SESSION 1 TALK ABOUT THE TOPIC

Exploring Extremes

FOCUS QUESTION

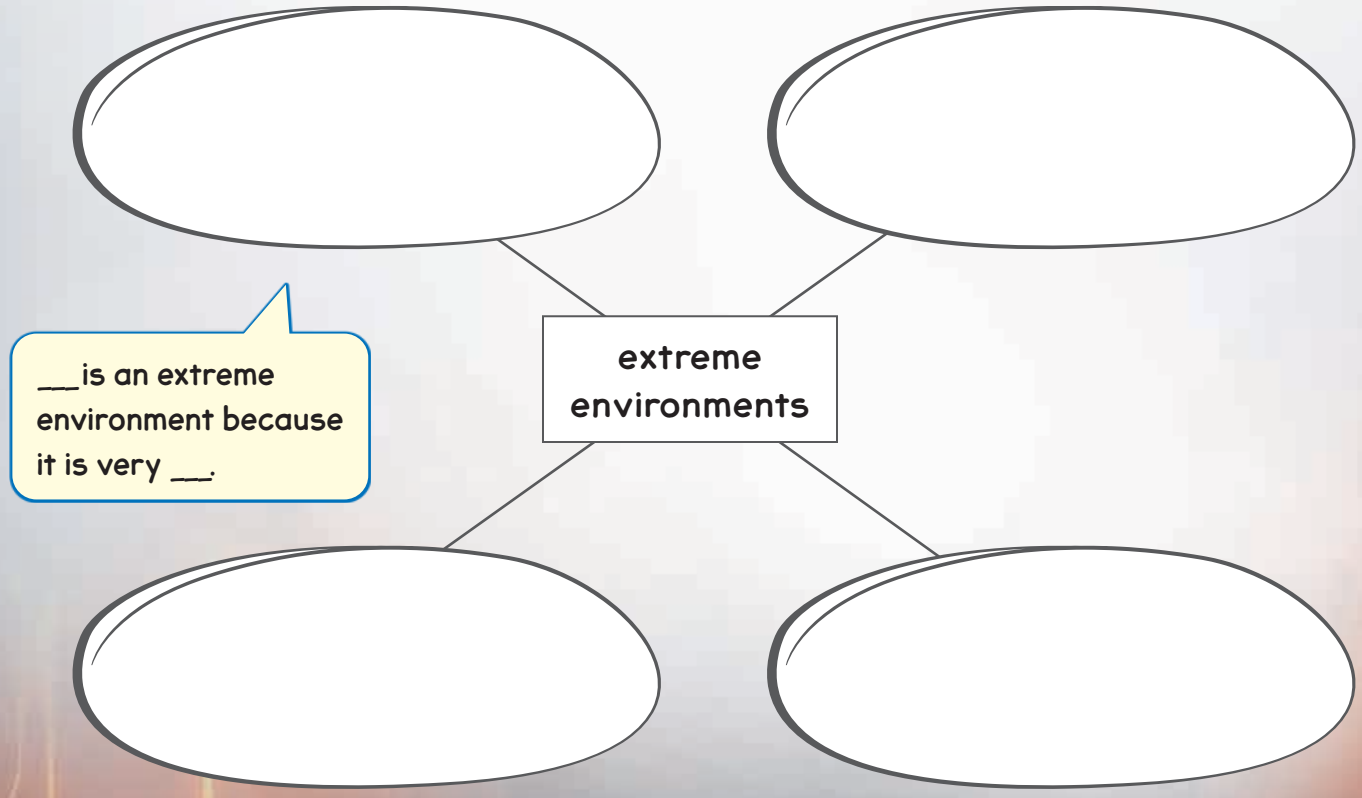
How and why do people explore extreme environments?

NOTICE AND WONDER

Look at the four texts you will read in this lesson. What do you notice? What do you wonder? Discuss your ideas with a partner.

