Norfolk Public Schools						
Science Learning in Place Plan: Earth science Lessons						
Week 4: April 6 – 10, 2020						
Monday	Tuesday	Wednesday	Thursday	Friday		
Sun-Moon-Earth Relationships: Eclipses Reading & Text Annotation: • Read "What is an Eclipse?" • Use Critical Reading Strategies to make note of the key points in the passage.	Sun-Moon-Earth Relationships: Eclipses Concept Analysis: Review the article "What is an Eclipse?" Answer the questions on the handout "What is an Eclipse? Concept Analysis"	Sun-Moon-Earth Relationships: Eclipses Reading & Text Annotation: • Read "The Moon's Two Shadows by Fred Espenak" • Use Critical Reading Strategies to make note of the key points in the passage.	Sun-Moon-Earth Relationships: Eclipses Concept Analysis: • Review the article "The Moon's Two Shadows by Fred Espenak" • Answer the questions on the handout "The Moon's Two Shadows by Fred Espenak Concept Analysis"	Sun-Moon-Earth Relationships: Eclipses Design an Experiment : Use the "Design an Experiment" image to explain to answer the question: "Why does the moon seem to change shape each night?" Write an experimental procedure.		
Week 5: April 13 – 17, 2020						
Monday	Tuesday	Wednesday	Thursday	Friday		
Spring Break						
	We	eek 6: April 20 – 24, 20	20			
Monday	Tuesday	Wednesday	Thursday	Friday		
The Atmosphere: Weather & Climate Reading & Text Annotation: • Read "What's the Difference between Weather and Climate?" • Use Critical Reading Strategies to make note of the key points in the passage.	The Atmosphere: Weather & Climate Concept Analysis: • Review the article "What's the Difference between Weather and Climate?" • Answer the questions on the handout "What's the Difference between Weather and Climate? Concept Analysis"	The Atmosphere: Weather & Convection Reading & Text Annotation: • Read "Convection is when Heat and Moisture Move Up through the Air?" • Use Critical Reading Strategies to make note of the key points in the passage.	The Atmosphere: Weather & Convection Concept Analysis: • Review the article "Convection is when Heat and Moisture Move Up through the Air?" • Answer the questions on the handout "Convection is when Heat and Moisture Move Up through the Air? Concept Analysis"	The Atmosphere: Convection Currents Concept Analysis: • Review the article "Convection Currents - Cross-Curricular focus: Earth Science" • Answer the reading comprehension questions on the handout.		



## Sun-Moon-Earth Relationships Concept Analysis

<u>Directions</u>: Answer and justify each question. Justify your answer by indicating the paragraph that supports your answer.

What is an Eclipse? Analysis Questions	Justifications
1. Why does a lunar eclipse only occur during a full moon?	1.
2. What does a solar eclipse and an annular eclipse reveal about the moon's orbit?	2.
3. When is it easiest for NASA scientists to study the sun's corona?	3.
4. Why do lunar eclipses last longer than solar eclipses?	4.
The Moon's Two Shadows by Fred Espenak Analysis Questions	Justifications
<b>The Moon's Two Shadows by Fred Espenak Analysis Questions</b> 1. Explain the concept illustrated with Visual A.	Justifications 1.
The Moon's Two Shadows by Fred Espenak Analysis Questions 1. Explain the concept illustrated with Visual A. 2. How does Visual A help to develop the main idea of the text?	Justifications 1. 2.
The Moon's Two Shadows by Fred Espenak Analysis Questions 1. Explain the concept illustrated with Visual A. 2. How does Visual A help to develop the main idea of the text? 3. How do the photographs in Visual C and D affect the explanation of the text?	Justifications 1. 2. 3.



## What is an eclipse?

By NASA, adapted by Newsela staff on 03.30.20 Word Count 874 Level 9401



This image of the moon crossing in front of the sun was captured on January 30, 2014, by NASA's Solar Dynamics Observatory observing the eclipse from its vantage point in space. NASA photo

An eclipse happens when one heavenly body such as a moon or planet passes into the shadow of another heavenly body. There are two types of eclipses on Earth: lunar eclipses and solar eclipses. The first are eclipses of the moon, while the second are eclipses of the sun.

## Lunar Eclipses

The moon orbits Earth and, at the same time, Earth orbits the sun. Sometimes Earth moves between the sun and the moon. When this happens, Earth blocks the light from the sun, which normally is reflected by the moon and which causes the moon to shine. Instead of light hitting the moon's surface, the moon is covered by Earth's shadow. This is an eclipse of the moon – a lunar eclipse. A lunar eclipse can occur only when the moon is full.

