Atmosphere

FINALIST
Environmental Film Festival in the Nation's Capital
2021

OFFICIAL SELECTION
Wildlife Conservation Film Festival
2021

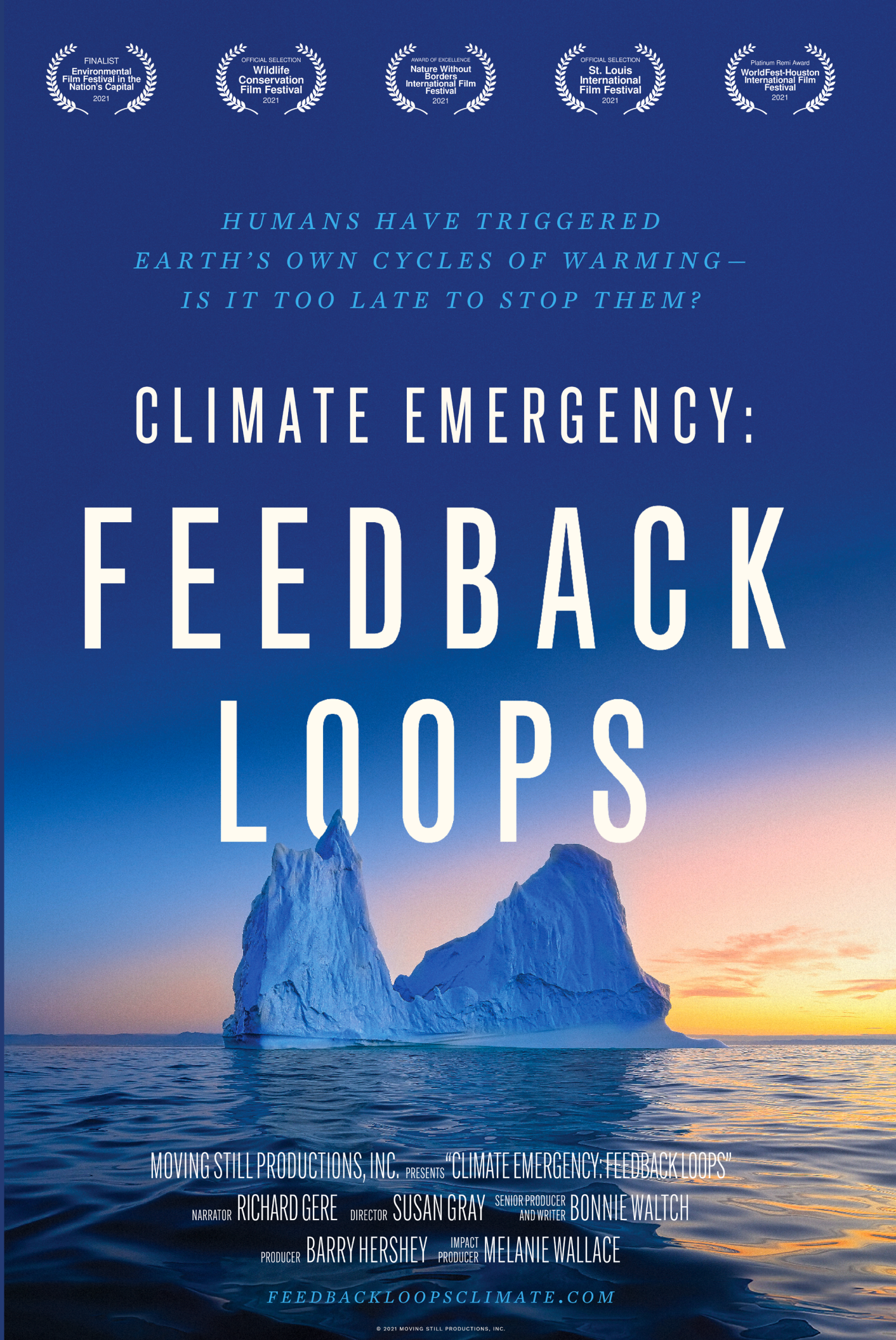
AWARD OF EXCELLENCE
Nature Without Borders International Film Festival
2021

OFFICIAL SELECTION
St. Louis International Film Festival
2021

Platinum Remi Award
WorldFest-Houston International Film Festival
2021

HUMANS HAVE TRIGGERED EARTH'S OWN CYCLES OF WARMING— IS IT TOO LATE TO STOP THEM?