CONCEPT WEB

What makes a place an *extreme* environment? Fill in the bubbles with words that describe extreme environments or examples of extreme environments.



Science on the Edge

by Stephen James O'Meara

River of Fire

by Stephen Krensky

Secrets of a Frigid World

by Morgan Parsons

Drawing Under Ice

by Kirsten Carlson

SESSION 1 READ

Science on the Edge

by Stephen James O'Meara

1 I know—as best anyone can know—how to walk across a lava flow. I am a volcanologist, a researcher who has traveled the globe to study and document erupting volcanoes. But even with that experience, I still wouldn't walk across just any active lava flow. There are limits, and you have to know them. And that knowledge comes with time and experience.

2 For example, while studying an eruption of Hawaii's Kīlauea volcano in 1982, I had to walk and leap across flowing lava to save my life. It was the first time I had experienced flowing lava in the field, and I was caught off guard. I was trapped on the edge of a 15-foot-high cliff between two lava flows. Beneath me was a pool of **molten** rock. The only way to escape was to cross the lava itself. To do that, I had to find places where the surface of the lava had cooled and hardened enough to support my weight. In these places, less than an inch of cooling rock would separate me from the roughly 1,000°F (538°C) lava below, a temperature about five times as hot as boiling water.

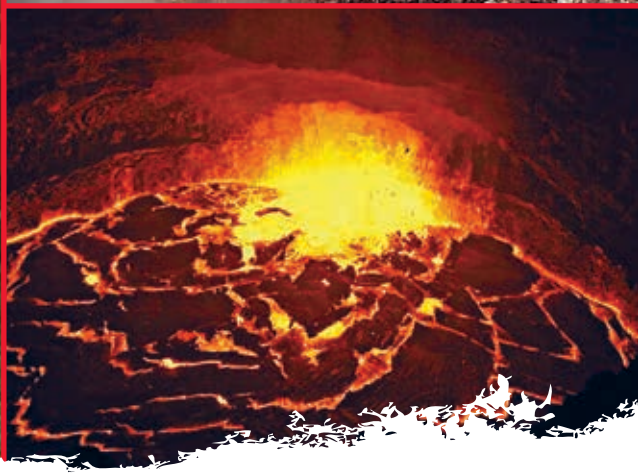
molten = melted

3 How did I know where to walk? Before the eruption, I had been educated—a Native Hawaiian who had walked across hot lava many times had carefully explained what to do and what not to do. I had also gained experience by walking on hot—but not flowing—lava before I found myself in this difficult situation. It takes serious education to do extreme science. And education for this kind of work means textbook knowledge *and* field experience.

Stop & Discuss

How did O'Meara learn to walk on lava? What did he learn to do?

Underline details that support your ideas.



Left and top: The author, Stephen O'Meara, studying lava
Bottom: A lava lake in Hawaii

4 Extreme scientists like me are on a mission. We have spent years studying some dangerous sides of nature. The only way to gain more answers is to take some big risks.

5 Where would we be if no one tried to find out what lies beyond what we already know? How do we know what the limits of research are until we prove them? Where would we be if the unknown always frightened us?

6 Extreme science is about adventure, discovery, and knowledge. Extreme scientists, like firefighters, are heroes, not because they do dangerous things, but because they put fear aside and do what they believe is right.

Stop & Discuss

Why does O'Meara explore this extreme environment?

Use details from the text to explain your answer.

SESSION 2 PRACTICE

Analyze a Firsthand Account

- A **firsthand account** is an informational text written by someone who saw or experienced an event as it happened.
- Firsthand accounts often focus on the author's thoughts and feelings and include sensory details.

Reread/Think

Reread "Science on the Edge." What does O'Meara tell us about his experiences as a volcanologist studying Kīlauea? Complete the chart with details from the text. Then describe the focus of the text.

