

Weather and Climate

Climate Change, Clouds, Natural Disasters, & Predicting the Weather



SS49
GRYPHON ROBOTICS



Meteorologist

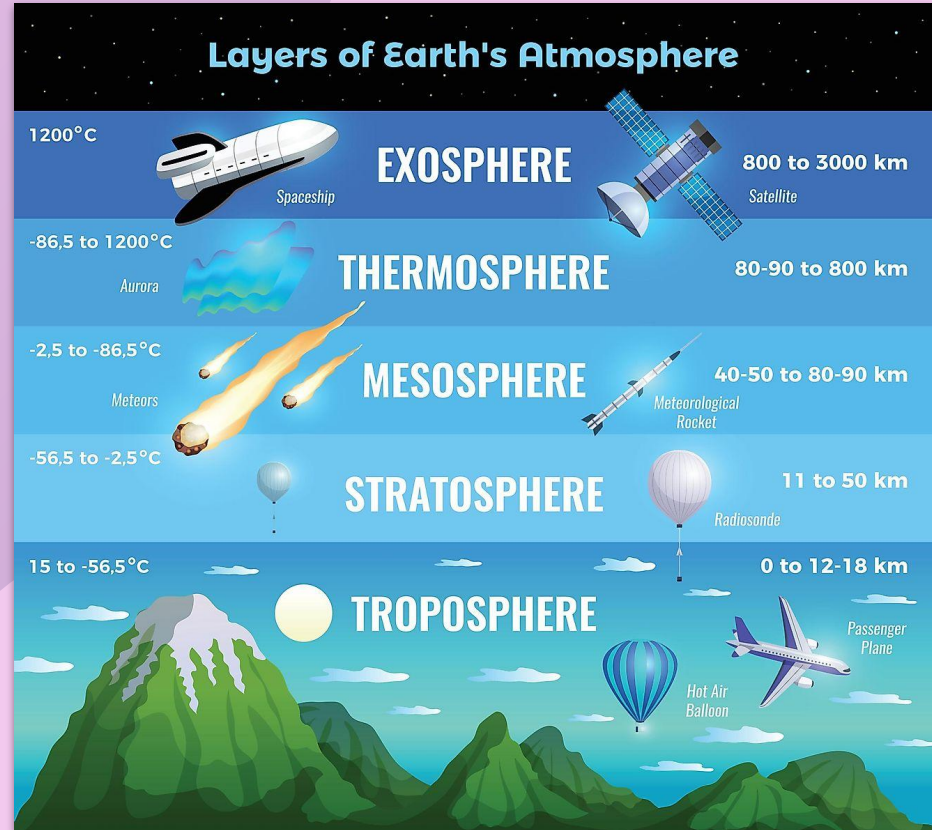
Weather and Climate Scientist

Climatologist

save our
H**OME**

Layers of Atmosphere

Earth's atmosphere has five major and several secondary layers. From lowest to highest, the major layers are the troposphere, stratosphere, mesosphere, thermosphere and exosphere.



Polar Vortex





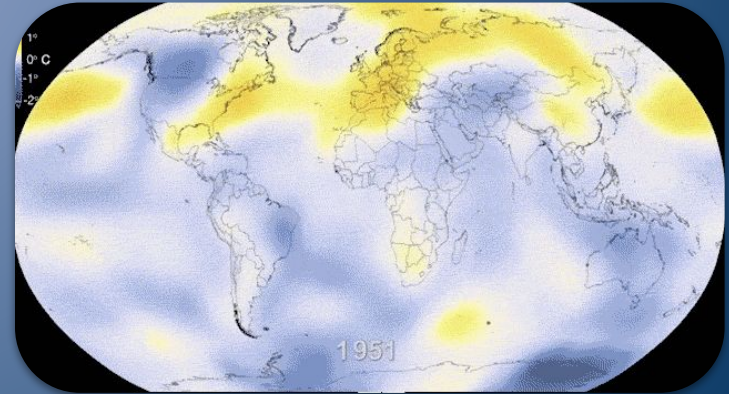
Climate Change

Climate Change

Materials

☁ Computer

What does climate change really mean? If it's cold in Texas how is that global "warming?"





WEATHER

VS



CLIMATE

SHORT-TERM STATE OF
THE ATMOSPHERE

LONG-TERM PATTERN
OF WEATHER



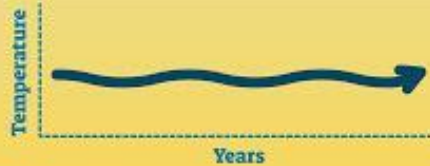
Rain



Tropical Climate



Can change within
minutes or hours




Average weather over
many years in one
specific place

It is important to note the difference between weather and climate.

Weather is short term. It may be raining, sunny, or 95°F that particular day at that particular time.

Climate is long term. Averaging weather patterns for a specific region and time over 30+ years.

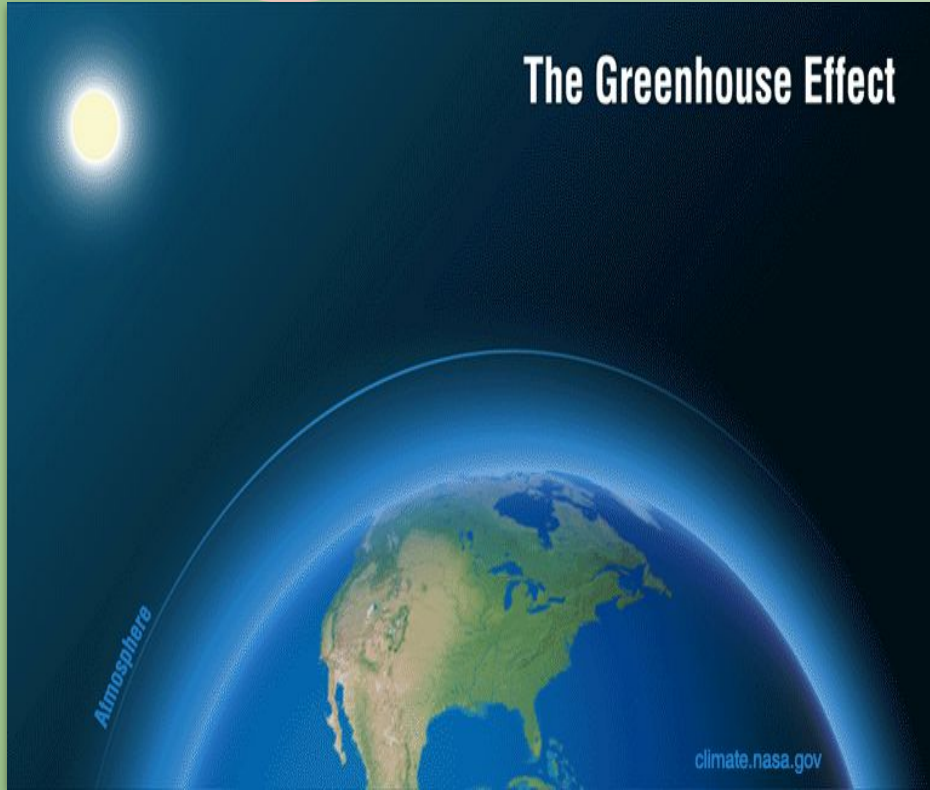


What is Climate Change

Climate change describes a change in the average conditions — such as temperature and rainfall — in a region over a long period of time. NASA scientists have observed Earth's surface is warming, and many of the warmest years on record have happened in the past 20 years. Learn more [HERE](#).



The Greenhouse Effect



The Greenhouse Effect



Greenhouse Gases

Water vapor
Carbon dioxide
Methane
Ozone
Nitrous oxide
Chlorofluorocarbons

Check out this website [HERE](#) to learn more!

National Aeronautics and Space Administration 

WATER VAPOR




visit climatekids.nasa.gov


H₂O

This is water in gas form, like steam above a boiling pot or water evaporating off a lake. It forms clouds and rains back on Earth. This can cause a cooling effect.



National Aeronautics and Space Administration 


CARBON DIOXIDE



visit climatekids.nasa.gov

CO₂

Made up of carbon and oxygen, CO₂ is all around us naturally. It comes from decaying and living organisms, and from volcanoes.