A lunar eclipse can be seen from Earth at night. There are two types of lunar eclipses: total lunar eclipses and partial lunar eclipses.

A total lunar eclipse occurs when the moon and the sun are on exact opposite sides of Earth. Although the moon is in Earth's shadow, some sunlight reaches the moon. The sunlight passes through Earth's atmosphere, which causes Earth's atmosphere to filter or block out most of the blue light. This makes the moon appear red to people on Earth, and is the reason why lunar eclipses are sometimes called blood moons.

A partial lunar eclipse happens when only a part of the moon enters Earth's shadow. In a partial eclipse, Earth's shadow appears very dark on the side of the



moon facing Earth. What people see from Earth during a partial lunar eclipse depends on how the sun, Earth and moon are lined up.

A lunar eclipse usually lasts for a few hours. At least two partial lunar eclipses happen every year, but total lunar eclipses are rare. It is safe to look directly at a lunar eclipse.

## Solar Eclipses

Sometimes when the moon orbits Earth, it moves between the sun and Earth. When this happens, the moon blocks the light of the sun from reaching Earth. This causes an eclipse of the sun, or solar eclipse. During a solar eclipse, the moon casts a shadow onto Earth.

There are three types of solar eclipses.

The first is a total solar eclipse. A total solar eclipse is only visible from a small area on Earth. The people who see the total eclipse are in the center of the moon's shadow. The sky becomes very dark, as if it were night. For a total eclipse to take place, the sun, moon and Earth must be in a direct line.

The second type of solar eclipse is a partial solar eclipse. This occurs when the sun, moon and Earth

eclipse. This occurs when the sun, moon and Earth are not exactly lined up. The sun appears to have a dark shadow on only a small part of its surface.

The third type is an annular solar eclipse. An annular eclipse happens when the moon is farthest from Earth. Because the moon is farther away from Earth, it seems smaller and does not block the entire view of the sun. The moon in front of the sun looks like a dark disk on top of a larger sun-colored disk. This creates what looks like a ring around the moon.



During a solar eclipse, the moon casts two shadows on Earth. The first shadow, called the umbra, gets smaller as it reaches Earth. It is the dark center of the moon's shadow. The second shadow,



called the penumbra, gets larger as it reaches Earth. People standing in the penumbra will see a partial eclipse, while people standing in the umbra will see a total eclipse.

Solar eclipses happen once every 18 months. Unlike lunar eclipses, solar eclipses only last for a few minutes.

## Why Does NASA Study Eclipses?

NASA is the U.S. space agency. Its full name is National Aeronautics and Space Administration. Experts and scientists at NASA observe how the moon, sun, stars and planets move, and they also study solar eclipses.

Scientists use solar eclipses as an opportunity to study the sun's corona. The corona is the sun's top layer. During an annular eclipse, NASA uses ground and space instruments to view the corona when the moon blocks the sun's glare. The sudden blocking of the sun during an eclipse reduces the light and changes the temperature on the ground. This creates conditions that can affect local weather and animal behavior.

## Viewing Safety

screen, not the sun.

It is important to never look directly at the sun - it can permanently damage your eyes!

The only safe way is through special-purpose solar filters, such as eclipse glasses or handheld solar viewers. Homemade filters or ordinary sunglasses, even very dark ones, are not safe for looking at the sun.





## The Moon's Two Shadows by Fred Espenak

### http://www.mreclipse.com/Special/SEprimer.html

An eclipse of the Sun (or solar eclipse) can *only* occur at New Moon when the Moon passes between Earth and Sun. If the Moon's shadow happens to fall upon Earth's surface at that time, we see some portion of the Sun's disk covered or 'eclipsed' by the Moon. Since New Moon occurs every 29 1/2 days, you might think that we should have a solar eclipse about once a month. Unfortunately, this doesn't happen because the Moon's orbit around Earth is tilted 5 degrees to Earth's orbit around the Sun. As a result, the Moon's shadow usually misses Earth as it passes above or below our planet at New Moon. At least twice a year, the geometry lines up just right so that some part of the Moon's shadow falls on Earth's surface and an eclipse of the Sun is seen from that region.

The Moon's shadow actually has two parts:

- o 1. Penumbra
  - The Moon's faint outer shadow.
  - Partial solar eclipses are visible from within the penumbral shadow.
- 2. Umbra
  - The Moon's dark inner shadow.
  - Total solar eclipses are visible from within the umbral shadow.

