Lesson Two - Sea level rise and carbon footprints
Lesson Planning Tool for Climate Change

Title of Lesson: Sea level rise and carbon footprints

Grade Level: 11th & 12th
Subject: Environmental Science

Source(s) of the lesson: NASA maps of future sea level rise. Carbon footprint self assessment. Carbon footprint country comparison.

Essential Question(s): How will sea level rise affect coastal communities into this century and beyond? How does your personal carbon footprint contribute to climate change? How does the average American compare to other global citizens?

Massachusetts Curriculum Frameworks Science Standards:
HS-LS2-2 Use mathematical representations to support explanations that biotic and abiotic factors affect biodiversity, including genetic diversity within a population and species diversity within an ecosystem.

Content Objectives	Practice Objectives	Language Objectives
SWBAT- determine the causes of sea level rise and how personal actions contribute to this phenomenon.	4. Analyzing and interpreting data 5. Using mathematics and computational thinking 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	SWBAT- define the factors causing sea level rise and justify how this will impact human populations across the planet.

Important Vocabulary: Climate change, albedo, acidification, feedback loops, atmosphere, precipitation, carbonic acid, carbon dioxide, methane, ozone, greenhouse effect, mitigation, anthropogenic, urban heat island, permafrost

Materials Needed:
NASA sea level change data analysis tool. https://sealevel.nasa.gov/data/data-analysis-tool
Boston Living with Water http://www.bostonlivingwithwater.org/
Personal carbon footprint calculator. https://www3.epa.gov/carbon-footprint-calculator/
CIA World factbook country comparison handout

Other Resources: (websites, videos, books, etc.)

Background Information for Teacher: Understand the contributing factors to global sea level change. Understand how to calculate a “carbon footprint”, and compare to other countries across the globe.

Background Information the Student Needs to Access the Lesson: What prerequisite knowledge should the students have?
Basic understanding of how carbon dioxide (and methane) contribute to the greenhouse effect. How the melting of land based ice, and the process of thermal expansion contribute to sea level change.

Lesson Structure

Lesson Launch (Do Now)	Students should view the NASA sea level change data analysis tool. https://sealevel.nasa.gov/data/data-analysis-tool Ask students to view what their location on earth will look like in the future, and brainstorm what can be done to mitigate the effects of sea level rise in the future.
Background Instruction (pre-activity)	Students should log on to the EPA carbon footprint calculator https://www3.epa.gov/carbon-footprint-calculator/ to calculate their personal CO_2 value. Once complete, they should compare with their classmates and write down at least three new pieces of information they learned.
Activity	In order to gain perspective on how much the average US citizen contributes to climate change, students should compare the US with a "developing" country of their choice (preferably one with a significant effect with sea level rise) by completing the accompanying handout pasted below.
Discussion/ Debrief	Students should complete the handout and be prepared to discuss their findings with their classmates.
Formative Assessment	Collect the handout and score for students understanding.

Notes:

Developing vs. Developed Countries

Use the World Fact book to gather data and analyze the energy usage of the average citizen in a developing country. This data will be used to compare and contrast against the energy audit, and carbon footprint data sheet you have completed.

Directions:

1. In the web browser go to: https://www.cia.gov/library/publications/the-world-factbook/ or simply type into Google the term “world fact book”.

2. At the top of the web page, use the tab to select the developing country you are choosing to investigate.

3. Once you have chosen your developing country, now you need to investigate specific facts about the lifestyle of the average citizen. You should gather information about the following topics. Read the profile for your developing country, but you do **NOT** need to answer any questions here.

1. Introduction
a. Country Background
    2. Geography
        a. Environment – Current Issues
        b. Environment – International Agreements
    3. People and Society
        a. Population
        b. Age Structure
        c. Drinking Water Source
    4. Economy
a. Electricity Consumption
b. Oil Consumption
c. Natural Gas Consumption

Data Analysis: *Please refer to the statistics provided on the world facts on the developing country of your choice and the average for an American citizen.*

1. What are the average per-person usage rates for Electricity, Oil, and Natural Gas in your developing country? How do this compare with the United States rates of consumption?

****Please note, this data varies for each country. You should look for electricity, oil and natural gas **consumption** values. If the consumption value does not exist, please do the following calculation.

Production + Imports - Exports

2. Your developing country uses what percentage of United States consumption of Electricity, Oil and Natural Gas? What do these numbers tell you about the average lifestyle of citizens in developing nations?

3. In your opinion, if all developing countries consumed natural resources at the same rate as the United States, what would this mean for the planet? Would this scenario be sustainable? Why or why not? Please be specific.

4. Describe the differences in access to clean water when comparing your developing country with the United States. What social or economic factors account for the differences? Is there anything one country could do to improve upon their current condition? Please be specific.

**The CIA World Factbook uses the following criteria for measuring Drinking Water Sources.
Improved drinking water - use of any of the following sources: piped water into dwelling, yard, or plot; public tap or standpipe; tubewell or borehole; protected dug well; protected spring; or rainwater collection.

Unimproved drinking water - use of any of the following sources: unprotected dug well; unprotected spring; cart with small tank or drum; tanker truck; surface water, which includes rivers, dams, lakes, ponds, streams, canals or irrigation channels; or bottled water.

5. Touching upon all of the data provided, describe in what ways is life different for the people in developing countries than the average person in the United States? Please be specific in your response and provide evidence where applicable.

6. Using the NASA sea level change data analysis tool. https://sealevel.nasa.gov/data/data-analysis-tool compare where you live in the USA to the developed country you chose, and analyze how sea level rise will affect both locations. How are they similar/different? How will life change for those who inhabit these areas? What can be done to address this problem?