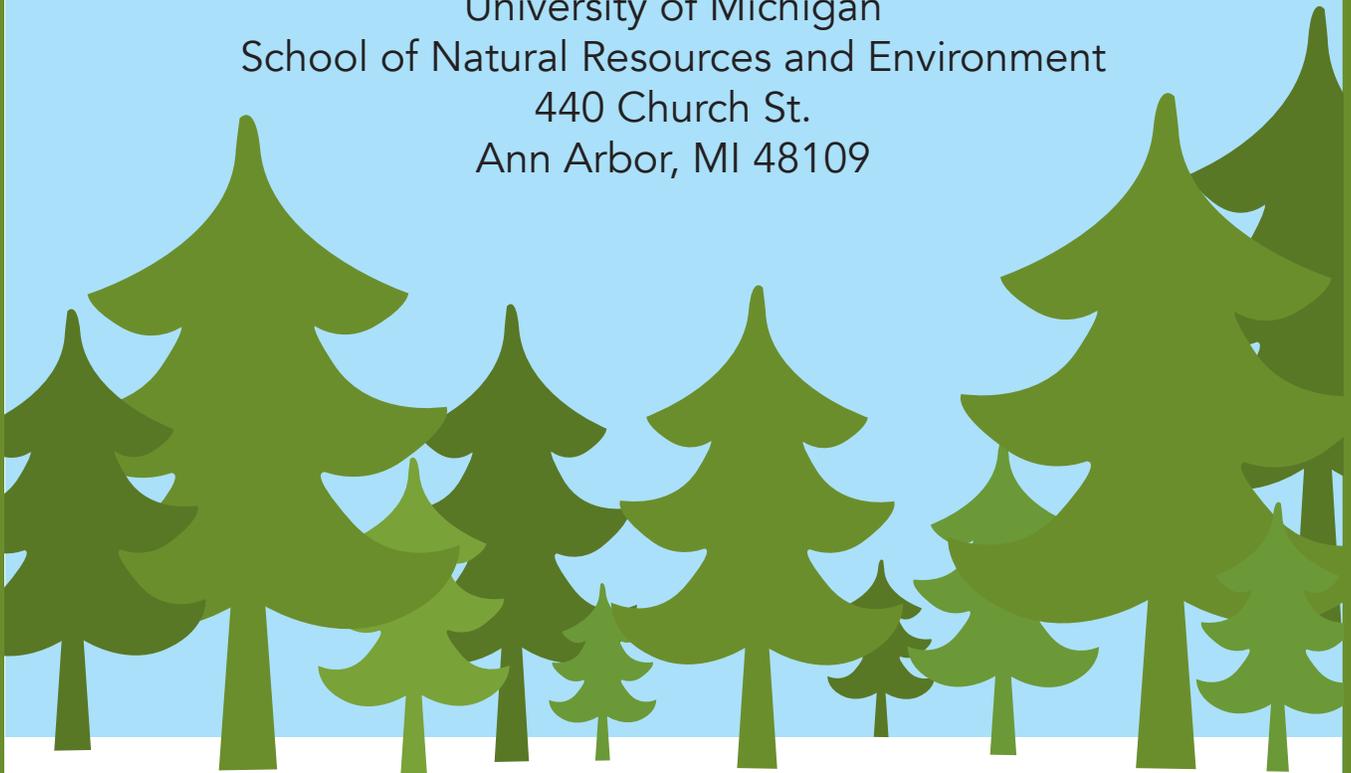


Climate Change & Michigan Forests

10-Day Middle School Science Unit

June 2015

University of Michigan
School of Natural Resources and Environment
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LESSON 1: Get in Touch with Trees!

Students identify the ecosystem services forests provide and describe the factors that influence plant growth. They describe the differences between coniferous and deciduous trees and explain adaptations that help trees survive.

LESSON 2: Connections to Climate Change

Students identify the causes of climate change and explain why climate change is important to humans and the environment.

LESSON 3: Down to the Core!

Students learn about how scientists study tree growth, and count and measure tree rings of a tree core. They also make a prediction about how temperature and precipitation will influence tree growth.

LESSON 4: Scientific Modeling

Students describe characteristics of scientific models. They enter their tree growth data into an online scientific modeling tool and create a scatterplot graph and a line-of-best-fit. They use the graphs to interpret the relationship between tree growth and precipitation and temperature over time.

LESSON 5: Making Sense of Data!

Students interpret their own graphs that model the relationship between temperature and tree growth. They also interpret more complex models made by forest ecologists. The models show predicted growth of six tree species in a future greenhouse gas emissions scenario.

