



### Deep Freeze

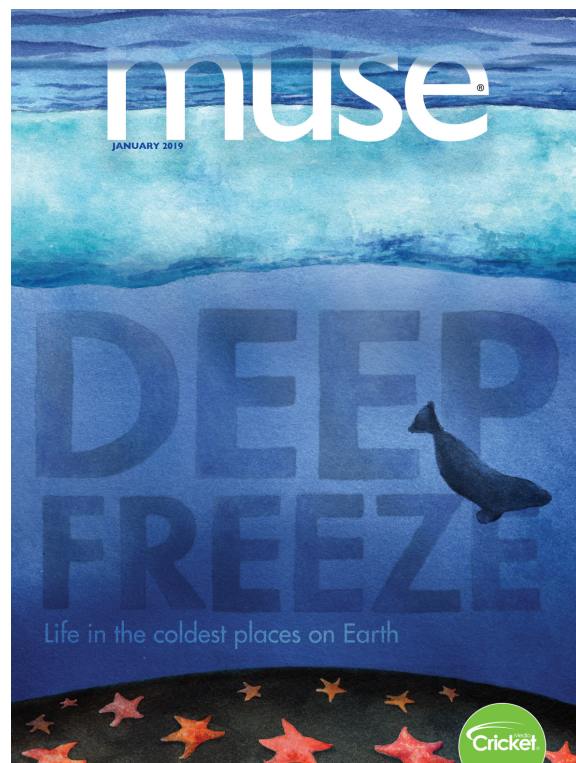
**Brrrr!** This issue of MUSE examines how some of our most valuable information regarding past climates is literally frozen in time. Readers will learn about the tools and strategies that scientists use to collect this data and how they utilize it to predict future climate patterns.

### CONVERSATION QUESTION

**How does studying polar environments help us to learn about past and future climates?**

### TEACHING OBJECTIVES

- Students will learn how glaciers provide a valuable record of past climates.
- Students will learn how scientists use radio waves to peer through thick layers of ice.
- Students will learn how Native Arctic people survive and thrive in their environment.
- Students will analyze evidence.
- Students will examine the interconnectedness of relationships.
- Students will obtain and record information.
- Students will create a graph that depicts world temperature trends.
- Students will research the effects of global warming.
- Students will create a travel brochure for a circumpolar region.



In addition to supplemental materials focused on core STEM skills, this flexible teaching tool offers vocabulary-building activities, questions for discussion, and cross-curricular activities.

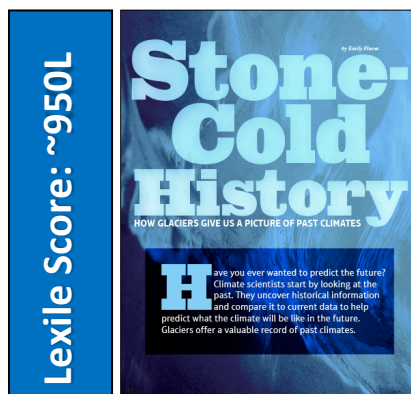
### SELECTIONS

- **Stone-Cold History**  
Expository Nonfiction, ~950L
- **Looking Down by Going Up**  
Expository Nonfiction, ~1050L
- **Elders Know-How**  
Expository Nonfiction, ~750L

## Stone-Cold History

### pp. 12–15, Expository Nonfiction

Students will learn why ice cores drilled from glaciers are so valuable in helping scientists acquire information about the past, as well as being a tool for predicting future climates.



## RESOURCES

- Ice-Cold Evidence

## OBJECTIVES

- Students will learn how glaciers provide a valuable record of past climates.
- Students will analyze evidence.
- Students will create a graph that depicts world temperature trends.

## KEY VOCABULARY

- **ice cores (p. 13)** long cylinders of glacial ice recovered by drilling through glaciers
- **interglacial periods (p. 14)** intervals (1,000+ years) of warmer global average temperatures that separate consecutive glacial periods
- **glacial periods (p. 14)** intervals of time within an ice age that are marked by colder temperatures and glacial advances

## ENGAGE

**Conversation Question:** How does studying polar environments help us to learn about past and future climates?

Create interest in the subject matter by showing a short clip from the movie *Ice Age*. Have students compare/contrast this fictional movie with their own knowledge about the ice age. Inform the students that they will be reading an article that explains how scientists gather information from glaciers to learn about this time period.

