

Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Lesson 9: Handout 1

### What are clouds?

#### Why can we see clouds?

When there is humidity in the air, we can't see the water vapor in the air. Why not? We can't see the water vapor in the air because it is a gas. In a gas, the molecules are too small and too spread apart for us to see them.

So what is it we are seeing when we see a cloud in the sky? Clouds are visible, which tells us they must be made of something large enough for us to see.



Clouds in the sky are made of two things. They are made of gases, and they are made of much larger water droplets or ice crystals suspended in those gases. We can see clouds because those water droplets or crystals are big enough to reflect a noticeable amount of light. That is also what makes them appear white. But the more water droplets or crystals in the cloud or the bigger they are, the more sunlight they absorb. Depending on the direction the sunlight is coming from, this can result in less sunlight reaching parts of the cloud. This will make parts of the cloud appear darker.

#### What is needed for droplets or crystals to form?

Water has to turn from gas into liquid or solid form in order for a cloud to start forming. This can only happen when the air is at a relative humidity of 100 percent and the air is cooled down. When cooling a substance turns it from a gas into a liquid, it is referred to as condensation. When cooling a substance turns it from a gas to a solid, it is referred to as deposition.

But cooling really humid air alone is not enough to start either of these processes. Something else is needed. The missing ingredient is a solid surface for the water to start sticking to.



In the experiment you did in class, that solid surface was the top of a bottle. When you are outside, that surface can be the ground. You might find water condensed out of the air to form dew on the grass in the morning. If it gets even colder, you might find it had deposited out of the air as frost. But if water vapor needs a solid surface to do this, how does this help explain cloud formation?

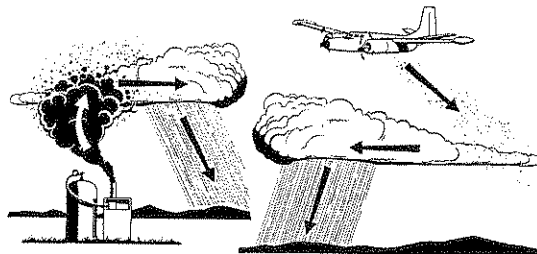
The air outside also contains small pieces of solids, such as dust, ash, pollen, and pollutants. These are the solid surfaces that droplets or ice crystals start forming on when clouds form. Any type of solid particle that water vapor sticks to as it cools down is referred to as cloud condensation nuclei (CCNs) or cloud seeds. When there aren't enough CCNs in the air, droplets or crystals won't form and no cloud will form.

### Can we change the weather by adding CCNs to the air?

Scientists and engineers have tested ways to add additional CCNs into the air to try to increase the amount of cloud formation and the amount of precipitation. These types of processes are called cloud seeding.

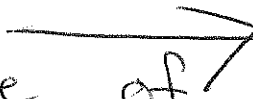
CCNs used in cloud seeding can be dumped into the air from aircraft. They can also be launched into the air from the ground from generators or canisters fired from guns or rockets.

All these techniques have been tested, but there isn't consensus among experts on whether these attempts produced a significant increase in precipitation at locations where they have been tried.



Draw a

picture of



Date: cloud formation.

Name: \_\_\_\_\_

Lesson 9: Handout 2

**Explaining the white solid**

A white solid appeared on the surface of the gel pack that wasn't there at the start of the frost demonstration.

1. What is happening to the amount of liquid water in the container (or cup) as the white solid appears on the gel pack? Why?
2. What is happening to some of the molecules of water at the surface of the water that helps explain this phenomenon?
3. What is happening to the molecules of water near the gel pack that helps explain this phenomenon?
4. What sorts of things in a cloud serve a similar function as the surface of the gel pack, when ice crystals start forming on it? How do those things help ice crystals start forming in the cloud?