

LAB: What is the Recipe for a Cloud?

name: _____

Pre-lab Questions:

1. Why would there be more humidity in the air above a warmer lake than there would be above a colder lake?
2. In order for a cloud to form, the humid air must be cooled below it's _____.
3. As air is compressed (squeezed), does it become warmer, or does it become cooler?
4. As air rises, will it be compressed, or will it expand? How will this affect its temperature?
5. What are "condensation nuclei"? Give two examples.

Materials: 2 liter plastic bottle (or similar juice bottle) with lid, matches, beaker, funnel

Procedures/Observations:

1. Trial #1: Get 300 mL of very cold water and then pour it into the plastic bottle. Firmly screw on the lid. Shake the bottle vigorously for 30 seconds. Squeeze the bottle for several seconds to increase the pressure, and then release it to allow the air inside to expand. Squeeze and release several times as you watch the air in the bottle.

Observations: _____

2. Trial #2: Unscrew the cap from the bottle. Light a match, blow it out into the bottle, and then hold it there for about 2 seconds. Quickly replace the cap. Squeeze and release in procedure #1.

Observations: _____

3. Trial #3: Empty the cold water from the bottle, and get 300 mL of very hot water (near microwave). Replace the cap, and shake the bottle for 30 seconds. Squeeze, release, and observe.

Observations: _____

4. Trial #4: Unscrew the cap, and hold a match into the bottle as you did in procedure #2. Quickly replace the cap, and then squeeze, release, and observe.

Observations: _____

Follow-Up Questions

1. Which of your four trials resulted in the best cloud formation?
2. Was cloud formation more impressive when smoke particles were present in the bottle?
3. 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)?
4. Which provided more vapor in the bottle . . . the hot water, or the cold water?
5. Based on your findings, what is the recipe for cloud formation? Circle 3)
cooling caused by high pressure; compression particles (smoke, dust, etc.)
cooling caused by low pressure; expansion water vapor
6. In your experiment, what served as the “condensation nuclei”?
7. Why did the cloud disappear when you squeezed the bottle? You must use the terms **evaporate** and **dew point** in your answer.
8. You can see clouds because they are made of _____ or _____.
Circle two.
water vapor water droplets ice crystals
9. Circle the letters of the **five** situations listed below that would contribute to cloud formation.
A. Moist air is forced upward as it encounters the Cascade Mountain Range.
B. Tomorrow’s forecast calls for an area of high pressure to be centered over your region.
C. The westerlies cause air to flow down the east side of the Rockies into Cut Bank.
D. During the afternoon, air over a large air force base begins to rise because it is so much hotter than air over the surrounding forest.
E. In autumn, the Santa Ana winds blow down from the mountain slopes of interior California out to the sea.
F. Intensely heated air over the equator rises in an area called the intertropical convergence zone.
G. As part of the global circulation pattern, air 30 degrees north of the equator is sinking in an area called the horse latitudes.
H. An intense low pressure system moves across the Midwest.
I. A cold air mass from Canada pushes into a mass of warm humid air over Nebraska.
10. How do particles such as smoke or dust help clouds form? (What is their role?)

Read the article below and then answer questions 11-13.

If you think Hurricane Fran was a full force when it slammed into the Carolina coast two years ago, think again. It would have been worse on Monday or Tuesday, say researchers at Arizona State.

The costliest storm in North Carolina history, the infamous weekend hurricanes Hazel and Hugo before it, was probably choked a bit by air pollution drifting off the East Coast during the workweek, according to climatologists Randall Cerveny and Robert Balling Jr. Their study was published in a recent edition of the science journal NATURE.

The duo found that average hurricane intensity over the past 50 years has been weaker for storms coming ashore at the end of the week and on weekends than for hurricanes striking on Mondays, Tuesdays, and Wednesdays.

They believe pollution particles coming out of smokestacks and tailpipes during the workweek drift into the Atlantic and provide tiny seeds (condensation nuclei) for cloud droplets to form around. The rain-forming particles help approaching hurricanes blow off some of their steam before the storms reach land, they concluded.

“Hurricanes are the biggest storms that we have on this planet, in terms of energy and precipitation,” Cerveny said. “And what we’ve found is that we’re having an impact on them. It’s a little daunting when you start thinking about it.”

11. In your own words, explain what the two scientists found out about “average hurricane intensity” over the past 50 years?

12. What do they believe is the reason for this? (Explain in 2-3 sentences, using your own words.)

13. What was it in your lab that played the same role as the pollution discussed in the article?

14. Write a question about cloud formation. Your question must begin with the word “why”?

Cut along this line if you want to do the extra credit project described below. **You must complete all of the questions on the worksheet first.**

Name: _____

EXTRA CREDIT (5 pts)

Use a plastic pop bottle or juice container, hot water, and a match to demonstrate cloud formation for one of your parents. Have them sign here, indicating that you’ve done this. The cloud will be easier to see if you hold the bottle over a lamp. Turn the lamp on, and shut off the other lights in the room.

Parent signature: _____

Go to www.formontana.net/benson.html to watch a video of the demo.

FOR THE TEACHER: This lab (including follow-up questions) takes about 30-40 minutes for my ninth grade Earth Science students to complete. Do the lab after the students have learned about humidity, relative humidity and the dew point. To watch a YouTube video of the activity, go to www.formontana.net/tube.html.

ANSWERS TO THE PRE-LAB QUESTIONS: Do these together, or give the students a few minutes to do them, and then go over them before doing the lab.

1. a lake with very warm water
2. dew point
3. warmer
4. it cools
5. particles that provide a surface for water molecules to condense on as they change from vapor to liquid

Before students do the activity, demonstrate the technique used to get smoke into the bottle. Read over Trial #1 and #2. Tilt the bottle as much as you can without spilling the water. Hold the match at the opening of the bottle, blow the match out by blowing into the bottle, and then keep it in the opening of the bottle for a couple seconds.

Also, tell the students to hold the bottle between their face and a light source for best viewing as they begin squeezing and releasing.

On trials 3 and 4, students will need very hot (150 to 170 F; not boiling) water. I use a microwave to provide this (1 liter beakers). If students have a problem with condensation, making it difficult to see inside the bottle, they can simply roll the bottle gently. This allows the water inside to rinse the condensation away.

EXPECTED RESULTS

- Trial #1: a cloud should not form here
- Trial #2: a very faint cloud may form here
- Trial #3: a faint cloud may form here
- Trial #4: students should see a fairly good cloud here

ANSWERS TO FOLLOW-UP QUESTIONS 1-11.

1. trial #4
2. yes
3. low pressure (by releasing)
4. hot water
5. vapor + condensation nuclei (smoke) + cooling (pressure decrease) = cloud
6. smoke
7. The air was warmed above its dew point, so the cloud droplets evaporated.
8. water droplets, ice crystals
9. A, D, F, H, I (Tell students to look for anything that suggests that air is rising, or references to low pressure.)
10. The particles provide a surface for the water to condense onto.

Follow-Up Demonstration: Go to www.formontana.net/tube.html and watch "The Ultimate Cloud Demo."