

Hazard Literacy Center

Hazard Literacy Education Program

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SOS from the Poles: Earthquakes



1. Program Overview

This program is an educational initiative that explores polar hazards and disasters, focusing on earthquakes in polar regions. Through diverse seismic case studies from Alaska, the Aleutian Islands, Antarctica, and Greenland, students will understand that polar ground shaking stems from various underlying causes. In particular, students explore the unique nature of polar seismic phenomena by comparing earthquakes generated by tectonic plate movement and faulting with those triggered by glacial movement, fracturing, and collapse. Furthermore, students analyze how polar earthquakes can escalate into diverse secondary impacts, including landslides, glacial collapses, tsunamis, coastal landform changes, and infrastructure damage. The program also highlights how sparse monitoring networks and limited transportation and communication infrastructure in polar regions create significant uncertainties in disaster monitoring and response, leaving local communities and Indigenous populations disproportionately vulnerable. Ultimately, the program is designed to help students view polar earthquakes as issues interconnected with glacial and oceanic shifts and global disaster risks, empowering them to scientifically interpret seismic data, predict cascading disasters, and formulate sound response strategies under conditions of uncertainty.

Grade Level	High school students	Instructional Methods	Lecture, Research, Data analysis, Discussion
Learning Environment	Classroom (with computer access)	Duration	Total 120 minutes
Required Materials	Activity sheets		

2. Learning Objectives (Hazard Literacy Framework)

① Compare and explain the causes and characteristics of earthquakes occurring in polar regions.
② Analyze the primary and secondary impacts of polar earthquakes on Earth systems and human society.
③ Assess the risks of polar earthquakes using maps and seismic data, and propose disaster scenarios and response strategies.

Learning Objectives	Knowledge & Understanding		Reasoning & Skills					Values & Attitudes			Psychology & Emotion			Behavioral & Practical Engagement		
	A1	A2	B1	B2	B3	B4	B5	C1	C2	C3	D1	D2	D3	E1	E2	E3
Objective ①	O		O					O								
Objective ②	O	O	O	O		O		O		O			O			
Objective ③		O	O		O	O		O		O		O		O	O	O

3. Key Concepts

- Plate Boundaries and Faulting
- Focus, Epicenter, Magnitude, and Intensity of Earthquakes
- Seismic Waves and Earthquake Monitoring
- Vulnerability and Response to Polar Hazards and Disasters

4. Program Sequence

Stage	Contents
Introduction	-Sparking student interest by showing videos of glaciers fracturing and collapsing -Predicting outcomes through prompting questions such as "What happens when the ground shakes in polar regions?" -Sharing initial ideas on the causes of earthquakes in polar regions
Global	-Identifying spatial patterns of earthquake occurrence by comparing global plate boundaries with earthquake distribution maps -Investigating polar earthquake case studies, such as Alaska and the Aleutian Islands -Inferring the causes of earthquakes using data such as focal depth, magnitude, location, and distance from plate boundaries
Local	-Exploring the primary and secondary impacts of polar earthquakes -Discussing why earthquake impacts vary—even for earthquakes of identical magnitude—depending on location, focal depth, topography, and glacial conditions
Personal	-Drafting a "Polar Earthquake Scenario" by selecting a specific polar seismic event -Discussing how to evaluate risks and make judgments when observational data is insufficient -Explicitly stating predictive uncertainties in the report
Wrap-up	-Presenting findings and engaging in reflection -Formulating personal perspectives on polar disasters

5. Theoretical Background and Activity Design for Disaster Education

This program is designed to help students understand polar earthquakes as complex phenomena unfolding through the interactions between Earth crustal systems and human society. Alaska and the Aleutian Islands are located along a subduction zone where tectonic plates converge, resulting in high seismic activity where large-magnitude earthquakes can trigger diverse hazards such as ground deformation, landslides, liquefaction, and tsunamis. The Alaska–Aleutian subduction zone is one of the most seismically active regions globally, where earthquakes as well as submarine and coastal landslides can generate tsunamis. Meanwhile, in Antarctica and Greenland, seismic events are observed not only within the lithosphere, but also as a result of internal glacial fracturing, ice motion, and iceberg calving. These signals serve not only as indicators of potential hazards, but also as valuable observational data for tracking glacial movement and transformations.

