

Hazard Literacy Center

Hazard Literacy Education Program

Hazard Literacy Center

SOS from the Poles: Subglacial Volcanoes



1. Program Overview

This program is an educational initiative that explores the interconnectedness of Earth systems and the nature of disasters, focusing on volcanic activity in polar regions. Through volcanic case studies from the Arctic and Antarctic, students will understand that polar volcanism is a complex phenomenon closely linked to the geosphere, atmosphere, hydrosphere, and biosphere. Furthermore, by examining how polar volcanic activity can trigger diverse impacts—such as volcanic ash, glacial melting, volcanic earthquakes, and climate effects—the program is designed to help students recognize that polar hazards and disasters are not isolated local issues, but globally interconnected challenges. Ultimately, the program aims to help students view polar volcanic activity and disasters not as distant events, but as global issues requiring collective understanding and action, thereby fostering the values and attitudes needed for a sustainable future.

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 Understand the causes and characteristics of polar volcanic activity.
② Scientifically and socially explore the impacts of polar volcanic activity on Earth systems and human society.
③ Explore case studies of polar volcanic hazards and disasters spatiotemporally using maps and data.

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							
Objective ③	O		O	O	O	O		O	O							

3. Key Concepts

- Volcanic Activity and Earthquakes
- Plate Boundaries and Hotspots
- Geographical and Environmental Characteristics of Polar Regions
- Interactions Between the Cryosphere and Volcanoes (Interconnectedness of Earth Systems)

4. Program Sequence

Stage	Contents
Introduction	-Sparking student interest by posing the question: "Why are the polar regions both a 'Land of Ice' and a 'Land of Fire'? -Understanding the geographical and environmental characteristics of the polar regions through Arctic and Antarctic media -Sharing initial ideas through prompting questions like "Are there volcanoes in the Arctic and Antarctic?"
Global	-Analyzing volcanic distribution and characteristics through historical eruption case studies -Investigating the causes of volcanic activity (e.g., plate boundaries, hotspots, and magma dynamics)
Local	-Investigating the primary impacts of polar volcanism -Investigating the secondary impacts of polar volcanism
Personal	-Understanding how polar volcanic activity triggers cascading changes across Earth systems -Comprehensively explaining the impacts of polar volcanism on climate, oceans, ecosystems, and human society -Drafting a Subglacial Volcanic Hazard Assessment Report based on research findings
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 identifies the unique nature of polar volcanoes through their interactions with the cryosphere. Polar volcanoes can be active beneath or around glaciers and ice caps; in these cases, eruptions extend beyond lava flows to cause glacial melting, flood hazards, volcanic ash dispersion, and increased atmospheric aerosols. USGS data indicates that glacial unloading and retreat can influence magma ascent and shifts in volcanic activity, highlighting the need to address climate change and volcanic hazards in tandem. Through this lens, students learn that climate change, cryospheric shifts, and volcanic activity are deeply interconnected.

From a disaster education perspective, this program emphasizes a process-oriented understanding. Volcanoes often exhibit various precursors prior to eruption—such as volcanic earthquakes, ground deformation, and changes in gas emissions—and actual monitoring systems assess risks by synthesizing these data points. This approach fosters both the ability to scientifically interpret hazards and the mindset to evaluate risks and formulate responses. In particular, the subglacial volcanic hazard report activity serves as a structured framework for understanding disasters. Students map the location and distribution of volcanoes and combine images, data, and explanatory narratives to articulate the causes, progression, impacts, and mitigation strategies within a cohesive story. Ultimately, this enables students to view hazards and disasters not as fragmented data, but as interconnected phenomena unfolding across the space and time of the Earth system.

6. Instructional Considerations

First, avoid presenting polar volcanoes purely as unfamiliar or isolated edge cases. To prevent students from viewing polar volcanoes as distant events unrelated to themselves, the curriculum should address their complex impacts on Earth systems and human society, alongside their broader global connections. Second, avoid oversimplifying the relationship between volcanic activity and its impacts. Since not all polar volcanoes generate hazards in the exact same way, it is necessary to explain that impacts such as volcanic earthquakes, volcanic ash, and glacial melting can vary depending on the specific case. Third, ensure that using maps and data does not remain a purely technical exercise. Guide students to interpret the materials by reflecting on why specific data was chosen, what it is intended to illustrate, and what significance it holds.

