**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. ![C:\Users\Jean_2\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\YFXJ1NT6\MC900048283[1].wmf]()**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? $V=πr^{2}h$ (Show all work.)

**V = 18.3 cm3**

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b. What is the surface area of the column of water? $A\_{C}=2π(r^{2}+ rh)$ (Show all work.)

**A = 78.9 cm2**

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1. ![C:\Users\Jean_2\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\O93VXABP\MC900048285[1].wmf]()**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? $V\_{S}=\frac{4}{3}πR^{3}$ (Show all work.)

**V = 4.19 cm3**

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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**

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c. What is the total surface area of the spherical water droplets? $A\_{S}=n 4πR^{2}$ (Show all work.)

**As = 54.9 cm2**

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1. ![C:\Users\Jean_2\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\NMKGRP78\MC900048411[1].wmf]()**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.)

**VCu= 1 cm3**

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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**

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

**ACu = 110 cm2**

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

|  |  |
| --- | --- |
| **Shape** | **Total Surface Area (cm2)** |
| cylindrical column | **78.9 cm2** |
| spherical droplets | **54.9 cm2** |
| cubical droplets | **110 cm2** |

1. **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.**