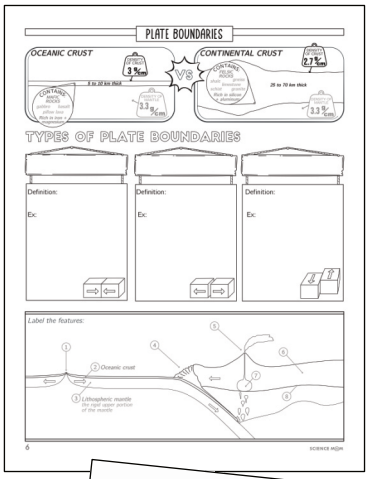
GEOSCIENCE

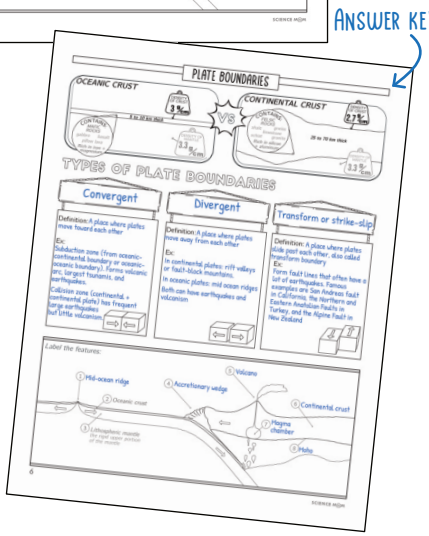
A Teacher's Guide

The goal of this teacher's guide is to assist you with getting the most out of our Geoscience course. Within the guide, you will find:

Disclaimer: Please keep in mind, especially with the science standards alignment, that we don't claim to be experts in the educational standards of your particular state or country. This guide is here to help you take the reins of your student's education - if you feel like you're inadvertently veering off course, relax, have fun, and jump back in.

Tips for Using the Notes





Each lesson in our Geoscience class contains a video and doodle-style notes to go along with it.

You'll find which pages go with each lesson in the table of contents.

There is also an answer key for the notes that contains answers in blue text. Both PDF files can be downloaded from the introduction page of the course website.

There are multiple approaches for using the notes. Choose the approach that works best for your learner!

Here are some ideas:

- **Study the notes before the lesson:** Become more familiar with the topic by reading over the selected pages. Fill in any labels that you already know. Think about what you expect to learn.

THEN

- **Fill out notes during the lesson:** pause the video and rewatch as needed.

OR

- **After the lesson:** fill in the notes after watching as a way to synthesize and review what was learned. Complete them after class or the following day as a review. Refer to the video as needed.

We hope you find the notes to be a valuable tool for deeper learning and reinforcement of key concepts.

Time Commitment and Suggested Pacing

We suggest 3 lessons per week. Lecture-style lessons are about 45 minutes. The hands-on activities will likely take around an hour. For those adding up their hours, that's about 2.5 hours per week.

For a thorough student who enjoys extensions and chooses to explore the deep-dive resources with each lesson, plan 1.5 hours per lesson and 2 hours per hands-on activity, or approximately 5 hours per week.

5 lessons per week

Most weeks will contain 2 hands-on activities.

Time to complete course:

9 weeks

3 lessons per week

Matches the pacing in the table of contents.

2 lecture-style lessons and 1 hands-on activity each week.

Time to complete course:

15 weeks

2 lessons per week

Will have a hands-on activity every other week.

