

Lesson: Concerning Climate- Weather Matters

*Arlington Echo works to continuously improve our lessons. This lesson may be modified over the course of the school year.



Environmental Literacy Question: How have humans affected the Chesapeake Bay and its watershed?

Topic/Essential Question: How is the earth's climate changing?

Unit/Lesson Sequence: This lesson is one of two lessons in the "Concerning Climate" 4th grade module based at Arlington Echo Outdoor Education center.

Content Standards:

Environmental Literacy

- 3.B.1.d Explain and diagram how greenhouse gases increase thermal energy in the atmosphere and its effect on earth's temperature and systems.
- 5.A.1. Analyze the effects on human activities on earth's natural processes.
- 1.A.5.f. Make recommendations supported by data to help address or resolve the issue.
- 8.F.1.b. Identify actions that can be taken as individuals and those that require the involvement of other people, organizations and government.

Science

- 2.E.2 Recognize and describe that each season has different weather conditions
- 2.E.2.a Describe different seasonal weather conditions using data collected from weather instruments, models or drawings.
- 6.4.B.1. Recognize and describe that people in Maryland depend on, change, and are affected by the environment.

Social Studies

- 3.D.1.b Geography. Describe ways and reasons people in Maryland depend on, change, and are effected by the environment.

Common Core

- CCSS.ELA-Literacy.RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graph) to contribute to an understanding of the text in which it appears.

Length of Lesson: 35 minutes

Student Outcome: Students will demonstrate an understanding of factors that determine the weather conditions. Students will collect measurements of current conditions and interpret the data. Students will be able to make connections between weather patterns and changes in the climate.

Knowledge of the Learner:

- Students' needs, interests, and previous learning will be determined during the pre-assessment.
- Differentiated: This lesson will appeal to different types of learners. Kinesthetic learners should do well with the physical act of taking measurements. Interpersonal learners will benefit from the team dynamic required to work together.

Knowledge of Content:

- Prerequisite knowledge, skills, and processes: Students must have a basic understanding of weather aspects.

- **Vocabulary:**

temperature	wind speed	wind direction
thermometer	anemometer	precipitation
Fahrenheit Celsius	wind vane	forecast

- **Resources:**

thermometers	TV monitor	Broadcast props:
rain gauge	Laptop	Winter Coat
anemometer	smartboard	Raincoat
wind vane	easel	Sunglasses
dry erase markers	clipboard	
Rags		

- **Supplements:**
 - A: Climate Change and Weather Information
 - B: Climate vs. Weather Chart
 - C: Carbon Emissions from Fossil Fuel Burning Graph
 - D: Weather Instruments Review
 - E: Weather Data Collection Sheet
 - F: Broadcasting scenario cards
 - G: Smart Board Instructions and Tips

Instructional Delivery

Lesson Setup:

Materials will be kept in the Sensory Room in Field hall. Arlington Echo staff will help set up the materials during your morning training session. Take the weather instruments outside to the picnic tables and set up the different weather stations. Place the thermometers for the temperature station on the bench just outside Field Hall. The precipitation and wind direction measurements can all be taken at the weather vane station. Set up the weather vs. climate poster on an easel at the picnic tables by Patapsco Cabin. For more information about climate change and weather before the start of the activity, refer to **(Supplement A)**.

Module Introduction: Before the lessons in the Concerning Climate module begin, students will play a game that demonstrates the effects of carbon dioxide in the atmosphere led by Arlington Echo staff.

Pre-Assessment:

Motivation/warm up:

1. Welcome students and let them know that they will be acting as meteorologists, collecting information on today's weather readings, but first, the students must identify how weather and climate differ, and how they connect.
2. Ask students if they know what weather and climate are, and why we care about both.
Weather: *A specific event or conditions that happen over a period of hours or days such as sunny today, rain tomorrow. We care about weather because it affects our day-to-day lives. Sun, rain, snow, temperature etc. will affect what we wear, where we go and how we will get there each day.*
Climate: *The average weather conditions in a place over a long period of time, usually measured in 30 year increments. (World Meteorological Organization www.wmo.int)*
We care about climate because the overall status of the climate, such as average annual air temperatures, affects the daily weather.

An easy way to remember the difference between weather and climate is to think about your clothes. Climate determines the type of clothes in your closet while weather determines the clothes you wear day-to-day.

