

## Lesson Two: Climate Change in the Great Lakes

### *How Does Climate Change Affect the Great Lakes Region?*

#### **Lesson Overview:**

This lesson focuses on the difference between weather and climate, how climate change occurs, and the unique impact that climate change has on the Great Lakes region. Students will distinguish between weather and climate through sorting cards, learn about the effects of climate change in the Great Lakes region, and complete a cause and effect chart with climate factors and impacts.

#### **Focus Questions:**

Students answer these essential questions:

- What is the difference between weather and climate?
- What are the effects of climate change on the Great Lakes region?
- How do climate factors impact Great Lakes coastal wetlands?

#### **Next Generation Science Standards:**

**Stability and Change:** Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)

**ESS3.D: Global Climate Change:** Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)

**ESS3.C: Human Impacts on Earth Systems:** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)

#### **Materials:**

- Tip of the Mitt Watershed Council, *Climate Change Adaptations for Coastal Wetlands: A Toolkit of Best Management Practices for Coastal Wetlands in Michigan*
- Weather or Climate? Matching Activity - Scissors and tape or glue, per team
- Climate Factor and Impact Chart Worksheet
- Internet access – Additional research

**Time:** 1-2 class periods

**Objectives:**

*Students will be able to:*

1. Identify the difference between weather and climate.
2. Understand how climate change affects the Great Lakes region.
3. Identify the impacts to coastal wetlands from environmental factors due to climate change.

**Advance Preparation:**

1. Make copies of Weather or Climate? Matching Activity and Climate Factor and Impact Chart. One copy each per pair of students. Scissors and tape or glue are needed, per pair.
2. Have *Climate Change Adaptations for Coastal Wetlands: A Toolkit of Best Management Practices for Coastal Wetlands in Michigan* available digitally or printed copies for pairs of students. This document is critical for the mini-unit and it is recommended that copies be produced for use with all lessons.
3. Selected pairs/groups for matching activity and completing chart.
4. Listed websites for students to visit for background.

**Common Misconceptions:**

Students understand the difference between weather and climate, but a common misconception occurs when we apply their understanding to climate change. This occurs when seemingly contradictory events: water is evaporating and water is declining in some parts of the world, while at the same time polar melting is occurring, creating an increase in sea levels. Climate change data is collected over decades and projected in computer models, another confusing concept for students.

**Background Information:**

How can there be global warming if it is snowing outside in April when it should be 50 to 60 degrees Fahrenheit? This is a very common question, and the answer lies in the difference between weather and climate.

**Weather** is highly variable and is made up of specific atmospheric conditions including temperature, rainfall, wind, and humidity. It occurs at any given place and time. Weather occurs over a short term (today, tomorrow, last week, etc.).

**Climate** (according to the National Weather Service's definition) is the average of weather over at least a 30 year period. Climate is much less variable; it is the typical weather for any given area, averaged out over many years. General weather conditions such as temperature, precipitation, humidity, air pressure, sunshine, cloudiness, and wind are averaged out over many decades to characterize climate.

**Climate** (according to the American Meteorological Society's definition) is "the slowly varying aspects of the atmosphere–hydrosphere–land surface system." More specifically, climate is frequently defined to be the average of weather over at least a 30 year period. Climate is much less variable; it is the typical weather for any given area, averaged out over many years. General weather conditions such as temperature, precipitation, humidity, air pressure, sunshine, cloudiness, and wind are averaged out over many decades to characterize climate.

A climograph is a way to represent the three most important elements of climate: average temperature, average precipitation, and seasonality. Typically, when climatologists talk about the mean temperature, they are referring to the average of the maximum and minimum temperatures.

The monthly temperature and precipitation for each year is averaged and represented in the climograph. Climographs usually represent data that occurred in a period of time, usually 30 years.

There are many different terms associated with climate, including global warming, climate change, and global change, but these terms cannot be used interchangeably. Climate is commonly defined as the average weather for a specific location, region, or the entire globe over an extended period of time (decades).

Atmospheric scientists investigating the possibility that human influences are changing the Earth's climate confront a significant problem: how do we actually detect climate change? We know that weather can be highly variable, but climate, which is based on longer time scales, can be variable as well. If the last 30 years were generally warmer worldwide than the previous 30 years, would this be solid evidence that the climate is changing in a particular direction? Or could this only be a long-term, normal statistical fluctuation in climate? This is a critical and surprisingly difficult question for atmospheric scientists to answer. While computer models may predict climate change, citizens are unlikely to support significant social, economic, and/or technological changes to slow the rate of change unless they are sure that the climate is truly changing, not just experiencing random variability.

It is important to understand what constitutes normal climate variability versus actual climate change. **Climate variability** is the way climatic variables (such as temperature and precipitation) depart from some average state, either above or below the average value. **Climate change** can be defined as a trend in one or more climatic variables characterized by a fairly smooth continuous increase or decrease of the average value during the period of record. As we look at 30-year average values, however, we also detect variability.

The term **global warming** refers to a sustained increase in global average surface temperature and the lowest layer of the atmosphere and is just one aspect of climate change. Global warming does not imply that the world will warm uniformly. In fact, as with

any average, there will be places that warm more or less than the average. Some areas may even cool.

