The Ice Loop

Use sea ice data to trace a change across Earth systems.

ES.ESS2.2 "Analyze geoscience data to make the claim that one change to Earth's surface can create feedback and interactions that cause changes to other Earth systems."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline two values that show a change in the ice-covered surface. Then number the steps in the passage that explain how this change could lead to more ice loss.

When Arctic Ice Retreats

(1) Each September, Arctic sea ice reaches its annual minimum after summer melting. Ice is a bright surface that reflects much of the sunlight it receives. Open ocean is darker and absorbs more sunlight. The table shows satellite estimates of September sea ice extent, the area of ocean with at least 15 percent ice cover, in four selected years.

ARCTIC SEPTEMBER SEA ICE EXTENT

Year	Extent (million square kilometers)
1980	7.67
2000	6.32
2012	3.39
2020	3.92

(2) From 1980 to 2012, September ice extent fell sharply. The 2020 value was higher than the 2012 value, so the decline was not steady. Still, both recent values were far below the 1980 value. Extent measures covered area, not ice thickness, and these four records alone cannot identify what started the warming.

(3) When ice retreats, more dark water is exposed. That water absorbs more solar energy, then releases heat to the air and nearby ice. Warmer air and water can melt additional ice, exposing still more ocean. This loop amplifies an initial loss of ice and links the ocean and atmosphere, although weather also affects ice extent.

2 ANSWER WITH EVIDENCE

Use the passage

1. Using two table values, calculate the change in sea ice extent from 1980 to 2012. What surface change does it show?

2. How could the surface change shown by the table affect the ocean and the nearby air?

3. Explain how that effect could cause further change to the ice-covered surface.

4. Sea ice extent rose from 2012 to 2020. Does that disprove the feedback claim? Use the values and a limit of the data to explain.

3 YOUR TURN

Your own words

Imagine dark shrubs spreading across a snowy region. In 3 to 4 sentences, name two measurements you would collect, explain a possible feedback linking the land surface and atmosphere, and describe a comparison that would help test your claim.

The Ice Loop

PART 1 · READ AND MARK

Underline two values that show a change in the ice-covered surface. Then number the steps in the passage that explain how this change could lead to more ice loss. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Using two table values, calculate the change in sea ice extent from 1980 to 2012. What surface change does it show?	**Extent fell from 7.67 to 3.39 million square kilometers, a decrease of 4.28 million square kilometers of ice-covered ocean.**
2	How could the surface change shown by the table affect the ocean and the nearby air?	**Retreating ice exposes darker water, which absorbs more sunlight and releases heat to the nearby air.**
3	Explain how that effect could cause further change to the ice-covered surface.	**Warmer water and air can melt more ice. This exposes more dark water, which can absorb more sunlight and add to the warming.**
4	Sea ice extent rose from 2012 to 2020. Does that disprove the feedback claim? Use the values and a limit of the data to explain.	**No. Extent rose from 3.39 to 3.92 million square kilometers, but both values were below the 1980 value of 7.67. Four selected years cannot show every yearly change or establish its cause.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would measure snow-covered area and air temperature where shrubs have spread. Dark shrubs could absorb more sunlight than snow, warming the nearby air and melting more snow. The newly exposed dark ground could absorb more sunlight, continuing the warming. I would compare these measurements with those from a nearby snowy area where shrubs have not spread.

Accept equivalent descriptions of the ice, ocean, and air feedback. For Your Turn, look for two relevant measurements, a plausible reinforcing loop, and a comparison that could help separate the effect of shrubs from other causes.