National Aeronautics and Space Administration 

METHANE




visit climatekids.nasa.gov


CH₄

Methane, made of carbon and hydrogen, is a normal gas released from wetlands, growing rice, raising cattle, using natural gas, and mining coal.



National Aeronautics and Space Administration 


OZONE



visit climatekids.nasa.gov

O₃

Up in the atmosphere where the planes fly, the ozone layer blocks the sun's radiation, which helps protect us from the powerful rays.



Play the
Greenhouse
Gas Game
[HERE](#)



*Note: You may have to click
“Run Game”

 Run game

Climate Change Cause & Effect



Explore Evidence for Climate Change

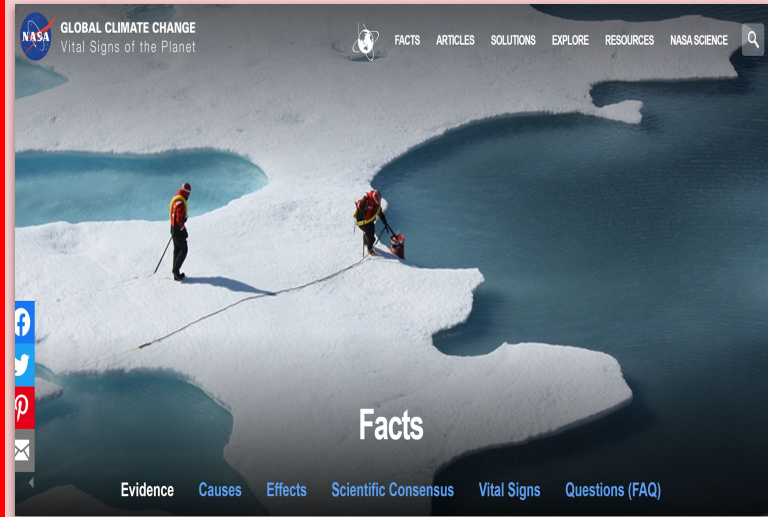
🌶️ Medium Exploration Option 🌶️

Explore the EPA's climate clue website linked [HERE](#)



🌶️🌶️ Spicy Exploration Option 🌶️🌶️

Explore NASA's climate facts website linked [HERE](#)



Climate
Change
Over Time
Click [HERE](#)

Climate Time Machine

This series of visualizations shows how some of Earth's key climate indicators are changing over time.

SELECT A TOPIC



Sea Ice



Sea Level



Carbon Dioxide



Global
Temperature



GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Climate Time Machine

> credits

It's cold in
Texas...

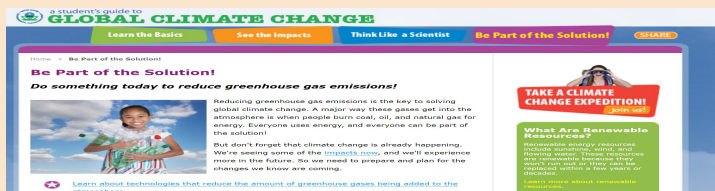
How is that
global
"warming?"



Solutions

Learn About Solutions

🌶️ Explore the EPA's climate change solutions linked [HERE](#) 🌶️

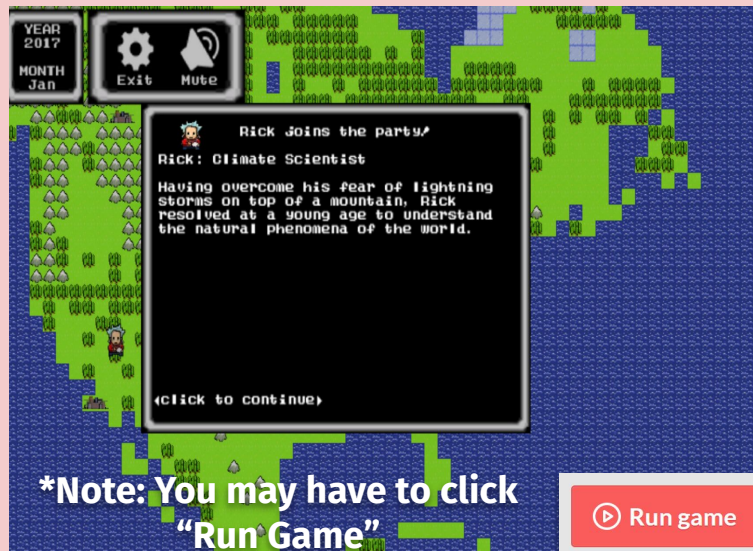


🌶️ Explore the NASA's mitigation and government solutions linked [HERE](#) 🌶️



Play the Climate Quest Game

Play the Climate Quest Game [HERE](#).



*Note: You may have to click "Run Game"

The image features a purple gradient background with stylized clouds. In the top right, there are two clouds: a yellow one on the left and a blue one on the right. In the bottom left, there are three clouds: a purple one on the left, a yellow one in the middle, and an orange one on the right. The word "Clouds" is centered in white text.

Clouds

Clouds

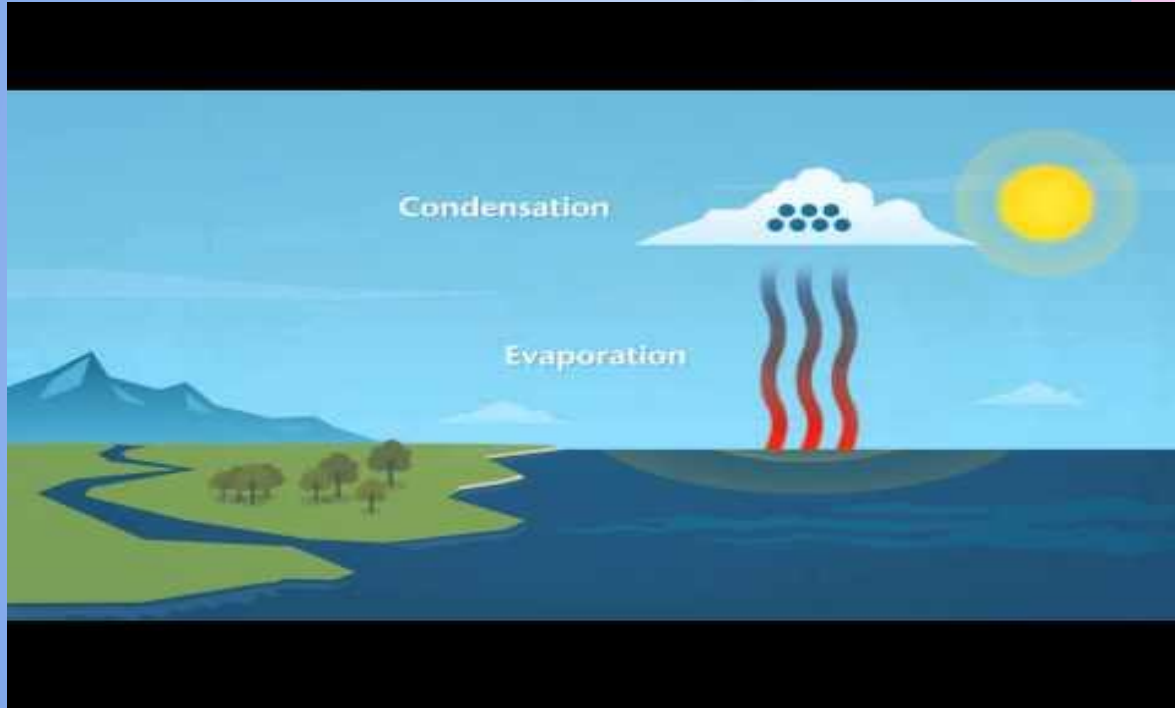
Materials

- ☁ Ice
- ☁ Jar with Metal Lid
- ☁ Hot Water
- ☁ Hairspray

Have you ever wondered how clouds formed? Or what their significance is?



