

Hazard Literacy Center

Uncovering the Secrets of Heavy Rainfall through Data Maps



1. Program Overview

TThis program is a data-driven inquiry program designed to help students understand the impacts of heavy rainfall. Rather than viewing these impacts simply as the result of excessive rainfall, students examine how local conditions can lead to different patterns of damage. These conditions include topography, water flow, land cover, and urban structure.
Using Seoul's Flood Trace Maps and Google Earth Pro, students compare flood traces and surrounding environments across different areas. They investigate how topography and elevation, potential water flow and accumulation, land cover, and urban structure may be related to heavy rainfall impacts. Based on their observations, students identify spatial patterns, develop hypotheses, and construct evidence-based explanations of how damage may occur.
Students also distinguish between what can be directly observed in the data and what is inferred from the evidence. They identify questions that cannot be answered with the available data and consider what additional information may be needed. Generative AI is used as a supplementary tool for information seeking and for checking explanations. Students are encouraged to evaluate AI-generated information by comparing it with reliable sources and the available data rather than accepting it at face value.
Finally, students use projections of future rainfall change and the results of their inquiry to examine potential risk factors in their local area. They then propose measures that individuals, schools, and local communities can take to prevent and respond to heavy rainfall hazards. Through these activities, students develop hazard literacy by using public data to understand disaster processes, evaluate risk based on evidence, and explore ways to improve the safety of their communities.

Grade Level	High school students	Instructional Methods	Lecture, project-based inquiry
Learning Environment	Computer lab	Duration	150 minutes total (3 × 50-minute sessions)
Required Materials	Internet-connected PC or tablet, writing materials		

2. Learning Objectives (Hazard Literacy Framework)

① Interpret spatial patterns and regional differences in heavy rainfall impacts using Seoul's Flood Trace Maps and Google Earth Pro
② Explain the mechanisms of heavy rainfall impacts based on the interactions among topography and elevation, potential water flow and accumulation, land cover, and urban structure
③ Critically evaluate information from public data and generative AI, and distinguish among observed evidence, inference, and uncertainty.
④ Design inclusive and sustainable preparedness measures for heavy rainfall by considering future changes in rainfall and local vulnerability, and communicate evidence-based recommendations to the community.

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	O												
Objective ②	O	O		O	O	O	O									
Objective ③					O	O	O	O				O				
Objective ④							O	O	O	O		O		O	O	O

3. Key Concepts

- Heavy Rainfall and Water Movement Processes
- Spatial Variations in Damage due to Topographic and Surface Conditions
- Interpreting the Earth Environment Using Geospatial Data
- Data-Driven Disaster Risk Assessment and Uncertainty
- Local Disaster Prevention and Response

4. Program Sequence

	Activity Sequence
Introduction	-Examine differences in regional damage patterns through cases of heavy rainfall impacts -Share initial ideas around the question, “Why does the same heavy rainfall cause different impacts across regions?”
Activity 1	-Compare flood traces and surrounding environments across different areas using Seoul’s Flood Trace Maps and Google Earth Pro -Observe topography and elevation, water flow, land cover, and urban structure, and develop hypotheses about differences in damage patterns
Activity 1	-Compare data from multiple areas to infer how water moves and accumulates during heavy rainfall -Distinguish between observations and inferences, and use generative AI, when needed, to check explanations -Connect observational evidence with scientific concepts to explain how damage occurs
Activity 1	-Explore risk factors in the local area based on projected changes in future rainfall and findings from the previous activities -Propose prevention and response measures at the individual, school, and community levels, taking local living conditions into account
Summary	-Share each group’s proposed response measures and compare their supporting evidence and feasibility -Review the importance of evidence-based disaster risk assessment and community-based prevention and response

5. Theoretical Background and Activity Design for Disaster Education

The impacts of heavy rainfall are not caused simply by the amount of rainfall. Rather, they result from complex interactions among rainfall, topography and elevation, water movement and accumulation, land cover, and urban structure. Even under similar rainfall conditions, water and sediment may move rapidly on steep slopes, while low-lying areas or locations where water converges may be more vulnerable to flooding. In urban areas with extensive impervious surfaces, such as roads and buildings, rainwater can move rapidly over the surface. Damage may become more severe when runoff exceeds local drainage capacity. Therefore, understanding heavy rainfall impacts requires examining the influence and interaction of multiple factors from an Earth system perspective.

This program is designed to help students investigate the spatial variation in heavy rainfall impacts using real-world data. Students use Seoul's Flood Trace Maps and Google Earth Pro to compare environmental conditions across different areas. They examine relationships among topography and elevation, potential water flow and accumulation, land cover, urban structure, and patterns of damage. During this process, students identify recurring spatial patterns, develop hypotheses based on observational evidence, and connect multiple factors to explain how heavy rainfall can lead to damage. They also distinguish between what they directly observe in the data and what they infer from the evidence. By identifying what cannot be explained by the available data and what additional information may be needed, students develop both data literacy and evidence-based reasoning.

