



Ambassadors of Conservation and the Climate

Pages 1-5 Dr. Katharine Hayhoe NGSS & CASEL lesson

Watch the Video [Here](#)

Materials Required for This Lesson/Activity	
Quantity	Description
Per student	Laptops
10	10 jars with lids
10	10 thermometers
10	10 flashlights/lamps
1 box	Sodium bicarbonate
1 bottle	Vinegar
1 gallon	Water (liquid)
2 trays	Ice cubes (dyed blue with food coloring)
1	Small basin
5	Cardboard tubes (paper towel roll)
1	Funnel
1	Tea kettle (electric)
5	Tablespoons
1	Book of matches
1	Scotch tape

Pages 6-8 Dr. Katharine Hayhoe NGSS & CASEL lesson

Watch the Video [Here](#)

Materials Required for This Lesson/Activity	
Quantity	Description
Per student	Laptops
1 package	Index cards

Ambassadors of Conservation & the Climate with Dr. Katharine Hayhoe

Grade/ Grade Band 6-12	Topic: Climate Change	
<p>Brief Lesson Description: Dr. Katharine Hayhoe loves to talk about climate change and, in her video, she discusses why it is important to talk about climate change. In the lesson, students will investigate the causes of climate change and discuss how the effects of climate change impact humans, animals, and the world.</p>		
<p>Performance Expectation(s): MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions. HS-ESS2-5 Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.</p>		
<p>Specific Learning Outcomes: Students will be able to describe the basic causes and effects of climate change.</p>		
Narrative / Background Information		
<p>Prior Student Knowledge: Students should be able to define: atmosphere, weather, and climate. Students should understand the weather and describe the causes and effects relating to weather patterns.</p>		
<p>Science & Engineering Practices: <u>Planning and Carrying Out Investigations</u> Planning and carrying out investigations to answer questions or test solutions to problems in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5) Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and redefine the design accordingly. (HS-ESS2-5) 	<p>Disciplinary Core Ideas: <u>ESS2.c: The Roles of Water in Earth's Surface Processes</u></p> <ul style="list-style-type: none"> The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5) The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosity and melting points of rocks. (HS-ESS2-5) <p><u>ESS2.D: Weather and Climate</u></p> <ul style="list-style-type: none"> Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) 	<p>Crosscutting Concepts: <u>Cause and Effect</u> Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5)</p> <p><u>Structure and Function</u> The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. (HS-ESS2-5)</p>
<p>Possible Preconceptions/Misconceptions: Many students confuse the ozone-hole problem with the greenhouse effect and believe they are the same thing. This lesson will model the greenhouse effect which emphasizes how carbon dioxide concentrations are warming the atmosphere. Students also confuse climate with weather. This lesson will require the teacher to state the difference: climate is defined by average and extreme atmospheric conditions over at least a 30-year period whereas weather is the instantaneous condition that may range over a few days at most.</p>		

LESSON PLAN – 5-E Model

ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:

Begin this lesson with students writing what they know about climate change.

Then show students the video [Ambassadors of Conversation and the Climate with Dr. Katharine Hayhoe](#) . Ask students to take notes and write a summary of the advice Dr. Hayhoe gives.

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions: procure the following items:

- 10 jars with lids
- 10 thermometers
- 10 flashlights/lamps
- Sodium bicarbonate
- Vinegar
- Water (liquid)
- Ice cubes (dyed blue with food coloring)
- Small basin
- 5 cardboard tubes (paper towel roll)
- Funnel
- Tea kettle (electric)
- 5 Tablespoons
- Book of matches
- Scotch tape

Create 5 stations illustrating weather and climate experiments.

Station One: Cloud in a Jar

Materials:

- Jar with lid
- 50 ml hot water
- Glass rod/spoon
- Matches
- 1-2 ice cubes

Instructions:

1. Carefully pour 50 ml of hot water into the glass jar.
2. Gently stir the water with a glass rod/spoon.
3. Light a match with the assistance of an adult.
4. Drop the match into the jar and close the lid.
5. Place 1 ice cube on top of the lid.
6. Observe and draw an illustration of the formation of a cloud.

