

Lesson 1

Carbon Cycles through Ecosystems

Unit Title: Carbon Cycles through Ecosystems	
Theme: Ecosystems & Cycles	Grade Level: 7
# of sessions for the unit: 3-5	Session #1: How can climate-change endanger fauna? An introduction
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Unit Description

Focusing on systems and cycles, students use their understanding of climate-change and how carbon and thermal energy interact with Earth's land and atmosphere. Students practice skills such as argumentation and collecting and analyzing data. Students gain experience with the interactions of humans and Earth processes with ecosystem dynamics, and with developing solutions to complex climate-change issues. The lessons generally follow this order:

- Introduce unit and culminating event: climate-change's effect upon fauna
- analyze global temperature and carbon dioxide trends
- understand personal climate-change experiences, such as weather, matter and energy uses
- collect wetland and upland forest soil carbon-stores
- sample atmospheric carbon-store
- analyze land and atmospheric carbon-stores
- understand the carbon cycle, pre-human and human era
- describe personal experiences with solid forms of carbon changing into atmospheric carbon
- develop and present solutions to save a fauna from climate-change issues

Standard(s)

Based upon the 2016 MA Science & Technology/Engineering Curriculum Framework

MA LS2 Ecosystems: Interactions, Energy, and Dynamics

MA 7.MS-LS2-3 Develop a model to demonstrate how matter and energy are transferred among living and nonliving parts of an ecosystem and that both matter and energy are conserved through these processes

Unit Goals

1. Create an action plan to decrease carbon in the atmosphere, increase carbon stored by the land, and preserve natural carbon-stores in the ground
2. Build background knowledge of how carbon cycles within a local ecosystem
3. Understand relevant climate-change issues in order to make informed decisions
4. Identify authentic scientific processes, such as sampling, gathering, and analyzing land and atmospheric carbon-content data, in order to validate evidence regarding climate-change

Unit Objectives

■ Students will be able to

understand that:

1. Carbon cycles through the atmosphere and land
2. Human activities increases atmospheric carbon by burning fossil fuel
3. Atmospheric carbon is a “greenhouse gas”
4. Greenhouse gases increase global temperatures
5. Wetlands and uplands store different amounts of carbon above and below ground

and to:

1. Sample, collect, and analyze primary-source data
2. Collect and analyze secondary data as a means to validate causes of climate-change

Lesson Objectives

1. Students research evidence and reasoning to argue that Human activities increases atmospheric carbon by burning fossil fuel
2. During the unit, students develop their argument that increased atmospheric carbon has harmed fauna

Note any potential barriers to the lesson – consider variability

■ Student challenges

- physical challenges when collecting samples
- anxiety about preparing and presenting this project
- vocabulary, reading, written expression

■ Teacher challenges

- computer availability for research
- website resources
- access to a wetland and upland forest

Evaluation/Assessment

(directly linked to the goals, i.e., Formative/Ongoing Assessment or Summative/End of Lesson Assessment)

■ Summative Assessment: End-of-Unit Fauna Climate-change Research Project

1. Visual
2. Presentation
3. See rubric at end of this lesson

■ Formative Assessment

1. Students choose their small-group
2. Students choose their fauna

Vocabulary

- fauna
- ecosystem
- argument
- evidence
- reasoning
- tipping point
- carbon footprint

NOTE: Consider the [UDL Guidelines](#) in selecting methods and materials to ensure that you provide options for engagement, representation, and action and expression.

Methods

(e.g., Anticipatory Set, Introduce and Model New Knowledge, Provide Guided Practice, Provide Independent Practice)



Hook: How will polar bears adapt to climate-change?

Introduce the idea that as the climate-changes, this may change ecosystems on Earth. If ecosystems change, they may affect the environment, which can affect the living things in that environment.

Day 1

1. Class discussion: Topics

A. Show data that 97% of scientists believe climate-change is real and is the result of human activity.

B. Ask students what the ‘poster child’ animal for climate-change is

- Most will say the polar bear

C. Ask what evidence and reasoning they have for picking the polar bear?

- Guide students through the evidence and reasoning model, using the following example:
What was the environment that polar bears used to have that helped them survive successfully?
- The ocean was ice-covered; air holes where seals came up to breathe allowed polar bears to grab and capture them for food
- Polar bears set up dens in the ice to raise their families

D. Discuss how climate-change has affected the polar bear’s typical environment:

- Evidence = ice environment melting
- Reasoning = harder to capture food, need to swim long distances, and no place to build dens on the ice for having and caring for baby polar bears
- Focus on how this is evidence that the climate is changing in the arctic

- E.** Discuss how this change is affecting the polar bear's survival, and this will be the reasoning:
 - Have they reached the tipping point?
 - Will they be able to survive?
 - What needs to change to bring back the polar bear's original environment?
- F.** Introduce the following project to students:
 - Inform students that they can work by themselves or with one other student in their class
 - Each individual/group will need to select a topic (animal, location) to research
 - In each class, there can be no duplicates.