	Text Details
What does O'Meara describe in paragraphs 1–3?	Details from paragraphs 1–3: These details help me understand:
What does O'Meara explain in paragraphs 4–6?	Details from paragraphs 4–6: These details help me understand:

What is the focus of this firsthand account? _____

_____

Talk

What kinds of details does O'Meara share about his experience? What do the details help you picture? What do the details help you understand?

O'Meara describes ___.

Details about ___ help me imagine ___.

Write

How does the author's firsthand account help you understand his work as a volcanologist? Use at least two details from the text to support your response.

WRITING CHECKLIST

- ☐ I described the focus of O'Meara's account.
- ☐ I used at least two details from the text in my response.
- ☐ I used complete sentences.
- ☐ I used correct spelling, punctuation, and capitalization.

SESSION 3 READ

River of Fire

by Stephen Krensky

Kīlauea erupting

1 Researchers called volcanologists describe the way the ground around a volcano rumbles and shakes. They report hearing harmful gases hiss, releasing the odor of rotten eggs. They describe a river of lava oozing from cracks in the volcano's surface. These signs show that the volcano may erupt at any time.

2 Volcanic eruptions are among the most powerful forces on earth. The most powerful volcanic eruptions shoot steam, rock, and lava hundreds of feet into the air. But not all volcanoes are the same. Some have not erupted in thousands of years. Others are much busier.

3 Kīlauea, on the southeast coast of the Big Island of Hawaii, is an active volcano. Since 1952, it has erupted 34 times. The word *Kīlauea* itself is a kind of warning. In the Hawaiian language, it means "spewing" or "much spreading." Most of the time, Kīlauea's lava slides slowly but steadily, steaming into the sea. But sometimes it travels inland, toward people's homes.

4 In the last 40 years, the volcano's lava has destroyed hundreds of homes and forced thousands of people to leave the area. Magma, a thick hot liquid made of melted rock, pushes up from deep inside the earth. It spills out of the volcano as lava, bubbling and spitting along the way. This river of fire is a glowing stream of heat. Nothing can hold it back.

Stop & Discuss

What does the name *Kīlauea* mean? Why do you think Hawaiians chose this name?

Use details from the text to support your ideas.

5 This river of fire holds important clues for researchers. Studying lava and volcanoes is the work of volcano scientists, or volcanologists. These scientists study lava for clues on how a volcano will act. For example, they study lava rock samples after the lava has cooled to find out its age. Knowing how old the lava is helps volcanologists predict how fast the lava will flow the next time the volcano erupts.

6 Fortunately, a volcano usually gives clues or warnings *before* it's ready to erupt. In addition to shaking ground, smelly gases, and oozing lava, a bulge may grow on top or on the side of a volcano. When scientists see this large bump, they know something on the inside is getting ready to push its way out.

7 When volcanologists see these different warning signs, they quickly alert others. This warning often gives people who live nearby time to get to safety.

Kīlauea erupting in 2018 with lava fountains up to 160 feet (48.8 meters) high

Stop & Discuss

What are three things volcanologists do?