Generative AI is used not as a source of correct answers, but as a supplementary tool for checking students' explanations and exploring additional information. Students are encouraged to evaluate AI-generated information by checking it against reliable sources and the data they have examined, and to revise or refine their explanations when necessary. Finally, students examine potential risk factors in their local area based on projected changes in future rainfall and the findings from their previous inquiry. They then propose prevention and response measures that consider local living conditions and diverse community members. Through these activities, students move beyond scientifically understanding the causes and processes of heavy rainfall impacts. They develop hazard literacy by using data to assess risk and by exploring ways to respond to hazards collaboratively within their communities.

6. Instructional Considerations

Teachers should guide students to understand that heavy rainfall impacts are not caused simply by the amount of rainfall. Rather, damage patterns can vary through interactions among multiple factors, including topography and elevation, water flow and accumulation, land cover, and urban structure. When using Seoul's Flood Trace Maps and Google Earth Pro, students should distinguish between what they directly observe in the data and what they infer from the evidence. They should also avoid assuming that an area is safe simply because no flood traces are shown, or drawing definitive conclusions about the causes of damage based solely on map data. Students should recognize that additional data may be needed and consider the limitations and uncertainties of the available data.

When using generative AI, students should be encouraged not to accept AI-generated information at face value. Instead, they should check it against reliable sources and the data they have examined, using AI as a tool to review and refine their explanations rather than as a source of correct answers. When proposing local prevention and response measures, students should also move beyond simple solutions such as installing infrastructure. They should consider the local natural environment and living conditions, as well as the circumstances of diverse community members who may be affected. Students should then explore practical prevention and response measures that can be undertaken by multiple actors, including individuals, schools, and local communities

Uncovering the Secrets of Heavy Rainfall through Data Maps

Theme	Uncovering the Secrets of Heavy Rainfall through Data Maps
What Will We Learn?	① Explain why the impacts of heavy rainfall vary across different areas. ② Use maps and public data to explore spatial patterns of heavy rainfall impacts and the factors associated with them. ③ Assess heavy rainfall risks in our local area based on evidence and propose prevention and response measures.

1 Let's Think

➢ Even under the same heavy rainfall event, the type and extent of damage can vary across regions. Examine the characteristics of different areas and predict what kinds of impacts might occur during heavy rainfall



➢ What factors influence the impacts of heavy rainfall? What conditions might affect the extent and type of damage? Write down your current ideas based on what you already know.

2 What Patterns Do the Flood Traces Show?

➢ Using Seoul's Flood Trace Maps and Google Earth Pro, compare the characteristics of flood traces across different area

	Characteristics of Flood Traces	Features Observed in the Surrounding Environment
Area 1		
Area 2		
Area 3		

➢ Why do you think the flood traces differ across the three areas?

➢ Based on your observations so far, develop a hypothesis to explain why the impacts of heavy rainfall vary across different areas.

My Hypothesis	
Evidence for My Hypothesis	
What I Want to Investigate Further	

3 Why Do Heavy Rainfall Impacts Vary Across Different Areas?

➢ Re-examine the three areas and identify characteristics that may be related to the impacts of heavy rainfall.

	Slope & Elevation	Water Flow & Accumulation	Land Cover	Urban Structure	Other
Area 1					
Area 2					
Area 3					

➢ Which characteristic do you think is most important in explaining the differences in damage among the three areas? Why?

➢ Let's distinguish between what we observed in the data and what we inferred from the evidence.

What We Observed in the Maps	**What We Inferred from the Data**
What Is Difficult to Determine from the Available Data	**Additional Data That Would Be Useful to Examine**

➢ Use generative AI to investigate questions that you would like to explore further in the explanation your group has developed.

What I Asked	
Information Generated by AI	
What I Verified by Comparing the AI Response with Reliable Sources and the Data We Examined	
What We Will Incorporate into Our Explanation and Why	

➢ Choose one of the three areas and explain the process through which heavy rainfall may lead to damage.

Selected Area:

How Heavy Rainfall May Lead to Damage:

4 How Can Our Local Area Prepare?

➢ Using the KMA Climate Change Situation Map, identify key patterns in projected future rainfall.

What We Found in the Data	Implications for Heavy Rainfall Risk in Our Local Area

➢ What can our local area do to reduce the impacts of heavy rainfall?

Our Group's Heavy Rainfall Safety Proposal	
Problem We Identified	
Risk Factor We Focused On	
Our Proposed Preparedness Measure	
Scientific Evidence Supporting Our Proposal	
People or Organizations That Should Be Involved	