## INTRODUCE VOCABULARY

After the motivational activity above, post the key vocabulary terms and definitions on the board. Discuss the meanings of the words with the class and then distribute the article.

## READ & DISCUSS

Reinforce comprehension of concepts in this article by arranging students in small groups to answer the following questions.

- Explain the difference between weather and climate.
- How do scientists learn about the temperature and landscape from the 1800s?
- What criteria must be met to officially refer to a large mass of snow and ice as a “glacier”?

## CONCEPT/SKILL FOCUS: Analyzing Evidence

**INSTRUCT:** Review with the students that collecting and analyzing evidence is how scientists form theories about the past. Furthermore, learning about the past often helps us to formulate ideas about the future. Instruct students to reread the article with a partner and to highlight sentences in the article that reveal evidence. Distribute the graphic organizer, *Ice-Cold Evidence*, and assign pairs of students the task of analyzing the evidence.

**ASSESS:** Circulate as the students are completing their graphic organizers and encourage students to use their own reasoning skills, as well as facts from the article to analyze the evidence. Collect the completed work to further evaluate understanding.

## EXTEND

**Mathematics** On page 13 of the article it is stated that the ten warmest years ever recorded occurred within the last two decades. Research this claim using books/internet to find actual temperatures for these years. Create a graph that visually depicts this information. Include a title, appropriate intervals, and an accurately labeled x and y axis. Alternatively, consider having some students research and graph the ten coldest years ever recorded.

## Ice-Cold Evidence

*Use information from the article and your reasoning skills to explain how each piece of evidence provides us with information about past and/or future climates.*

Definition/description of a glacier: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Evidence	Analysis (What does the evidence tell us?)
<b>Natural Clues:</b>  tree rings  ice cores	
<b>Historical Documents:</b>  descriptions of harvests  church records  ship logs	

## Looking Down by Going Up

pp. 17–20, Expository Nonfiction

This article invites readers to share the flight path of scientists and pilots as they navigate frozen territories. Students will learn how glaciologists use radar to get a glimpse of the landscape that lies hidden below the ice.



## RESOURCES

- Frosty Flight

## OBJECTIVES

- Students will learn how scientists use radio waves to peer through thick layers of ice.
- Students will examine the interconnectedness of relationships.
- Students will research the effects of global warming.

## KEY VOCABULARY

- **ice shelves** (p. 18) floating sheets of ice permanently attached to a landmass
- **radargram** (p. 18) a radar image (using radio waves) of mineral deposits
- **sediment** (p. 18) the matter that settles to the bottom of a liquid

## ENGAGE

**Conversation Question:** How does studying polar environments help us to learn about past and future climates?

Display the article's title, "Looking Down by Going Up." Lead a discussion about how different perspectives can give us different information. Ask students to notice what they can see from their seats and then allow them to stand on their chairs and reevaluate their surroundings. Ask the question, "How do different perspectives expand your knowledge base?"

## INTRODUCE VOCABULARY

Post and discuss the key vocabulary terms and definitions. Remind the class of the article's title and challenge students to verbally predict the content of the article using the keywords in their forecasted explanations. Begin reading, "Looking Down by Going Up." Upon completion, revisit the prereading predictions.

## READ & DISCUSS

Pose the following questions to the students to facilitate meaningful discussion.

- What factors determine how ice sheets move and change?
- How does radar technology give glaciologists information about glacial ice?
- Explain how developing new tools to study glaciers requires a crossover between science and engineering.

## CONCEPT/SKILL FOCUS: Examining Relationships

**INSTRUCT:** Review the information presented in the article and divide the class into small groups. Instruct the groups to examine the interconnectedness of the concepts and terms listed. Distribute the graphic organizer, *Frosty Flights*, and direct students to use details from the text to thoroughly explain and record the relationships between the pairs of terms listed.

**ASSESS:** Have mini-conversations with the groups as they work on their graphic organizers. Collect and review worksheets to further evaluate their understanding of interconnected relationships.