Station Two: Greenhouse Effect

Materials

- 2 Jars
- 2 thermometers
- Flashlight or lamp
- One piece of aluminum foil

Instructions:

1. Tape a thermometer inside of each jar such that the tip of the thermometer is not touching the jar.
2. Place foil over the opening of one jar.
3. Record the temperature.
4. Turn on the light source (flashlight or lamp) positioning it and pointing it at the jar.
5. Observe for a minimum of 6 mins and record the temperature.

Station Three: Rising Sea Levels

Materials:

- Basin
- Jar
- 1000 ml of water
- Six ice cubes (dyed)

Instructions:

1. Pour 1000 ml of water into the basin.
2. Place a jar in the basin upside down.
3. Carefully add 3 blue-colored ice cubes on top of the jar.
4. Turn on the light source (flashlight or lamp) positioning it and pointing at the ice on top of the jar.
5. Observe for a minimum of 6 minutes and record.

Station Four: Climate Change

Materials:

- o 2 Jars with lids
- o 2 thermometers
- o 2 cardboard tubes (5 cm)
- o 2 flashlights/lamps
- o Funnel
- o Scotch tape
- o 1 tablespoon of sodium bicarbonate
- o 15 ml vinegar

Instructions:

1. Label one Jar A and the other Jar B.
2. Tape each thermometer to the outside of a cardboard tube.
3. Add 1 tablespoon of sodium bicarbonate to Jar A.
4. Attach one cardboard tube with the thermometer to each of the jars so you can read the thermometer.
5. Place the funnel in Jar A and carefully pour 15 ml of vinegar (be sure not to get any vinegar on the thermometer or the tube).
6. Quickly close the lids of both jars.
7. Shine the light sources on the jars.
8. Observe and record the temperature every 2 minutes for 6 minutes.

Station Five: Carbon Footprint

Materials:

- o 5-10 Laptops

Instructions:

1. Go to the 8 Billion Trees website at 8billiontrees.com
2. Calculate your carbon footprint by completing the survey.
3. Record your carbon footprint, how many earths we would need if everyone lived like you, and how many trees you need to plant to offset your carbon footprint.
4. Select 3-5 things you can do and will do to offset your carbon footprint.

Students rotate through the stations in small groups. After completing all five stations, give students 5 minutes to reflect on their observations and ask them to write a description explaining how these experiments relate to climate change.

EXPLAIN: Concepts Explained and Vocabulary Defined: Begin by asking students the difference between weather and climate.

Tell students that when we talk about the climate we are talking about long-term averages of daily weather, and how the atmosphere “behaves” over relatively long periods of time. Weather is what conditions of the atmosphere are over a short period of time, think days not years. Ask students how they would define **climate change**. Explain that climate change refers to long-term shifts in weather patterns (i.e. the average temperature in the US in December 1895 was 31.7°F, in Dec 1925 it was 32.5°F, in Dec 1985 – 28.8°F and in Dec 2015 it was 38.6°F according to NOAA). Ask students what they think was the biggest difference between 1985 and 2015 (possible ans.: more people, computers, mobile phones, internet, globalization).

Tell students that some causes of climate change are greenhouse gas emissions, deforestation, and fossil fuel consumption. Explain that the effects of climate change may include rising sea levels, increased amount of severe weather events, and changes in ecosystems.

Then define greenhouse gases as gases like methane, hydrofluorocarbons, and CO₂ that trap heat in the atmosphere. Ask students to identify some sources of greenhouse gases (possible ans.: cars, planes, gas-burning stoves, humans (breathing), cows/livestock, farms, and household appliances like the refrigerator). Be sure to explain that CO₂ emissions make up the vast majority of greenhouse gases and it enters our atmosphere through burning fossil fuels, solid waste, and trees. Methane (CH₄) is emitted during the production and transport of coal, natural gas, and oil as well as from livestock and agricultural practices and the decay of organic waste (like in landfills).