CLIMATE EMERGENCY: FEEDBACK LOOPS



MOVING STILL PRODUCTIONS, INC. PRESENTS "CLIMATE EMERGENCY: FEEDBACK LOOPS"

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FEEDBACKLOOPSCLIMATE.COM

JOURNEYS IN FILM™
educating for global understanding

About *Journeys in Film*

Journeys in Film is a 501(c)(3) nonprofit organization that amplifies the storytelling power of film to educate the most visually literate generation in history. We believe that teaching with film has the power to help educate our next generation with a richer understanding of the diverse and complex world in which we live.

We transform entertainment media into educational media by designing and publishing cost-free, educational resources for teachers to accompany carefully chosen feature films and documentaries while meeting mandated standards in all core subjects. Selected films are used as springboards for lesson plans in subjects like math, science, language arts, social studies and more. Our resources support various learning styles, promote literacy, transport students around the globe, and foster learning that meets core academic objectives.

In addition to general subject areas, Journeys in Film's programs engage students in meaningful examinations of human rights, poverty and hunger, stereotyping and racism, environmental issues, global health, immigration, and gender roles. Our teaching methods are successful in broadening perspectives, teaching for global competency, encouraging empathy, and building new paradigms for best practices in education. We seek to inspire educators, school administrators, community members and home-schooling parents to use our innovative curriculum to capture the imagination and curiosity of their students.

We also develop discussion guides for films that don't necessarily lend themselves to academic standards but cover topics and themes that are valuable for classroom discussions and in other settings, such as after school clubs, community screenings, and college classes.

Journeys in Film is a 501(c)(3) nonprofit organization.

Why use this program?

In an age when literacy means familiarity with images as much as text and a screen has become a new kind of page, 21st-century students are more connected to media than any previous generation.

This offers educators unprecedented opportunities to engage students in learning about a variety of subjects and issues of global significance. Films, television, documentaries, and other media platforms can provide an immediate, immersive window to a better understanding of the world and matters affecting all of us.

We teach our students literature that originated from all around the world, but we tend to forget that what often spurs the imagination is both visual and auditory. Films evoke emotion and can liven up the classroom, bringing energy to a course. We believe in the power of films to open our minds, inspire us to learn more, provide a bridge to better understanding the major issues of 21st-century concern, and compel us to make a difference.

When properly used, films can be a powerful educational tool in developing critical thinking skills and exposure to different perspectives. Students travel through these characters and their stories: They drink tea with an Iranian family in *Children of Heaven*, play soccer in a Tibetan monastery in *The Cup*, find themselves in the conflict between urban grandson and rural grandmother in South Korea in *The Way Home*, and watch the ways modernity challenges Maori traditions in New Zealand in *Whale Rider.* Journeys in Film brings outstanding and socially relevant documentaries to the classroom that teach about a broad range of social issues in real-life settings, such as famine-stricken and war-torn Somalia, a maximum-security prison in Alabama, and a World War II concentration camp near Prague. They explore complex and important topics like race and gender. Students tour an African school with a Nobel Prize–winning teenager in *He Named Me Malala* and experience the transformative power of music in *The Music of Strangers: Yo-Yo Ma & the Silk Road Ensemble* and *Landfill Harmonic*.

Our hope is that this generation of youth will contribute to the betterment of humankind through kindness and understanding, together with scientific knowledge to help solve some of the world's most pressing issues.

