Climate Science Overview

	Essential Questions	Core Lesson	Extensions
1	What is weather? What is climate? Do our climate records indicate climate change?	**1. What is Climate** – Students are introduced to the distinction between weather and climate. They will then examine and graph temperature and precipitation climate records at the local, state, and national level to draw conclusions about climate change trends.	- Climate Across the United States - NCDC Webquest
2	How does the sun heat the Earth? How does the atmosphere help balance the energy received?	**2. Energy Balance** – Students will work through an example of what happens to the energy from the sun and how it balances (radiative equilibrium) to keep the Earth warm.	- Changes in Earth's Energy Balance - Investigating Earth's Energy Balance
3	What is the greenhouse effect? The enhanced greenhouse effect? What are the main greenhouse gases and sources, and how do their heat trapping mechanisms vary?	**3. The Greenhouse Effect** – Students develop an understanding of the greenhouse effect and the enhanced greenhouse effect (global warming) as it relates to the Earth's energy balance through a series of activities, readings and diagrams.	- Extension Lesson: Modeling Greenhouse Gases - Investigating Greenhouse Gases Activity
4	What is the Carbon Cycle? How do human actions (in Michigan) affect the Carbon Cycle?	**4. The Carbon Cycle** – Students examine the carbon cycle, and identify sources and sinks within the environment. Students relate this information to greenhouse gas emissions of carbon dioxide in the context of greenhouse gas emissions in Michigan.	- Explore the potential of carbon sequestration in Michigan - Outdoor carbon hike - Create a carbon cycle game
5	What are the major factors which can influence climate change? Why is making climate prediction so hard?	**5. Climate Forcing and Uncertainty** – Students identify the factors which can influence climate change and identify reasons for uncertainty.	
6	How are atmospheric carbon dioxide and temperature related, and what is the predicted global temperature increase in 2100? What other evidence suggests climate change?	**6. Evidence of Change** – Students explore the evidence and impacts of climate change. The students graph atmospheric carbon dioxide, emissions of carbon dioxide, and temperature throughout the years and compare the trends. They explore models of future climate projections and impacts of climate change.	- Read *Frequently Asked Questions about Global Warming and Climate Change* - Use the *Gathering the Evidence* student activity - Design a method for determining Earth's average temperature. - View NASA's animations
7	How do scientists model the climate system? What do the models predict?	**7. Climate Models** – Students explore the basis of models which project climate change	- Use *The Educational Global Climate Modeling Suite* - Run Great Lakes Climate Scenarios - Use Climate Wizard - Show *Climate Models* and *Climate in a Box* videos

Climate Impacts Overview

Essential Questions	Core Lesson	Extensions
8. What are some indicators of climate change? What are the expected regional impacts?	**8. Climate Change Indicators** – Students synthesize evidence about climate change, specifically in the Great Lakes region, and explore potential impacts.	– Climate Ready Great Lakes Training Module 1 – Explore Your Eco-Region – Comparing projections from a variety of websites
9. What is phenology and what are possible implications of phenological changes to the state economy? What impacts could these changes have on Michigan agriculture?	**9. Plant and Animal Phenology** – In this two-part lesson, students first explore changes through an analysis of phenological observations. In part two students examine the effects of seasons with longer degree days and spring freeze, and consider projections into the future, focusing their efforts on tart cherry production in Michigan.	– Going Outdoors with Phenology – Discussing Regional differences – *Sand Country Almanac* class reading – Video clips: tart cherry industry, honey bees.
10. What is the **geographic range** of a plant or animal species? How do species adapt to climate change?	**10. Ecosystem Relationships** – The geographic range of a plant or animal species is an indication of its environmental "preferences," the conditions that it finds ideal, acceptable, or intolerable. If the climate changes, therefore, it is reasonable to expect that plant and animal species might "move" to occupy different places. The big question is: "What species will move, and where will they go?" In this lesson, students approach this question through three activities.	– Mixed Pine Ecosystem of Michigan – Alternative Model Projections – Using DNR Posters – Measuring carbon storage of school-yard trees.
11. What is water balance and how does it affect lake levels in the Great Lakes? How does climate change affect the Great Lakes region?	**11. Water Balance** – Climagraphs can tell us about the seasonal shifts in climate due to climate change. Changes in growing season and water balance in the Great Lakes region will have economic impacts.	– *Making a Climagraph* to show water balance
12. What can be done to help mitigate climate change? What can one person do?	**12. What Can I Do** – Students will review potential impacts of climate change on Michigan and determine both adaptive and individual mitigation strategies. Through an optional service learning project, they will get the word out about climate change and that actions can be taken to reduce emissions of greenhouse gases.	– Play *The Global Climate Game* – Host a Community Conversation – Discuss the Carsey Institute Report – What are communities and companies in Michigan doing about sustainability and climate change?
13. What are the social, economic, and environmental impacts of climate change in Michigan? How could climate change affect Michigan citizens differently?	**13. Community Conversation** – Students participate in a class wide dialogue after conducting research on one of many Michigan personas on their views and solutions to climate change.	– Play *The Global Climate Game* – Host a Community Conversation – Discuss the Carsey Institute Report – What are communities and companies in Michigan doing about sustainability and climate change?
14. How is climate change represented in the news? What kind of research is being conducted about climate change?	**14. Climate Change In the News** – Students examine news sources and compare the type of coverage climate change receives as well as the objectivity of the sources.	– Meet the Researcher – Plan a climate change symposium – Compare news reports from the past