STRATEGIC ENERGY INNOVATIONS

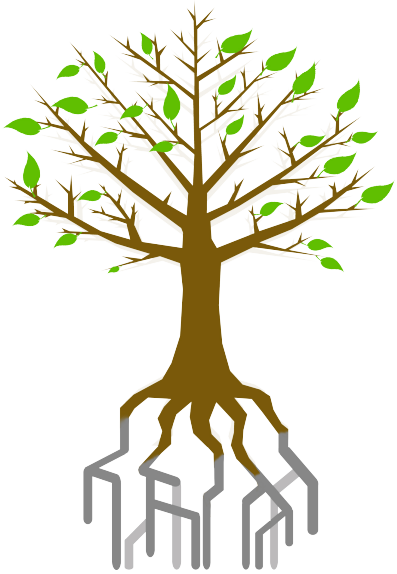
Grade: 9-12

Version 2

Sept 2017

Biomimicry:

Engineering Inspired by Nature



Investigate biological systems and design nature-inspired solutions to address changing environmental conditions

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Lesson 2 Overview

Estimated Time
45 minutes (one 45-minute class period)
Standards
NGSS: HS-ESS3-1, HS-ESS3-4
ELA: Reading for Informational Text 7, Reading for Literacy in Science & Technical Subjects 4, 7, 8, 9, Speaking & Listening 1a&c, 2, 4, 5, Language Standards 1, 2a-b, 6, Writing for Literacy in History/Social Studies, Science & Technical subjects, 2a-e, 7, 9, 10
CTE: Agriculture & Natural Resources E1.5, Energy, Environment, & Utilities A2.0, A2.2-2.3, 2.6

Objectives: Students will be able to:
- Explore the effects of climate change in different environments
- Interpret the significance of rising CO_2 levels in the atmosphere
- Model changes in temperature and other environmental factors
- Explain climate change mitigation strategies

Prep Time
- 45 mins

Handouts
- 2.8: Adaptive Housing Challenge

Materials
- Internet access
- Handouts
- Adaptive Housing Challenge: paper, cardboard, toothpicks, tape, paint trays, water

Lesson 2: Mitigation and Adaptation

After being introduced to several climate change impacts in lesson 1, students will now learn about ways humans have begun to adapt. Additionally, students will explore the natural responses of Earth's systems to increasing global temperatures, and create their own designs aimed towards adapting to the changing global climate.

KEY WORDS

Vulnerability: The relationship that people have with their ability to withstand changes to their environment.

Ecosystem: A biological community of interacting organisms and their physical environment.

Mitigation: The action of reducing the severity, seriousness, or painfulness of something. Environmental mitigation is intended to offset impacts on an existing natural resource such as a wetland.

PREPARATIONS

- Read through the lesson materials.
- Collect materials for activities. See the Materials List at the beginning of the unit for the materials required for the activity
- Reserve a computer lab for research.
- Print the following handouts:
  - Handout 2.1: Adaptive Housing Challenge – one per student
- Recommended Daily Lesson Breakdown
- Day 1: Mitigation and Adaptation
  - Mitigation and Adaptation
  - Discussion
  - Adaptive Housing Challenge
  - Optional Natural Disasters Report

SETTING THE STAGE: MITIGATION & ADAPTATION

- **Mitigation** is the act of reducing the severity, seriousness, or painfulness of something. Climate change mitigation refers to efforts made to reduce the causes of climate change.
  - For example, using renewable energy sources instead of burning fossil fuels will reduce the buildup of greenhouse gases in the atmosphere.
- The goal of climate change mitigation is to prevent climate change before it starts rather than address the impacts of climate change after it has caused significant harm.
- For more information on climate change mitigation, read this article:
  - http://www.bbc.com/news/science-environment-26980837
- **Adapting** to climate change means to change and adjust to the impacts of climate change. Earth's ecosystems are already experiencing the impacts of climate change and species around the world are attempting to make changes to survive. Many organisms will not be able to adapt quickly enough because of the rapid pace of climate change.
  - For example, birds are adjusting their migration patterns to account for warmer weather. Populations of trees are moving northward to grow in more favorable conditions. People are adjusting building design to address extreme weather and building levies to protect against sea level rise.

DISCUSSION: MITIGATION AND ADAPTATION

- What are ways humans can mitigate climate change? *Renewable energies, preventing deforestation, energy efficiency, energy conservation, etc.*
- What are behavioral changes we can make in our personal lives to mitigate the impacts of climate change? *Reduce our carbon footprint by riding a bike to school or work.*
- How are animals attempting to adapt to climate change? *Changing migration patterns, finding new habitats, etc.*
- What will happen to organisms that cannot adapt as quickly as the climate is changing? *They will likely become endangered or go extinct as their habitat changes.*
- How are humans adapting to climate change? *Moving, installing sea walls and levies to prevent sea level rise from causing flooding, improving the building insulation and HVAC technology, etc.*
- What are the pros and cons of mitigation and adaptation?