Time to complete course:

22 weeks

Supply List for Hands-on Activities

Lesson 3 - A Ring of Fire
- Pencil & colored pencils or crayons
- Internet connection or book(s) to use for researching volcanoes and earthquakes

Lesson 6 - Shake, Rattle, Resilient
- A small box
- Cardboard (at least 3x as long as the small box)
- Cylindrical pencils or markers
- Smart phone
- Various household objects

Lesson 9 - Stream Table Study
- Sand and gravel
- Plastic paint tray or a long bin or storage container
- Drill or nail
- Rocks or brick to elevate tray/container
- Cups or an empty gallon jug

Lesson 12 - Geology Assessment
Students could make the geology assessment into an activity by:

- *Making a geology poster with key terms and concepts*
- *Creating a new set of questions and using that to quiz friends or family members*

Lesson 15 - Cloud in a Jar
Adult supervision recommended
- 4 glass jars with lids
- Ice
- Water
- Matches
- Paper or tape and pen for making labels

Lesson 18 - Humidity Lab
- A small piece of cloth or gauze
- Fan
- Rubber band
- 2 identical thermometers

Lesson 21 - Convection Convention
Adult supervision recommended
- 2 to 4 identical clear cups
- 2 paper cups (will need to be cut)
- Stiff wire, taller than the paper cups
- Scissors or exacto knife
- Thin flat piece of plastic
- Food coloring
- Water (some of it heated to be very warm)
- Ice cubes
- Salt
- Tray
- 1 large clear container
- Pencil
- Matches
- Tea candle

Lesson 24 - Tropical Storm Quest
- Pencil & colored pencils or crayons
- Internet connection or book(s) to use for researching a historic hurricane

Lesson 27 - Weather and Atmosphere Assessment
Students could make the atmosphere assessment into an activity by:

- *Making a weather and atmosphere poster with key terms and concepts*
- *Creating a new set of questions and using that to quiz friends or family members*

Lesson 30 - Stackable Food Chain & Food Web
- Cardboard
- Colored pencils, crayons, or markers
- Yarn
- Tacks or pins
- Scissors
- Gluestick

Lesson 33 - Competing Compost Jars
- 2 identical clear containers
- Lids for the containers with ventilation holes OR 2 pieces of cloth and 2 rubber bands
- Newspaper
- Scissors
- Grass clippings or vegetable scraps such as carrot peels, apple cores, or squash rinds etc
- A small sample of soil, if possible, containing invertebrates such as earthworms, millipedes etc

Lesson 36 - Invasive Species Comic
- Cardboard
- Colored pencils, crayons, or markers
- Scissors
- Gluestick

Lesson 39 - Natural Resource Scavenger Hunt
- Pencil and lesson handout

Lesson 42 - Ecology and Human Systems Assessment
Students could make the ecology assessment into an activity by:

- *Making an ecology and human systems poster with key terms and concepts*
- *Creating a new set of questions and using that to quiz friends or family members*

UNIT ONE

1. Continental Drift (pages 4-5)

Plate tectonics is the bedrock theory of geology. It explains most geological phenomena on our planet.

Vocabulary

Inner Core	Outer Core	Mantle
Continent	Tectonic Plate	Convection
Mohorovičić discontinuity or "Moho"		

Learning Objectives

After this lesson, the student should be able to:

- Describe the theory of plate tectonics
- Explain that plate movement is influenced by convection in the mantle
- Identify and name the following major plates on a world map:

African Plate	*Antarctic Plate*
Australian Plate	*Eurasian Plate*
Indian Plate	*North American Plate*
Pacific Plate	*South American Plate*

- List the main pieces of evidence that led to the discovery of plate motion ("puzzle piece" shape of continents, matching fossils and rock formations on different continents, mid-ocean ridges, magnetic striping of sea floor)

Extensions

Woods Hole Oceanographic Institute articles about Marie Tharp:

An edited excerpt of "Connect the Dots: Mapping the Seafloor and Discovering the Mid-ocean Ridge" by Marie Tharp, from *Lamont-Doherty Earth Observatory of Columbia Twelve Perspectives on the First Fifty Years 1949-1999*

Marie Tharp: Pioneering Mapmaker of the Ocean Floor

Picture Books:

Ocean Speaks: How Marie Tharp Revealed the Ocean's Biggest Secret by Jess Keating

Magnetic Striping and Polar Reversals:

USGS has a page in its FAQ section with several good articles relating to magnetic field reversal.