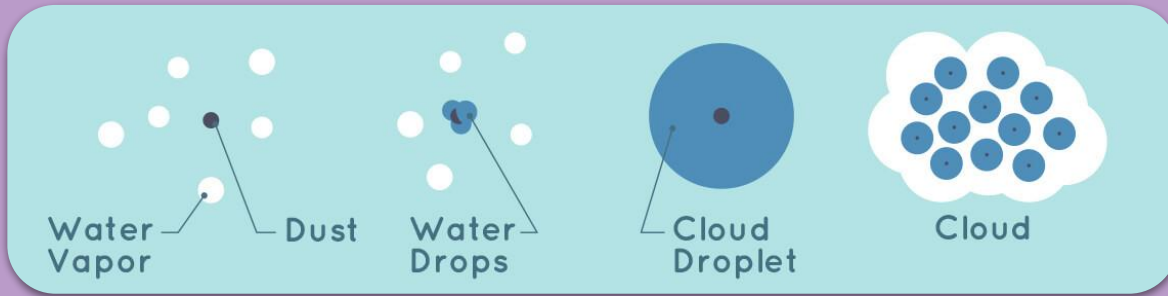
The Water Cycle



Before we can fully understand how clouds are formed, please make sure you review the water cycle!

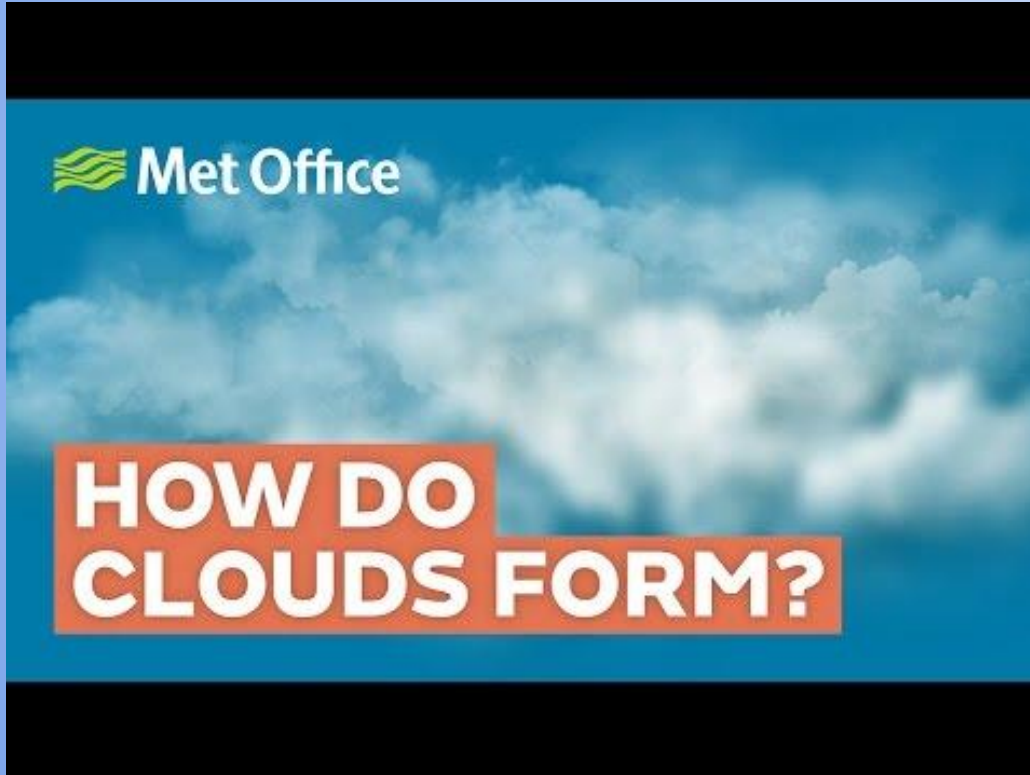
What is a cloud?

A cloud is a mass of water drops or ice crystals suspended in the atmosphere. Clouds form when water condenses in the sky. The condensation lets us see the water vapor. There are many different types of clouds.



By watching the clouds we can determine the weather moving into a specific area and get a better understanding of the atmosphere.

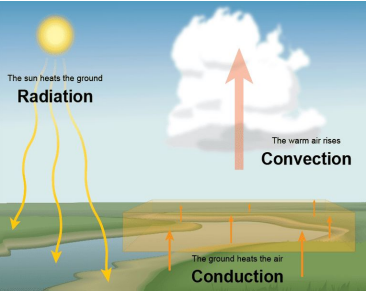
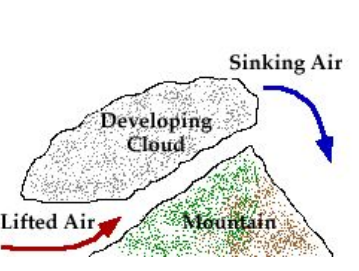
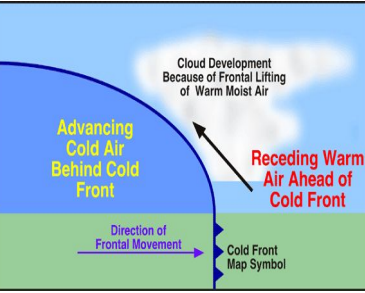
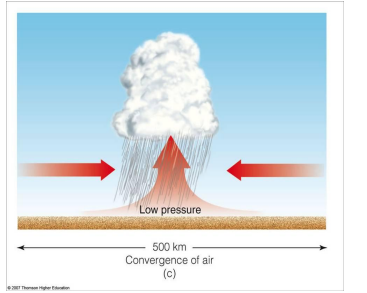
Cloud Formation Process



Main Ingredients

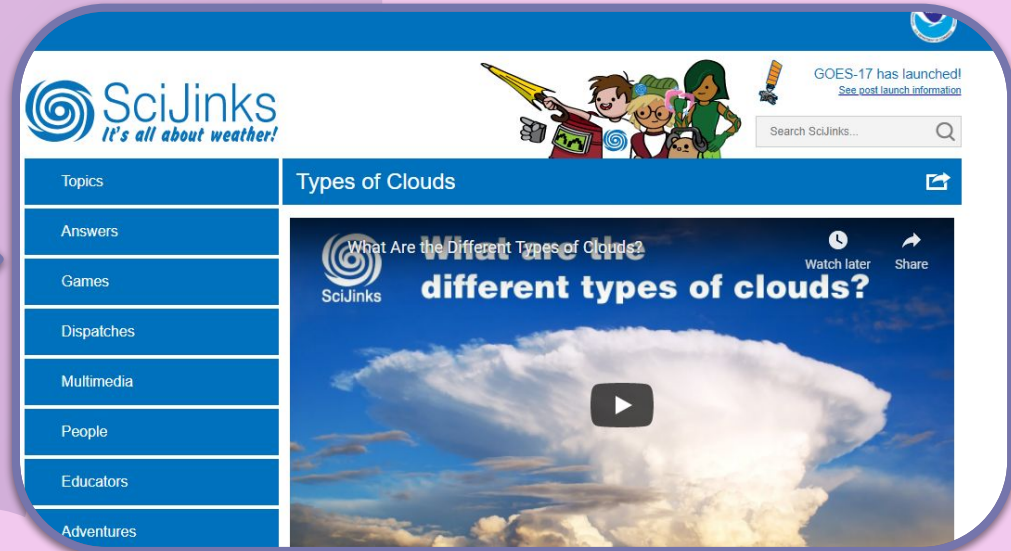
- ☁ Condensation → Smoke, dust, and even sea spray can be used to condensate water droplets
- ☁ Water Vapor → Enters the atmosphere through evaporation
- ☁ Temperature → Dew Point is the measure of moisture in the air and temperature when atmosphere becomes saturated

