Smithsonian

All About CLOUDS

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TCM Teacher Created Materials

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Captivating Clouds

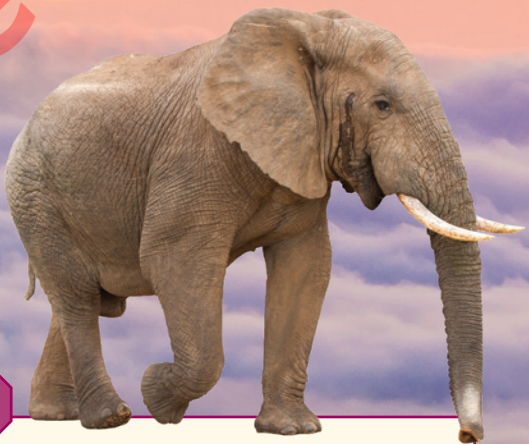
Floating feathers, gigantic puffballs, and misty stripes—clouds are shape-shifting marvels. Some clouds, such as stormy cumulonimbus, are legendary. Others, such as rainbow-colored nacreous clouds, are surprising and rare. Earth's skies are full of these wonders.

So, what exactly are clouds? Though clouds may look like fluffy cotton balls, they are actually made up of millions of itty-bitty water droplets. Clouds can also be made of tiny ice crystals or a mixture of ice crystals and water droplets. This may seem simple, but how, why, and where clouds form is a complex process.

Cloud formation relies on many factors. For starters, evaporation and condensation are key parts of cloud creation. Evaporation happens when water changes from a liquid to a gas. Condensation happens when water changes from a gas to a liquid. Temperature, **air pressure**, and region also affect how clouds form.

Clouds shape all kinds of weather around the world, and certain cloud types are more likely to appear in certain regions. For example, China is prone to storms called *typhoons*. Oklahoma and Texas are famous for their storms called *tornadoes*. Both of these severe weather events involve clouds.

Unraveling the mystery of why clouds do what they do is a fascinating journey. Let's take to the skies and learn all about clouds!