Our goal is to create relevant and engaging curricula and programming around media that encourage cross-cultural understanding, empathy, and knowledge of the people and environments around the world. We aim to prepare today's youth to live and work as globally informed, media- literate, and competent citizens.

Why We Must Act Now

"We're reaching the stage in the heating of the earth when fundamental systems are disrupted: the jet stream, the Gulf Stream, even the way the planet reflects and absorbs sunlight. As these five films will make clear to to all who view them, we are kicking off feedback loops beyond our ability to control—once we've melted the Arctic no one has a plan for refreezing it; the great forest fires pour ever more carbon into an already overloaded atmosphere. We've run out of margin—we must act now to stop the burning of fossil fuel that lies at the bottom of this cascading crisis."

—Bill McKibben, author, environmentalist, and co-founder of anti-carbon campaign group *350.org*

"The global average temperature continues to set new records. Extreme heat waves and intense droughts now affect much of the globe, damaging agriculture and facilitating wildfires. Simultaneously some regions are experiencing extreme storms, precipitation, and flooding. These specific changes were anticipated by some scientists 40 years ago, but the changes were not supposed to happen until 2100 or later. Why now? The direct warming has melted reflective ice and snow and released additional heat trapping gases from permafrost and other lands. These feedbacks have amplified the warming and disrupted the climate decades to a century sooner than anticipated. We can unwind this accelerating downward spiral by rapidly reducing heat trapping gases and by allowing more forests and other natural systems that are already removing 31% of our annual emissions each year to accumulate additional carbon out of the atmosphere. This will eventually slow global warming and diminish the feedbacks, facilitating the return to a more benign climate. The feedback loop videos identify four major feedbacks and clearly demonstrate how they interact to accelerate further warming and increase the resulting climate change consequences."

— William Moomaw, Professor Emeritus, The Fletcher School, Tufts University
Lead author of the Nobel Prize-winning Intergovernmental Panel on Climate Change

Introducing *Climate Emergency: Feedback Loops*

The five short films of *Climate Emergency: Feedback Loops* were released in 2021, a year after one of the hottest years on record. In 2020, the Earth experienced a range of extreme weather that may have finally caught the attention of policy-makers:

- A Siberian heat wave set temperature records in excess of 100 degrees Fahrenheit within the Arctic Circle.
- Wildfires ravaged the western United States and Australia.
- The Atlantic hurricane season, with an extraordinary 30 named storms, caused over $46 billion in damages to property.
- The area of Arctic sea ice was at a record low.
- Super Typhoon Goni hit the Philippines with sustained winds of 195 miles per hour.
- Monsoon flooding in China destroyed or damaged 1.4 million homes and businesses.

Extreme as these events were, scientists are even more worried about the Earth's natural feedback loops that have the potential to create even more disastrous weather events. According to an article in *Scientific American,* "…catastrophic climate change could render a significant portion of the Earth uninhabitable consequent to continued high emissions, self-reinforcing climate feedback loops and looming tipping points."[1]

What is a feedback loop? Feedback loops are a continuous system in which a change in one (or more) parts of the system act to influence the rest of the system, either positively (increasing the effects of the system) or negatively (decreasing the effects of the system). A positive feedback loop is a circular chain of events that can amplify a change within a system. In a negative feedback loop, series of events dampen the change within the system, helping make it more stable.

1 https://www.scientificamerican.com/article/the-climate-emergency-2020-in-review/

The five films of *Climate Emergency: Feedback Loops* use stunning video, interviews with leading climate scientists, and thoughtful narration by Richard Gere to educate the viewer on key feedback loops greatly accelerating climate change. The "Introduction" film drives home the point that human activity is increasing global warming and leading to climate change. It explains the concept of feedback loops and shows briefly how this concept applies to forests, atmosphere, permafrost, and albedo.

"Forests" explains that the world's trees have long served as a "carbon sink," removing carbon dioxide from the air, storing carbon in wood, leaves, branches, and trees' soils, and in turn releasing water vapor and oxygen. The shrinking of forests, due to human activities like logging and clearing areas for agriculture, means that less carbon is captured and global temperatures increase.