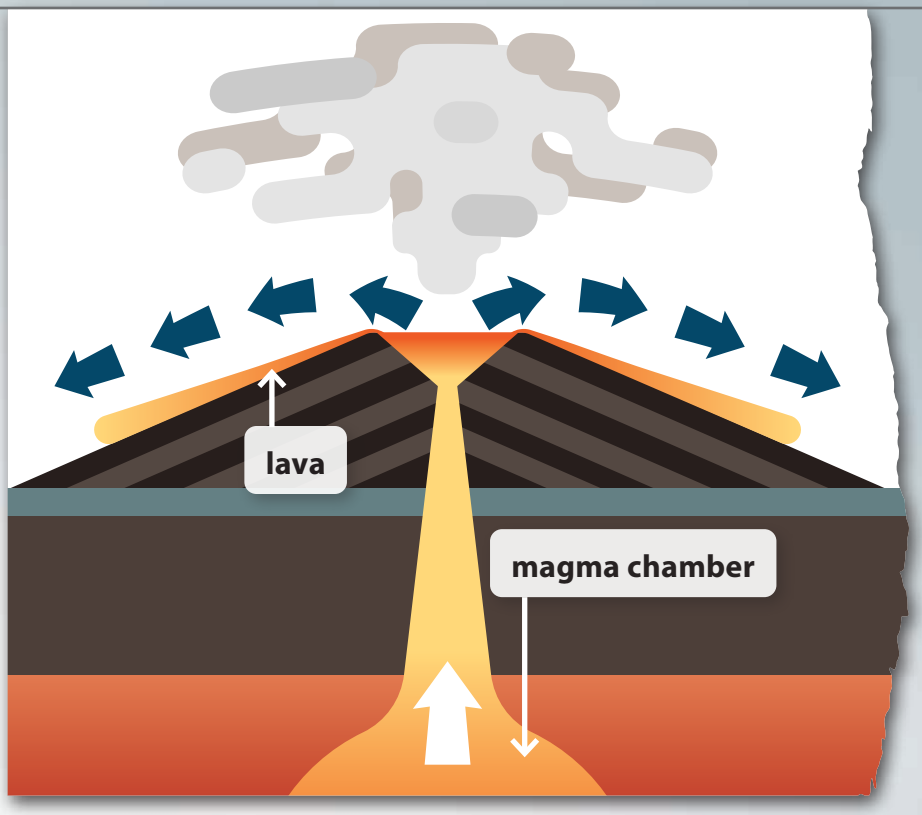
Underline details about what volcanologists study, what they look for, and what they do with this information.

One thing volcanologists do is ___.

Volcanologists look for ___ so they can ___.

SESSION 3 READ

A geologist uses a thermal camera to measure the temperature (about 93°C or 200°F) of a ground crack.



Magma forms far below Earth's surface and rises, filling the magma chamber under the volcano.

magma chamber = an underground space that holds liquid rock

8 Warnings about Kīlauea are especially important because scientists know this volcano has been active for much of its 300,000- to 500,000-year history. Although the eruptions have mostly stopped for now, the danger remains. In 2019, scientific tools revealed that Kīlauea's **magma chamber** was slowly filling up. This is a sign that the volcano could erupt in the near future. When will the volcano erupt? How big will the eruption be? Right now, nobody knows for sure, but one thing is certain. Volcanologists are there, searching the volcano for the answers.

Stop & Discuss

What are two things volcanologists know about Kīlauea?

- ☐ Kīlauea has been active for much of its history.
- ☐ Kīlauea's magma chamber is filling with lava.
- ☐ Kīlauea's next eruption will be big.

Compare Accounts

- Comparing a firsthand account with a secondhand account can help you understand more about a topic or event.
- A **secondhand account** is an informational text about a topic or event written by someone who was not there.
- Secondhand accounts include background information and factual details based on research.

Reread/Think

Reread the secondhand account "River of Fire." What does the author tell us about Kīlauea and the volcanologists who study it? Complete the chart with information from the secondhand account.

	Text Details
What does the author describe about volcanoes in paragraphs 1–4?	Details from paragraphs 1–4: These details help me understand:
What does the author explain about volcanologists in paragraphs 5–8?	Details from paragraphs 5–8: These details help me understand:

What is the focus of this secondhand account? _____

_____

SESSION 4 PRACTICE

Talk

Use your charts to compare the firsthand account "Science on the Edge" and the secondhand account "River of Fire."

- What does each account tell you about the work volcanologists do?
- What does one account explain that the other does not?
- Which account do you like better? Why?

Share your ideas with a partner. Listen to your partner's ideas.

I like the firsthand account because it describes ___.

I like the secondhand account because it tells more about ___.