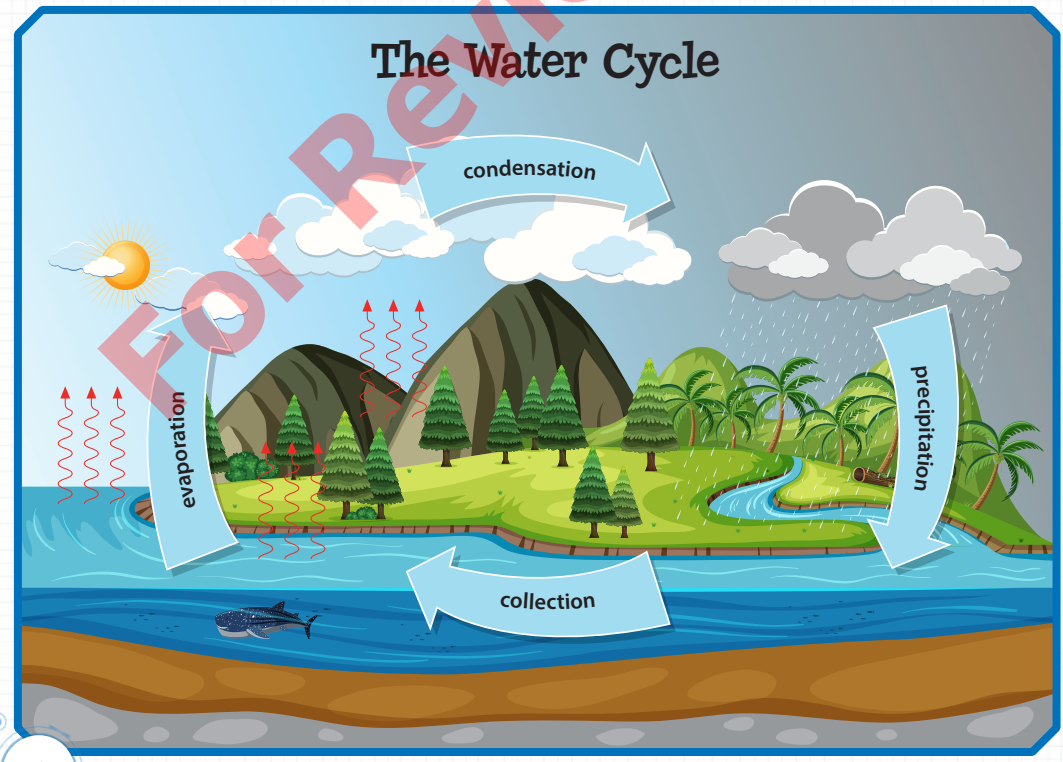
FUN FACT

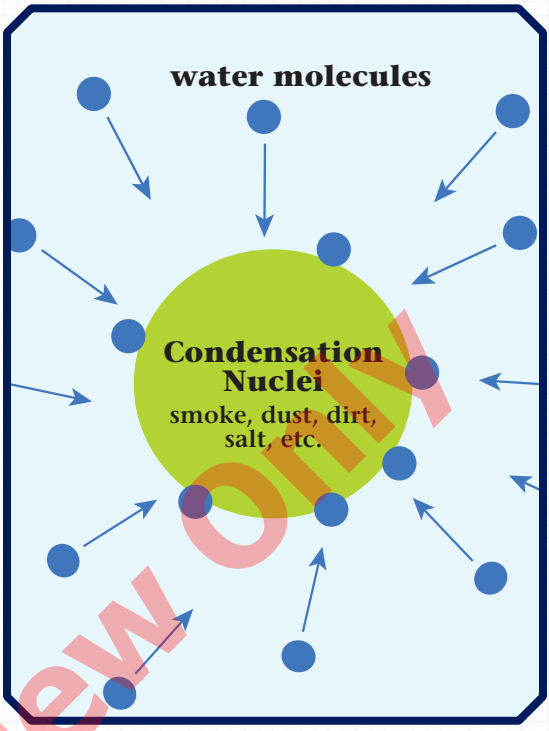
Clouds can be enormously heavy. They can weigh about 500,000 kilograms (1.1 million pounds). That's about as much as 100 African elephants weigh!

The Basics of Cloud Formation

Cloud formation relies on water and evaporation. Across the planet, water is constantly evaporating. Water evaporates from places like streams, lakes, and oceans. Water can also evaporate from the leaves of plants through a process called *transpiration*. When water evaporates, the air becomes filled with an invisible gas called *water vapor*. Water vapor that **condenses** high in the sky becomes clouds.

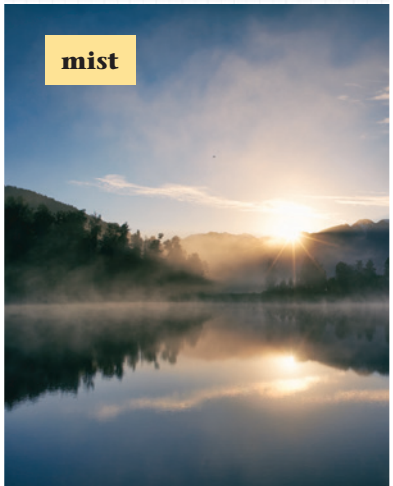
Let's look closer at how water changes from an invisible gas to visible water droplets. As more water evaporates, more water vapor fills the air. Over time, the air becomes saturated. This means that the air cannot hold any more water vapor. The water molecules in the vapor need to condense and turn into water droplets.