In the video "Permafrost," the viewer learns that this area of frozen ground, which covers about a quarter of the Northern Hemisphere, stores massive amounts of carbon underground. As it begins to thaw, microscopic animals are waking and feeding on frozen vegetation and animals and then releasing more gases into the atmosphere, creating additional warming.

"Atmosphere" deals with warming that is altering the Earth's weather pattern and making extreme weather events more common. Even the jet stream is being affected, resulting in warmer weather moving north and stalling for longer periods of time, with consequent changes in rainfall patterns and flooding.

"Albedo" refers to the ability of Arctic ice to reflect the sun's rays and temper their warming effect. However, the volume of ice is decreasing; it has shrunk 75% in the past forty years,

and consequently the albedo effect has diminished. The Arctic may soon be ice-free in the summer.

Taken together, these five short films make the case that time is running out to prevent catastrophic climate change, change that could result in the extinction of whole species and drastically affect human societies. Unless we demand and implement dramatic changes, the Earth will reach a "tipping point" from which there is no return.

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PRODUCER: Barry Hershey
IMPACT PRODUCER: Melanie Wallace
ASSOCIATE PRODUCER: Talia Sabato
NARRATOR: Richard Gere
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CINEMATOGRAPHER: Jesse Beecher
EDITOR: Tim Raycroft
GRAPHICS DESIGNER: James Carlson

Climate Emergency: Atmosphere Lesson

(Environmental Science, Earth Science)

Enduring Understandings

- Global warming is altering Earth's weather patterns dramatically. A warmer atmosphere absorbs more water vapor, which in turn traps more heat and warms the planet further in an amplifying feedback loop.
- Climate change is disrupting the jet stream, triggering a feedback loop that brings warm air northward and cold air southward, further warming the Arctic and causing weather patterns to stall in place for longer.
- The atmosphere is complex, and scientists continue to work to understand how fossil fuel emissions are altering the chemistry and general dynamics of the atmosphere and therefore contributing to climate change.
- Clouds play a critical role in trapping heat, as well as reflecting energy away from Earth.
- Since the problem has been human driven, so is the solution. A social change is required to help bring the Earth back into its natural cyclical pattern.

Essential Questions

- What are feedback loops and how do they impact climate?
- What role do clouds play in Earth's climate?
- How does water vapor affect temperature?
- How does the jet stream influence climate, and how has it changed over time?
- How do we reduce carbon emissions?
- How can we spread awareness and reduce our carbon footprint?

Notes to the Teacher

This lesson is designed to teach students about climate locally, regionally, and globally, while providing opportunities to practice scientific literacy and presentation skills, learn about educational and career pathways in climate science, and explore possible solutions to the climate change problem.

The lesson is divided into four parts. Part 1 of this lesson is designed to address the first four essential questions listed at left. Students will work in groups of four to discuss, research, and teach one another about each essential question. (Groups can be determined by the teacher prior to class.) Each student will be responsible for preparing a presentation to demonstrate understanding of one essential question.

The second part introduces students to the possible changes to the climate in their state or region. It teaches students how to locate and explore the climate archives that each land-grant university maintains. (A land-grant university is an institution of higher learning designated under the Morrill Acts of 1862 and 1890. In response to the Industrial Revolution, states were given federal lands to sell to raise money for colleges that would teach practical skills like agriculture, science, engineering, and even military science. These generally became large state public universities.)

Students will act like scientists by asking a question that they want to explore, conducting the necessary research, preparing their findings using tables and graphs, incorporating one thing they learned from the atmosphere chapter, and then presenting their findings to the class. There is also an extension activity if students are interested in exploring other climate-change-related stories anywhere in the world.