A central focus of this program is ensuring that students do not gauge the severity of a disaster solely by earthquake magnitude. The actual impact of a disaster depends not only on the physical scale of the earthquake itself, but also on focal depth, topography, coastal proximity, glacial instability, population density, and structural seismic resilience. Consequently, students construct varying damage scenarios for earthquakes of equal magnitude, learning that disasters stem from the dynamic interaction between natural events and societal vulnerabilities. The "Polar Earthquake Scenario" activity serves as a structured tool to analyze an earthquake through its causes, progression, impacts, and response measures. Using maps and data, students examine the spatial characteristics of earthquakes and systematically analyze the cascading processes connecting seismic activity to landslides, glacial collapses, and tsunamis. Furthermore, by explicitly identifying data limitations and predictive uncertainties, the program fosters a scientific mindset that avoids framing uncertain information as definitive fact.

6. Instructional Considerations

First, guide students not to equate earthquake magnitude with the scale of damage. Even a high-magnitude earthquake may cause limited direct casualties in areas with low population and sparse infrastructure. Conversely, a relatively smaller earthquake can lead to severe secondary damage if it triggers glacier collapses or landslides.
Second, take care not to foster simplistic cause-and-effect thinking, such as assuming that melting glaciers will inevitably cause major earthquakes. While changes in glacial loading can influence the stress state of the Earth's crust, glacial melting alone cannot be used to predict the exact timing or magnitude of a specific earthquake.
Third, emphasize that scenario planning is an exercise in exploring possible futures, not in asserting what will actually occur. Guide students to clearly distinguish among scientifically verified facts, data-driven inferences, and uncertain assumptions in their work.

7. References

- Lee, J. H. (2021, January 3). Jijin-e jjijgin 'metan jeojanggo', bukgeuk onnanwha buchaejilhaetda [Methane reservoirs torn by earthquakes accelerate Arctic warming]. The Kyunghyang Shinmun. https://www.khan.co.kr/article/202101032131035
- Lee, J. H. (2026, June 19). Namgeuk-ui bimil, AI-ga pulda…bingha sok jijin 500geon pochak [Unlocking Antarctica's secrets: AI detects 500 earthquakes beneath the ice]. ZDNet Korea. https://zdnet.co.kr/view/?no=20260619130407
- Lee, W. S., Park, Y. C., & Lee, C. K. (2021). Choegun namgeuk sejonggwahakgiji ingeun beuraenseupildeu haehyeob-eseo balsaenghan isang jijin hwaldong (2020.08.–2021.02.) [Unusual seismic activity occurring in Bransfield Strait near King Sejong Station, Antarctica (August 2020–February 2021)]. Journal of the Geological Society of Korea, 57(5), 717–726. https://doi.org/10.14770/jgsk.2021.57.5.717

