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# K-12 Partnership Lesson Plan

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# *The climate is changing…*

# *But will it change me?*

## Overview

This lesson takes a look at some of the ways that climate change may directly affect the life of a Michigander. It includes several opportunities for discussion about student’s observations and their connection to data. Using an internet-based weather forecasting tool for Michigan, students will complete an activity that allows them to visualize how several climatic changes will affect their lives.

**Objectives**

At the conclusion of the lesson, students will be able to:

* Describe three different climatic changes that scientists are predicting for Michigan
* Provide examples of how those changes will affect their and their families day-to-day lives
* Draw conclusions based on maps and simplified data
* (For more advanced students) Use internet tools and data to make predictions about additional climate scenarios

**Length of Lesson**

30-45 minutes

**Grade Levels**

Primarily intended for middle school or high school, but the lesson could be adapted for lower or higher levels.

**Standards covered (NGSS)**

Disciplinary Core Ideas:

 *Middle School*

* **MS-ESS3-5**: ask question to clarify evidence of the factors that have caused the rise in global temperatures over the past century
* **MS-ESS3-4**: construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems

*High School*

* **HS-ESS3-5:** Analyze geosciences data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

Cross Cutting Concepts:

* Patterns
* Stability and change of systems

Science and Engineering Practices

* Asking questions and defining problems
* Developing and using models
* Analyzing and interpreting data

***Previous Michigan Standards Met:***

* **S.IP.E.1**: inquiry involves generating questions, conducting investigations, and developing solutions to problems through reasoning and observation.
* **S.IA.E.1:** inquiry includes an analysis and presentation of findings that lead to future questions, research, and investigations.
* **S.RS.E.1:** reflecting on knowledge is the application of scientific knowledge to new and different situations. Reflecting on knowledge requires careful analysis of evidence that guides decision making and the application of science throughout history and within society.
* **L.EC.M.4:** environmental impact of organisms- All organisms (including humans) cause change in the environment where they live. Some of the changes are harmful to the organism or other organisms, whereas others are helpful.
* **E.ES.E.2:** weather- weather changes from day to day and over the seasons.
* **E.ES.E.3:** weather measurement- scientists use tools for observing, recording, and predicting weather changes.
* **E.ES.M.4:** human consequences- human activities have changed the land, oceans, and atmosphere of the Earth resulting in the reduction of the number and variety of wild plants and animals, sometimes causing extinction of species.
* **E.ES.M.6:** seasons- seasons result from annual variations in the intensity of sunlight and length of day due to the tilt of the axis of the Earth relative to the plane of its yearly orbit around the sun.
* **E.ES.M.7:** weather and climate- global patterns of atmospheric and oceanic movement influence weather and climate.
* **E.ST.M.4:** geologic time- earth processes seen today (erosion, mountain building, and glacier movement) make possible the measurement of geologic time through methods such as observing rock sequences and using fossils to correlate the sequences at various locations.
* **E1.1:** scientific inquiry
* **E1.2:** scientific reflection and social implications
* **E2.1B:** analyze the interactions between the major systems (geosphere, atmosphere, hydrosphere, biosphere) that make up the Earth.
* **E2.1C:** explain, using specific examples, how a change in one system affects other Earth systems.
* **E2.2D:** identify the main sources of energy to the climate system.
* **E5.4:** climate change

**Materials**

* State map climate change activity pages
* Internet resources handout (both available on “The Climate is Changing…” lesson page on the KBS GK-12 website)

**Background**

The climate is definitely changing, and the scientific community is in agreement on that (IPCC 2007). Global temperatures will increases 4°F to 7°F by 2100. Precipitation will increase in some places, and decrease in others. Sea levels will rise. Extreme weather events will be more frequent. The effects on humans are predicted to be most harsh in equatorial, coastal, and undeveloped parts of the world. Does that mean Michigan will be okay?

Changes in weather will not be the same everywhere, so how will Michigan change? In general, Michigan will be warmer and drier overall (UCS 2009). Precipitation will increase in the winter, but decrease in the summer. The result will be a complex combination of factors. Growing seasons will be longer due to earlier warm-up in the spring, but the possibility of late frosts and mid-summer drought increase the potential for agricultural losses. As a result, many local crops will be harder to find, requiring Michigan to import apples, cherries, and many other foods from the Pacific Northwest, South America, and China, and prices will rise as local economies are strained. Higher temperatures will also increase the number of days we use air-conditioners and will require them to work hard, known as “cooling degree days.”