Before teaching Part 2, search the Internet for the state climate office for your state. Each state's climatology data are kept by the State Climatologist; their offices are located on each state's land-grant campus (for example, at the University of New Hampshire, the University of Vermont, University of Massachusetts Amherst, etc.) Locate the archived climate history for your state and become familiar with its organization and data so that you can assist your students in their research.

Part 3 gives students an opportunity to listen to young people who are activists fighting against climate change. After considering the example of Malala Yousafzai, who started a global movement to protect girls' right to an education, students listen to speeches by an array of climate activists, including the well-known Greta Thunberg. Then they consider ways they can make their own voices heard on this subject.

To follow up with this lesson, consider moving on to Lesson 5, "Re-Greening the Earth," which helps students research particular steps that could be taken.

Common Core Standards addressed by this lesson

CCSS.ELA-Literacy.RST.9-10.1
Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions

CCSS.ELA-Literacy.RST.9-10.7
Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

CCSS.ELA-LITERACY.RH.11-12.7
Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.

CCSS.MATH.CONTENT.HSF.IF.B.6
Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Next Gen Science Standards addressed by this lesson

HS.Interdependent Relationships in Ecosystems
Students who demonstrate understanding can:

HS-LS2-6.
Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]

HS-LS2-7.
Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]

HS-LS4-6.
Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. [Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]

The performance expectations to the left were developed using the following elements from the NRC document A Framework for K-12 Science Education:

Science and Engineering Practices
Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. (HS-LS2-7)

Disciplinary Core Ideas
LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6)
- Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7)

LS4.D: Biodiversity and Humans

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HS-LS2-7)
- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through over-population, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7), (HS-LS4-6)

ETS1.B: Developing Possible Solutions

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HS-LS2-7),(secondary to HS-LS4-6)
- Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (secondary to HS-LS4-6)

Crosscutting Concepts

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-8),(HS-LS4-6)

Scale, Proportion, and Quantity

- The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-LS2-1)
- Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. (HS-LS2-2)

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS2-6),(HS-LS2-7)

Duration of Lesson

Part 1: 3 class periods—Atmosphere and Climate Change
Part 2: 2–3 class periods—Climate Patterns in Your State
Part 3: 1–2 class periods—Meet the Scientists
Part 4: 4–5 class periods—Student Activism Project and Presentations

Assessments

Brainstorming notes
Handouts, webquest, and worksheets
Class discussions
Student or group projects and presentations

Materials

Handout 1: Essential Questions Worksheet
Handout 2: Student Feedback Form
Handout 3: Climate Patterns in Your State
Basic art supplies for making posters
Whiteboard or overhead to record and display class ideas and questions
Computers with Internet access
Climate Emergency: Feedback Loops documentary "Atmosphere" at https://feedbackloopsclimate.com/atmosphere/

Procedure

Part 1: Atmosphere and Climate Change

1. Explain to students that a well-designed lesson has at least one important question for students to investigate; then tell them that this lesson has four questions they will be studying. Pass out copies of **Handout 1: Essential Questions Worksheet** and read through the four Essential Questions. Tell students they will be working in small groups and will be responsible for researching and teaching their group members about one of the four questions.

2. Watch the *Climate Emergency: Feedback Loops* documentary "Atmosphere" with the entire class.

3. Divide the class into groups of four and have the groups spread out around the room. If you have an odd number of students, here are some options:

a. More than one student in the group could create presentations on the same essential question.
b. Students from the same group could work together on a single presentation of an essential question.
c. The group could work together to create presentations for questions not selected by individuals.

4. Give time for group members to determine which question each student will select for this activity. They should circle their chosen question in the space provided on **Handout 1**. Allow students time to work together to brainstorm what each remembers from the video about any of the four essential questions to help each other get started. Students should write down these ideas in the space provided on the handout. If desired, have students begin their research for homework.

5. Begin the next class by letting students know they will have most of the class period to research and create a plan for a presentation poster. As they work, circulate around the room to check in with students and help as needed.

6. About 15 minutes before the end of the period, have students sketch and share with you a draft of a poster on their essential question that they will be using for the small group presentation.