ACTIVITY 2: ADAPTIVE HOUSING CHALLENGE

Rising Sea Level

- The current worldwide average sea level rise is 3.20 mm per year[1], and there are no signs of stopping. The primary contributors to sea level rise are the thermal expansions of oceans and the melting ice caps and glaciers, both results of increased global surface temperatures.
- This is especially important for plants, animals, and people located near the coast or in other low-lying ecosystems, including cities. Guangzhou, China has more than 14 million residents and is only 68 feet above sea level. The southeastern United States is another particularly vulnerable area.
- To adapt to the rising sea level, people have turned to three main strategies.
    - Relocation to a higher elevation: This can be a costly option and is not possible for people of all incomes.
    - Build coastal houses on stilts to defend against the tide.
    - Construct a sea wall or other coastal defense structure to block the incoming water and redirect the flow.
- In this activity, students will construct a small paper box to represent a home. They will then be challenged to design and construct adaptions to their homes or environments to adjust for rising sea level. Students may work individually to construct their own homes or work in small

[1] Lindsey, Rebecca. "Climate Change: Global Sea Level." *National Ocean and Atmospheric Administration.* https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level. *I.* Accessed 26 July 2017. .

groups. Once students have constructed their homes, assign 3-4 homes per paint tray that will simulate the coastal environment.

- First, ask students to construct a small paper box using the following template. If possible, it is recommended that students include a small item like a few paper clips in their boxes.
  - Paper Box Template: http://mathfour.com/wp-content/uploads/2013/04/MathFourTinyBoxTemplate.pdf
- Once students have constructed the boxes, provide them each a copy of the Adapting to Climate Change Handout. Explain to students they will now have to design an adaptation to their own homes or their environment, to keep their homes safe from rising sea levels. Begin by discussing strategies for adapting to sea level rise.
- Students may work individually to protect their homes or they may work in teams to find a collective solution, like a sea wall. Provide each student with a limited number of toothpicks, paperclips, and tape to construct their adaptations. Allow 10-15 minutes for construction.
- After groups have made adjustments to their homes or environments, incrementally add water to the paint tray to gauge the success of their adjustments. Depending on time, you may give students an opportunity to make modifications to their designs after each stage of adding water.

After students have completed this activity, show the students the following images so they can see these types of adaptations currently in use.

Raised Home on Stilts

[2]

[2] Source: https://www.fema.gov/media-library/assets/images/54621

Sea Wall

 [3]

- For real life examples of around the world climate change adaptations check out these 10 design ideas:
  - http://otecorporation.com/2015/08/27/10-designs-fighting-the-devastating-effects-of-climate-change/

Discussion

- Did your group choose to collaborate? Why or why not? In this activity, each student was given the same set of materials, but making these modifications to one's home are costly. How would your collaboration decisions and designs been different if not everyone could contribute equally? *This activity can lead to a discussion about the politics of making adaptations like constructing a sea wall. Who would pay for it?*

- Do you think there are elements of your designs that can be applied to a real-world adaptation?

- What are the pros and cons of living in low-lying areas near the ocean? Do you think the pros outweigh the cons?

- How does sea-level rise affect all humans, even if one doesn't live near the sea? *Many major shipping ports and airports exist at sea level. Their degradation would drastically affect worldwide commerce and transportation.*

- If sea-level rise continues to occur at a rapid rate, what would you advise future city leaders to do?

[3] Source: http://pubs.usgs.gov/of/2005/1370/figures/fig11.html

ASSESSMENT

Name one way that anthropogenic (human-caused) climate change could affect your daily life in the future. (2-3 sentences)

ASSIGNMENT

- History has shown us that floods, earthquakes, and other natural disasters have caused massive destruction throughout the world. Investigate one natural disaster of your choice that occurred in the United States within the past 250 years. Write a one-page report that considers the following questions:
    - What kind of event happened? Who did it affect?
    - Did the general public have any warning? Was it a surprise?
    - If the public was aware, what sort of precautionary measures did they take?
    - What was destroyed?
    - What efforts did the local/state/and or federal governments undertake to rebuild or return the environment to normalcy? Did anything new result, such as laws or regulations, from the event?
    - With climate change and the increasing temperatures we are experiencing today, is your natural disaster more likely to occur? Why or why not?