Lead students in a discussion about their thoughts on climate change, what concerns them, and what actions they think they can take to address the issue. Remember to refer to the experiments, be sure to explain that clouds need particles in order to form, and how CO₂ is released when baking soda and vinegar are combined to serve as a model of the greenhouse effect.

Vocabulary:

Weather- the state of the atmosphere at a particular place and time as regards to heat, cloud cover, dryness, sunshine, wind, and precipitation

Climate- the average weather in a given area over a long period

Greenhouse gases- gases that trap heat in the atmosphere

Carbon Footprint- a measure of the amount of carbon dioxide released in the atmosphere as a result of the activities of an individual, an organization, or a community

Climate Change- refers to the long-term shifts in temperature and weather patterns

ELABORATE: Applications and Extensions:

Prior to starting the elaboration section of this lesson, you will need to gather the following materials (per student): computers, access to a video camera (on computer or smartphone), [Flipgrid](#) account

Students are going to create their climate change story. As Dr. Hayhoe suggests: we must determine what people think about climate change - we have to talk about climate change, and to talk about it we need to find what we have in common that is impacted by climate change, in order to make a difference.

In small groups, students will identify a common interest. Then they will research how that interest may be impacted by climate change. Here are a few resources by topic:

Sports: [earth.org](#), [Washington Post](#), [asics](#)

Fashion: [The Eco Hub](#), [The New York Times](#), [Teen Vogue](#)

Video Games: [One Green Planet](#), [Cosmos](#), [Games for Change](#)

Careers: [Green Citizen](#), [Sci Journal](#), [indeed](#)

Animals: [National Park Service](#), [WWE](#), [CDC](#)

Encourage students to visit the links for more stories on the subject. They need to gather 5 facts about how climate change is impacting their area of interest.

Then students will create a script for their Public Service Announcement talking about their climate change story.

After students write their scripts, they may use their smartphones or the web camera on the laptop to create a Flipgrid video.

[Flipgrid](#) is a free video discussion and sharing app that allows teachers and students to create a grid about a specific topic. It's an opportunity for students to find their voices and share them with others. Click on [Flipgrid](#) to set up your account and create the assignment for this activity.

EVALUATE:

Formative Monitoring (Questioning / Discussion): Data collected from mini-investigations, discussion on climate change, stating causes and the effects

Summative Assessment (Quiz / Project / Report): PSA on Climate Change

Elaborate Further / Reflect: Enrichment: As a class, plan the school's Earth Day Celebration. It should be an opportunity to educate the staff and student body on climate change, its impact, and what people can do to make a difference.

SOCIAL EMOTIONAL LEARNING ACTIVITY

CASEL Competency: Relationship Skills

The ability to establish and maintain healthy and supportive relationships requires good communication and collaboration. Dr. Hayhoe explained that in order to ask folks to do something about a big idea like climate change, you need to start small and discuss things you have in common. Basically, you need to build a relationship. This activity called HOT SEAT, is a fun way to build community in the classroom. It requires students to work together, listen carefully, communicate clearly, and think creatively.

Directions:

1. Divide the class into two groups.
2. Place two empty chairs aka "hot seats" at the front of the room facing away from the board.
3. Take one volunteer from each team to sit in the "hot seat" facing their teammates.
4. Using a prepared list of vocabulary words, write one word on the board.
5. Each team will take turns trying to get their teammate in the "hot seat" to guess the word, using synonyms, antonyms, and definitions as clues. (Be sure the team members are working together positively)
6. When the term is correctly identified, that team earns a point, and a new set of students enter the "hot seat".
7. A new term is written on the board and the teams begin to share their clues.