7. For homework, have students complete the poster and prepare talking points for a two- to three-minute presentation for the next class period.

8. At the beginning of the next class, distribute a copy of **Handout 2: Student Feedback Form** to each student. Then have students return to their initial groups.

9. Explain to students that now each student in the group will take a turn to present a poster and talking points that answer the essential question to group members. During the presentation, group members need to take notes on the information learned from the poster and presenter. After each presentation, they should record comments and questions for the presenter in the space provided on **Handout 2**. When they have finished, they should provide feedback to the presenter in the form of comments and questions. Group members can also offer specific compliments and constructive criticism for the presenter. The presenter should write notes about the feedback from group members in the space provided on the Student Feedback Form.

10. Have students begin their small group presentations; they should be happening simultaneously in the classroom. Rotate among groups to observe, listen, and guide discussion as necessary.

11. Wrap up the class period by having students share take-aways from the process. Possible questions include:

- What was most interesting to you?
- What did you learn?
- What did your classmates do well?
- What can we all work on to improve?

Finally, summarize the session to help students connect the four essential questions by asking: How does Earth's atmosphere affect global climate? Give students an opportunity to complete **Handout 2** to summarize the answer to this question.

Important points for students to cover on the poster and in discussion:

<u>What are feedback loops and how do they impact climate</u>?

- Feedback loops are a continuous system in which a change in one (or more) parts of the system act to influence the rest of the system, either positively (increasing the effects of the system) or negatively (decreasing the effects of the system). [See below for examples of how changing factors (clouds and water vapor) may impact the climate system.]

<u>What role do clouds play in Earth's climate?</u>

- Clouds can affect Earth's climate in two major ways.
  - Clouds reflect sunlight back into space, reducing the warming effect that sunlight has on the Earth's surface (exposed rocks and soil, water, urban areas, etc.) This effect results in reduced warming of the Earth's atmosphere.
  - Clouds can also act as a blanket, preventing the natural cooling that occurs overnight if the skies are clear.
- If increased evaporation (including transpiration) occurs due to warming, increased cloudiness may have the effect of slowing the warming of the atmosphere.
- If, on the other hand, increased evaporation/transpiration results in increased levels of water vapor (see below) instead of clouds, the rate of atmospheric warming will increase.

How does water vapor affect temperature?

- Water vapor is a powerful greenhouse gas, more powerful than CO_2 or CH_4 (methane), and will increase atmospheric enhanced greenhouse warming.
- Several major climate models differ in their projections of future warming, based on their assumptions regarding more clouds (reduced rate of warming) or increased water vapor (increased rate of warming) in the atmosphere. At this point, it is not clear which of these results may happen.

How does the jet stream influence climate and how has it changed over time?

- The jet stream is a pattern of high-altitude winds moving from west to east around the Earth.
- There are several jet streams, both north and south of the equator. The north polar jet stream has a strong impact on weather patterns in the northern hemisphere by moving high pressure (clear and sunny) and low pressure (cloudy and rainy) systems around the planet.
- Weather is what happens day-to-day or week-to-week, while climate is more long-term (changes over years, decades, or longer).
- The warming of the Arctic has changed jet stream patterns in the northern hemisphere over the past 40–50 years (beginning in the 1970s). Over that period of time, the north polar jet stream has become more erratic, resulting in dramatic changes in our weather, such as frequent fluctuations in hot and cold weather patterns.

Part 2: Climate Patterns in Your State

1. Begin the class by brainstorming questions students would like to answer about climate in their state or region. (10 minutes) Examples could be:

a. Is my state in a drought?
b. Is my town experiencing a drought?
c. Is my state experiencing higher than normal temperatures?
d. Has there been a change in snowfall or rainfall patterns in the last year, decade, or century?

2. Give each student a copy of **Handout 3: Climate Patterns in Your State**. Tell them to begin by writing down one of the questions they generated during the brainstorming session. Show students how to access their state's climate office and how to filter the necessary data. Then allow students to conduct their own research while you circulate to assist them.