Different Ways Clouds Form

Convection	Orographic	Frontal	Convergence
<p>Air containing water vapor rises from heated surfaces</p>	<p>Air is forced up along topographic barriers such as mountains</p>	<p>Less dense, warm air is forced to rise over cooler, dense air as a frontal moves through an area</p>	<p>Air near the surface flows together and is pushed upwards when it is squeezed together</p>
 <p>The sun heats the ground Radiation</p> <p>The warm air rises Convection</p> <p>The ground heats the air Conduction</p> <p>This diagram illustrates the process of convection. On the left, a sun icon emits yellow arrows representing radiation hitting the ground. Below the ground, orange arrows point upwards, labeled 'Conduction', indicating the ground heating the air. In the center, a large white cloud is shown with a red arrow pointing upwards from the ground, labeled 'Convection', representing the rising warm air. The text 'The sun heats the ground' and 'The warm air rises' are placed near their respective parts of the diagram.</p>	 <p>Sinking Air</p> <p>Developing Cloud</p> <p>Lifted Air</p> <p>Mountain</p> <p>This diagram shows a mountain range. A red arrow labeled 'Lifted Air' points up the slope of a mountain. A blue arrow labeled 'Sinking Air' points down the other slope. A grey, textured cloud is shown on the mountain peak, labeled 'Developing Cloud'.</p>	 <p>Advancing Cold Air Behind Cold Front</p> <p>Receding Warm Air Ahead of Cold Front</p> <p>Cloud Development Because of Frontal Lifting of Warm Moist Air</p> <p>Direction of Frontal Movement</p> <p>Cold Front Map Symbol</p> <p>This diagram depicts a cold front. A blue wedge-shaped area labeled 'Advancing Cold Air Behind Cold Front' is moving to the right, as indicated by a blue arrow labeled 'Direction of Frontal Movement'. A red wedge-shaped area labeled 'Receding Warm Air Ahead of Cold Front' is being pushed back. At the boundary between them, a cloud is shown with the text 'Cloud Development Because of Frontal Lifting of Warm Moist Air'. A blue line with triangles pointing right is labeled 'Cold Front Map Symbol'.</p>	 <p>Low pressure</p> <p>500 km</p> <p>Convergence of air (c)</p> <p>This diagram shows air converging from the left and right towards a central point. A large white cloud with rain is shown above the convergence point. A red arrow points upwards from the ground at the convergence point, labeled 'Low pressure'. A horizontal double-headed arrow below the ground is labeled '500 km' and 'Convergence of air (c)'. A small copyright notice '© 2011 Thomson Digital Education' is visible at the bottom left.</p>

Different Types of Clouds

Explore [THIS](#) webpage to learn about the different type of clouds and where in the atmosphere they are formed!



The screenshot shows the SciJinks website interface. At the top left is the SciJinks logo with the tagline "It's all about weather!". To the right of the logo is a cartoon illustration of three children and a satellite. Further right is a notification for "GOES-17 has launched!" with a link to "See post launch information". Below the notification is a search bar labeled "Search SciJinks...".

The main content area is titled "Types of Clouds". On the left side of this area is a vertical navigation menu with the following items: Topics, Answers, Games, Dispatches, Multimedia, People, Educators, and Adventures. The "Types of Clouds" page is currently selected.





The main content area displays a video player. The video title is "What Are the Different Types of Clouds?". The video player includes a play button, a "Watch later" button, and a "Share" button. The video thumbnail shows a large, white, fluffy cloud against a blue sky.

Test out [THIS](#) interactive to see how clouds form

Cloud Classification



4 MAIN Cloud Classifications

Cirro-Form	Strato-Form	Cumulo-Form	Nimbo-Form
<p>These wispy clouds are mostly made of ice crystals and are observed at high altitudes. They usually appear ahead of storm systems.</p>	<p>Typically broad and widespread, covering a large area. This mid-level clouds can sometimes be compared to a blanket.</p>	<p>These appear as white fluffy, cotton balls that seem denser than other clouds. These low clouds have a flat base, and a fluffy top.</p>	<p>The majority of precipitation falls from these clouds. These are typically found in the mid-level altitudes.</p>
 A photograph showing wispy, white cirrus clouds against a clear blue sky. The clouds are thin and streaky, typical of high-altitude ice crystals.	 A photograph showing a wide, grey, overcast layer of stratus clouds covering the sky. In the foreground, there is a body of water and some trees, illustrating how these clouds can blanket a large area.	 A photograph showing a large, white, puffy cumulus cloud with a flat base and a fluffy top, set against a clear blue sky. This is a classic example of a low-level cloud.	 A photograph showing dark, heavy, and layered nimbostratus clouds. A bright lightning bolt is visible striking the ground from the dark clouds, illustrating that these clouds are associated with precipitation.

Why don't Clouds Fall Out of the Sky?

Um.. Excuse me what??



Cloud in a Jar Demo

Materials

- ☁ Ice
- ☁ Jar with Metal Lid
- ☁ Hot Water
- ☁ Hairspray



The background is a solid light purple color. There are four stylized clouds: a yellow one at the top left, a blue one at the top right, a purple one at the bottom left, and an orange one at the bottom left. The text "Natural Disasters" is centered in white.

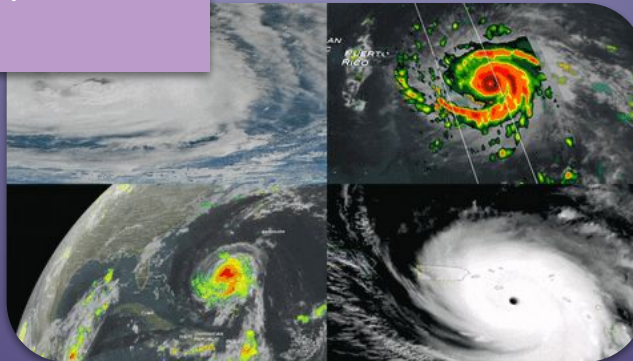
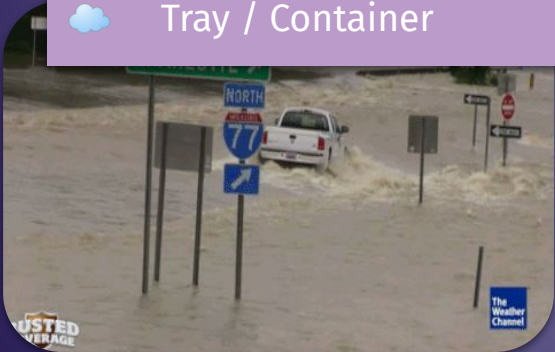
Natural Disasters

Natural Disasters

Materials

- ☁ Computer
- ☁ Small water bottle
- ☁ Party Hat / Construction Paper
- ☁ Baking Soda
- ☁ Vinegar
- ☁ Scissors
- ☁ Red Food Coloring
- ☁ Measuring scoop and cup
- ☁ Tray / Container

How do hurricanes and other natural disasters occur? Can you stop natural disasters from happening?



What is a Natural Disaster?

A natural disaster is a catastrophic event that occurs because of the earth with no human interference. They can cause severe damage to people, property, and the environment.

There are different reasons for different natural disasters. Some common causes are global warming, activity in the earth's crust, moon activity soil erosion, air pressure, ocean currents, and pollution.

Fun Fact! Natural disasters can be predicted by scientists by using fractals. Read more [HERE](#).

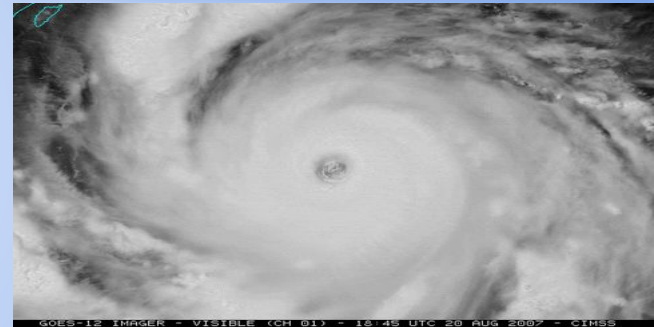
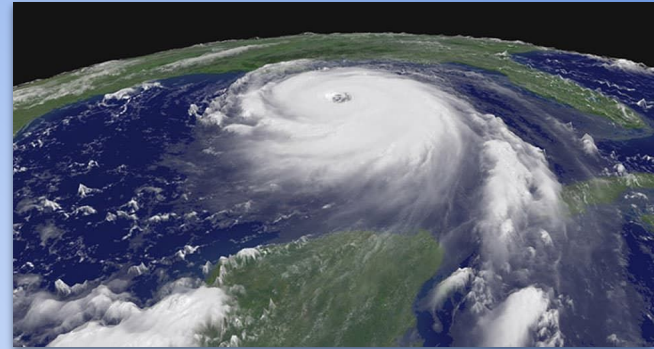


Hurricanes

Hurricanes are powerful swarms of wind that are fueled by warm/tropical waters. When the warm air rises over the ocean, vacuums of low pressure form underneath and more air comes to fill this spot. The air rises more and cools which causes clouds to form and than thunderstorms. As more air rises and cools, the storm grows bigger and bigger.