7. References

- Kim, H. J. (2025, January). Jigu-onnanhwa-e namgeuk eoleum mit-i bugeulbugeul… Hwasan 100-yeogae pokbal ganeungseong jegi [Antarctic ice boiling due to global warming… Potential eruption of over 100 volcanoes]. Weekly Chosun, 2844, 84–85.
- Son, C. H. (2025, May 25). Jigu gotgot-eseo ullineung hwasan-ui gyeonggo-eum [Volcanic warnings sounding across the globe]. Sungdae Newspaper. https://www.skkuw.com/news/articleView.html?idxno=32194
- U.S. Geological Survey. (n.d.). Volcanoes can affect climate. https://www.usgs.gov/programs/VHP/volcanoes-can-affect-climate

SOS from the Poles: Subglacial Volcanoes

Topic	Subglacial Volcanoes
What will we learn?	① Understand the geographical and environmental characteristics of the polar regions and explain subglacial volcanoes. ② Explain the impacts of subglacial volcanoes on the Earth system.

1 What hazards and disasters occur in the Arctic and Antarctic?

2 What is a "subglacial volcano"?

➢ Read the news about subglacial volcanoes and write down something new you learned or discovered.

➢ Why can subglacial volcanoes be hazardous?

3 Exploring Past Volcanic Events

	Region (Location)	Volcano Name	Characteristics
1			
2			
3			

4 Exploring Volcanic Examples in the Polar Regions

➢ The Arctic and Antarctic have different geographical and environmental characteristics, so the patterns and distribution of volcanoes also differ. Unlike ordinary volcanoes, subglacial volcanoes erupt beneath ice, where magma melts the surrounding ice, producing unique phenomena. Investigate volcanoes located in the Arctic and Antarctic regions and describe their characteristics.

	Region (Location)	Volcano Name	Characteristics
1			
2			
3			

5 Conditions Increasing Volcanic Eruption Risk

➢ Find and write down three conditions that can increase the risk of a volcanic eruption in the polar regions.

	Condition
1	
2	
3	

6 Impacts of Volcanic Activity

➢ When a hazard occurs, it can cause various impacts or damage in nearby areas as well as in areas far away. These impacts can be classified as primary and secondary impacts

➢ Primary impacts occur directly when a hazard happens, while secondary impacts occur as a chain of consequences. Let's organize the primary and secondary impacts that may occur when a subglacial volcano erupts.

Primary impacts:

Secondary impacts:

➢ Write down the impacts of a subglacial volcano on the Earth system.

Atmosphere	**Biosphere**
Hydrosphere	**Geosphere**

➢ Write down the impacts that a subglacial volcano could have on society.

Polar research stations and researchers	**Polar-region residents**
Countries and the international community	**Future generations**

Based on your research, write a hazard prediction report!

7 Subglacial Volcano Prediction Report

	Contents	
Date		
Purpose		
Area	Place Name (Location)	
	Volcano Name	
	Google Map	Use Google Maps to find the latitude and longitude of the selected location, then insert a screenshot.
Characteristics of the Area	Geographical Characteristics	
	Environmental Characteristics	

7 Subglacial Volcano Prediction Report

Evidence and Rationale for Selection	✓ Evidence 1 : Why this fact increases the hazard : ✓ Evidence 2 : Why this fact increases the hazard : ✓ Evidence 3 : Why this fact increases the hazard :
Expected Changes Immediately After the Eruption	✓ Changes in the atmosphere : ✓ Changes in the geosphere : ✓ Changes in the hydrosphere : ✓ Changes in the biosphere :
Certainty and Uncertainty of the Prediction	✓ Changes that can be predicted with relatively high confidence : ✓ Changes that are possible but uncertain : ✓ Additional data needed :

7 Subglacial Volcano Hazard Prediction Report

Hazard Level Assessment	Therefore, the hazard level of the subglacial volcano was assessed as follows. ☐ Very Low ☐ Low ☐ Moderate ☐ High ☐ Very High ☐ Difficult to determine from the available data Key evidence used to determine the hazard level First, _____ Second, _____ Third, _____
Conclusion	In conclusion, this subglacial volcano was assessed as _____ in terms of hazard level because _____. If this volcano erupts, changes in _____ are likely to occur first. It may then affect _____, and other areas. However, because there is insufficient data on _____, not all impacts can be predicted with certainty. Therefore, continued monitoring and research will be necessary.