

Activity 1 Cloud Formation Extension

In this activity we will make clouds in bottles using various substances. A cloud forms when water vapor is **condensed** in the atmosphere to form very tiny water droplets. This occurs as a result of energy from the sun **evaporating** water from a land or water body. The next step involves the condensation of the water which can collect on particulate matter or aerosols in the air also called the **condensation nuclei**. This occurs because as the air containing evaporated water rise up into the atmosphere it cools down and the amount of water that can be retained in gaseous phase decreases leading to condensation. As enough of the water molecules attach to the particles the visible cloud begins to form. This type of cloud formation is called **convective cloud** formation and it occurs as a result of changes in pressure.

Materials Required For This Activity:

1. Plastic squeezable bottle with lid such as a 16oz water bottle or a 2 liter soda bottle (labels removed)
2. Water
3. Isopropyl alcohol
4. Acetone based nail polish remover
5. Pen light

Procedure

Part I control

1. Remove labels from 4 clear plastic containers at least 16 oz in size of similar dimensions.
2. Rinse the containers using only water. (Do not use soap).
3. Label one container
Water (control)
Acetone
Isopropyl alcohol



Mix



2. To the bottle marked control add enough tap water to cover only the bottom of the container.

3. Swirl the water around so that there are droplets on the wall of the container.

4. Close the container and squeeze the bottle. Note your observations in the question sheet in line **1a**.

5. Shine a pen light through the bottle. Record your findings in line **1b**.

6. Open your bottle. Light a candle or match then extinguish the flame by blowing the smoke emitted by the candle or match directly into the bottle. (Make sure the smoke gets into the bottle).



7. Immediately cap and tighten the container (the container should be firm but you must be able to compress it).

8. Squeeze the container several times; the cloud will appear inside of the bottle.

9. Shine a pen light through the bottle when the bottle is compressed and when it is not compressed. Record your observations in line **1c**. How do your results from part 1a compare to results from part 1b? Record your answer to this question in section **1d**.

Part II Test in Different Aerosols

10. To the bottle marked acetone add enough liquid to cover only the bottom of the container.

11. Swirl the acetone around so that the wall of the container is coated with liquid.

12. Close the container and squeeze the bottle. Note your observations in the question sheet in line **2a**.
13. Open your bottle. Light a candle or match then extinguish the flame by blowing the smoke emitted by the candle or match directly into the bottle. (Make sure the smoke gets into the bottle).

**NOTE: ACETONE AND ISOPROPYL ALCOHOL ARE BOTH
FLAMMABLE DO NOT DROP THE SMOKE SOURCE INTO THE
LIQUID. ADULT SUPERVISION IS REQUIRED.**

14. Immediately cap and tighten the container (the container should be firm but you must be able to compress it). Record your findings in line **2b**
15. Shine a pen light through the bottle when the bottle is compressed and when it is not compressed. Record your observations in line **2c**. How do your results from part 2a compare to results from part 2b. Record your answer to this question in section **2d**.
16. Squeeze the container several times; the cloud will appear inside of the bottle.
17. Repeat steps 9-13 with isopropyl alcohol and then with a 50% mix of isopropyl and acetone. Answer the questions related to this section on lines 3a-3d in the question section of this activity.

Analysis Questions

1a.

1b.

1c.

1d.

2a.

2b.

2c.

2d.

3a.

3b.

3c.

3d.

Conclusion Questions

1. Which procedure created the most cloud vapors? Why do you think that was?

2. Did the cloud appear when you caused high pressure on the air in the bottle (by squeezing), or when you caused low pressure (by releasing)?

3. Which solvent produced the most cloud cover?

4. In your experiment, what served as the condensation nuclei?

5. Think about how air pollutants get into the atmosphere. In what way(s) did this lab simulate that scenario?

Extension

1) Cloud seeding is a process by which particles are dispersed in the air in an attempt to increase the amount of precipitation in a particular area. Research the history and effectiveness of cloud seeding. Provide at least three examples where it has been used. In addition, provide three arguments for or against the use of cloud seeding.

Explanation of Activity

Evaporation happens at the surface of a liquid. The particles at the surface of the liquid in the bottle have enough energy to separate from the liquid phase. Once this is achieved, squeezing the bottle allows for the molecules to get compressed together. In turn this forces more particle interactions and increase the temperature. (Guy Lussac's law). When the pressure is released the temperature drops and the gases condense. The condensation collects on various particulate matter in the air inside the bottle and the cloud is formed.

Using different solvents can provide remarkably different results. The intermolecular forces of the acetone and the alcohol are both weak. This is why you can smell them. Since more

molecules are able to escape into the gases phase there are more particles to condense thus greater cloud will be produced.

References

Seinfeld, J.H., Pandis, S.N. (2006), Atmospheric Chemistry and Physics from Air Pollution to Climate Change second edition. John Wiley & Sons, Inc. Hoboken, NJ.

The Habitable Planet. <http://www.learner.org/courses/envsci/unit/text.php?unit=11&secNum=11>