■ Day 2:

- 1.** Students select fauna and teacher arranges small groups
 - A.** Provide computers to students (in the computer lab or with Chromebooks) for students to select their topics and to begin their research
 - B.** The teacher records each student's/group's topic.
 - Be specific in identifying animals (there are many different types of penguins and sea turtles)
 - Certain topics can be assigned to students that will help them better understand these topics: ocean acidification, coral reefs, mosquitos (which love climate-change), or other specific topics for your location (example: cod fish are on the decline in the gulf of Maine due to the warming climate).
- 2.** Remind students that they will complete their projects at the end of the unit and about the project details.
 - A.** Students need to
 - include information learned over the next few weeks during discussions of climate-change
 - additional class time can be used to ensure that students make the connections with the lessons and how they can do their final product for this project
 - Students will present their findings during class time — allow at least 10 minutes for each presentation

Hand out assignment sheet to distribute to students and post on teacher's webpage

Lab Report

Carbon Cycles through Ecosystems

*Looking for Evidence:**How is Climate-change Affecting the World Around Us?*

This project is worth xx points

You will pick one geographic area/animal/thing that is changing due to climate-change.

Inform the teacher what your topic is to have it approved.

Research this area and prepare a report to present to the class. You must create a poster to demonstrate your understanding; it is also OK to make a PowerPoint or Google slides or to use another method approved by the teacher for the presentation (with little to no transitions) that clearly includes the following information in detail (5 points for each):

1. The topic being researched — include details; describe it and where it is found.
2. Describe your topic's "normal" environment when it was doing well.
3. What evidence is there that the environment has changed? (Describe how your topic's "normal" environment has changed).
4. Using reasoning, how has this change in the environment affected your topic? Be specific — can your topic adapt? Has your topic reached its tipping point? How close is it to the tipping point?
5. Create an action plan for how you can help slow down or stop the climate-changes already occurring? Include some ways we can reduce the amount of carbon dioxide in the atmosphere and ways we can increase the amount of carbon stored by the land. You must include some ways you personally can reduce your carbon footprint by reducing electricity use and transportation needs.
6. Presentation: You and/or your team will present your report to the class. (Poster or PowerPoint presentation)

Grading Guide

Carbon Cycles through Ecosystems

Grading: Each section of the presentation is worth xx/6 points based on how completely each section is explained.

	Deficient: Poor 0-10	Needs Improvement: Fair 11-19	Proficient: Good 20-22	Advanced: Excellent 23-25	Points
Evidence			Provides valid evidence that the environment has changed <ul style="list-style-type: none"> • before industrial revolution • since industrial revolution • accurate evidence • accurate scientific vocabulary 		
Reasoning			Using an evidence-reasoning chain <ul style="list-style-type: none"> • links evidence: reasons of why a change in your animal's environment negatively affected it • links evidence: reasons why your animal tried to adapt • links evidence: reasons related to your animal's tipping point — have they reached it? How close is it? • reasoning supported with valid evidence and details • addresses possible counterclaims (misconceptions) 		
Action Plan			The action plan includes action strategies to <ul style="list-style-type: none"> • slow down or stop the climate-change from occurring • reduce the atmospheric carbon dioxide • increase land-based carbon-stores • personally reduce your carbon footprint by reducing electricity use and transportation needs 		
Presentation			During your class presentation, your group <ul style="list-style-type: none"> • integrated your hand-drawn poster into presentation • included detailed graphs supporting your evidence-reasoning chain • presented information in a logical order, using clear and easy to follow helpful visuals • attractive appearance, uncluttered and clear 		
				Total Points	

Materials

Access to computers, Powerpoint or Google slides

Suggested technology tools

1. Noodle Tool group research tool www.noodletool.com
2. Actively Learn guided reading homework www.activelylearn.com
3. Brain Pop video and guiding questions www.brainpop.com as homework resource
4. Students create slideshow within Google Classroom

Posterboard and markers.

Conclusion

1. Start with an introductory sentence briefly explaining how you did this lab experiment
2. Use your bar graph to answer questions
3. Then answer this question: Why should someone switch the type of light bulb they use in their house?
4. Include evidence about each type of bulb and reasons why the bulb you chose is better for a household.
5. Use the questions on the other side when writing this conclusion.
6. Use these questions when writing your conclusion.
7. Did your results support your claim? Explain.
8. Explain why the temperature readings were different or the same for each type of bulb during the experiment.
9. Where does the energy go when using an incandescent light bulb?
10. Where does the energy go when using a compact fluorescent light bulb?
11. What scientific concepts did you learn from the experiment?
12. How does this experiment apply to the real world?
13. What further experimentation could you do?
14. Write any other thoughts about what you think happened and why.

Notes and Comments

■ Examples of websites that will help with this project from a google search for 'animals affected by climate-change'

<https://www.worldwildlife.org/magazine/issues/fall-2015/articles/animals-affected-by-climate-change>

<http://news.nationalgeographic.com/news/2014/03/140331-global-warming-climate-change-ipcc-animals-science-environment/>

<https://www.nwf.org/Wildlife/Threats-to-Wildlife/Global-Warming/Effects-on-Wildlife-and-Habitat.aspx>

■ Examples: Fauna affected by climate-change

- Mountain yellow-tail frogs
- Panamanian golden frog
- Golden frogs (and many other types of frogs)
- Pika
- Sea turtles: Green, leatherback, plus more
- Eastern Hemlock Forests
- Tiger
- Emperor penguins, adelic penguin (plus several other penguins)
- Snow fox
- Snowshoe hare
- Puffins
- Cod
- Krill
- Different types of whales
- Different types of birds
- Coral reefs
- Shellfish/fish due to ocean acidification
- Panda bears
- Koalas
- Mosquitoes
- Nutrition of leafy greens
- Increased temperatures in an environment/
drought
- French wine grapes
- Permafrost