## EXTEND

**Environmental Science** On page 18 of the article, it states that the manner in which ice behaves can be the difference between some minor melting and a catastrophic collapse. Have students investigate the far-reaching effects of global warming. Encourage them to use books, the internet, and current newspaper and magazine articles to produce a short research paper. If possible, have the students visit younger grades and share their acquired knowledge on the subject.

## Frosty Flights

*Explain the relationship between the pairs of terms.*

ice sheets  sea level

glacial material/temperature  behavior of ice

radar technology  continental bedrock

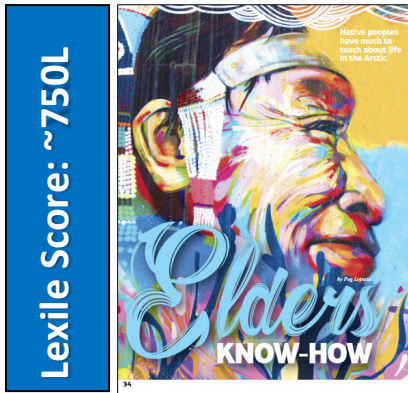
radio glaciology  space exploration

science  engineering

## Elders Know-How

### pp. 28–31, Expository Nonfiction

Put your compass aside and join tribes of Native Arctic peoples as they use nature to navigate the world. Learn how they depend on the land, sea, and sky to survive and thrive in some of the world's harshest climates.



## RESOURCES

- Arctic Expertise

## OBJECTIVES

- Students will learn how Native Arctic people survive and thrive in their environment.
- Students will obtain and record information.
- Students will create a travel brochure for a circumpolar region.

## KEY VOCABULARY

- **circumpolar** (p. 29) situated around or inhabiting one of earth's poles
- **indigenous** (p. 29) produced, grown, or living naturally in a particular region; native
- **nomadic** (p. 30) roaming about from place to place; wandering

## ENGAGE

**Conversation Question:** How does studying polar environments help us to learn about past and future climates?

Ask students what lessons they have learned about life so far and how they have acquired this knowledge. Direct students to consider if people in different regions may gather knowledge differently. Introduce the topic (Native Arctic peoples) and title, “Elders Know-How.” Discuss why survival for this group of people may depend on their ability to learn and share important life lessons at an early age.

## INTRODUCE VOCABULARY

Children will enjoy this vocabulary activity as an updated alternative to simply writing sentences. Challenge students to write a tweet (280 characters) using all three vocabulary words. Post the key terms and definitions on the board for reference. Remind students that their tweet must demonstrate understanding of the words, and if possible, allow them to send the tweet.

## READ & DISCUSS

Reinforce the facts and concepts studied in the article by using the following prompts to direct discussion.

- What is the best way to live well in the Arctic? Why?
- Why are children of the Arctic taught to be mindful of where they are?
- Explain how knowledge is shared through oral tradition.
- What is the meaning of the following sentence from page 29, “Modern life has arrived, but their wisdom remains”?

## CONCEPT/SKILL FOCUS: Obtain Information

**INSTRUCT:** This article explores the many different ways that Native Arctic people obtain information about their world. Advise students to reread the article and highlight strategies that are used by these native groups to acquire data and to gain wisdom. Instruct students to use the graphic organizer, *Arctic Expertise*, to record this information.

**ASSESS:** Circulate and converse with students as they are working on their organizers. Collect and review to further assess understanding.

## EXTEND

**Social Studies** The article, “Elders Know-How,” lists eight different circumpolar regions (p. 29) where different groups of Native Arctic people are currently living. Have students locate each of these regions on a map. Divide the class into small groups and assign each group the task of learning more about one of the particular regions. Have them create a travel brochure that includes location, climate, food, language, and daily life activities.

# Arctic Expertise

*Use information from the article, "Elders Know-How," to record the wisdom that Native Arctic people acquired by being mindful of their world.*

Page Number	Wisdom Acquired by the Native Arctic People
Page 30	You can't be greedy. The Inuit people understood that if seven eggs are found in a nest, it is smartest to take four and leave three. Those three eggs may grow into birds that lay more eggs.