When the Moon's penumbral shadow strikes Earth, we see a partial eclipse of the Sun from that region. Partial eclipses are dangerous to look at because the un-eclipsed part of the Sun is still very bright. You must use special filters or a home-made pinhole projector to safely watch a partial eclipse of the Sun (see: <u>Observing Solar Eclipses Safely</u>).

What is the difference between a solar eclipse and a lunar eclipse? A lunar eclipse is an eclipse of the Moon rather than the Sun. It happens when the Moon passes through Earth's shadow. This is *only* possible when the Moon is in the *Full Moon* phase.



Visual A:TotalSolar Eclipses and the Path of Totality

If the Moon's inner or umbral shadow sweeps across Earth's surface, then a total eclipse of the Sun is seen. The track of the Moon's umbral shadow across Earth is called the *Path of Totality*. It is typically

10,000 miles long but only about 100 miles wide. It covers less than 1% of Earth's entire surface area. In order to see the Sun become completely eclipsed by the Moon, you must be somewhere inside the narrow path of totality.

The path of a total eclipse can cross any part of Earth. Even the North and South Poles get a total eclipse sooner or later. Just one total eclipse occurs each year or two. Since each total eclipse is only visible from a very narrow track, it is rare to see one from any single location. You'd have to wait an average of 375 years to see two total eclipses from one place. Of course, the interval between seeing two eclipses from one particular place can be shorter or longer. For instance, the last total eclipse visible from Princeton, NJ was in 1478 and the next is in 2079. That's an interval of 601 years. However, the following total eclipse from Princeton is in 2144, after a period of only 65 years.



Visual B: 2006 Total Solar Eclipse A composite image reveals subtle structure in the Sun's corona.

### Awesome Totality

The total phase of a solar eclipse is very brief. It rarely lasts more than several minutes. Nevertheless, it is considered to be one of the most awe inspiring spectacles in all of nature. The sky takes on an eerie twilight as the Sun's bright face is replaced by the black disk of the Moon. Surrounding the Moon is a beautiful gossemer halo. This is the Sun's spectacular <u>solar corona</u>, a super heated plasma two million degrees in temperature. The corona can only be seen during the few brief minutes of totality. To witness such an event is a singularly memorable experience which cannot be conveyed adequately through words or photographs.



Visual C: Annular Solar Eclipse and the Path of Annularity

## Annular Solar Eclipses

Unfortunately, not every eclipse of the Sun is a total eclipse. Sometimes, the Moon is too small to cover the entire Sun's disk. To understand why, we need to talk about the Moon's orbit around Earth. That orbit is not perfectly round but is oval or elliptical in shape. As the Moon orbits our planet, it's distance varies from about 221,000 to 252,000 miles. This 13% variation in the Moon's distance makes the Moon's apparent size in our sky vary by the same amount. When the Moon is on the near side of its orbit, the Moon appears larger than the Sun. If an eclipse occurs at that time, it will be a total eclipse. However, if an eclipse occurs while the Moon is on the far side of its orbit, the Moon appears smaller than the Sun and can't completely cover it. Looking down from space, we would see that the Moon's unbral shadow is not long enough to reach Earth. Instead, the *antumbra* shadow reaches Earth.

The track of the antumbra is called the path of annularity. If you are within this path, you will see an eclipse where a ring or *annulus* of bright sunlight surrounds the Moon at the maximum phase. Annular eclipses are also dangerous to look directly with the naked eye. You must use the same precautions needed for safely viewing a partial eclipse of the Sun (see: <u>Observing Solar Eclipses Safely</u>).

Annularity can last as long as a dozen minutes, but is more typically about half that length. Since the annular phase is so bright, the Sun's gorgeous corona remains hidden from view. But annular eclipses are still quite interesting to watch.



Visual D: 2005 Annular Solar Eclipse : This sequence shows the eclipse just before, during and after annularity.

## "Design an Experiment"

Use the image below to explain how the items shown can be used to answer the question: **"Why does the moon seem to change shape each night.** Write a procedure in the space provided.



"Why does the Moon Seem to Change Shape Each Night?" Experimental Procedure

Experimental Procedure				

## The Atmosphere Concept Analysis

<u>Directions</u>: Answer and justify each question. Justify your answer by indicating the paragraph that supports your answer.