3. Pass out the weather and climate cards randomly to students and have them take turns deciding which category their card goes into on the poster **(Supplement B)**.
4. Once the cards have been sorted correctly into two groups, let students know that climate change can affect our day-to-day weather.
 - *The climate changes naturally over time, cycling between warm and cool periods. However, human activities have increased carbon dioxide emissions, causing the climate to change at an accelerated and amplified rate. Today, the amount of CO₂ in the atmosphere is higher than it has been at any time in the last 800,000 years. This is mainly a result of human activities, beginning with the Industrial Revolution, that burn fossil fuels (nasa.gov). **(Supplement C)**. Can you think of examples of human activities that cause CO₂ emissions?*
 - Driving cars, flying planes, using electricity, producing goods, deforestation*All of that extra CO₂ in the atmosphere traps heat, warming the planet. This can cause changes in weather patterns like increased thunderstorms. Can you think of any other examples of extreme weather?*
 - Higher daily temperatures, more droughts, unpredictable snow events, more intense storms, heat waves.
5. Ask the students “How do you think scientists learn about climate?” Climate is many weather events over time, so scientists study weather each day to understand the changes of climate. Arlington Echo needs your help to collect this information to see if the weather today is being affected by the changing climate. Today, the students will be meteorologists collecting data on the weather by using various scientific instruments and creating and weather report!

Procedures:

1. Review the weather instruments the students will be using to make a weather forecast **(Supplement D)**
2. Divide the students into groups of 2-3. Hand out data collection sheets, clipboards and markers to each group.
3. Take the groups to the field to take measurements. The students should work in their small groups to complete all weather stations in any order and record their finding on the weather data sheet. When needed, help the students use the measurement tools.
 - a. **Temperature Station:** Record the air temperature in Fahrenheit using thermometers.
 - b. **Wind Speed Station:** Record wind speed in mph using the anemometer and a stop watch.
 - c. **Wind Direction:** Using the weather vane above the rain gauge, students can determine which direction the wind is blowing (N, S, E, W, or a combination).
 - d. **Precipitation Station:** Students should note if there has been any precipitation today. If so, record the type of precipitation (rain, ice, snow, etc.) and use the rain gauge to measure how much, in inches
4. Take the group inside to the Sensory Room and divide the students into groups of 3 or 4.
5. Assign each group a different scenario for their broadcasting report and give them a scenario card **(Supplement F)**. Have students fill out the corresponding teleprompter poster. One group will report today’s weather and the other groups will report the future weather conditions.
6. Use the camera and the smart board (instructions in **Supplement G**) for the students to give their broadcast report in their small groups. Have the students use the props to act as newscasters.
7. Collect clipboards and markers for the next group rotation. Make sure the data sheets and posters are wiped clean.

Assessment:

Finish the lesson by having the students answer the question: “How can climate change affect the weather?” Students should share their ideas with the group.

Notes for inclement weather:

Since this activity is all about measuring weather, the students need to get outside whenever possible to take measurements and make observations. If Arlington Echo has found it to be unsafe then some activities may take place inside of Field Hall in the Sensory Room.

Notes for Clean up:

Please clean, organize and return the lesson materials to their proper locations at the end of each day of instruction. Remember to inform the Arlington Echo staff if you need assistance or if any materials are damaged or missing.