3. Provide time in class for students to locate the appropriate data to answer their question. They should sketch drafts of how to present the data in tables and graphs. (You can decide if you would like students to complete the tables and graphs by hand or using digital tools.)

4. Ask students to include in their report one thing they learned from the "Atmosphere" video to demonstrate their understanding of the material. (They could draw a feedback loop, explain the changes to the jet stream, discuss the frequency and intensity of hurricane activity, or explain the role of water vapor and clouds in the climate system.)

5. Conduct a whole-class discussion of what students have learned about the climate in their state. What are the implications for the future, based on what they learned in the film "Atmosphere"?

6. If desired, assign the extension activity at the end of **Handout 3** to have students analyze the causes and effects of certain recent extreme weather events.

Part 3: Meet Some Student Activists

1. Ask students if it is really possible for a teenager to bring about any movement to stop climate change. Discuss briefly.

2. Ask students if they have ever heard of a young woman named Malala Yousafzai. If they do not recognize the name, explain that she was a teenager in Pakistan when she was almost assassinated because she was advocating for the right of girls to attend school. After she recovered, she became an international leader in the fight for girls' education. She was even invited to address the United Nations and she won a Nobel Peace Prize at age 17. There is a documentary about her called *He Named Me Malala*.

3. Explain to students that there is another global campaign started by a teenager, one that tries to influence governments to adopt policies to stop climate change. Its leader is Greta Thunberg, a Swedish activist born in 2003. She is known all over the world for her actions and speeches to raise awareness of the problems that are inevitable with continued global warming.

4. Ask students how they think they could make their own voices heard. Encourage them to think about writing a letter to the editor for their local paper, planning a presentation to the school community, networking with local conservation organizations, etc.

5. For an extension activity, if there is sufficient student enthusiasm, consider using Lesson 5 from this guide, which helps students research and plan one step that could be taken to "regreen the Earth."

Extension Activities

These additional activities will show students the many career opportunities in science and help them understand how to pursue possible interests in climate science.

1. Arrange for students to interview a scientist who is working in the area of climate change. You can locate one through your local university, the climate office for your state, or an environmental agency. The interview can be either in person or on Zoom. Some possible questions students might ask are:

a. What did the scientist want to be as a young person?
b. Were there any surprising changes in the scientist's path?
c. Where did the scientist go to school?
d. When did the scientist know climate science was the right fit?
e. What schools have programs for this kind of work? Are there internships in this field or Extended Learning Opportunities (ELOs) that would provide some experience?

2. Spend a day in the library exploring educational and career pathways.

Additional Resources

IPCC [Intergovernmental Panel on Climate Change] Climate Change 2014 Synthesis Report Summary for Policymakers
http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

Howard Hughes Medical Institute (HHMI)—Paleoclimate: A History of Change
http://media.hhmi.org/biointeractive/click/paleoclimate/

NASA—Global Climate Change: Vital Signs of the Planet
https://climate.nasa.gov/

HHMI—Geologic Carbon Cycle
http://www.hhmi.org/biointeractive/geologic-carbon-cycle

Global Footprint Network—Ecological Footprint Calculator
https://www.footprintnetwork.org/our-work/ecological-footprint/

Carbon Brief—Mapped: How Climate Change Affects Extreme Weather Around the World
https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world

Bozeman Biology
http://www.bozemanscience.com/biology-main-page/

USGS—Climate and Land Use Change
https://www.usgs.gov/centers/norock/science/climate-land-use

New York Times—"Climate Change Is Complex. We've Got Answers to Your Questions."
https://www.nytimes.com/interactive/2017/climate/what-is-climate-change.html?rref=collection%2Fbyline%2Fjustin-gillis&action=click&contentCollection=undefined&region=stream&module=stream_unit&version=latest&contentPlacement=3&pgtype=collection

Scientific American—10 Solutions for Climate Change
https://www.scientificamerican.com/article/10-solutions-for-climate-change/

Solutions for climate change from Project Draw-down
https://drawdown.org/solutions

Laurie David and Heather Reisman's *Imagine It: A Handbook for a Happier Planet* (New York: Rodale Books, 2020) provides suggestions for individuals and families to change their own habits in order to reduce their use of natural resources.