What's the Difference between Weather and Climate? Analysis Questions	Justifications
1. What is the evidence that climate change is occurring?	1.
2. What actions should be stopped to slow climate change?	2.
3. How have human activities affected global warming?	3.
4. Why are weather forecasts increasingly important?	4.
Convection is when Heat and Moisture Move Up through the Air Analysis Questions	Justifications
1. State a common misconception about convection.	1.
2. Explain why convection is the cause of many different types of weather events.	2.
3. Explain why some surfaces warm faster than others.	3.



# What's the difference between weather and climate?

By National Geographic Society, adapted by Newsela staff on 01.29.20 Word Count 734 Level 1030L



Weather events, like this hailstorm in Marion, Kansas, are not the same as the climate of a region. Image by Roger Hill/Science Source Image by Roger Hill/Science Source

Nearly all scientists agree that climate change is real, and that it is caused by human activity.

At the same time, however, we have had some recordbreaking cold winters. In January 2019, a polar vortex plunged parts of North America into Arctic

conditions. In the weather event, the cold air and low pressure that normally surrounds the north pole moved south, causing bitter cold conditions.

Yet cold weather does not mean climate change is not happening. That's because weather and climate are two different things.

Weather Refers To Short-term Conditions



Weather refers to the short-term changes in the lower atmosphere. The lower atmosphere is an area that begins at the Earth's surface and extends up to 12 miles high. Weather includes rain, snow, temperature, humidity, wind direction, wind speed, and atmospheric pressure. It could be sunny, cloudy, rainy, foggy, cold, hot, windy, stormy or snowing.

The sun drives different types of weather by heating air in the lower atmosphere. Warm air rises and cold air rushes in to fill its place, causing wind. These winds, along with water vapor in the air, influence the formation and movement of clouds, rain or snow, and storms.

Atmospheric conditions are always changing, which is why the weather is always changing. Meteorologists analyze data from satellites, weather stations, and instruments that float in the ocean. The data help them predict weather conditions over the upcoming days or weeks. Weather forecasts are very important as they warn people of big storms that can cause flash flooding or dry winds that can whip up forest fires.

#### Climate Refers To Long-term Conditions

While weather refers to short-term changes, climate refers to conditions in the lower atmosphere that happens over longer periods of time, usually 30 years or more. This is why it is possible to have an especially cold spell even though, on average, global temperatures are rising. The cold winter is a relatively small atmospheric change within a much larger, long-term trend of warming.

Despite their differences, weather and climate are linked. As with weather, climate depends on rain or snow, wind speed and direction, humidity, and temperature. In fact, climate can be thought of as an average of weather conditions over time. More importantly, a change in climate can lead to changes in weather patterns.

Climate conditions vary in regions of the world and influence the types of plants and animals that live there.

#### Human Activity Has Accelerated Climate Change

Climate change is not a new concept. The global climate has changed many times over the course of Earth's history. However, it is changing much faster now than it has in the past, and this time human activities are to blame.

The main contributor to climate change now is the burning of fossil fuels, like coal, gas and oil. We use fossil fuels to power our cars, trucks, buses and trains. We use it to make electricity, heat our homes, and run factories. Burning fossil fuels releases large amounts of carbon dioxide into the atmosphere. Carbon dioxide is a greenhouse gas. These gases are like the glass roof in a greenhouse. They allow heat from the sun to enter the atmosphere, but stop it from escaping. The atmosphere heats up, causing global warming.

In the last 100 years, Earth's temperature has risen by 0.8 degrees Celsius (1.4 degrees Fahrenheit). Global warming is already happening. Arctic sea ice is melting. Glaciers are shrinking. Sea levels are rising. Extreme weather events – like floods, wildfires and hurricanes – are becoming more common and severe. Animals and plants are moving to cooler areas.

#### The World Tries To Address Global Warming

Scientists first discovered how greenhouse gases affect the atmosphere in the early to mid-1800s. In the late 1930s, scientists found that temperatures were already rising. But it took until the 1980s for the science to gain acceptance and for action to be taken.

In 1988, the global community came together to form the Intergovernmental Panel on Climate Change. Since then, countries have agreed to lower the amount of carbon dioxide they release to combat climate change. In 2015, 197 countries signed the Paris Agreement. It is a pledge to stop global temperatures from rising by more than 2 degrees Celsius (3.6 degrees Fahrenheit). In 2017, however, the United States, which releases the second-largest amount of greenhouse gases in the world, announced it would withdraw from the agreement.