Write

Compare the firsthand account "Science on the Edge" and the secondhand account "River of Fire." Explain what each account helps you understand about the work that volcanologists do. Use details from both texts to support your response.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

WRITING CHECKLIST

- ☐ I identified what each account explains about volcanologists.
- ☐ I used details from both accounts to explain my ideas.
- ☐ I used correct spelling, punctuation, and capitalization.

Secrets of a Frigid World

by Morgan Parsons

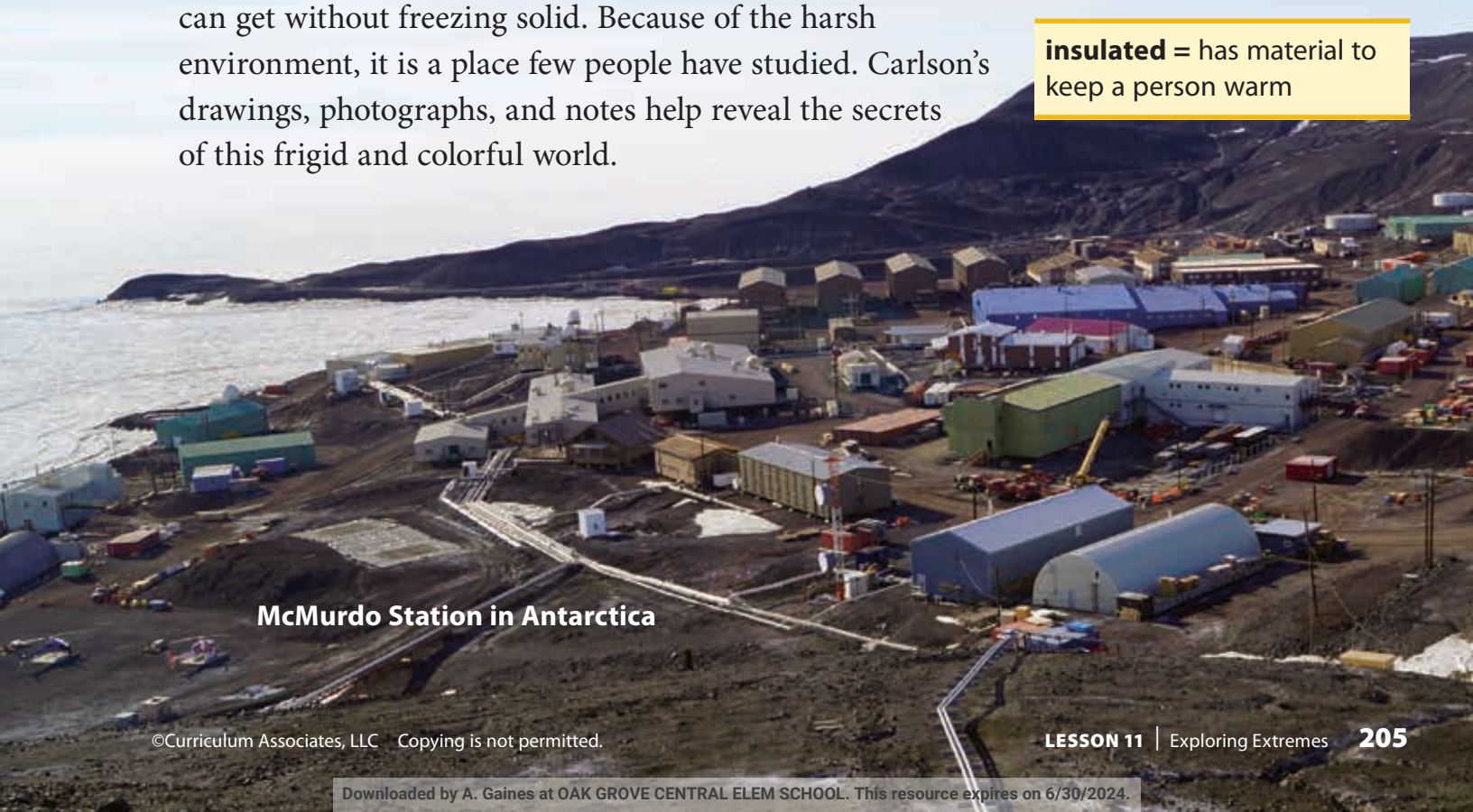
1 The snowy, icy land of Antarctica might seem empty and bare. But beneath the ocean surface, a world full of life awaits.