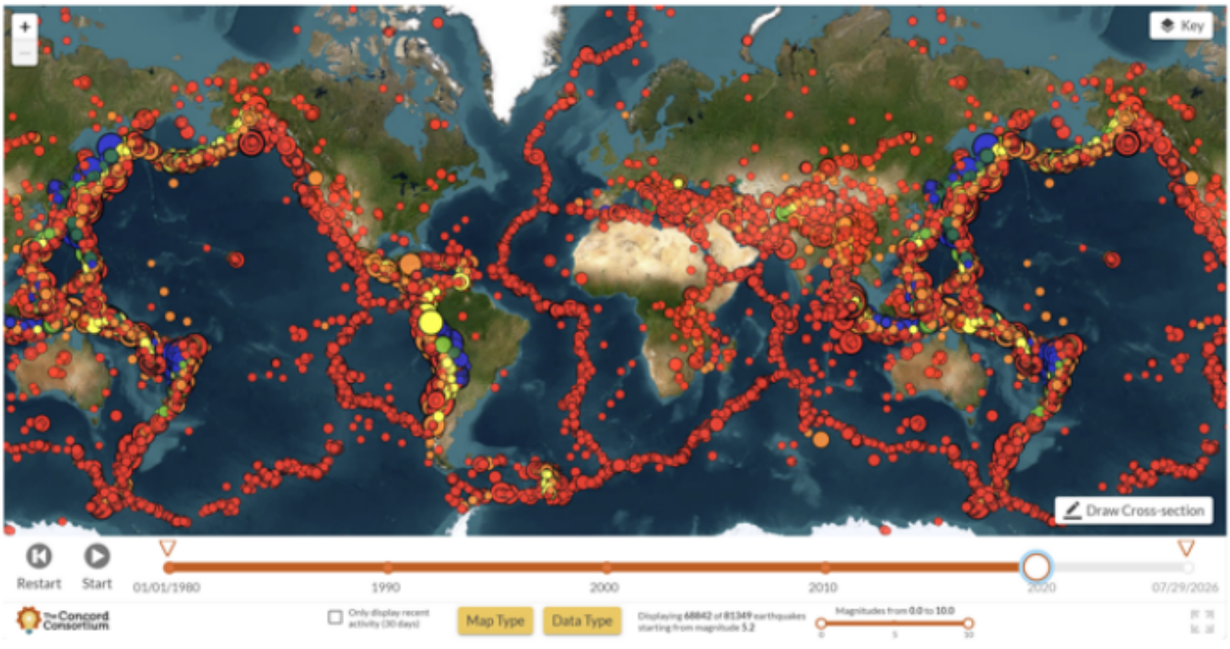
SOS from the Polar Regions: Earthquakes

Topic	Earthquakes
What will we learn?	① Explain the causes of earthquakes. ② Explain the primary and secondary impacts of earthquakes in the polar regions from an Earth system perspective.

1 Global Distribution of Earthquakes

➢ Using digital inquiry tools such as **Google Maps, Padlet's world map, and Seismic Explorer**, explore areas where earthquakes occur and identify and describe the common characteristics of earthquake-prone regions.

Image: https://seismic-explorer.concord.org



2 Exploring Past Earthquake Cases

	Region (Location)	Volcano Name	Characteristics
1			
2			
3			

3 Exploring Earthquake Cases in the Polar Regions

	Region (Location)	Volcano Name	Characteristics
1			
2			
3			

4 Investigating the Causes of Earthquakes in the Polar Regions

➢ What causes earthquakes in the Antarctic and Arctic regions?

5 Impacts of Earthquakes

When a disaster occurs, it can cause various impacts or damages not only in the surrounding area but also in areas farther away. After a disaster occurs, these impacts can be classified as primary and secondary impacts.

Primary impacts are those that occur directly as a result of the disaster, while secondary impacts are those that occur through a chain of subsequent effects. Let's classify and organize the possible impacts of an earthquake occurring in the polar regions into primary and secondary impacts.

Primary impacts:

Secondary impacts:

- Why can the impacts of earthquakes vary even when they have the same magnitude?
- Consider factors such as the earthquake's location, focal depth, terrain, and glacier conditions, and explain why

Based on your research, write a scenario for an earthquake in the polar regions!

6 Polar Earthquake Scenario

	Contents	
Earthquake Occurrence	Date	
	Location	
Magnitude and Intensity	Magnitude	
	Intensity	
Tectonic or Geological Background		
Surrounding Glaciers and Marine Environment		
Sequence of Events		
Cascading Impacts		

➢ Write an earthquake warning message to be delivered to a polar research station or local residents.