Supplement A – Background Information

Climate Change and Weather

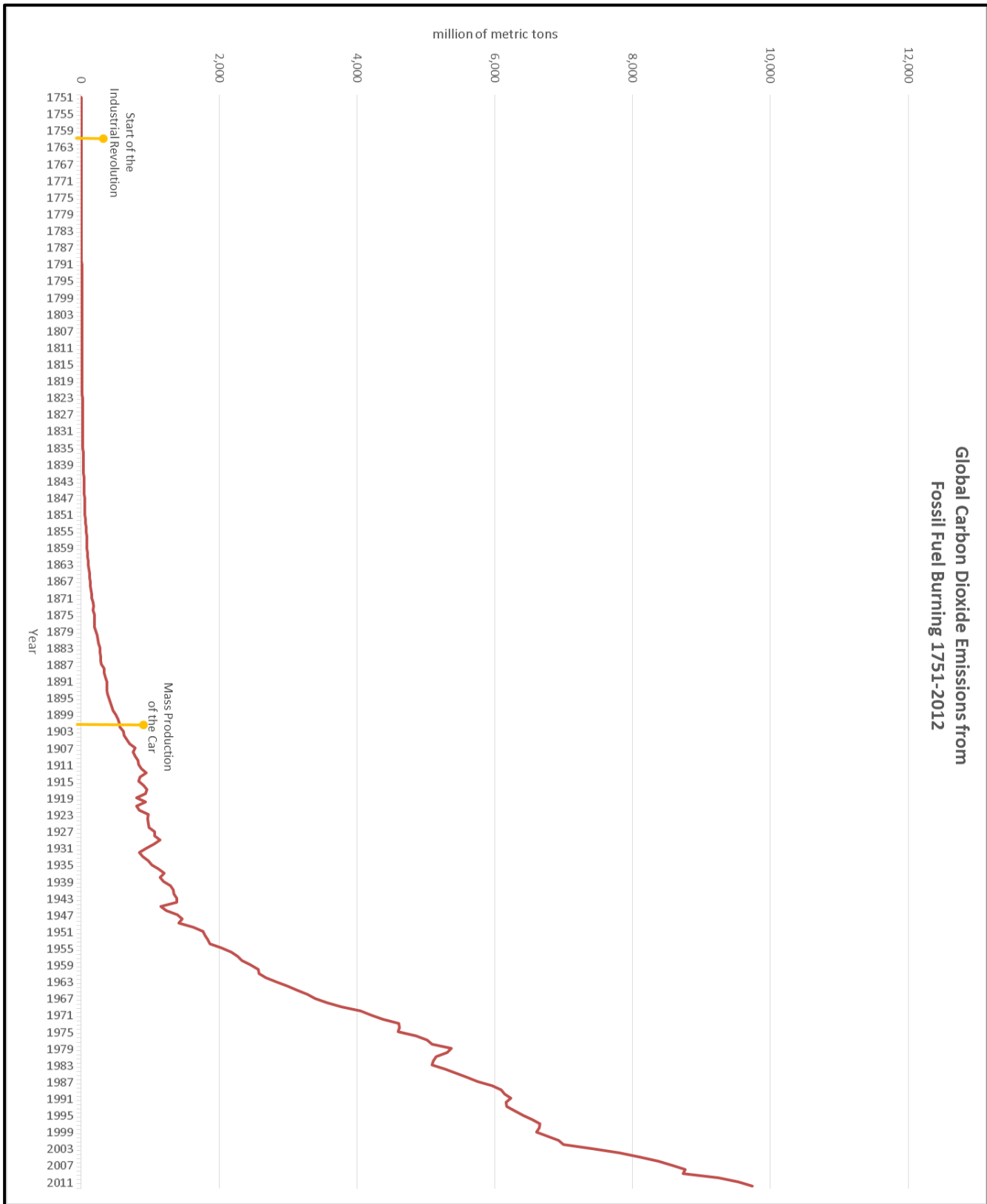
- 1. How are climate change and weather connected?** Climate describes the normal conditions in a given area during different parts of the year, such as seasons and average temperature. When a change occurs in climate, it can affect the average for the area. For example, a global average temperature rise as little as 1°F can lead to severe weather events like storms or droughts because heat is a driving force in weather patterns. The following (and more) information can be found at The National Wildlife Federation (www.nwf.org) and the Environmental Protection Agency (www.epa.gov).
- 2. What are Greenhouse Gases?** Greenhouse gases, including carbon dioxide (CO₂), trap heat in the Earth's atmosphere and warm the planet. In general, this is a good thing. Without greenhouse gases, it would be too cold to support life, like on Mars. However, with too many, it can get too hot to support life. Earth is sometimes called the Goldilocks Planet because it is "just right."
- 3. Why is the climate changing?** We know a lot about what the Earth's climate was like thousands or millions of years ago because of clues that remain in rocks, ice, trees, corals, and fossils. These clues tell us that the Earth's climate has changed many times before. The pre-industrial revolution concentration of CO₂ in the atmosphere was 280 parts per million (ppm). As of January 2017, it has reached 405 ppm (<http://climate.nasa.gov/vital-signs/carbon-dioxide/>). This amount of CO₂ is higher than it has been at any time in the last 650,000 years, and the global average temperature is increasing faster than ever before.
- 4. How is climate change affecting our water?** The average sea level is rising and is expected to rise seven to twenty three inches before the end of this century. Out of the Earth's 1,100 glaciers, all but 100 of them are receding (more ice melts in the summer than what re-forms the following winter).
 - Sea level rise poses risks for cities near the ocean, including loss of homes and businesses.
 - Wetlands protect the shore from flooding, and they also provide important habitats for many types of plants and animals. As sea level rises, salt water could flood parts of the wetlands, leaving animals such as birds, frogs, turtles, and dragonflies with fewer habitats.
 - Coral reefs are created in shallow tropical waters by millions of tiny animals called coral polyps. Each coral makes a skeleton for itself, which build up to create coral reefs. Warmer water has already caused damage to corals in many parts of the world and by 2050, live corals could become rare. This will disrupt the oceanic food web and reduce habitat for other living organisms in the water.
- 5. How is climate change affecting our land?** As the Earth gets warmer, plants and animals that need to live in cold places, such as polar bears in the arctic, might not have a suitable place to live. If the Earth keeps getting warmer, up to one fourth of all the plants and animals on Earth could become extinct within 100 years. Every plant and animal plays a role in the ecosystem; losing one species can affect many others.
 - Climate change could make it too hot to grow certain crops, and droughts caused by a warmer climate could reduce the amount of water available for irrigation. Climate change is also likely to cause stronger storms and more floods, which can damage crops. If the global temperature rises an additional 3.6°F, U.S. corn production is expected to decrease by 10 to 30 percent.