After a few rounds, lead a discussion with the class asking them the following: what they learned from this activity, how do you communicate clearly, why was it important to listen and to be creative?

INTERDISCIPLINARY CONNECTIONS/IDEAS**ELA/Literacy**

RST.6-8.1 - Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-5)

RST.6-8.9 - Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ESS2-5)

WHST.6-8.8 - Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ESS2-5)

Mathematics

6.NS.C.5 - Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-ESS2-5)

MP.2 - Reason abstractly and quantitatively. (MS-ESS2-5)

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1	Tea kettle (electric)
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Lesson Created by Stacy Douglas
For questions, please contact info@usasciencefestival.org

Ambassadors of Conservation & the Climate with Dr. Mireya Mayor

Grade/ Grade Band 9-12	Topic: Conservation	
Brief Lesson Description: During the lesson, students will examine climate change factors endangering wildlife. Then they will create a computer model illustrating the impact.		
Performance Expectation(s): HS-ESS3-3 Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. (HS-ESS3-3)		
Specific Learning Outcomes: Students will design a computer-generated model illustrating how climate change is impacting wildlife.		
Narrative / Background Information		
Prior Student Knowledge: Students should be able to describe the causes and effects of climate change. Students should be familiar with using Scratch to code. Students should be familiar with the concept of computer-generated models.		
Science & Engineering Practices: Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. ● Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-ESS3-3)	Disciplinary Core Ideas: ESS3.C: Human Impacts on Earth Systems ● The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)	Crosscutting Concepts: Stability and Change Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-3)
Possible Preconceptions/Misconceptions: Students may believe there is no scientific consensus on the existence or causes of global climate change. Students may also believe the climate is always changing or has changed many times before humans began burning coal and oil. So there is no reason to believe humans are causing warming today.		
LESSON PLAN – 5-E Model		
ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions: Begin this lesson by showing students the video Ambassadors of Conversation and the Climate with Dr. Mireya Mayor . Ask students to take notes and write a summary of Dr. Mayor’s journey to becoming a primatologist. Ask students to list how they believe climate change impacts wildlife (possibly ans.: droughts/floods impact food production, rising sea levels flood homes along the coasts and increase beach erosion, warming temperatures, and droughts foster wildfires which increase air pollutants and respiratory issues).		
EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions: Students will need access to laptops and the internet for this activity. Students will explore examples of computer models for climate change by playing games on the NASA resource website. Coral Bleaching: https://climatekids.nasa.gov/coral-bleaching/ Climate Time Machine: https://climatekids.nasa.gov/time-machine/ Allow students ample time to engage with both websites, asking them to record the following in their notebooks: 1. Describe how these games illustrate the impact of climate change. 2. In what ways are these three concepts interconnected?		

3. What was the coolest aspect of the games?
4. Could you apply any knowledge you learned to playing the games?
5. Did you learn anything by playing the games?

Next, in small groups, assign students to a specific endangered species i.e., bumblebees, monarch butterflies, Hawaiian honeycreepers, Giant Mountain lobelia, Adelie penguin, White lemuroid ringtail possum, Staghorn coral, cottontail rabbits, red squirrels, and whales. Students will research their species' habitats, reproduction habits, food sources, behavior, the impact of humans on their environment, and any causes that result in changes in population numbers (ie., rising sea levels, loss of habitat; lower temperatures less food; increase human presence, decrease predators). Let students know that this research will be the basis for the computational model of how climate change is impacting the species they are researching.

Here are a few resources to start the research:

[Earth Day](#)- 10 Animals Threatened by Climate Change

[The Guardian](#)- The 10 species most at risk from Climate Change

[Forbes](#)- How Rabbits Could Be The Next Climate Change 'Canary In The Coal Mine'

[Fauna & Flora](#)- Which plants and animals are affected by climate change? Some of the names may surprise you.