LESSON 6: Climate and Plant Growth

Students review the climatic factors that influence plant growth and review the concept of growing seasons. They read and interpret climographs and characterize the climates of multiple biomes. They also discuss how plant growing seasons are limited by different factors in each biome.

● **LESSON 7: Regional Impacts and Predictions**

Students discuss how climate change impacts weather, ecosystems, and human economic activity within one terrestrial biome. Students collect, interpret, and organize information from Climate Change Impacts Articles in order to complete a worksheet that asks them to make a Claim, collect Evidence, and provide their Reasoning.

● **LESSON 8: Student Actions**

Students define climate change mitigation and adaptation and discuss examples of each. They work in groups to collect information on how climate change impacts biomes, and actions they can take to mitigate and adapt to climate change. They create an informational poster summarizing the information they have collected.

● **LESSON 9: Student Conference**

Students present their posters to the class and grade each others' work using a peer evaluation rubric.

● **Field Trip (The field trip can occur at any time during the unit.)**

Students visit a local forest to examine tree growth patterns by observation and data collection using a variety of scientific equipment. They also discuss abiotic and biotic factors that influence tree growth, abundance, and distribution, and learn about different seed dispersal methods. They learn how climate change can impact these processes and forest ecosystems.

Introduction to *Climate Change and Michigan Forests*

Climate Change and Michigan Forests is a 10-day middle school life science unit based on forest ecology research conducted at the University of Michigan. This curriculum incorporates hands-on data collection, technology in the classroom, exploratory learning, and a field trip to a local forest to enhance student knowledge of forest ecology and climate change research techniques. Optional exercises are provided throughout the unit. Utilize these activities if you have more than 10 days to complete the unit, or if your students need a more thorough review of specific topics.

Climate Change and Michigan Forests introduces students to plant growth and climate change concepts, current forest ecology research methods, and how climate change can impact forests. In this unit, students use scientific modeling to describe and predict the impacts of global climate change on forests. A focus on using scientific modeling to organize ideas, analyze data, and make predictions, reflects the predominant current research techniques used at state and federal agencies, and by scientists and other researchers throughout the world. Understanding how, and why, scientific models are used in scientific research is an important aspect of science, and climate change, literacy. In addition, each lesson was designed to meet Michigan Grade Level Content Expectations and Next Generation Science Standards.

Climate Change in the Classroom

Climate change science can be a controversial topic. There is always chance that issues will arise when covering sensitive subject matter that receives a lot of mixed media attention. For example, you may have students who have not learned basic climate change research concepts such as the greenhouse gas effect, or who do not believe that the recent changes documented by climate scientists are caused by the burning of fossil fuels by humans. In addition, some parents might be concerned with their child learning a topic that they may believe to still be up for debate.

This unit does not include a lesson that explicitly allows students to debate climate change science and draw a conclusion about how and why climate change is occurring. However, it is important to recognize that everyone one has a right to their own viewpoints and opinions, and below we offer

some strategies for opening the discussion with students or parents, and some additional resources for reference. Here we offer some ideas to keep in mind that will help you prepare for using *Climate Change and Michigan Forests* and also for approaching a discussion with your students and/or their parent(s) if any concerns arise.

Tips for using *Climate Change and Michigan Forests*

- Before you begin the unit, contact your principal, science curriculum head, department head, and other teachers in your school. It is important that other school staff members are informed in advance about the subject matter you will be covering, and are in support of the content, in case problems arise.
- Keep in mind that students will learn a variety of things in school that help them understand the way people think and to interpret what others have observed.
- There are many reasons learning about climate change is important that do not necessarily relate to one's belief or trust in the scientific process. For example, one important lesson we learn from studying climate change is cause and effect. In science especially, observing and interpreting patterns of cause and effect is an integral part of the scientific process. Another example of how this curriculum is useful is that it gives students an opportunity to read and interpret graphs.
- Current state and federal science standards, including Michigan Grade Level Content Expectations and Next Generation Science Standards, include climate change science at the middle school level. Students will be asked relevant questions on standardized tests as well.
- If you have a student who cannot participate in the class for any reason, one suggestion is that they could create a presentation about the trees studied in the unit. They could use the tree information cards to compare the differences and similarities between species' characteristics and economic and environmental value. This is not optimal, but could be used as a practical solution if needed.

If you have additional suggestions or teaching strategies that you have used successfully in the past and would like to share with us, please contact Dr. Michaela Zint at zintmich@umich.edu.

