Climate Change Mitigation and Adaptation

Program Duration: total time ~90 minutes
Grade Level(s): Middle School (8th)- High School (9th-12th)

Program Overview

Provides students with activities that will promote solutions to the climate change crisis. Students will brainstorm and present their own ideas to clean up a polluting sector of society and play a board game that simulates fallout of climate change and the need for adaptation. The goal of this plan is to provide an optimistic outlook on a bleak topic and strengthen problem solving skills.

Relevant Vocabulary (key terms italicized)

Abiotic - Physical characteristic rather than biological; not derived from living organisms.
Adaptation - physical modification of the environment to lessen the impacts of changing global temperatures, sea level rise, etc.
Anthropogenic - Originating via human activity.
Atmosphere - The envelope of gasses surrounding the earth or another planet.
Biodiversity - The variety of life in the world or in a particular habitat.
Biome - A large naturally occurring community of flora and fauna occupying a major habitat.
Biosphere - The regions of the surface, atmosphere, and hydrosphere of the Earth occupied by living organisms.
Biotic - Relating to or resulting from living things, especially in their ecological relations.
Carrying Capacity - The number of people or things that can be held by a vehicle or container.

Climate - The weather conditions found in an area in general or over a long period.
Cyclic - Occurring in cycles or regularly repeated..
Ecosystems - A biological community of interacting organisms and their physical environment.
Elements - A substance that cannot be broken down by ordinary processes.
Equilibrium - A state in which opposing forces are balanced.
Erosion - A process of eroding or being eroded by wind, water, or other natural agents.
Feedback Loops - A feedback loop is the part of a system in which some portion of that system's output is used as input for future behavior.
Fossil Fuels - A natural fuel such as coal or gas, formed in the geological past from the remains of living organisms.
Genetics - The study of heredity and the variation of inherited characteristics.
Geomorphology - The study of the physical features of the surface of the earth and their relation to its geological structures.
Igneous - A rock that has solidified from lava or magma.
Lithosphere- The solid outermost layer of the Earth.
Metamorphic- Rocks that have been subject to severe heat and pressure causing a change in the form and composition.
Migration- Large-scale movement of members of a species to a different environment
Mitigation - Science- and policy-based action to reduce (the rate of increase for) greenhouse gasses and global temperatures
Molecules - Groups of atoms bonded together.
Nonrenewable Energy- Energy that comes from sources that will run out or will not be replenished for thousands-millions of years.
Nutrient Cycling- A system where energy and matter are transferred between living organisms and non-living parts of the environment.
Observational Data - Collection of data without the subject of the study being directly involved.
Pollution **-** Introduction of harmful materials into the environment that damage air, water, and soil quality.
Population Growth Rates **-** Rate at which the number of individuals in a population increases in a given time period, expressed as a percentage of the initial population.
Renewable Energy **-** An energy resource that is replaced rapidly by a natural process.
Sedimentary Rock - Produced by the deposition of individual grains and lithified.
Species - a group of organisms that are closely related and can mate to produce fertile offspring.
Tectonics Plates - Massive slabs of solid rock composed of continental and oceanic lithosphere.
Urban Heat Island **-** When cities experience much warmer temperatures than nearby rural areas.
Waste Management **-** Collection, transport, and processing of waste materials, usually produced by human activities to reduce effect on human health.
Weather **-** Behavior of the atmosphere at any given point on a planet's surface

Mitigation and Adaptation Unit Introduction

Length: 10-15 minutes

Introductory Video: https://www.youtube.com/watch?v=-5KEgq1f7J0

Reflection and Warm Up

1. have students define concepts of "adaptation" and "mitigation"
2. compare and contrast the two terms.
3. Discuss actions that climate scientists have proposed (e.g. carbon tax, sustainable usage of resources, controlled burns to prevent wildfire)

    a. Categorize proposed actions as being examples of “adaptation” or of “mitigation”
4. Ask students to write down actions they could take to lead more sustainable lifestyles (e.g. reduce meat consumption, using reusable water bottles and shopping bags).
5. Share IPCC Representative Concentration Pathways (RCPs) to show the necessity of climate change mitigation
    a. Graphic: What are the RCPs?
    b. Takeaway: more mitigation = less adaptation
6. Introduce Activity 1 (Mitigation)

Activity 1 - Mitigation Brainstorming!

Length: 30-40 minutes

Materials

Dry-erase board and marker • Student writing utensil and notebook paper

Summary of Activity

The purpose of this activity is to educate students on real-world societal and environmental issues caused by climate change and apply their understanding and creativity to think through mitigation efforts. This activity will put students in the shoes of policymakers and environmental scientists by allowing them to think critically about emission sources and propose mitigation solutions. Students will need to evaluate the costs and benefits associated with the solution and whether or not the solution would create new problems. They then need to think of how this solution could be implemented. Will it require new laws? Does it require a change in infrastructure? A change in behavior? How will it affect different communities? (i.e. working class and indigenous people).

Students may find it difficult to come up with a perfect mitigation solution. That is OK! This is the nature of the situation. A solution does not need to be perfect to cause positive change. Mitigation is about reducing the severity of an impact, not necessarily eliminating that impact. Students can ask themselves, “What will happen if no action is taken? What if we ignore the problem?” This can help them realize how important even small actions can be.

Link to full activity instructions: Mitigation Activity

Debrief and Discussion Questions

(Ask as many or as few questions as you would like. These questions should wrap up the activity and help students fully understand the concepts of emission and climate change mitigation.)

1. What was the hardest part of this exercise?

2. Do you think we as a nation should only be pursuing the “best” emission mitigation efforts, or should we pursue as many as we can?
3. Had you considered how poor communities are affected disproportionately by climate change issues?
4. Do you feel like your daily choices can make a difference? What if you became more of an activist for the environment?
5. Do you think you could change someone's mind about environmental issues?