NASA has a good article called "Flop Flop: Why Variations in Earth's Magnetic Field Aren't Causing Today's Climate Change"

Conversation starters for the dining room table:

Was the scientific community correct in their initial rejection of Wegener's theory? Why or why not?

Joke: Pangea was my favorite band. Earth just hasn't been the same since it broke up!

2. Plate Boundaries (pages 6-7)

The movement of tectonic plates is the cause of many of Earth's geologic features, including mountains, rift valleys, and ocean basins. Tectonic plates are also responsible for most volcanoes and earthquakes.

Vocabulary

Convergent boundaries	Divergent boundaries	Transform boundaries
Subduction	Continental Crust	Oceanic Crust
Rift Valley	Hotspot	

Learning Objectives

After this lesson, the student should be able to:

- Explain how movement at the three types of plate boundaries causes earthquakes, volcanoes, and mountain building
- Identify convergent boundaries, including subduction and collisions, as places where plates come together
- Identify divergent boundaries, including rifts and mid-ocean ridges, as places where plates separate
- Explain transform boundaries as places where adjacent plates shear past each other

Extensions

Conversation starters for the dining room table:

If you made a geology version of the rock, paper, scissors game, which boundary would defeat which? What hand signals would you make for convergent, divergent, and transform? Create your rules and then play a few rounds!

If you were a scientist studying Cotopaxi and Mauna Loa in Hawaii, what evidence would you look for to figure out whether these mountain were formed by a plate boundary or hotspot?

What tectonic plate do we live on?

Where is the nearest boundary? What type of boundary is it?

3. Activity: Ring of Fire (pages 8-11)

The Pacific Ring of Fire is the most geologically active zone on Earth. It contains seventy five percent of Earth's active volcanoes and ninety percent of the world's earthquakes!

Learning Objectives

After this activity, student should be able to:

- Explain why major volcanic eruptions and earthquakes are most often located near plate boundaries
- Describe how the severity of volcanic eruptions and earthquakes are measured: Volcanic Explosivity Index (VEI) and moment magnitude scale (Mw)
- Draw or locate the "Ring of Fire" on a world map
- Identify resources with additional information about the Ring of Fire, earthquakes, or volcanic eruptions.
- List tips for verifying if a resource is reliable or not (Who made it? What evidence does it use? Why was it published? Can the information be confirmed?)

Extensions

Online resources:

- The National Geographic Ring of Fire website has an interactive mapmaker tool where students can adjust layers and look at where plate boundaries, earthquakes, and volcanoes occur.
- USGS Ring of Fire page has several articles about the ring of fire and an earthquake map
- The USGS Earthquake Hazards Program has a map of latest earthquakes and a catalog where you can look up historic earthquakes
- USGS - the main page has links to the latest volcanic and earthquake notifications
- Smithsonian Institution National Museum of Natural History Global Volcanism Program Global Volcanism Program | Current Eruptions
- National Science Foundation's Seismological Facility for the Advancement of Geoscience (SAGE) has a seismic monitor page with a great visual of where recent earthquakes have occurred around the world. They also have a video series on geoscience careers, articles that explain how seismographs work, etc.

Books:

Science Comics: Volcanoes: Fire and Life by Jon Chad

Fault Lines: Understanding the Power of Earthquakes by Johanna Wagstaffe

Volcano Atlas: An Epic Journey Around the World's Most Incredible Volcanoes by Tom Jackson and Maggie Li

DK Eyewitness Volcano and Earthquake

The Great Quake: How the Biggest Earthquake in North America Changed Our Understanding of the Planet by Henry Fountain

A Crack in the Edge of the World by Simon Winchester

Conversation starters for the dining room table:

How can you tell if a source is reliable?

Why do subduction zones produce the world's largest earthquakes?

Joke: How should an excellent student of volcanology graduate? Magma cum laude.

Joke: How could you recognize the Ring of Fire when it was a toddler? It was always throwing a tantrum and making mountains out of molehills!

4. Weathering vs Tectonics (pages 12-13)

Mountains are being raised up and weathered away in a never ending battle between tectonic forces and erosion.