2 This is the world artist Kirsten Carlson explored for seven weeks in 2017. She stayed at the McMurdo Station in Antarctica, where many scientists do research. Artists like Carlson are invited to the station so they can share the many wonders of Antarctica through their work.

3 Kirsten Carlson did her creative work underwater. Covered in **insulated** gear, she bravely dove beneath the ice 33 times. There, the water is around 28°F (–2°C), as cold as sea water can get without freezing solid. Because of the harsh environment, it is a place few people have studied. Carlson's drawings, photographs, and notes help reveal the secrets of this frigid and colorful world.

Kirsten Carlson (right) before her last dive in Antarctica at Turtle Rock

insulated = has material to keep a person warm



McMurdo Station in Antarctica

Divers swimming up toward a hole in the ice

4 On her dives, Carlson heard the strange calls of Weddell seals. These animals spend much of their time hunting for food beneath the ice. She saw sea stars, sea slugs, jellyfish, and many other creatures. She sketched a naked dragonfish, a kind of fish without scales, hiding near its eggs. Two pointy teeth stuck up from its lower jaw, like a bulldog's. She also drew a giant sea sponge that was almost as big as she was.

5 Back at the surface, Carlson shared her discoveries with the world. She hopes that her team's work will encourage people to think about the connections between art, science, and the natural world in different ways.

Kirsten Carlson's underwater drawing equipment

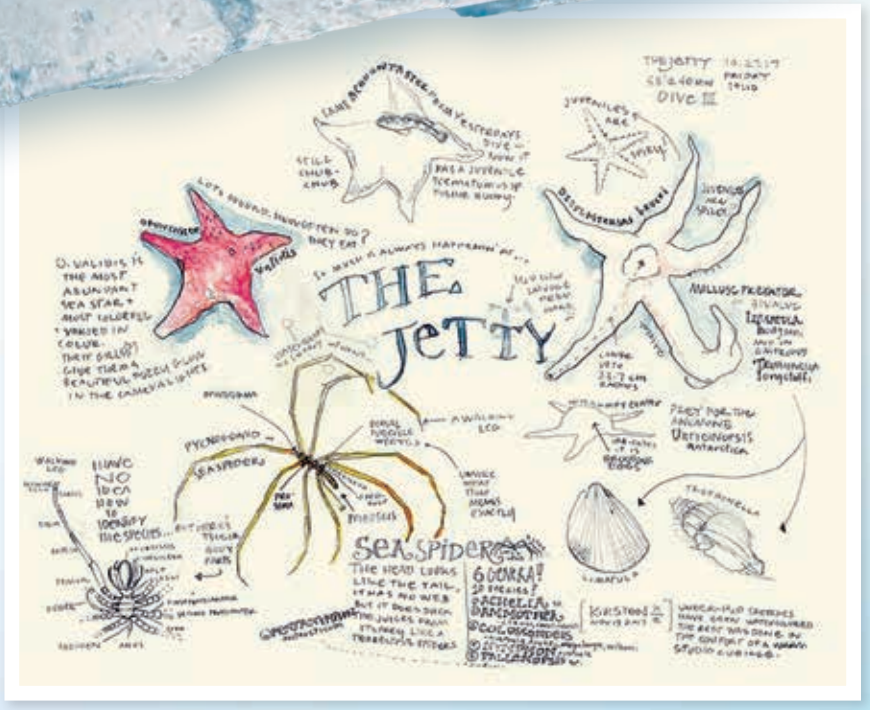
DRAWING UNDER ICE

by Kirsten Carlson

Kirsten Carlson is a scientific illustrator who traveled to Antarctica to explore an amazing undersea world.

