COSEE Networked Ocean World Presents:

Antarctica melting

A Collaborative Investigation of Climate Change

Materials

- ✓ Whiteboard or chart paper and a marker
- ✓ Air Temperature Data graph
- ✓ Specialist Fact Sheet (1/ student)
- ✓ Flowchart cards (1 set/ student)

Overview

The effects of climate change can be felt at both the local and global level. At the global level, in addition to alterations in temperature and precipitation patterns, climate change will result in adverse effects such as species displacement. In western Antarctica, this species displacement becomes evident through the migration of penguin species. Adelie penguins, which were abundant throughout this area for the past 600 years, are now being replaced by Chinstrap and Gentoo penguins. The reason for this decline in Adelie penguins may be linked to the increase in temperatures and the resulting decrease in sea ice. The sea ice provides the Adelie penguins, which cannot swim quickly, with a nearby food source (krill) so they do not have to swim long distances. Moreover, the sea ice helps to decrease the amount of snow that falls by reducing the amount of water evaporated from the ocean and forming clouds. Extra snow can melt too late in the year and cause the suffocation of Adelie eggs. Meanwhile, chinstrap and gentoo penguins are well adapted to open water areas and thrive during times of decreased sea ice extent.

This activity allows students to teach each other about the many factors involved in the climate change of the western Antarctic and then has them work together to derive a connection between these factors.

Motivating Question: **How has the ecosystem of the Antarctic Peninsula changed due to climate change?**

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Activity Outline

Engage:	This activity will help the students convey their understanding about the environment in Antarctica and will provide information to ensure students are ready for the activity.	10 minutes
Explore:	This activity has students take part in role-playing. Students take on the persona of different scientist and evaluate evidence of climate change in Antarctica.	20 minutes
Make Sense:	This activity allows each group of students to share their findings with the class. The students then combine their findings with those of others in order to form a complete picture of how climate change is impacting Antarctica.	20 minutes
	Total:	50 minutes

Preparation (15 minutes)

1. Write the motivating question on the board or a large piece of paper:

   Q: How has the ecosystem of the Antarctic Peninsula changed due to climate change?

2. Make enough copies of the specialist fact sheet and flowchart cards so that each student can receive a full set. These cards can be found within the original lesson by Constible et al. at: http://www.units.muohio.edu/cryolab/education/documents/PenguinLesson_Constible.pdf

3. Make copies or an enlarged version of the Air Temperature graph (provided below).

Engage (10 minutes)

1. **Think**: Ask students to think about the location, climate, and landscape of Antarctica. If you like, have the students jot down their thoughts in a notebook.

2. **Pair**: Ask students to turn to the person next to them and discuss what sea birds, like penguins, in Antarctica would eat and how this would impact where the birds live on Antarctica.

3. **Share**: Have a few pairs share their thoughts with the group. Record all their responses on flip-chart paper, but be careful not to correct or comment on the students' answers.

4. Explain to the students that because the Antarctic climate is covered by permanent ice sheets, sea birds must live along the coastline or on small islands.

Adelie Penguins

Chinstrap Penguins

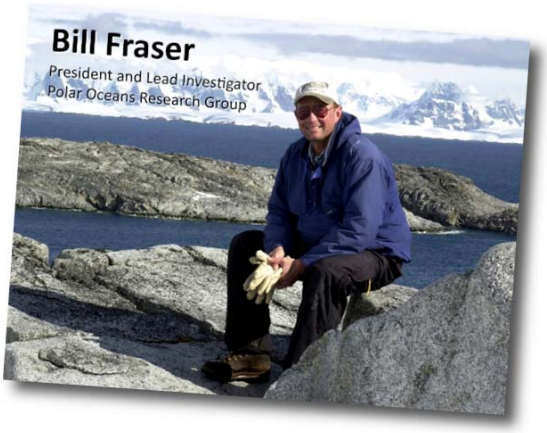
Gentoo Penguins

5. Point to the motivating question and explain that today's experiments they will focus on these sea birds and other environmental factors to investigate the following question:

   Q: How has the ecosystem of the Antarctic Peninsula changed due to climate change?

   Again, have students share their ideas about the question with a partner and then with the table group. Finally, ask volunteers to share the ideas from their table group with the entire room.

Explore (20 minutes)



1. Instruct students to read the Specialist Fact Sheets. Each student will assume the identity of a scientist from the list.
2. Split the class into five different Scientist/Specialist Groups (ornithologist, oceanographer, meteorologist, marine ecologist, and fisheries biologist)
3. Introduce yourself as follows: "Welcome! I am a climatologist with the Intergovernmental Panel on Climate Change in Geneva, Switzerland. In other words, I study long-term patterns in climate. My colleagues and I have studied changes in air temperatures on the Antarctic Peninsula since 1947. We have observed that although air temperatures on the Peninsula cycle up and down, they have increased overall [show Figure 4]. We think this is occurring because carbon dioxide emissions have enhanced the Earth's natural greenhouse effect. Carbon dioxide and other greenhouse gases trap some of the sun's heat and reflect it back to the earth, rather than releasing it back to space. We are interested in the effects that recent warming has had on the Antarctic ecosystem. This is where you come in. It is your job to describe the interconnected effects of warming on Antarctica's living and nonliving systems."
4. Direct the specialists to meet with their respective Specialist Groups. Specialist Groups should not interact with each other.
5. Distribute the data sets, Specialist Group Report Sheets, and graph paper to each Specialist Group. Each group will be answering the following:

   a) In your own words, summarize the general trend or pattern of your data. Attach a graph of your data to the back of this sheet.