Source: The national Wildlife Federation (www.nwf.org) and the Environmental Protection Agency (www.epa.gov)

Supplement B – Weather vs. Climate chart

Weather	Climate
<ul style="list-style-type: none">• Sunny• Rain• Tornado• Thunderstorm• Snowstorm• Cloudy• Windy• Hurricane• Today's Temperature• Flood	<ul style="list-style-type: none">• Tundra• Tropical• Artic• Arid, Dry, Desert• Temperate• Glacial Period• Interglacial Period• Average Temperature

Supplement C – Global Carbon Emissions from Fossil Fuels Graph



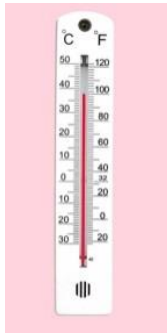
Source: Earth Policy Institute (www.earthpolicy.org)

Supplement D – Weather Instruments Review

Weather Background Information

Weather is defined as the conditions of the atmosphere in terms of heat, wind, pressure, and moisture. A description of the weather will usually include an aspect of at least three of these four elements. Weather is a measure of these conditions over a short time period (day or two) whereas climate is a trend or average of conditions over years.

Heat



Tool: Air Thermometer

Unit: In the U.S., we measure in degrees Fahrenheit. (°F)

Directions: There are two units of measurement on the thermometer, Celsius and Fahrenheit. We will be measuring in Fahrenheit. To take the temperature, look at where the top of the red line is and read the corresponding number in degrees Fahrenheit. Numbers go by units of ten, and each smaller line represents 2 degrees.

Description: When temperature changes in different parts of the atmosphere, so does weather. The sun is the heat source for Earth and can be absorbed by surfaces (such as soil, water, or pavement) and by the atmosphere. The more dense the atmosphere is, the more heat that can disperse into the air. As you rise in altitude, the atmosphere thins, dropping the temperature.

Wind chill is also an indication of the temperature brought about by wind speed. Higher winds make us lose heat quickly.



Liquid and Solid – Precipitation

Tool: Rain Gauge

Unit: Inches

Directions: Hold the rain gauge at eye level. Each line is worth a half an inch, with each whole inch marked on the rain gauge. Locate where the top of the water sits and read the line. For example, if the top of the water line sits at the line between one and two, there was one and a half inches of precipitation.

Description: Precipitation such as rain, snow, sleet, and hail can only occur if clouds are in the sky. However, not all clouds produce precipitation. Temperature and the presence of tiny particles or ice crystals determine whether precipitation will occur and which form it will take. Rain is formed when water molecules in the clouds collide and form bigger, heavier droplets. When the droplets become heavy enough, they fall as rain. Snow is formed as water condenses on small crystals of ice, which grow into snowflakes.

Wind



Wind Speed

Tool: Anemometer (wind speed)

Unit: Miles per hour (mph)

Directions: Have one student keep time and another count (if in groups of three, have the third student measure the wind direction). The student keeping time will set the timer for one minute. When the timer is started, the student counting will keep track of how many times the red cup spins past them. The student will stop counting rotations after one minute. Every ten rotations per minute are equal to one mile per hour. For example, if the red cup passes the counter 60 times in one minute, the wind speed is 6 miles per hour.



Wind Direction

Tool: Wind Vane


Unit: Cardinal directions – North, South, East, West

Directions: There are four posts on the wind vane, each designating a direction. The top part of the vane will be moved by wind and indicates wind direction. To find the direction, look at which directional post the pointing side of the vane lines up with. If it lines up between two posts, combine the directions for a more specific wind reading (either NW, NE, SW, SE).