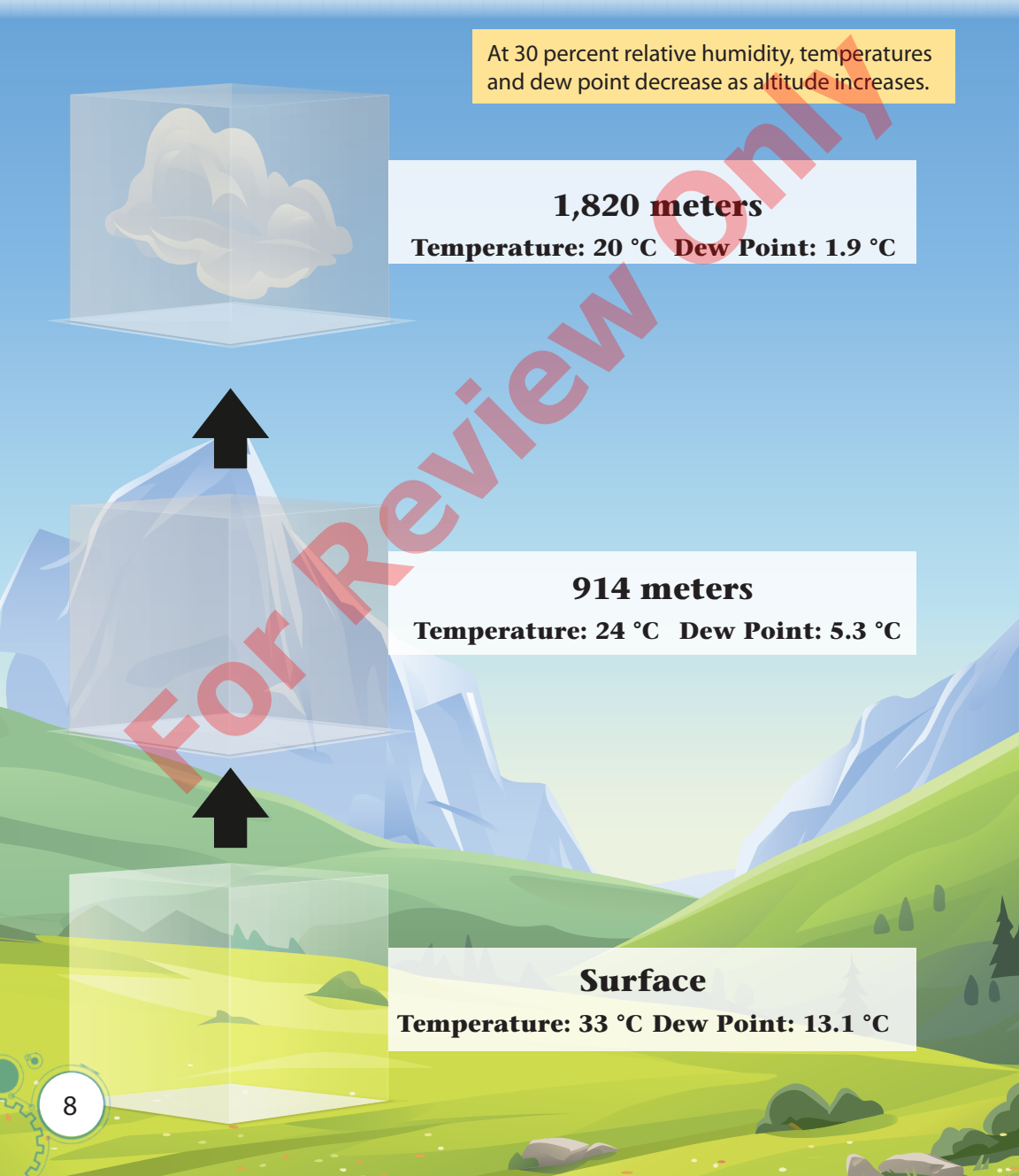
However, to become droplets, the water molecules must find a surface to latch onto. But these molecules have a hard time bonding to each other. This is where cloud condensation nuclei come in. These are teeny-tiny particles that are also called *cloud seeds*. Water molecules bond to these particles. Cloud condensation nuclei can be smoke, dust, dirt, and even salt from oceans. These particles make up very small parts of water droplets. Each is about one hundredth the size of a full droplet.