Vocabulary

Weathering	Erosion	Deposition
Uplift	Subduction	Tectonic forces
Mechanical weathering	Chemical weathering	Biological weathering

Learning Objectives

After this lesson, the student should be able to:

- Distinguish between tectonic forces (uplift, subduction, volcanism) and weathering/erosion processes
- Explain how tectonic forces can build and raise landforms while weathering and erosion wear them down
- Explain why famous mountain ranges such as the Himalayas and Appalachians are growing or shrinking from year to year
- Identify examples of mechanical weathering, chemical weathering, and biological weathering

Extensions

Lichens have fascinating and diverse abilities for biological weathering. Learn more about them with these resources:

British Lichen Society webpage What is a Lichen?

Smithsonian Webcast Exploring the Amazing World of Lichens with Manuela Dal Forno

Conversation starters for the dining room table:

How does the hardness of a material help you predict how it might change when exposed to the elements?

Imagine you could watch a mountain range for millions of years. What clues would help you figure out whether tectonic forces or weathering is "winning" in that location?

Joke: Geologists never get stressed. They just let things weather out.

Joke: Erosion is a crime - it's terrain robbery!

Joke: What did Sherlock Holmes say when Watson asked him what type of rock he'd found? "Sedimentary, my dear Watson!"

5. Faults and Earthquakes (pages 14-15)

When rocks experience stress, they can bend or break.

Vocabulary

Tension	Compression	Shear stress
Deformation	Strain	Stress
Brittle deformation	Ductile deformation	Elastic deformation
Normal fault	Reverse fault	Strike-slip fault
Epicenter	Focus	Seismic wave

Learning Objectives

After this lesson, the student should be able to:

- Identify the 3 major types of stresses on rocks (tension, compression, shear)
- Differentiate between brittle, ductile, and elastic deformations
- Describe the 3 major fault types and their associated movements
- Describe different seismic wave types and how they are measured

Extensions

- Javalab Seismometer demo: https://javalab.org/en/seismometer_and_inertia_en/
- Javalab P-wave and S-wave demo: https://javalab.org/en/seismic_wave_en/
- IThe Pacific Northwest Seismic Network has a good page with information on the Cascadia Subduction Zone Megathrust fault
- USGS - scroll down to "real-time data" and pull up the map for earthquakes. Use the settings to toggle on faults. Then look at your location. Click on layers and turn on faults (available for US locations) and/or plate boundaries (available for all locations). Then open settings and show earthquakes from the past 30 days. How do earthquakes relate to faults and plate boundaries? Were there any earthquakes near your area? Did you feel them? Why or why not?

Conversation starters for the dining room table:

What is the difference between an epicenter and a focus?

What clues from a fault or earthquake could help you figure out how much energy was released during the rupture?

Joke: Geologists aren't perfect - but all of their faults are stress related.

6. Activity: Shake, Rattle, Resilient (pages 16-17)

There is no such thing as "earthquake-proof" but there are many ways to make structures more earthquake-resistant.

Learning Objectives

After this activity, student should be able to:

- Plan and carry out a fair experiment by changing just one variable between iterations
- Interpret quantitative data (e.g., acceleration readings) and use that information to evaluate which design worked best to minimize shaking
- Connect the results of the cardboard box experiment to the engineering designs used to minimize damage to larger buildings

Extensions

Online resources

- Practical Engineering has a good article about Tuned Mass Dampers in Skyscrapers.
- A paper by Koji Nakahara and others titled: EARTHQUAKE RESPONSE OF ANCIENT FIVE-STORY PAGODA STRUCTURE OF HORYU-JI TEMPLE IN JAPAN
- The NSF's Seismological Facility for the Advancement of Geoscience (SAGE) has an short animation of buildings on different types of rock experiencing different types of earthquake waves. It's called Buildings & Bedrock: Effects of amplification.

Conversation starters for the dining room table:

What is the nearest active fault to where you live? Has it ever had an earthquake?

Joke: Want a ground-breaking career? Be a seismologist!