Additional Resources

Climate Change in Science Education

Title	Reference	Web Address
Getting skeptical about global warming skepticism	Skeptical Science	http://skepticalscience.com/
Defending climate change education	National Center for Science Education	http://ncse.com/climate/taking-action/defending
Michigan Grade Level Content Expectations	State of Michigan	http://www.michigan.gov/documents/mde/Complete_Science_GLCE_12-12-07_218314_7.pdf
Climate Change Education	National Center for Science Education	http://ncse.com/climate
Parenting in an Age of Climate Change	American Geophysical Union	http://blogs.agu.org/wildwildscience/2013/04/24/parenting-in-an-age-of-climate-change-communicating-the-tough-truths-to-children/
Climate Change Included in Science Teaching Guidelines	Yale Climate Connections	http://www.yaleclimateconnections.org/2013/04/climate-change-included-in-science-teaching-guidelines/
Defending Climate Science's Place in the Classroom	National Public Radio	http://www.npr.org/2012/01/20/145525000/defending-climate-sciences-place-in-the-classroom
Climate Change Causes Heated Battles for Science Teachers	Huffington Post	http://www.huffingtonpost.com/2012/01/18/climate-change-skeptics-science-teachers_n_1214049.html?

Climate Change Research

Title	Reference	Web Address
Climate Change	United States Forest Service	http://www.fs.fed.us/research/climate-change/
Getting skeptical about global warming skepticism	Skeptical Science	http://skepticalscience.com/
What We Know	American Association for the Advancement of Science	http://whatweknow.aaas.org/
Fifth Assessment Report	Intergovernmental Panel on Climate Change	https://www.ipcc.ch/index.htm
Global Climate Change	National Aeronautics and Space Administration	http://climate.nasa.gov/
Climate Change	National Academies of Science	https://nas-sites.org/americasclimatechoices/

Climate Change & Religion

Title	Reference	Web Address
A Religious Response to Global Warming	Interfaith Power and Light	http://www.interfaithpowerandlight.org/

How to use *Climate Change and Michigan Forests*

Each lesson in this unit, with the exception of the Field Trip, is intended to take 50 minutes to complete. This does not include teacher preparation time. Important parts of each lesson are described below.

Materials needed to complete the lesson.

Day 3
Down to the Core!

Summary
Students learn about how scientists study tree growth and count and measure tree rings of a tree core. They also make a prediction about how temperature and precipitation will influence tree growth.

Lesson Objectives
Students will be able to:

- Count and measure tree core rings.
- Record their measurements onto a data table.
- Predict how precipitation and temperature will influence tree growth.

Vocabulary

- *Tree cookie*: A circular and complete cross section of a tree.
- *Tree core*: A cylindrical cross section of a tree trunk that can be taken without permanently damaging the tree.
- *Tree increment borer*: A drilling tool used to remove a tree core sample from a tree.

Materials

In kit:

- Tree cookie samples
- Tree core samples
- Laminated tree core images
- Rulers (not included)

In binder:

- Tree Core Data Sheet
- Tree Core Data Sheet Keys
- Tree Information Cards
- Question/Claim Worksheet
- Down to the Core! Homework

On disk

- Lord of the Rings Video

Teacher Preparation

Part 1

- Test view Lord of the Rings video
- Locate tree cookie samples

Part 2

- Copy Tree Core Data Sheet (1 per group)
- Locate tree core samples
- Divide student activity materials into 8 groups. Each group set should include (sort

Brief synopsis of main concepts introduced in the lesson.

Specific learning objectives for the lesson.

Key terms and concepts introduced or used repeatedly in the lesson.

Recommended teacher preparation for the lesson, in chronological order.

Science standards met
by individual lesson

Michigan Grade Level Content Expectations (Grade 7)

- S.IP.07.11 Generate scientific questions based on observations, investigations, and research.
- S.IP.07.12 Design and conduct scientific investigations.
- S.IP.07.13 Use tools and equipment (meter sticks and tapes, hand lens, thermometer, tree corer) appropriate to scientific investigations.
- S.IP.07.14 Use metric measurement devices in an investigation.
- S.IP.07.15 Construct charts and graphs from data and observations.
- S.IP.07.16 Identify patterns in data.

Next Generation Science Standards (Middle School)

Performance Expectations

- MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
- MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

Science and Engineering Practices

- Obtaining, Evaluating, and Communicating Information

Disciplinary Core Ideas

- LS1.B Growth and Development of Organisms
- LS1.C Organization for Matter and Energy Flow in Organisms

Crosscutting Concepts

- Cause and Effect
- Systems and System Models
- Structure and Function