1 Putting on all my warm, waterproof diving gear took longer than the dive itself. I prepared to enter the chilly water through a large round hole drilled through thick sea ice. These ocean temperatures are colder than a glass of ice water. But peeking through the hole was like looking at a starry nighttime sky. Through the crystal-clear water, sea stars on the ocean floor far below seemed to glow.

Above: Kirsten Carlson's drawing of her drysuit
Below: Kirsten Carlson drawing underwater on an earlier dive



2 During my dive, I used a pencil and waterproof paper to sketch sea stars and a giant sponge, one that was shaped like a vase and almost as big as me. I drew a fish peeking out at me from the inside of the sponge. A white, ruffled sea slug hurried across the ocean floor. I used my camera to capture the colors I saw. Many of the creatures are white and pastel: pinks, pale yellows, and lavenders.

3 Thirty minutes into the dive, I felt my hands tingle and knew it was time to surface. Though Antarctica is an extreme environment, it is the best place for scientists to study the toughest animals on Earth.

Kirsten Carlson's sketches and paintings of sea creatures

Respond to Text

Reread/Think

Reread "Secrets of a Frigid World" and "Drawing Under Ice." Choose the best response to each question.

1. PART A

Which detail would the authors of "Secrets of a Frigid World" and "Drawing Under Ice" **most likely** agree with?

A. Sea slugs are the most interesting creatures found in Antarctica.

B. The best way to show Antarctica is through photographs.

C. Antarctica can be a dangerous place to explore.

D. Most trips to Antarctica are only a few days long.

PART B

Which detail from "Drawing Under Ice" **best** supports the answer in Part A?

A. "These ocean temperatures are colder than a glass of ice water." (paragraph 1)

B. "But peeking through the hole was like looking at a starry nighttime sky." (paragraph 1)

C. "A white, ruffled sea slug hurried across the ocean floor." (paragraph 2)

D. "I used my camera to capture the colors I saw." (paragraph 2)

2. Read this sentence from paragraph 1 of "Secrets of a Frigid World."

> The snowy, icy land of Antarctica might seem empty and **bare**.

Which word from the sentence helps the reader understand the meaning of *bare*?

A. "snowy"

B. "land"

C. "Antarctica"

D. "empty"

SESSION 5 PRACTICE

Reread/Think

3. Write an X in the box next to each description to show whether it tells about "Secrets of a Frigid World," "Drawing Under Ice," or both texts.

	Secrets of a Frigid World	Drawing Under Ice	Both
Firsthand account			
Secondhand account			
Describes equipment needed to explore the ocean			
Explains how long Carlson stayed in Antarctica in 2017			

Write

Compare the accounts "Secrets of a Frigid World" and "Drawing Under Ice." Describe how the two texts add to your understanding of Kirsten Carlson's work. Use at least one example from each text in your response.

WRITING CHECKLIST

- ☐ I compared the information in both texts.
- ☐ I used at least one example from each text.
- ☐ I used complete sentences.
- ☐ I used correct spelling, punctuation, and capitalization.

Respond to the Focus Question

How and why do people explore extreme environments?

Reread/Think

Reread the text you were most interested in. Then answer the questions.

TEXT: _____

How did a person in the text explore extreme environments? _____

_____

_____

_____

Why did a person in the text explore extreme environments? _____

_____

_____

_____

Talk

Share what you learned about why people explore extreme environments.

Which environment did you read about? Why?

If you could explore any extreme environment, what would it be, and why?

Share your ideas with a partner. Listen to your partner's ideas.

The extreme environment I would like to explore is ___ because ___.

I would like to find out ___.

Write

Describe the extreme environment you would like to explore. Why would this place be worth exploring? What do you think you might discover there?