Joke: What did the house say to the earthquake? You crack me up!

7. Go with the Flow (pages 18-19)

Rivers are engines of erosion that transform the landscape.

Vocabulary

Stream	Headwaters or Source	Tributary
Oxbow Lake	River mouth	Sediment load
Delta	Alluvial fan	Point bar
Cut bank	Continental divide	Watershed

Learning Objectives

After this lesson, the student should be able to:

- Define the term watershed
- Identify the parts of a stream system (eg headwaters, tributaries, main trunk, mouth) and identify which parts are associated with sediment production, transport, and deposition
- Identify and explain how deltas and alluvial fans form from river deposition
- Explain why rivers curve by describing variations in stream velocity at different depths and locations, and how these variations contribute to the formation of a point bar and cut bank, and the exaggeration of the streams meandering over time

Extensions

- A NASA photo of the day called Meandering Mississippi is great for a discussion on state or country borders, which often use rivers. The image shows the current Mississippi River with a yellow line showing the border between Arkansas and Mississippi. What do you notice about the yellow line (which used to trace the river) and the modern river path?
- The USGS article How Streamflow is Measured has information about how scientists measure the amount of water in rivers. It's a complicated and interesting topic!

Conversation starters for the dining room table:

If you were building a home next to the meander of a river, which side would you build a home on and why?

What clues help predict where erosion will happen and where new land will form around a river?

Joke: How does a river keep cool on hot summer days? With an alluvial fan.

Joke: What do you get when you cross a stream and a river? Wet feet.

8. Permafrost and The Cryosphere (pages 20-21)

Most of the world's freshwater is frozen. Glaciers and icecaps are engines of erosion that move massive amounts of sediment.

Vocabulary

Cryosphere	Permafrost	Glacier
Crevasse	Moraine	Till
Accumulation zone	Ablation zone	Albedo effect

Learning Objectives

After this lesson, the student should be able to:

- Define the cryosphere and identify its major components including land ice, sea ice, and permafrost
- Explain how glaciers are engines of erosion and shape landforms.
- Describe two major consequences of the cryosphere shrinking.

Extensions

- Google Earth Engine Timelapse of Columbia Glacier Retreat. This timelapse shows the retreat of the glacier from 1985 to 2022.
- A virtual tour of the Permafrost Tunnel at the Permafrost Tunnel Research Facility (PTRF) near Fairbanks, Alaska. The tunnel is rarely open to the public, so in 2023 they hosted a live virtual tour and the recording is an excellent way to learn more about permafrost in general as well as the tunnel and current research.
- This VR Glaciers and Glaciated Landscapes site put together by Dr. McDougall through the University of Worcester looks promising (disclaimer - I haven't explored it myself)

BOOK RECOMMENDATION:

The Two-mile Time Machine: Ice Cores, Abrupt Climate Change, and Our Future by Richard B Alley

Conversation starters for the dining room table:

Joke: What do you call a duck stuck in a glacier? A quack in the ice

Joke: Why do glaciers avoid warm hugs? They prefer to stay ice-o-lated

9. Activity: Stream Table Study (pages 22-23)

Experience erosion firsthand by constructing a landscape and unleashing a river on it.

Learning Objectives

After this activity, student should be able to:

- Model how moving water shapes landforms using a stream table and connect their observations to real landforms such as meandering streams, deltas, alluvial flans, etc.
- Plan and conduct a scientific experiment by changing one variable and observing the impact on channel shape and sediment movement.

Extensions

Online resources:

- If building a larger stream table, there are some tutorials or instruction pages that might be helpful:
  - How to Build a Recirculating Stream Table, hosted by Texas A&M University
  - The American Geosciences Institute also has instructions for setting up and using a stream table.
- If your stream table got either too steep or too wet, you likely observed a **landslide** where a large portion of sediment moved all at once. The U.S. Landslide Inventory and Susceptibility Map by USGS has an interactive map where students can explore landslide risk by area and learn more about landslides.
- At https://landslides.nasa.gov/ students can learn more about landslides and view NASA's Daily Global Landslide Exposure Map. The map uses precipitation, soil moisture, and topography information to calculate landslide risk. In addition to the map, there is a Global Viewer where you can view real-time precipitation amounts around the globe.

