension acts like a stretched elastic sheet, and tries to minimize the surface area. For the same volume, spherical droplets with large enough radii require less surface area than a column of water.