Handout 1

***Climate Emergency*: Atmosphere Lesson**

(Environmental Science, Earth Science)

Essential Questions Worksheet

Name _____ **Date** _____

Directions: Your task is to prepare a brief presentation answering one of the four essential questions from the *Climate Emergency: Feedback Loops* documentary "Atmosphere." Please use this worksheet to explore and learn about the question you choose.

Step 1: Select a Question

Spend some time in your small group to determine which question each student would like to take for this activity. Circle your choice below.

Essential Questions

- What are feedback loops and how do they impact climate?
- What role do clouds play in Earth's climate?
- How does water vapor affect temperature?
- How does the jet stream influence climate and how has it changed over time?

Step 2: Brainstorm as a Group

Work with your group members to brainstorm ideas of what was learned from the video about each essential question. In the space below, write notes from the group discussion that pertain to your question.

Step 3: Individual Research

Find information about the answer to your essential question. Record what you learn in a science journal or notebook.

Step 4: Poster Plan

Sketch a rough draft of the poster you will be using in your presentation. Be sure your poster answers your essential question completely. It should be visually appealing with a balance of images, diagrams, and text.

Step 5: Check-In

Share your draft with your teacher and group members for feedback.

Step 6: Project Completion
Create a final draft of your poster and write notecards with talking points for a two- to three-minute presentation.

Handout 2

***Climate Emergency*: Atmosphere Lesson**

(Environmental Science, Earth Science)

Student Feedback Form

Name _____ **Date** _____

Directions: Use this sheet to take notes during each group member's presentation. At the end of each presentation, provide feedback to the presenter in the form of comments and questions. Group members can also offer specific compliments and constructive criticism for the presenter. Write notes about the feedback given to you in the space under your question. Then use the information you learn to answer the big question: How does Earth's atmosphere affect global climate?

Essential Questions

- What are feedback loops and how do they impact climate?

- What role do clouds play in Earth's climate?

- How does water vapor affect temperature?

How does the jet stream influence climate and how has it changed over time?

- How does Earth's atmosphere affect global climate?

Handout 3

***Climate Emergency*: Atmosphere Lesson**

(Environmental Science, Earth Science)

Climate Patterns in Your State

This is your chance to learn about the climate in your state or region. Each state has a university land-grant school where the climate data for that state are archived. For example, the University of New Hampshire houses the New Hampshire State Climate Office, which can be found here: https://mypages.unh.edu/nhsco/home. Your task is to generate a state- or regional-climate question to research and report out to the class. You may want to know if your state is experiencing a drought or excessive rainfall over the past year or decade.

Step 1: What question would you like to learn more about in your state or region?

Step 2: Locate your state climate office and explore the resources available to answer your question. Write down your notes and findings below:

Step 3: Construct tables and graphs to communicate your findings to the class. Sketch below your rough draft ideas to share with your teacher.

Step 4: Apply one thing you learned in the "Atmosphere" video to help your audience understand the possible changes in climate. Consider feedback loops, impact of water vapor, cloud cover, or changes to the jet stream, for example.

Step 5: Present your results to the class. Be sure to include the following:

a. Question
b. Tables and graphs
c. Summary of findings
d. Knowledge from video to support your presentation
e. Optional: other images to support your findings

Extension Activity: Research a climate change issue that has been in the news recently. You could explore the drought in New England, the heat wave in the Northwest, water shortages in the West, or the Australian wildfires. This website has archived many of the climate-related events around the world to help you generate ideas:

> Carbon Brief—Mapped: How Climate Change Affects Extreme Weather Around the World
> https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world

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