**Climate change** refers to a long-term shift in climate measured as a change in some or all of the features associated with weather, such as temperature, wind, precipitation. It is a long-term continuous change to the average weather (e.g., warming or cooling as indicated by the average temperature) as well as changes to the range of various weather conditions (e.g., high and low temperatures) and extreme events (e.g., frequency of tornadoes). Climate change can result from either natural or anthropogenic (human-influenced) causes. For example, natural factors affecting climate include changes in the Sun's energy or slow changes in the Earth's orbit around the Sun. Human activities that change the atmosphere's make-up (e.g. burning fossil fuels) and the land surface (e.g. cutting down forests, planting trees, etc.) also affect the climate.

**Global change** is the broadest term and it encompasses more than just climate change. According to the U.S. Global Change Research Act of 1990, global change is defined as: "changes in the global environment (including alterations in climate, land productivity, oceans or other water resources, atmospheric chemistry, and ecological systems) that may alter the capacity of the Earth to sustain life."

Additional background can be found in extensions and resources below.

### Procedure:

1. Ask students to think about the difference between weather and climate. Create a simple two-column chart on white board and have students come up with examples of each.
2. Hand out Weather or Climate? Matching Activity to pairs of students. Scissors and tape or glue will be needed for completing the activity.
3. Working in pairs, students complete the matching activity. Share and compare choices.
  - Students cut out Weather or Climate Cards.
  - Students place Weather or Climate Cards in the corresponding column on the Weather or Climate? Worksheet.
4. Use chart on white board to review accurate answers.
5. Teams read pgs. 3-5 in *Climate Change Adaptations for Coastal Wetlands: A Toolkit of Best Management Practices for Coastal Wetlands in Michigan* and discuss as a class each "arrow" on page 4 that represents observable changes over the last century. This should be an open-ended discussion, focused on data recorded.
6. Read aloud to class: Page 5 Climate Change Impacts to Wetlands.
7. Hand out Climate Factor and Impact Chart per team. Students use the chart on page 6 to complete the chart. This chart will be used in Lesson 3.
8. Discuss the following questions as a class:
  - What climate factor do you think has the most impact?
  - What impact would climate factors have on plants and animals in coastal wetlands? (Refer to Lesson 1- Coastal Wetland Habitats)

- What impacts might affect how humans enjoy and use these coastal wetlands?
- Why is it important to understand how climate change affects Great Lakes coastal wetlands?

**Extensions:**

These additional lessons address climate change in the Great Lakes in depth.

1. Great Lakes Climate Change Curriculum: How will Climate Change Affect a Great Lakes State? (Background and Teacher Guide)
2. Great Lakes Climate Change Curriculum: Water Levels on the Great Lakes [http://changingclimate.osu.edu/assets/docs/2013edu\\_CurriculaWaterLevelsV3.pdf](http://changingclimate.osu.edu/assets/docs/2013edu_CurriculaWaterLevelsV3.pdf)

**Additional Resources:**

Union of Concerned Scientists: Climate Hot Map – Global Warming Effects Around the World

<http://www.climatehotmap.org/>

Great Lakes Climate Change Curriculum: How Will Climate Change Affect A Great Lake State?

[http://changingclimate.osu.edu/assets/docs/2012edu\\_CurriculaGoogleV3.pdf](http://changingclimate.osu.edu/assets/docs/2012edu_CurriculaGoogleV3.pdf)

EPA: A Student's Guide to Global Climate

Change <https://www3.epa.gov/climatechange/kids/index.html>

National Oceanic and Atmospheric Administration (NOAA) – Great Lakes Environmental Research Laboratory: Great Lakes Maximum Ice Cover on the Great

Lakes <https://www.glerl.noaa.gov//data/ice/historicalAnim/>

Great Lakes Literacy Resources

<http://greatlakesliteracy.net/resources/3/>

**Adapted From:**

Michigan Environmental Education Curriculum Support (MEECS): Understanding Climate Change

## Weather or Climate Cards

The sun rose at 7:36 am	Today the sky is sunny
It has only rained twice this month	Michigan winters are cold and snowy
On average there is less than 3 inches of rainfall in April in Michigan	For the winter of 2010-2011, Muskegon received 103.1 inches of snow
The average yearly snowfall over the past 96 years for Lansing, MI has been 48.8 inches.	In the last 100 years, there has not been a hundred degree day in April in Michigan
Over the course of the day, the barometric pressure dropped	It is 50 degrees outside now
There is a tornado watch	I will have to wear a coat to stay warm today
Over the past fifty years, the average temperature has never been above 34 degrees in February in Michigan	Michigan summers are always warmer than Michigan winters
It snowed 12 inches last weekend	Friday it's predicted to rain

### Weather or Climate? Matching Activity

<b>Weather</b>	<b>Climate</b>

## Climate Factor and Impact Chart

What Climate Factors are Causing Impacts in the Great Lakes Region?

Use page 6 of *Climate Change Adaptation for Coastal Wetlands: A Toolkit of Best Management Practices for Coastal Wetlands in Michigan* to complete chart.

Great Lakes Region IMPACTS	Climate FACTORS
Frequency of heavy rainfall events increasing year-round	
Variable by lake; Lake Michigan likely to become ice free soonest	
Lake Superior warming fastest; warmer water holds less oxygen for fish and other animals	
Summer warming faster than winters	
Decrease likely, but increase also plausible; lake level variability to continue regardless	
Increase in lake effect snow, likely decrease in snowfall otherwise	
Up overall, but variable by season	
Heat waves are likely to be more frequent, longer lasting and more severe	
Average wind speeds declining, but may have more high intensity wind events	
Increase larger in summer; loss of winter lake ice will increase evaporation off lakes	
Up overall, but variable by season: Fall and winter much rainier, summers drier	
Likely to increase by 3-6 weeks by the end of the century	