Phenomena Contributing to the Earth's Atmosphere – Grade 6, Level 3

Lesson Overview

In this lesson, students will examine how climate change in Antarctica affects the penguins that live there. Students will take on the role of different scientists to analyze the effects of global warming on Antarctica's living and nonliving systems. Students will analyze scientific arguments based on evidence concerning climate change.

Alignment

Standard/Indicator Addressed

6.E.2A.2 Critically analyze scientific arguments based on evidence for and against how different phenomena (natural and human induced) may contribute to the composition of Earth's atmosphere.

Science and Engineering Practices

S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.

S.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.

Students should also ask questions and define problems; construct explanations and design solutions; engage in scientific argument from evidence; and obtain, evaluate and communicate information.

ELA Inquiry Standards

Standard 3: Construct knowledge, applying disciplinary concepts and tools, to build deeper understanding of the world through exploration, collaboration, and analysis.

Standard 4: Synthesize integrated information to share learning and/or take action.

Content area literacy: Students should *analyze data from a variety of sources, including informational text, argue based on evidence, obtain data from various sources, evaluate and communicate evidence.*

Connections

Disciplinary Literacy Strategies (for Purposeful Reading, Meaningful Writing, and Productive Dialogue)

Give Me Five
Table Talk
Graphic Organizer: Cause and Effect
Line Up
Jigsaw
Highlighting
Concept Map/Flow Chart
Exit Ticket/Exit Slip

Computational Thinking

*Computational thinking (CT) is a problem-solving process that includes (but is not limited to) the following **characteristics**:*

- Logically organizing and analyzing data
- Representing data through abstractions such as models and simulations
- Generalizing and transferring this problem solving process to a wide variety of problems

*These skills are supported and enhanced by a number of dispositions or attitudes that are essential dimensions of CT. These **dispositions or attitudes** include:*

- Confidence in dealing with complexity
- The ability to deal with open ended problems
- The ability to communicate and work with others to achieve a common goal or solution

Lesson Plan

Time Required – Two 45-50 minute class periods
Disciplinary Vocabulary – climate, global warming, population, behavior, survival, biotic, abiotic, variables, Ornithologist, Oceanographer, Meteorologist, Marine Ecologist, and Fisheries Biologist

Materials Needed:

- Video clip "Penguins Response to Climate Change"
- Graphing Paper
- Pencil

- Highlighters
- Legal Size Paper to make Flow Chart
- 10 index cards for each group

- Specialist Fact Sheet for selecting Scientist's Role (1 per group)
- Climatologists: Air temperature data set Handout (may be used to create a class visual)
- Best Fit Line Graph (may be used to create a class visual)
- Data sets for each Specialist Group
- Report sheet questions
- Cause and Effect Graphic Organizer (may be used to create a class visual)

Formative Assessment Strategies: Students will be assessed by the presentation of their flow chart and explanations; Exit Ticket/Slip

Computational Thinking: This lesson addresses computational thinking by allowing students to interact with authentic data to organize and analyze data about penguins in Antarctica, represent the data in a graph, use evidence, apply logic, and construct arguments for their proposed explanations, and evaluate and communicate the information scientifically.

Misconceptions:

- Greenhouse gas sources and their composition in the atmosphere(Cannot identify some of the human activities that increase the amount of CO2; Cannot identify sources of carbon emissions produced by US citizens)
- Unaware of the role of water vapor as a key greenhouse gas (Do not understand the role of water vapor to trap heat and add to the greenhouse effect)
- How the greenhouse effect works (Do not understand the role of greenhouse gases as major contributors to increasing Earth's surface temperature)
- Erroneous cause-effect relationship between the greenhouse effect, global warming, and ozone layer depletion
- Do not understand that climate occurs on a time scale of decades (most think it is weeks or months)
- Do not know the main atmospheric contributors to global warming
- Cannot describe human activities that are causing the long-term increase of carbon - dioxide levels over the last 100 years
- Cannot describe carbon reduction strategies that are feasible for lowering the levels of carbon dioxide in the atmosphere

Engage

- Show the video ***Understanding Penguin Response to Climate Change:*** (4 minutes 34 seconds) ***https://www.youtube.com/watch?v=gOOFPWcbU2s***
- Ask the following questions and use the Give Me Five strategy to select students to respond.
    - What were some of the major obstacles that the penguins had to face? *Penguins had to endure extreme blizzards and large icebergs. The icebergs made their journey for food much longer and more difficult.*
    - Why do the Adélie penguins thrive on Ross Island? What changes might challenge the vitality of the penguin colonies found there? *Penguins thrive because all of their needs are met on Ross Island. It provides food, breeding grounds, and shelter. Climate change can challenge the vitality of the penguin colonies.*
    - Why are penguins in more danger during incubation periods than at any other time of the year? *During incubation periods there are extreme blizzards; penguins cannot leave their nests and can get buried in the massive amounts of snow.*
    - Why is the area in Antarctica where Adélie penguins live being hit by more severe storms today than in the past? *Rising ocean temperatures are adding more moisture in the air causing more severe storms with high snow accumulations and wind.*
    - One of the predicted climatic changes associated with global warming is less predictable weather. What are some of the problems associated with this unpredictability, for both Adélie penguins and human societies? *Answers will vary.*