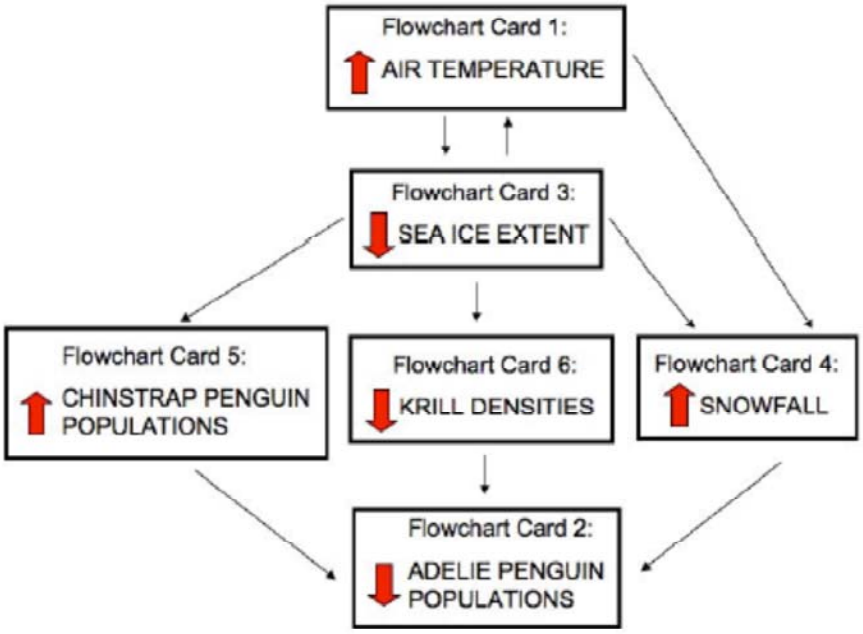
a) List possible explanations for the patterns you are seeing.

b) With the help of the facts at the top of each data sheet, choose the explanation that you think is most likely. Why do you think that explanation is most likely?

Make Sense (20 minutes)

1. Bring the class back together and hand out a complete set of flowchart cards.
2. One representative from each specialist should make a brief presentation to the class on what their graph shows and what has caused this.
3. After all of the presentation, the class should work together to construct a flowchart on a large piece of paper or whiteboard. Remind the scientists throughout this process that the weight of evidence should be used to construct the flowcharts.

Sample Flowchart presented in the lesson by Constible et al.



4. Lead a class discussion using the following questions:

Q: How has the ecosystem of the Antarctic Peninsula changed due to climate change?

Q: What are the most likely explanations for these changes?

Q: Are you convinced by the evidence for these explanations? Why or why not? What further questions are left unanswered?

Q: 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 in you flowchart

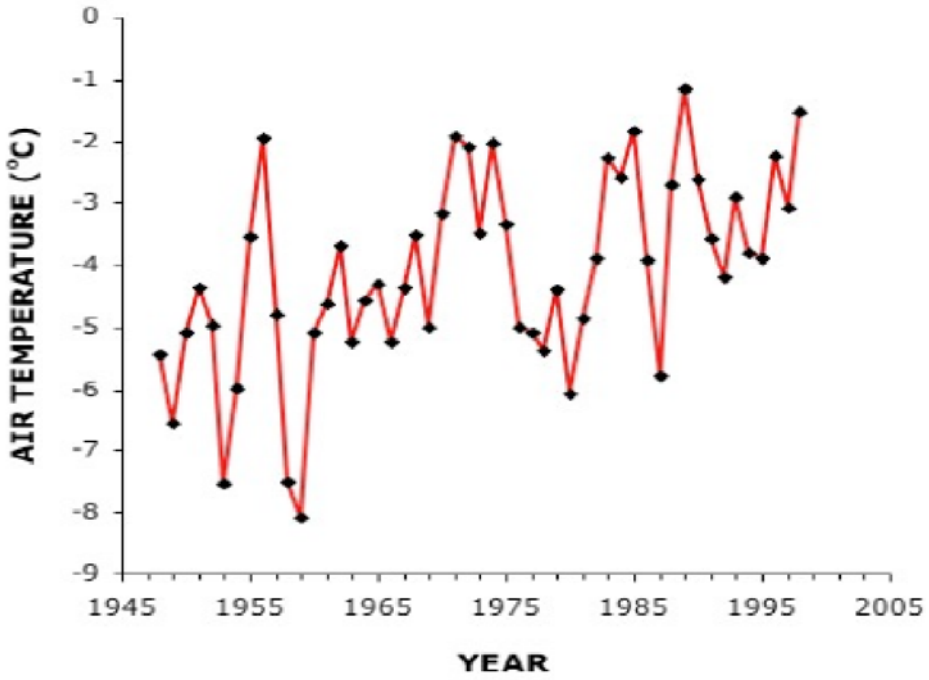
5. Have the students watch **Act III: An Adelie exit** and ask the students to compare their findings to those of the scientists in the slideshow.

Video: *Act 3: An Adelie exit*, available at: *http://coseenow.net/antarctica*

Source: This lesson was copied and adapted from "A Collaborative Classroom Investigation of Climate Change on the Antarctic Peninsula" developed by Juanita Constible, Luke Sandro, and Richard Lee.

Figure 4.

CLIMATOLOGISTS: Air Temperature Data Set (Flowchart Card 1)



Graph from "A Collaborative Classroom Investigation of Climate Change on the Antarctic Peninsula" developed by Juanita Constible, Luke Sandro, and Richard Lee.