This is why most hurricanes are by shore lines or near large bodies, more than 50 feet deep, of warm water, over 78 degrees fahrenheit. Hurricanes will usually start out as another storm or tropical wave before turning into a hurricane.

Hurricanes are officially hurricanes when their wind speeds are over 74 mph.



How Hurricanes Form

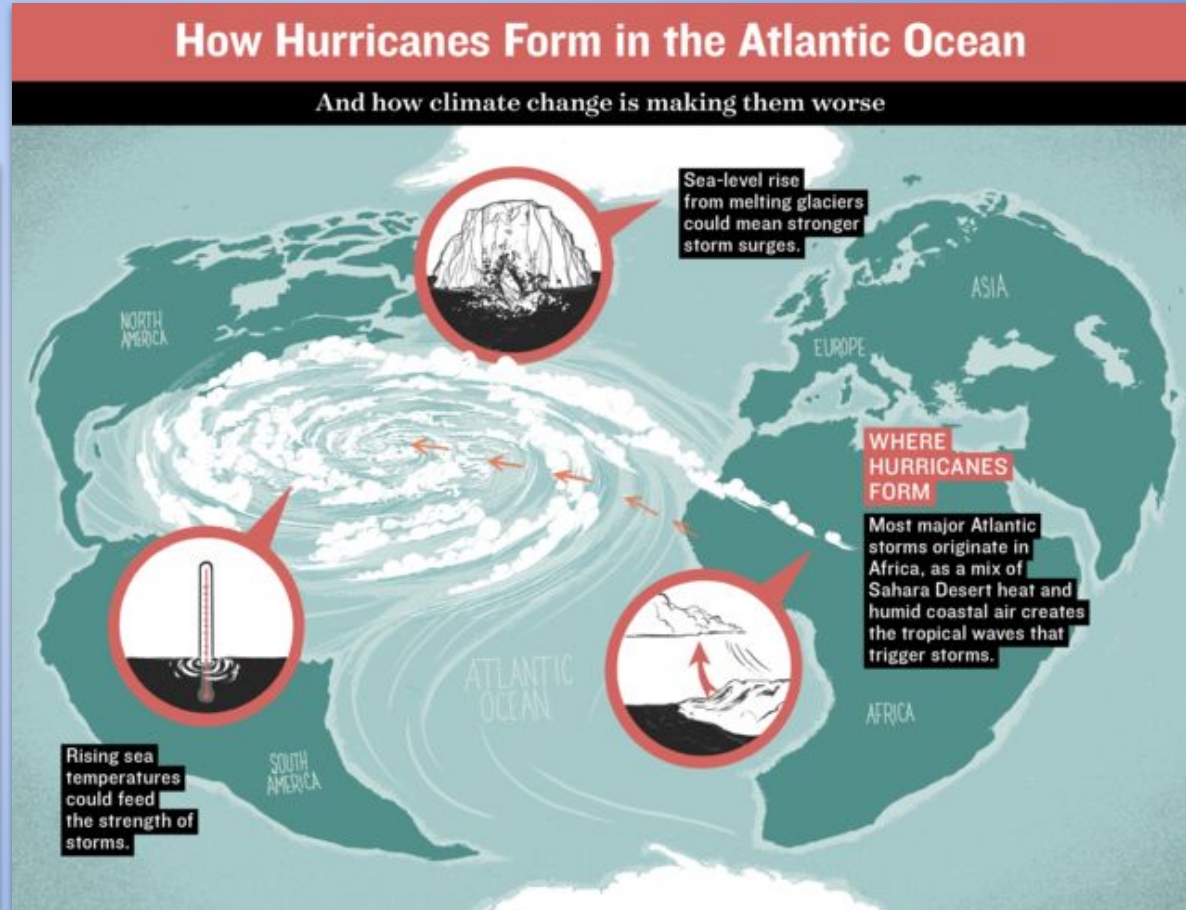


Hurricanes & Human Impact

With hurricanes becoming more and more frequent, scientists are looking at the correlation of human effects on hurricanes.

As stated previously, hurricanes are formed with warm water. As the global climate increases due to human gasses and the greenhouse effect, the likelihood of hurricanes also increases.

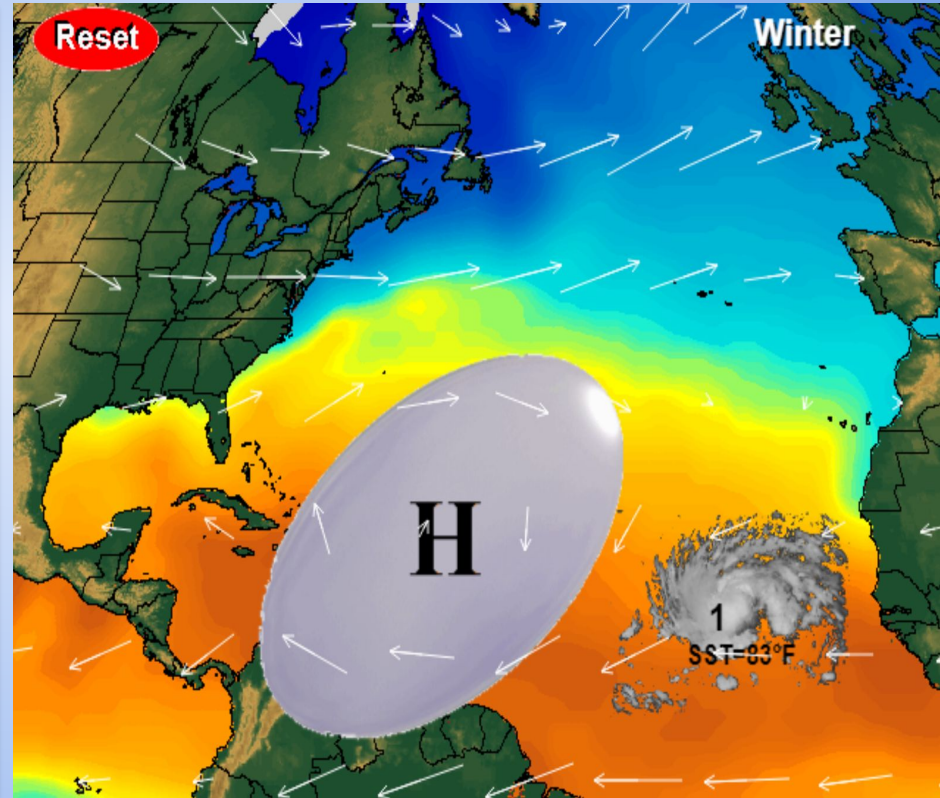
Learn more [HERE](#).



Hurricane Simulator Game Click [HERE](#)

You are in control!

- ☁ Drag the hurricane around to see the effect surface temperature has on the hurricane.
- ☁ Drag the grey high pressure area around to see how pressure and winds influence hurricane paths.
- ☁ Click the season name to rotate through seasons. Ocean temperatures change with each season.
- ☁ Click Reset to start over.





Tornados



Tornados take on a narrow funnel like shape and occur all over the world, especially in the United States. “Tornado Alley” or from South Dakota to the top of Texas, the most Tornadoes occur in this location in the United States.