# Convection is when heat and moisture move up through the air

By ThoughtCo.com, adapted by Newsela staff on 11.04.19 Word Count 526 Level 1020L



Image 1. Cumulus clouds are visible forms of convection, which is the vertical transport of heat and moisture in the atmosphere. Photo by: Artur R. Mazurek, EyeEm/Getty Images

You might have heard the term "convection" before. Meteorologists use it quite often to explain weather events. Convection describes how heat and moisture move upward through the atmosphere. Air tends to rise from a warmer area at the surface to a cooler area above.

The word "convection" is sometimes used interchangeably with thunderstorms. However, this is incorrect, because the formation of thunderstorms is a result of convection, meaning they are not the same thing.

Before we dive into atmospheric convection, let's look at an example you may be more familiar with -a boiling pot of water. When water boils, hot water in the bottom of the pot rises to the surface, creating bubbles and steam. When bubbles rise to the surface, they transfer heat from the hot water at the bottom of the pot to the cooler water at the top.

This example is similar to convection in the air. When you boil water, the hot water in the pot rises from the bottom to the surface. This is just like how warm air rises from the ground into the

atmosphere. The warm air cools as it reaches an area of lower pressure.

## How Atmospheric Convection Works

Let's look at a step-by-step process of atmospheric convection.

The process of convection typically begins at sunrise and continues as follows:

1. The sun's radiation first strikes the ground and heats it.

2. As the ground's temperature warms, it heats the layer of air directly above it. This process is known as conduction, which is the transfer of heat from one substance to another. Conduction happens without the movement of physical material.



3. Certain surfaces warm faster than others. Barren

surfaces like sand, rocks, soil and pavement warm quickly, while surfaces covered by water or vegetation warm slowly. Because different surfaces warm at different rates, the air at and near the surface heats unevenly, and as a result, some pockets of air warm faster than others.

4. When a pocket of air receives enough heat from the Earth's surface, it expands. The warm air becomes less dense than the cooler air that surrounds it. Then, the warm air begins to rise. These rising columns or currents of air are called "thermals." As the air rises, heat and moisture are transported upward into the atmosphere along with it.

## **Convection Can Cause Thunderstorms**

The stronger the sun heats the ground, the stronger the convection. This causes the warm air and moisture to rise higher up into the atmosphere. This is why convection is especially active on hot summer afternoons and can cause thunderstorms.

After this main process of convection is complete, a number of scenarios could happen. Each of these scenarios results in a different type of weather. Clouds, precipitation and winds can all occur as a result of convection.

You might even hear a meteorologist use the term "convective" when describing a weather event. For example, they may use the term "convective winds," because convection can lead to the formation of winds.

## **Convection Currents** Cross-Curricular Focus: Earth Science



You may not be able to see the wind, but you can see the effects of wind on the things around you. You can feel it blowing across your face on a chilly day. You can see the leaves blowing down the street and see the sail on the sailboat puff up when the wind catches it. So why does the air move? The simple answer is that the sun heats Earth unevenly, causing different amounts of air pressure in different areas.

The simple explanation does not really give you much of an idea about what causes the wind to blow. You have to look a little deeper. **Convection currents** are loops of moving air or water that transfer energy from one location to another. When convection currents occur in the air, they cause wind.

Local winds, like mountain breezes and valley breezes, stay in a fairly small area. Mountains absorb more heat during the day than the valleys do, so warm air rises off the mountainside. The cooler air from the valley rushes in to take its place. During the night, the mountains cool faster than the valleys, so the whole process happens in reverse. A cool breeze blows down from the mountains.

In areas that are near the ocean, sea breezes blow from the water toward the land during the day and from the land to the water at night. During the day, the land heats faster than the ocean. When the warm air rises over the land, cool air rushes in from the ocean to take its place. Once the water finally warms up, it holds onto the warmth longer than the land. When the warm air rises off of the ocean, the cooler air from the land rushes out to take its place over the ocean.

Global winds cover larger areas. Uneven heating of certain parts of the planet results in planetary winds. These are long-lasting wind patterns that circle the globe in predictable patterns. They curve to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. Fast-moving currents called jet streams blow up to 149 miles per hour in the atmosphere surrounding Earth.

All of these wind patterns influence the weather. Winds blow clouds from one area to another, and clouds carry precipitation. Understanding the patterns of the wind can help you know what kind of weather to expect. Name:

Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.

1) What is the simple explanation for why air moves?

2) What are convection currents?

3) How do convection currents influence the weather?

4) How does wind occur near mountains in the daytime?

5) What is the difference between local winds and global winds?