Additional Resources for Teacher:
https://www.epa.gov/smartgrowth/smart-growth-and-climate-change
https://www.epa.gov/arc-x/public-health-adaptation-strategies-climate-change
https://science.sciencemag.org/content/360/6392/987

Activity 2 - Game of Floods

Length: 30-40 minutes

Materials (order game board here**)**

Tabletop Game Board • Game Piece Key Handout (1 per person) • Game Pieces • Facilitator Script/Blank labels • Planning Commission Worksheets (1 per person) • Scenario Cards (1 per person) • Sticky Arrows • Easel • Large Notepad • Markers • Dice

Reference Sheet - Reference Sheet.pdf

Additional Materials - materials.pdf

Full Game Instructions - Instructions - Game of Floods

Summary of Activity

The Game of Floods is a resource-management game. Players play on the playing board with hexagonal flood zones. They manage community assets, which could be flooded at any moment. Players strategize on how to protect their chosen parcels while constantly worrying about community well-being and resources. They have to consider the potential loss or deterioration of homes, community facilities, roads, agricultural land, beaches, wetlands, lagoons, and other resources.The game instructs participants to consider several factors in the proposal, including costs/funding, private property impacts, environmental impacts, and equity/social justice concerns.

Benefits:

1. Players will learn about many climate impacts and adaptation options.

2. Players are encouraged to engage into public discussions regarding the tradeoffs of adaptation measures.
3. Players learn to plan and strategize for dealing with future hazards.
4. The game can help foster collaboration and provide a deeper understanding of the environmental, economic and social choices that communities will face in preparing for sea level rise.

Debrief and Discussion questions

1. Was your group able to complete all the tasks with the resources you had?
2. In what ways could you have used your resources better or more creatively?
3. Are there resources you wish you had?
4. *Optional*: Did you use any creative solutions?
5. Does anyone see any conflicts in the plan? This could include proposals which are excessively costly, negative private property impacts, negative environmental impacts, equity/social justice concerns, or other.
6. If there are conflicts can compromises be made?

Unit Wrap-Up

Length: 5 minutes

There are many different solutions to the climate change crisis and it is clear that solving these issues requires creativity and teamwork. Students worked together to brainstorm ideas to clean up a polluting sector of society and participated in a simulation of the fallout of climate change and were able to experience the need for adaptation. One of the main lessons was to provide an optimistic outlook on a bleak topic and strengthen problem solving skills for the future generation that will ultimately be the ones dealing with the effects of climate change. Another main lesson was to emphasize the importance of collaboration because successfully fighting the huge issue of climate change is going to take all of society working together towards a sustainable, cleaner future. Some discussion questions that could be asked include:

1. Do adaptation and mitigation actions both have to be done to successfully address climate change? (i.e. Is it enough for society to simply adapt and let climate change worsen?)
2. What mitigation actions can make the biggest impact? (i.e. What solutions should be prioritized?)
3. What can each of us do differently (no matter how small the action/choice) to help solve the climate change crisis?

Indiana Science Standards

6-8.E.3 Analyze data from investigations to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Earth and Space Science - 8th Grade

8.ESS.1 Research global temperatures over the past century. Compare and contrast the relation to the theory of climate change

8.ESS.3 Research how human consumption of finite natural resources (i.e. coal, oil, natural gas, and clean water) and human activities have had an impact on the environment (i.e. causes of air, water, soil, light, and noise pollution).

Earth Cycles and Systems - HS Earth and Space Science Standard 3

ES. 3.4: Evaluate the use of sustainable versus nonrenewable resources. Explain the consequences of overuse and continued increased consumption of limited resources. Analyze and evaluate the benefits of researching, designing, and developing sustainable resources for private use and industry.

Environmental Systems - HS Environmental Science Standard 1

Env.1.2 Understand and explain that human beings are part of Earth's ecosystems and give examples of how human activities can, deliberately or inadvertently, alter ecosystems.

Env.1.7 Identify tools and technologies used to adapt and alter environments and natural resources in order to meet human physical and cultural needs.

Flow of Matter and Energy - HS Environmental Science Standard 2

Env.2.8 Cite examples of how all fuels, renewable and nonrenewable, have advantages and disadvantages that society must question when considering the trade-offs among them, such as how energy use contributes to the rising standard of living in the industrially developing nations. However, explain that this energy use also leads to more rapid depletion of Earth's energy resources and to environmental risks associated with the use of fossil and nuclear fuels.

Environmental Policy - HS Environmental Science Standard 4

Env.4.1 Explain environmental policies/organizations (Clean Water Act, Clean Air Act, Endangered Species Act, Species Survival Plan, Resource Conservation and Recovery Act, Department of Energy, and the World Health Organization) and identify their impact.

Env.4.2 Understand that environmental policies/decisions have negative and positive impacts on people, societies, and the environment

Pollution - HS Environmental Science Standard 7

Env.7.1 Identify evidence, consequences, and prevention for climate change produced by anthropogenic sources.
Env.7.6 Understand and explain how the burning of fossil fuels releases energy, waste heat and matter (air pollutants)

https://www.doe.in.gov/standards/environmental-science-resources
https://www.doe.in.gov/standards/earth-and-space-science-resources

Additional Reading - Suggested Teaching Resources:
Chapter 28: Reducing Risks Through Adaptation Actions
Chapter 29: Reducing Risks Through Emissions Mitigation
Forests - Fourth National Climate Assessment
Reducing food's environmental impacts through producers and consumers
Sources of Greenhouse Gas Emissions