Description: The force of wind is created by differences in air pressure, friction, and rotation of the earth. If there were no wind, weather would remain the same. Finding wind direction can help determine the weather forecast.



Supplement E – Data Collection Sheet

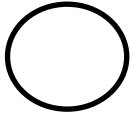
Arlington Echo

 Millersville, MD

_____ ° **F**

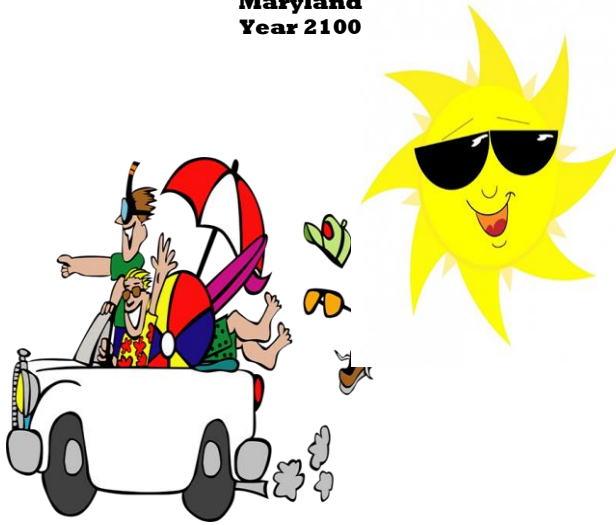
Current conditions:

<p> Precipitation</p> <p>_____ in.</p>	<p>Wind</p> <p>_____ mph</p> <p style="text-align: center;"></p>
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Supplement F: Broadcast scenarios

**Maryland
Year 2100**



**Maryland
Year 2100**

You are broadcasting live from the future! Maryland's weather has changed since 2017 and the number of warm summer days has doubled! Instead of flying to Florida's beaches, people are spending their vacations in Ocean City! We have noticed a few more of those crazy summer thunderstorms too!

Your viewers want to know what the weather will be like in the future. Explain to your viewers how Maryland's temperature have changed.

**Alaska
Year 2100**



**Alaska
Year 2100**

You are broadcasting live from the only arctic region in the United States. Alaska has experienced a drastic increase in temperatures since 2017. The loss of glaciers and sea ice here have caused sea levels to rise!

Your viewers want to know what the weather will be like in the future. Explain how climate change affects glaciers and sea ice.

**Florida
Year 2100**



**Florida
Year
2100**

You are broadcasting live from the future. Florida is noticing the effects of climate change. Hurricanes have become much stronger than they were in 2017!

Your viewers want to know what the weather will be like in the future! Explain how climate change will affected storms.

**Louisiana
Year 2100**



**Louisiana
Year 2100**

You are broadcasting live from the future! Louisiana has lost many of their wetland habitats that used to protect them from flooding. Some of their highways are underwater! People may have to use boats instead of cars! **Your viewers want to know how weather will affect humans in the future. Explain how we may adapt to these changes.**

Supplement F (continued)

Arizona Year 2100



Arizona Year 2100

You are broadcasting live from the future!
Arizona has been experiencing long periods of drought. It's been a while since we've had rain! This is one reason why we have experienced more wildfires.

Your viewers want to know what the weather will be like in the future. Explain how climate change affects the weather in dry climates.


Supplement G – Smart Board Instructions and Tips

Using the Smart Board and Camera

Arlington Echo staff will set up the computer each day for use but in case an Echo staff member is not available here is a set of directions that could be helpful to using the technology.

1. Turn on computer.
2. Using the gray SmartBoard remote, turn on the SmartBoard. The power button is in the top corner of the remote.



3. Log onto the computer with the provided username and password. It will be sitting on or by the computer.
4. Once logged on, click the Google Chrome symbol  at the bottom of your computer screen and the home page will open up.
5. Click the upper tab that says Arlington Echo-Weather Bug for weather data.



6. This will bring you right to the site you need.

To switch to the Document Camera:

7. On the document camera push the power button to turn on the machine. The silver power button is located on the side. It is already facing the direction it needs to be for the assignment.
8. Once it is on, hit the button on the top that says **PC/Camera**. It will switch the Smart Board from the computer screen to the “Weather Forecast Screen”.

Please turn off the Smart Board in between module rotations to save the light bulb! Thank you 😊