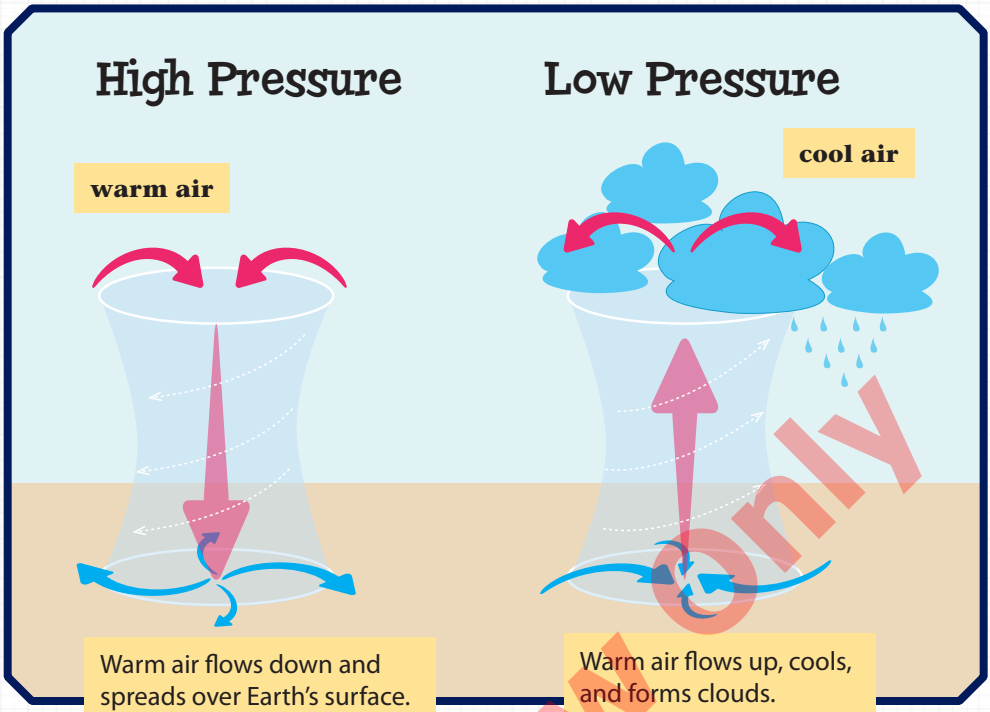
Near the ground, we see droplets as **dew**, **mist**, and **fog**. High in the air, we see these droplets as clouds.



Temperature and Air Pressure

Environmental factors, such as temperature and air pressure, can affect how clouds form. These forces aren't stable. They change constantly. This is why clouds can rapidly form, grow, and **dissipate**.





Temperature plays a key part in cloud formation. The air's temperature dictates how much water vapor the air can hold. Warm air can hold more water vapor than cool air. Plus, warm air is lighter than cool air. This helps warm air rise. As moist, warm air rises, it begins to cool slightly. That's because temperatures drop as altitude, or height from the ground, increases. Clouds begin to form when air is cooled to its dew point. The dew point is the temperature at which air is saturated with water vapor. Dew points vary depending on location and air pressure.

Air pressure is the total weight of the air around us, and it also affects cloud formation. Air pressure is either high or low. Just like temperature, air pressure drops as altitude increases. When air pressure is low, water vapor can expand. This causes it to cool and condense. So, low air pressure leads to water condensation and cloud formation. Areas that experience low air pressure usually have more clouds and storms. Meanwhile, areas that experience high air pressure usually have mild weather.

STEAM CHALLENGE

Define the Problem

Meteorologists have a challenging job. Not only do they have to predict weather based on probability, but much of what they interpret and conclude is based on instruments they use rather than what they can see. Meteorologists are looking for a visible model that demonstrates how air masses interact with one another. Your job is to provide them with a demonstration that proves how air masses flow within the atmosphere.

Constraints: You may only use the materials provided to you.

Criteria: Your model must use two liquids and should clearly and accurately demonstrate how areas of high and low atmospheric pressure interact.

CAREER ADVICE
from Smithsonian

Do you want to be a meteorologist?

Here are some tips to keep in mind for the future.

"Use a weather app to compare cloud forecasts with what you actually see in the sky. It's an excellent way to develop your meteorology skills."

– Dr. Natasha Hinojosa, Postdoctoral Researcher, Smithsonian Tropical Research Institute

"Keep a cloud journal! Observe and sketch the clouds you see each day to learn about different types and weather patterns."

– Dr. Aaron O'Dea, Staff Scientist, Smithsonian Tropical Research Institute

Read and Respond

1. What are condensation nuclei, and how do they help clouds form?
2. How have scientists categorized different types of clouds?
3. Choose three cloud types and describe how they are different from one another.
4. How and why does water vapor condense?
5. How do fronts affect weather?
6. Describe the three stages of thunderstorms.