- Teacher introduces self as a climatologist and introduces the data.
- Say: "Welcome! I am a climatologist with the Intergovernmental Panel on climate change in Geneva, Switzerland. I study long term patterns in climate. My colleagues and I have researched changes in air temperatures on the Antarctic Peninsula since 1947. "
- Give the Climatologists: Air temperature data set handout.
- Say: "Take a minute, study the data, and discuss it with your group."
- Students use the **Table Talk Strategy** to discuss the data provided.
- Students should draw a conclusion with supporting data and record this information.
- Say: "We have observed that although air temperatures on the Peninsula cycle up and down, they have increased overall. We think this may be occurring due to greenhouse gases, but we are unsure of the impacts on the Antarctic ecosystem. Your team's job is to describe the interconnected effects of warming in the Antarctica's living and nonliving systems."
- Have participants draw a conclusion with supporting data and then show the line of best fit. A line of best fit is a straight line drawn through the center of a group of data points plotted on a scatter plot. Scatter plots depict the results of gathering data on two

variables. The line of best fit shows whether these two variables appear to be correlated and can be used to help identify trends occurring within the dataset. (http://www.investopedia.com/terms/l/line-of-best-fit.asp#ixzz4KS1pNBvR)

Explore

- Say: "Let's get to know the penguin by reading some informational text."
- Have students read the informational text on the Adélie penguin and record information in a Cause and Effect **Graphic Organizer.**
    - Students draw arrows from causes to effects; a cause may have more than one effect; an effect may lead to another cause; arrows do not have to go straight across.
- Use **Line Up** to divide students into groups of five. Then use the **Jigsaw Strategy** to form expert groups.
    - Create home groups of 5 people; each person in the group selects a scientist's role. (Ornithologist, Oceanographer, Meteorologist, Marine Ecologist, and Fisheries Biologist)
    - Participants then move into groups based upon their field (i.e. All the oceanographers get together)
    - Each student receives only the data related to his/her field. Home groups should not collaborate at this time.
    - Give students time to read over their data "piece" at least twice and become familiar with it. Have students use the **highlighting strategy** to identify main ideas or key concepts along with supporting details
    - Have students in the "expert groups" discuss the main points of their "piece" of the text using **Table Talk** and plan and rehearse how they will present the information to their Jigsaw group. (Give students an adequate amount of time to complete the task.)
    - Each student answers the report sheet questions.
    - Each group works together to graph and analyze the data on legal size paper. (Each scientist needs a copy to take back to his/her home group).

Explain (Day 2)

- Have students return to their (HOME) groups to share the "piece" of the information with the Jigsaw group. Remind the rest of the students to listen carefully, take notes of important information, and ask questions as needed for clarification and understanding.
- Each of the 5 science specialists should briefly present to the Home Group using the information on the report sheet.
- Hand out 10 index cards to each group of students.
- Home Groups will then analyze the data from each specialist and make connections between the biotic and abiotic factors of the Antarctic. *For example disappearance of ice*

in Antarctica leads to the depletion of Adele penguin population, and the warming of the oceans temperatures decrease the amount of krill.

- Each group will decide on 10 pieces of data to go on the index cards.
- Home Groups should then construct a flowchart using all ten index cards showing the relationship between these factors. *Remind the students throughout this process that they should use the weight of evidence to construct the flowcharts. In other words, each idea should be accepted or rejected based on the amount of support it has.*
- The teacher may wish to draw an example of a flow chart on the board to guide students.
- Students present flow charts.
- **Exit Tickets/Slips Strategy**: Students select one of the questions and provide a response before leaving class.

    - How has the ecosystem of the Antarctic Peninsula changed in the last 50 years? What are the most likely explanations for these changes?
    - Is there sufficient evidence to support these explanations? Why or why not? What further questions are left unanswered?
    - Did your Specialist Group come up with any explanations that you think are not very likely (or not even possible) based on the complete story presented by your Home Group?

Lesson adapted from SPRINTT Polar Research "Plummeting Penguin Populations"

Sponsored by: National Science Foundation (NSF Award 0732793)

Other information on this indicator(s) can be found in the support documents/resources on the SC State Department website.

www.ed.sc.gov (Instruction → Standards and Learning → Science → Support Documents and Resources)

Content Area (Disciplinary) Literacy strategies and descriptions can be found on the S2TEM Centers SC website:

s2temsc.org (Resources → Disciplinary Literacy Virtual Library → Strategy Warehouse)

Computational Thinking Reference:

https://csta.acm.org/Curriculum/sub/CurrFiles/CompThinkingFlyer.pdf
https://csta.acm.org/Curriculum/sub/CompThinking.html

Additional Information

Level 1 lessons contain a realignment to the 2014 Science and/or the 2015 Mathematics Standards.
Level 2 lessons contain Level 1 information and Content Area Literacy and Disciplinary Literacy Strategies.
Level 3 lessons contain Level 1 and 2 information and Computational Thinking Connections.
Level 4 lessons contain Level 1, 2, and 3 and integration of at least 2 content areas.