### Activities of the session

1. Begin with powerpoint presentation giving a brief overview of climatic changes projected for next century, concluded with projections for where the effects will be felt the strongest, which could be interpreted as “anywhere but Michigan.”
2. Lead a discussion about the changes that people have noticed in the weather as a precursor to looking at the data. (If possible, have students ask their parents the night before, as students have not been alive long enough to recognize weather patterns.)
3. Continue with the powerpoint, which gives an overview of changes that Michigan will face.
4. Introduce the specific scenarios that students will look at using the maps (changes in periods of drought, cooling-degree days, and length of growing season). Have students make predictions about how they expect these variables to be changing given climate change.
5. Have students color in the maps according to the keys. This can be subdivided if there isn’t time for each student to color in every map – for example, students can be divided into groups and one group will color the maps for each scenario.
6. Bring students back together as a class. Have them report on the patterns they observed in each scenario and go over the end-of-session discussion questions (they can either look at these in their groups before coming back together or they can all do it as a class).

**Resources**

* Powerpoint presentation, activity pages, discussion question and key, and internet resource page found on “The climate is changing . . . ” lesson page on the KBS GK-12 website
* Pileus Project: Climate Science for Decision Makers. 2007. Michigan State University Board of Trustees. ([www.pileus.msu.edu](http://www.pileus.msu.edu))

## Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds). [Cambridge University Press](http://www.cambridge.org/features/earth_environmental/climatechange/wg2.htm),Cambridge, United Kingdom and New York, NY, USA. (<http://www.ipcc.ch/publications_and_data/ar4/wg2/en/contents.html>)

## Union of Concerned Scientists. 2009. Confronting climate change in the US Midwest: Michigan.( <http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/climate-change-michigan.pdf>)

**Extensions and Modifications**

Teachers whose students are younger may be able to use the coloring pages if they simplify the introductory lesson to a level appropriate for their students. If a teacher has more advanced students, they may be able to go directly to some of the on-line resources and use those data and tools to look more deeply at some scenarios or come up with entirely new ones.

**Assessment**

Have students (in groups, as a class, or individually) complete the attached discussion questions. Go over the answers with them to make sure they are on the right track.

**The climate is changing… but will it change me?**

**Discussion Questions**

1. Briefly describe the patterns you see in each scenario. How are conditions predicted to change over time?
2. Are the predicted changes consistent with patterns you observed this summer? Why might there be differences?
3. What are some ways you might be affected (both directly and indirectly) by the predicted changes?
4. Will longer growing seasons automatically mean more crops? What other changes could affect productivity?

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**Discussion Questions – ANSWERS**

1. Briefly describe the patterns you see in each scenario. How are conditions predicted to change over time?

*According to the predictions in these scenarios, we see an increase in the number of dry periods over time, an increase in the number of cooling-degree days (greater demand for energy in the form of air conditioning) over time, and an increase in the length of the growing season over time.*

1. Are the predicted changes consistent with patterns you observed this summer? Why might there be differences?

*The answer to this will depend on what recent weather patterns have been like, but summer 2012 did indeed have long periods of drought and an increased demand for air conditioning. Recent weather patterns may not conform to long-term predictions; since weather is different than climate, the* ***average*** *trend for the climate may be one thing, but there may be lots of variation in individual years.*

1. What are some ways you might be affected (both directly and indirectly) by the predicted changes?

*This will depend on the students, but students and their families may need to use more air conditioning than they have in previous years. Students whose families have gardens or farms may be directly impacted by changes in growing season. Those who are not directly involved in farming may feel the impacts indirectly as food prices change.*

1. Will longer growing seasons automatically mean more crops? What other changes could affect productivity?

*Not necessarily – if the growing season is longer but there are more periods of drought, that may be harmful to crops. Students may also have examples from the cherry growing season, where early warm spells followed by freezing may also damage the harvest. Students may also have other plausible answers.*