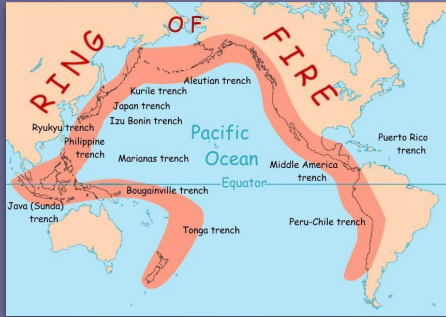
Tornado Formation

1. A large thunderstorm occurs in a cumulonimbus cloud
2. A change in wind direction and wind speed at high altitudes causes the air to swirl horizontally
3. Rising air from the ground pushes up on the swirling air and tips it over
4. The funnel of swirling air begins to suck up more warm air from the ground
5. The funnel grows longer and stretches toward the ground
6. When the funnel touches the ground it becomes a tornado

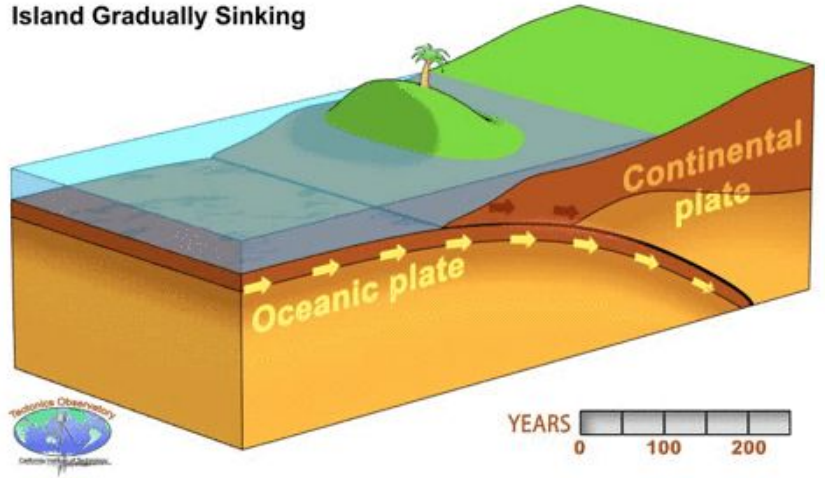
Play the
Tornado
Simulation
[HERE](#)



Earthquakes



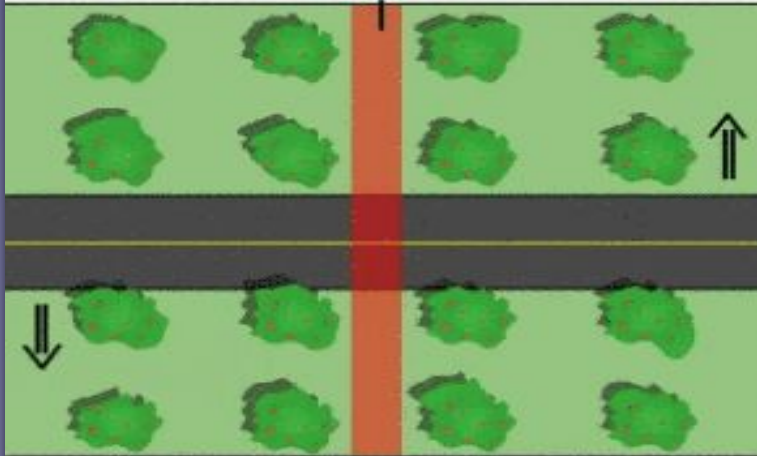
Island Gradually Sinking



An earthquake is caused by a slip in the tectonic plates in the Earth's crust. These plates are always moving slowly and when they get caught, friction is built, and then energy is released in waves. Around 3 million earthquakes happen each year, with around 8,000 a day.

81% of earthquakes occur in the rim around Pacific Ocean because the rim exists alongside a lot of connection points of tectonic plates. This rim is called the "ring of fire"

Fault Zone



As tectonic plates are slowly moving, their edges are locked in place, causing bending of the crust along the plate edges.

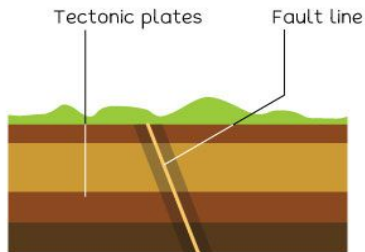


BEFORE

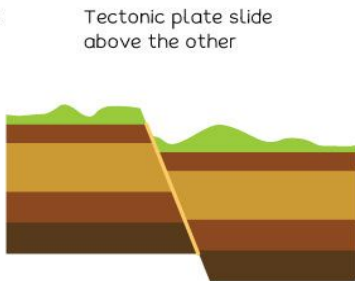


AFTER

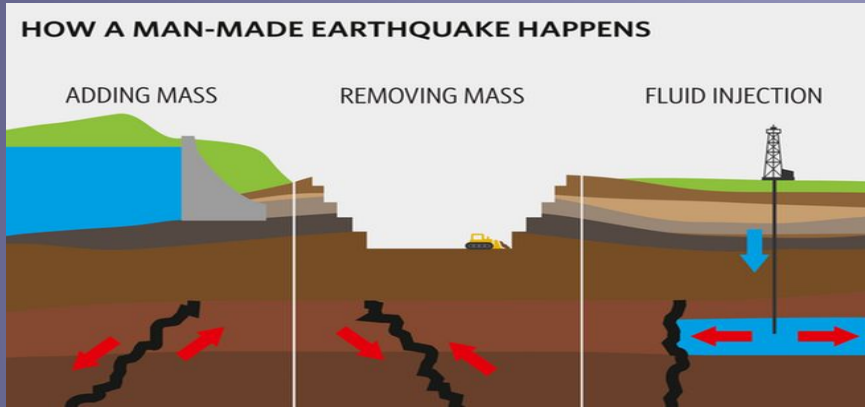
BEFORE EARTHQUAKE



AFTER EARTHQUAKE



Additional Causes for Earthquakes



Human's can also cause seismic activity, or a very low intensity earthquake with large crowds, like at [sporting events](#).

Human's can also cause earthquakes, these are called Human-Induced Earthquakes.

These can be caused by mining ground products like oil or water. When the product is removed, the plates shift earlier than predicted.

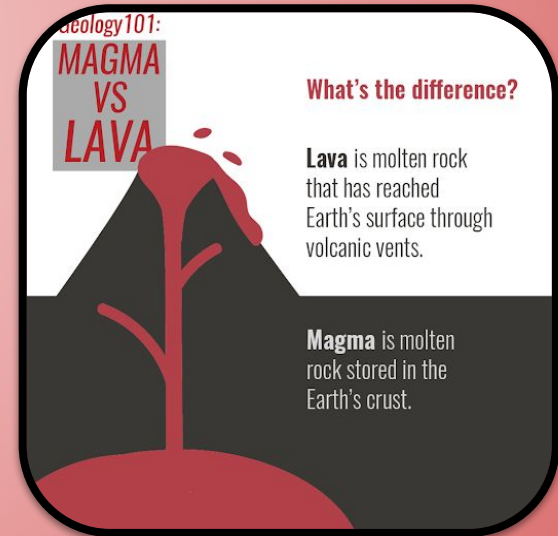
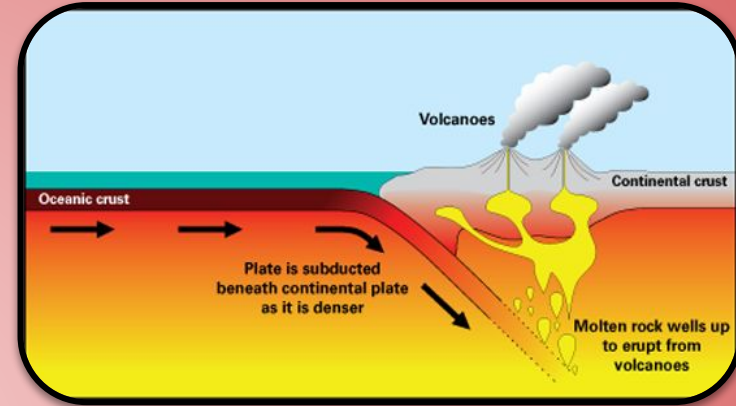
They can also be caused by dams or reservoirs of water, which adds stress to the earth's crust. Fluids being injected back into the Earth can also cause earthquakes. Volcanic action can also cause earthquakes.

Volcanoes

Volcanoes exist on several different planets and moons, including Earth.