Conversation starters for the dining room table:

If the river of your stream table was a real river near a town, where would you build and where would you never build—and why?

Did any of your streams remind you of a real-world river system? If yes, what type of river or stream did they resemble? A steep mountain stream? Meandering river? Braided river?

Joke: Why is it a bad idea to invite a landslide to dinner? They take things downhill fast.

10. How Old are Rocks (pages 24-25)

The techniques of stratigraphy and radiometric dating can be used to compare and find the ages of rocks.

Vocabulary

Fossil	Mineralization	Stratigraphy
Relative dating	Radiometric dating	Isotope
Superposition	Crosscutting	Parent isotope
Daughter isotope		

Learning Objectives

After this lesson, the student should be able to:

- Explain the difference between relative dating and absolute dating of rock layers
- Describe the principles of stratigraphy such as superposition and crosscutting and explain how they can be used to determine the relative age of rock layers
- Define an isotope, and how ratios of isotopes can be used in radiometric dating

Extensions

- The University of Colorado Boulder has a Phet simulation called Radioactive Dating Game which allows students to explore carbon dating and half life in more detail

Conversation starters for the dining room table:

How does the idea of half-life help scientists estimate the age of rocks or fossils?

What would make some isotopes more useful than others for dating very old or very young materials?

Joke: What did the scientist say when he found 2 isotopes of helium? Hehe

Joke: Why did the rock cross the road? -To demonstrate the principle of lateral continuity!

11. Geologic Time (pages 26-27)

The Earth has existed for billions of years. To better understand Earth's history, scientists have divided it into eons, eras, periods, and epochs. The supercontinent Pangea existed for approximately 100 million years before breaking up during the beginning of the Jurassic period.

Vocabulary

Index fossil	Supercontinent	Pangea
Stratigraphic correlation	Eon	Era
Period	Epoch	

Learning Objectives

After this lesson, the student should be able to:

- Define an index fossil and explain why they are useful for dating rock layers
- Describe stratigraphic correlation
- Recognize and name some of the eons, eras, and periods of the geologic time scale

Extensions

- The EarthViewer page from hhmi (Howard Hughes Medical Institute) has an interactive view of Earth with a slider that lets students rewind time and see the movement of continents.
- Australia's National Science Agency has an interactive chronostratigraphic chart where students can explore the geologic timescale and see it with a logarithmic or linear scale, which helps show how long some of the early periods were.
- The University of Berkeley also has an interactive geologic timescale where each eon and era has links that tell more about the fossils and life of that time.
- The Dinosaur Database has an interactive globe of ancient Earth where students can select different milestones (such as first corals, land plants, or dinosaurs) and see what Earth looked like during that period.

BOOK RECOMMENDATIONS:

- The Map that Changed the World by Simon Winchester
- The Ends of the World: Volcanic Apocalypses, Lethal Oceans, and Our Quest to Understand Earth's Past Extinctions by Peter Brannen

Conversation starters for the dining room table:

If you could use a time machine to visit a previous geologic period, which would you choose to see and why?

What does "the present is the key to the past" mean?

Why is geology perhaps the only area of study where "a few million years" is considered brief.

Joke: What do you call a pirate that digs for fossils?- An Arrrr-cheologist

12 and 13: Geology Assessment and Quiz Show (pages 29-31)

We have covered a lot of ground! Here are some ideas to review and/or celebrate material learned, as well as information on the invasive species that Math Dad dressed up as for students to defeat during the quiz show.