[PBS](#)- Preventing Plant Extinction Caused by Climate Change

EXPLAIN: Concepts Explained and Vocabulary Defined: *Prior to the lesson set up Teacher and Class accounts on [Scratch](#) (see below for tutorial).*

Explain to students, scientists use computers to model complex and dynamic phenomena. Computational modeling allows students and scientists to represent invisible agents and overcome any physical limitation to studying a problem. Define computational modeling as representations of systems with interrelated parts.

Ask students to identify the variables that are impacting the population of their assigned species (ex. temperature, precipitation, sea level)

Explain the steps involved in creating a computational model using Scratch:

1. Open Scratch and select Create
2. Choose a background by clicking on the stage in the lower right-hand corner
3. Choose your characters by adding "SPRITES" (here is where students select the character to represent the species studied)
4. Add code by clicking on the "SCRIPTS" tab to code your "Sprites" to control its behavior (i.e., "sprite" moves when temp. changes)
5. Add variables by clicking on the "DATA" tab. The variables are values that change such as precipitation or sea level. You can use variables to control the behavior of your "sprite."
6. Test your simulation by clicking the "Green Flag." Use the sliders to control the variables and record changes in the behavior of your "sprite."
7. Refine your simulation; adjust the code to make the "sprite" respond in a way that is more visually appealing.

Tutorial for the teacher: <https://youtu.be/PPHcvbHZtLg>

Tutorial for students: <https://scratch.mit.edu/projects/837341776/editor>

Vocabulary:

Computational modeling- representations of systems with interrelated parts; they represent measurable (quantitative) relationships within systems and change behavior based on different inputs into variables

ELABORATE: Applications and Extensions: *Students will need access to laptops and login to Scratch*

Students will use the information gathered during research to create a computational model that illustrates the impact of climate change on the assigned species of wildlife. The simulation should include variables such as changes in temperature, precipitation, and sea level. Once the simulation is complete, students will use the data generated to analyze the impact of climate change on the assigned species and write a report discussing how these changes could lead to a decline in the population of the species.

EVALUATE:

Formative Monitoring (Questioning / Discussion): discussion about climate issues facing their community; research gathered about assigned species

Summative Assessment (Quiz / Project / Report): computational model; report analyzing data collected during simulations

Elaborate Further / Reflect: Enrichment: Students can create a list of possible solutions to the problem of climate change and its impact on wildlife. They should consider short-term and long-term solutions and discuss the potential benefits and drawbacks of each in a social media campaign.

SOCIAL EMOTIONAL LEARNING ACTIVITY

CASEL Competency: Responsible Decision-Making

Being open-minded is essential to Dr. Mayor's work, climate change, and conservation. Because Dr. Mayor is curious, she can use her voice to help save lemurs from extinction and tell the world about new lemur species. Responsible Decision-Making is making caring and

constructive choices about personal behavior and social interactions across diverse situations. It is about demonstrating curiosity, and open-mindedness, and identifying solutions for personal and social problems. In this activity, students will develop their open-mindedness and responsible decision-making skills.

Use the following materials:

- index cards

Begin by dividing the class into small groups and asking each group to brainstorm and record any social problems they know about in their community or the world. After 5 minutes bring the class back together to discuss the problems they have identified. Next, give each student an index card and ask them to write down a solution they think can address one of the social problems discussed. Collect the index cards and mix them up.

Divide students back into their groups and give each group an index card and 15 minutes to discuss the solution listed and create a presentation. Then each group shares their presentation of the solution and why they think it can be effective.

After every group presents, students then reflect on the activity. Have each student write down one thing they did today that illustrated their ability to be open-minded and one example of responsible decision-making they made during today's activity.

INTERDISCIPLINARY CONNECTIONS/IDEAS

Mathematics

MP.2 - Reason abstractly and quantitatively. (HS-ESS3-3)

MP.4 - Model with mathematics. (HS-ESS3-3)

Materials Required for This Lesson/Activity

Quantity	Description
Per student	Laptops
1 package	Index cards



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