Volcanoes form when the pressure and heat from underneath the earth turns rocks into magma. The magma is forced up to the surface, there it's called lava. The magma cools into rock. Lot's of magma does this over time and forms a pile of rock, with magma through the middle. This is what's called a volcano.

Once the volcano has too much pressure, it can erupt. There are several types of volcanoes and their eruptions can be different.



Types of Volcanoes

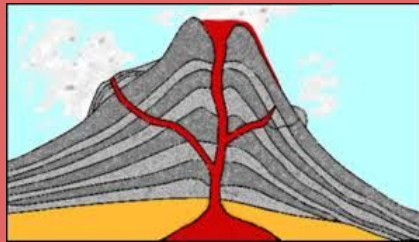
Cinder Cones

The most common type of volcano, these volcanoes have a giant gap at the top. An example is the Paricutin Volcano in Mexico.



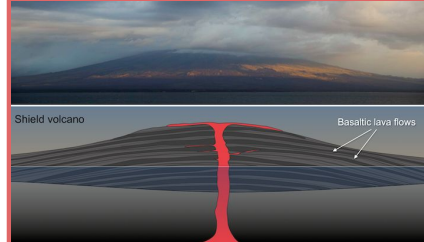
Composite Volcanoes

These are the mountainous volcanoes, they have steep sides that are built up layers of magma and ash, there is also a conduct system of magma through several points of the volcano.



Shield Volcanoes

These volcanoes are built out of fluid lava. They are typically short and flat and have a lots of vents that have a continuous flow of lava when they erupt.



Lava Domes

Lava domes are formed by piles of lava that's too thick to flow so it forms a giant mass instead. These often are formed in craters of Composite Volcanoes, an example of this is Mont Pelee.



👁️ Pick One to Watch!

🌶️ Volcano Types [HERE](#) 🌶️



🌶️ All About Volcanoes [HERE](#)



Volcanoes and the Hawaiian Islands (Click [HERE](#))



Science & Math

How volcanoes formed the Hawaiian Islands

Present Save Read Aloud Share Hide Print Add To Text Set



A volcano explodes in Hawaii. Photo by: National Geographic

By National Geographic Society, adapted by Newsela staff



Volcano Demo

Materials

- ☁ Small water bottle
- ☁ Party Hat / Construction Paper
- ☁ Baking Soda
- ☁ Vinegar
- ☁ Scissors
- ☁ Red Food Coloring
- ☁ Measuring scoop and cup
- ☁ Tray / Container

Follow step by step instructions [HERE](#) and/or follow along with the video.



Impact on Humans

Natural disasters can lead to major damage on the environment and the people that live in the area.

Infrastructures, or buildings, can collapse, there can be major health issues and food and water scarcity. Natural disasters can also lead to lots of people being displaced and with injuries.

Major damage can also be done to the surrounding environment.



Solutions

There's no way to completely stop natural disasters but there are ways to minimize their effects.

Some examples include:

- ☁ Building more stable buildings could lead to less collapsed building during storms and earthquakes.
- ☁ More emergency measures and emergency evacuation during a natural disaster
- ☁ Better predictions of natural disasters
- ☁ Educational Outreach

Read more about natural disasters at [this](#) website.



The background is a solid light purple color. There are four stylized clouds: a yellow one at the top center, a blue one at the top right, a purple one at the bottom left, and an orange one at the bottom left. The text "Predicting the Weather" is centered in white.

Predicting the Weather

Predicting the Weather

Materials

- ☁ Computer
- ☁ Gizmo access
- ☁ glass, jar, or can
- ☁ plastic wrap
- ☁ a straw
- ☁ rubber band
- ☁ index card or lined notebook paper
- ☁ tape
- ☁ scissors



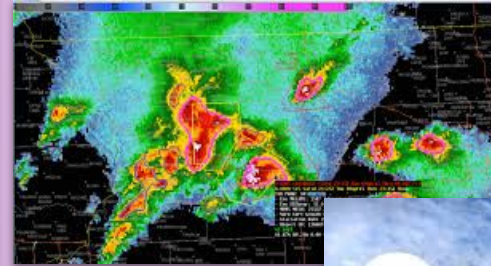
Have you ever wondered how meteorologist can interpret and predict the weather?



How do Meteorologist Predict Weather?

Meteorologist are in charge of predicting weather, they can do this using a variety of tools. They combine data from atmospheric sensors, weather balloons, radar, satellites, and aircraft monitoring to predict storms and day to day weather. Weather and satellite data is processed in supercomputers which can model the atmospheres behavior.

Read a more in depth overview of techniques [HERE](#).



Weather Tools Used

Click on the pictures to learn more

Anemometer

These are used to measure wind speed. An anemometer uses three cups to measure wind speeds based on how fast the cups spins.



Barometer

Barometers measure air pressure. By comparing air pressure over the course of several days, weather patterns can be traced by the changes in pressure.



Thermometer

Thermometers are the most common tool and measure air temperature. They measure ambient temperature, or the temperature at that moment.



Hygrometer

A hygrometer measures humidity or the moisture in the air. They can detect humidity by the expansion or contracts based on the amount of humidity.



Weather Tools Used

Click on the pictures to learn more

Rain Gauge

A rain gauge is a very simple tool that measure the amount of precipitation. Gauges can help track precipitation patterns.



Weather Balloon

A weather balloon carries instruments into the upper atmosphere to record weather variables, like pressure and humidity and sends the data back to earth.



Weather Satellites

Weather satellites are used to gather data from outside thousands of miles above earth's surface. From there it can see clouds and predict weather patterns.



Weather Radar

Weather radar is used to estimate precipitation type and the amount. Radar does this by sending pulses and than based on the size of the pulse that bounces back, scientists can predict the type of weather.



Predicting Storms

The drone sent in the middle of the hurricane



Meteorologist can predict storms and weather using different characteristics:

Hurricanes: hurricanes are slower moving storms and can be forecasted using the Dvorak technique, which uses satellite imagery to estimate where the hurricane will land and the intensity of it. The specifics of a hurricane like air temperature, humidity, wind speed, and direction are all found by the Hurricane Hunter Aircraft which is deployed once the hurricane comes within range of the coast. Other severe storms can be predicted using similar methods.

Tornados: to predict where tornadoes touch down, scientists measure wind speeds and pressure through weather stations. Tornados usually last less than 10 minutes so it's hard to collect data and have time to warn people of the emergency. Also because tornados are funnels, there is not much sign of them in the upper atmosphere, making them hard to predict. So scientists have started looking for supercells, which as another word for thunderstorms that have rotating updrafts. These supercells can form into tornados so by tracking supercell movement, scientists can better predict tornados.



Play the
Extreme
Weather
Game
[HERE](#)

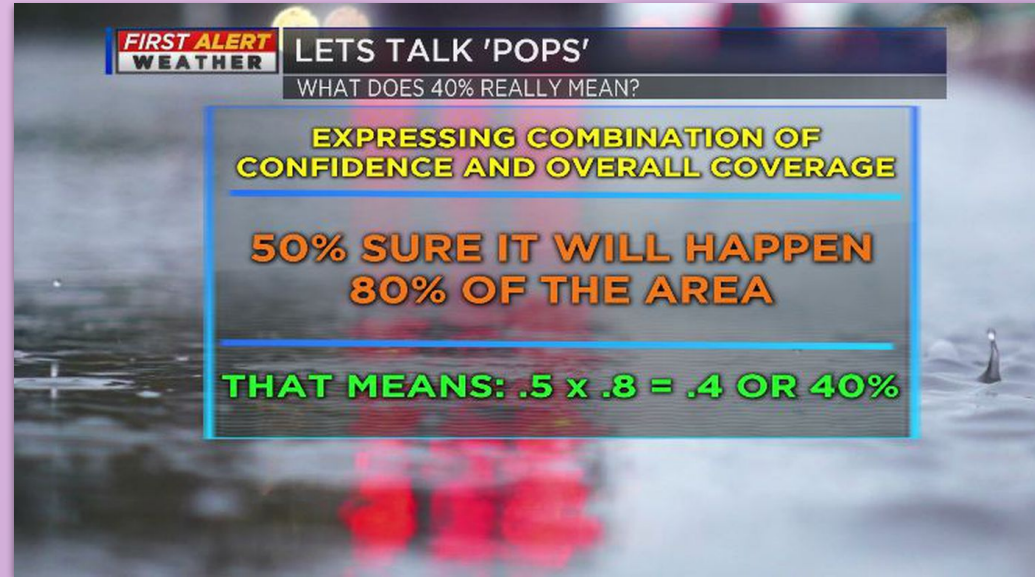


How scientist track hurricanes and footage from inside a hurricane

How to Predict Rain Percentages

The **Probability of Precipitation** or PoP refers to the chance of rain during the day. The PoP is calculated by multiplying the **confidence of precipitation** by the percentage of the **area that will receive measurable precipitation**.