Ideas for Studying and Review:

- Play charades using the vocabulary terms from class
- Play the "Flyswatter Game" with geology vocabulary:

  -Write 20 of the vocabulary words on index cards and place them on a wall or table

  -Give flyswatters to each competitor

  -Read the definition of the vocabulary term. The first player to swat the word with the flyswatter gets to keep the card. The player with the most vocabulary cards at the end wins.
- Make a geology-themed poster such as:

  -An artistic representation of key terms and concepts

  -A review poster listing each lesson title and 3 facts about each lesson
- Host a family quiz show where the student writes 20 questions from the lessons and then quizzes family members

Ideas for celebrating the end of the unit:

- Make an edible treat to commemorate stratigraphy:

  -Math Dad's raspberry jello cake was an adaptation of the Raspberry Jello Cake from Natasha's Kitchen

  - The Joy-Filled Kitchen and House of Nash Eats both have recipes for layered rainbow jello

  -"Fossil dig" pudding cups (chocolate pudding with layers of buried gummy candies and/or crushed pretzles or cookies as sediment layers)
- Plan a field trip or activity to tie-in principles learned:

  -Visit the nearest Natural History Museum

  -Look up a geologic map of your area and then go on a hike or walk and see if you can find some of the rocks mentioned

Invasive Plant Information

Each boss Math Dad dresses up as during the quiz shows in this class is named for a different invasive species. To learn more about Reynoutria japonica or Japanese Knotweed, see:

- Penn State Extension's 3 minute video on how to identify knotweed.
- King County Noxious Weed Control Program has a PDF on invasive knotweeds with information on how to identify and remove the plants.
- USGS has a page with basic information as well as a map showing where knotweed has been observed in the United states and Canada.

14. Relative Humidity (pages 32-34)

At higher temperatures, water molecules have more energy and more of them will be in the air as water vapor. Relative humidity is the percent of actual water vapor in the air versus the total amount it could hold at saturation. The air temperature when air is at 100% humidity is called the dew point.

Vocabulary

Evaporation	Condensation	Precipitation
Absolute humidity	Relative humidity	Dew point
Water vapor	Saturation vapor pressure	

Learning Objectives

After this lesson, the student should be able to:

- Explain how temperature impacts evaporation and condensation.
- Define relative humidity and explain how it is different than absolute humidity
- Define the term dew point.
- Explain the basic forces that drive the formation of an afternoon thunderstorm

Extensions

- NOAA has a page with a Relative Humidity Calculator. You can input the temperature and dew point and it will calculate the relative humidity.
- The UK met office has a page called Understanding Humidity with a great 4-minute explainer video on humidity. It explains why hair can become more frizzy with humid weather and also shows how hygrometers work to measure humidity.

Conversation starters for the dining room table:

What's is relative humidity? How is it different than absolute humidity?

Have you ever seen an afternoon thunderstorm?

Joke: What do you call humidity with no sense of direction? -Mist-placed

Joke: Did you hear about the water that evaporated? -It will be mist.

15. Activity: Cloud in a Jar (page 35)

Model cloud formation with water, ice, glass jars, and matches.

Learning Objectives

After this lesson, the student should be able to:

- Explain the impact that small particles (aerosols) have on cloud formation
- Explain whether cloud formation is more likely to occur over over warm or cold water

Extensions

- Weatherstem has an interactive Cloud Formation page where students can adjust surface temperature and dewpoint to see where clouds could form. The cloud formation page is part of a longer module that walks the student through how clouds form, different types of clouds, and why only some clouds produce rain.
- NOAA has a page called How Clouds Form that talks more about cloud nuclei.
- The UK MetOffice also has a good page on clouds that covers what clouds are and how they form.
- To see truly incredible pictures of clouds and better appreciate their variety, check out the Cloud Appreciation Society's picture gallery. Their cloud of the day and cloud of the month photos are always spectacular and often contain information about how the clouds formed.

Conversation starters for the dining room table:

When did you last see thick low lying clouds? Do you remember what the weather conditions were on that day?

When did you last see a sky with no clouds or only high wispy clouds? Do you remember what the weather conditions were on that day?

What do you think it would it feel like to be inside a cloud?

Joke: Where do clouds keep their money? -In a fog bank

Joke: Why did I failed my paper on condensation? -I missed the dew date.