First data from weather radars and satellites are collected and then predictions are formed for a small area, this is then multiplied to cover a larger area.



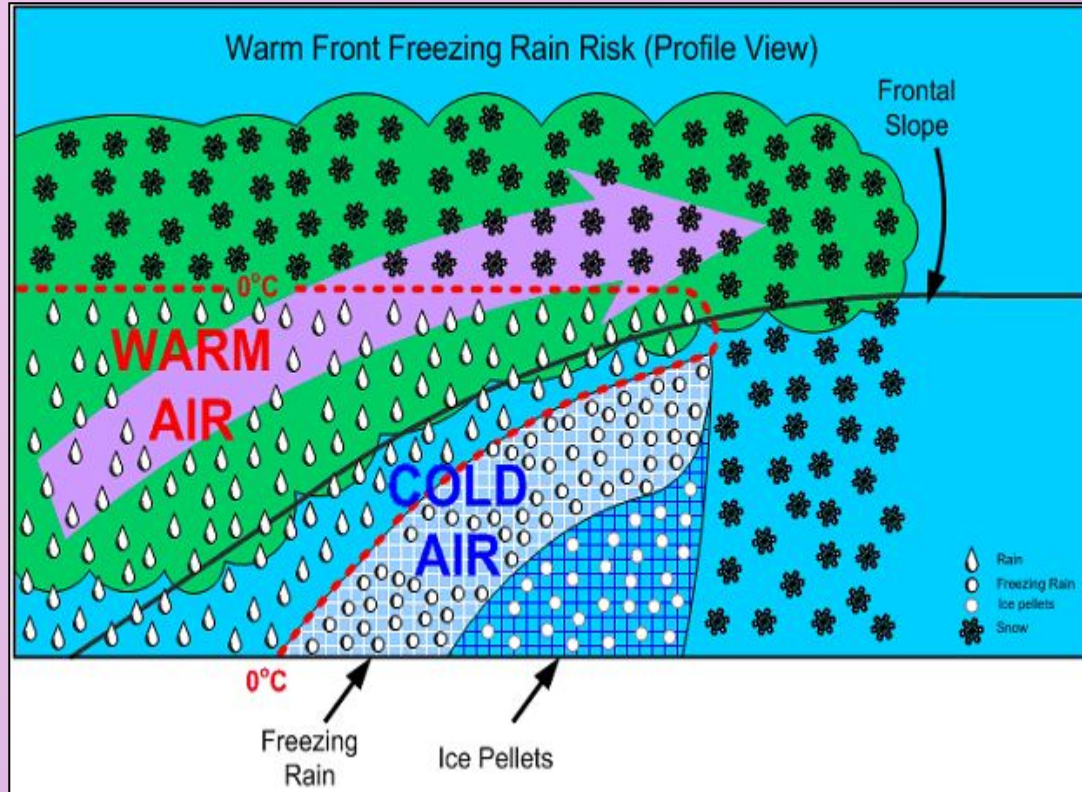
FIRST ALERT WEATHER LETS TALK 'POPS'
WHAT DOES 40% REALLY MEAN?

EXPRESSING COMBINATION OF CONFIDENCE AND OVERALL COVERAGE

**50% SURE IT WILL HAPPEN
80% OF THE AREA**

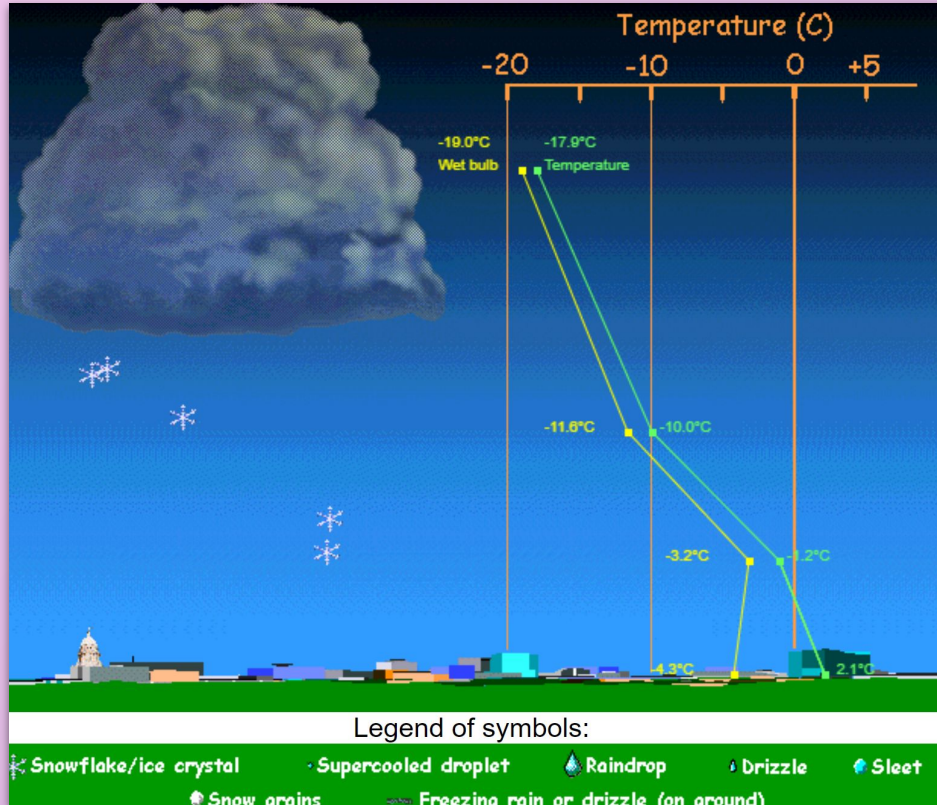
THAT MEANS: $.5 \times .8 = .4$ OR 40%

Will it Rain, Sleet, or Snow??



Read the following article [HERE](#) to learn the important questions meteorologist must answer... Will it rain, sleet, or snow today.

SNOW SNOW SNOW... or.. Rain? Or sleet? Or....



Explore this simulator [HERE](#) to determine how air temperature and liquid temperature at different altitudes can change the result of precipitation

How to Read A Weather Map

🌶️ **Medium Exploration Option** 🌶️

Weather School [HERE](#)



🌶️🌶️ **Spicy Exploration Option** 🌶️🌶️

Meteorologist Explains [HERE](#)



Weather Maps Gizmo

Using [THIS](#) google doc and the related Gizmo you will learn about standard symbols used in meteorology to construct weather maps.



**Why it's so
hard to
predict the
weather**



Barometer Activity

Construct your own Barometer. High pressure will cause the plastic wrap to push in and the straw will drop. When pressure is low, the plastic wrap will push out and the straw will lift. Read more on why it works [HERE!](#)

- ☁ glass, jar, or can
- ☁ plastic wrap
- ☁ a straw
- ☁ rubber band
- ☁ index card or lined notebook paper
- ☁ tape
- ☁ scissors



1. Cover the top of your container with plastic wrap. You want to create an airtight seal and a smooth surface.
2. Secure the plastic wrap with a rubber band. The most important part of making the barometer is getting a good seal around the rim of the container.
3. Lay the straw over the top of the wrapped container so that about two-thirds of the straw is over the opening.
4. Secure the straw with a piece of tape.
5. Either tape an index card to the back of the container or else set up your barometer with a sheet of notebook paper behind it.
6. Record the location of the straw on your card or paper.
7. Over time the straw will move up and down in response to changes in air pressure. Watch the movement of the straw and record the new readings.