

Hazard Literacy Center

Hazard Literacy Education Program

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Flood Risk Mapping : Which Areas Are Most Vulnerable to Heavy Rain?



1. Program Overview

This program is a data-based educational program in which students explore flood risk during heavy rainfall using spatial data and information about local landforms and surrounding environments. Centered on the question, “Which Areas Are Most Vulnerable to Heavy Rain?”, students learn how heavy rainfall and flooding occur and explore how various factors, including elevation, distance from rivers, the distribution of roads and buildings, and drainage conditions, influence flood risk. Rather than understanding flooding simply as a phenomenon in which “heavy rain causes water to overflow,” students learn that flooding is a disaster resulting from the combined effects of rainfall, landforms, urban environments, and other factors.

The program consists of four stages: understanding how flooding occurs, exploring actual flood-risk areas, analyzing the landforms and surrounding environments of areas vulnerable to flooding, and exploring safe actions during heavy rain and flooding. Using tablets or computers, students examine the Flood Risk Map provided through the SGIS Natural Disaster Statistical Map and compare the spatial distribution and expected flood depths of areas in Seoul. They then take a closer look at flood-risk areas by examining their distance from rivers, landform characteristics, the distribution of roads and buildings, underground spaces, and green spaces, and analyze how these factors are related to flood risk. Finally, students use the heavy rain safety guidelines provided by KMA Weather Nuri to explore appropriate actions before, during, and after heavy rain, places to avoid during flooding, and safe evacuation methods.

This program is designed to help students understand heavy rainfall and flooding from geographical and spatial perspectives, interpret flood risk using real-world data, and make appropriate decisions about safety actions during disasters. Through these activities, students learn that flooding results from the combined effects of natural factors, local landforms, and urban environments. They also develop the ability to use spatial information to explore disaster risks in their surroundings and respond appropriately.

Grade Level	Upper Elementary or Middle School Students	Instructional Methods	Inquiry-based activities
Learning Environment	Classroom with Access to Internet	Duration	4 sessions, 180 minutes
Required Materials	Worksheets, an internet-enabled digital device		

2. Learning Objectives (Hazard Literacy Framework)

① Understand that heavy rainfall and flooding are hazards caused by the combined effects of various factors.
② Use flood risk maps and spatial information to explore and analyze the distribution of flood-risk areas and the characteristics of their surrounding environments.
③ Understand potential risks during heavy rain and flooding and determine and practice appropriate safety actions and evacuation methods before, during, and after a disaster.

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	
Objective ③		O		O		O			O	O		O		O	O	O

3. Key Concepts

- Relationship between heavy rain and flooding
- Characteristics of areas vulnerable to flooding
- Terrain and surrounding environments affecting flood risk
- Identifying flood-prone areas using maps
- Safe actions and evacuation during flooding

4. Program Sequence

	Activity Sequence
Introduction	-Watch videos of recent heavy rainfall and flood damage. -Ask “Why do some places flood faster than others when it rains?” -Understand how flooding occurs and the characteristics of urban flooding. -Share ideas about places near the school that may be at risk of flooding.
Inquiry 1	-Understand the concepts of heavy rainfall and flooding and the relationship between them. -Examine the characteristics of places that are more likely to flood. -Identify factors that influence flood risk.

	Activity Sequence
Inquiry 2	-Learn how to use the SGIS Flood Risk Map. -Identify areas in the local community that are expected to flood and examine their expected flood depths. -Compare the distribution of flood-risk areas in Seoul. -Identify the spatial characteristics of flood-risk areas.
Inquiry 3	-Select one flood-risk area. -Use online maps to investigate its landforms and surrounding environment. -Analyze factors that influence flood risk. -Explain why the selected area is vulnerable to flooding.
Conclusion	-Review safety guidelines for before, during, and after heavy rain. -Distinguish between places to avoid and places to consider for evacuation during flooding. -Summarize key safety principles to remember during heavy rain and flooding.

5. Theoretical Background and Activity Design for Disaster Education

Heavy rainfall can cause river flooding and urban flooding, potentially resulting in loss of life and property damage. In urban areas, large amounts of rain falling within a short period of time can exceed the capacity of drainage systems and lead to flooding. Areas near rivers, low-lying areas, and underground spaces may be more vulnerable to flooding. The flooding of semi-basement homes in Gwanak-gu, Seoul, in 2022 and the flooding of the Osong underpass in Cheongju in 2023 demonstrate the vulnerability of underground spaces and underpasses to flooding (Kyunghyang Shinmun, 2025; The Korea Transport Institute, 2023). The Korea Meteorological Administration (KMA) also identifies low-lying areas, areas with a history of repeated flooding, and underground spaces as hazardous areas during heavy rain and advises people to stay away from rivers, flooded roads, and underpasses (KMA, n.d.)

Flooding, therefore, should not be understood simply as the result of heavy rainfall. It is a disaster caused by the combined effects of multiple factors, including rainfall, rivers, landform characteristics, and urban drainage conditions. The Flood Risk Map provided by SGIS spatially represents expected flood extent and depth under scenarios in which river flooding exceeds the design capacity of embankments or rainfall exceeds the capacity of stormwater drainage facilities such as pumping stations (Ministry of Data and Statistics, n.d.).

This program is designed to help students explore these characteristics of flooding using real-world spatial data. Students use the Flood Risk Map from the SGIS Natural Disaster Statistical Map to examine the distribution and expected depths of flooding and explore how flood risk varies spatially across different areas. They then use online maps to investigate the surrounding environments of flood-risk areas, including distance from rivers, landform characteristics, the distribution of roads and buildings, underground spaces, and green spaces, and analyze factors that influence flood risk. The SGIS Natural Disaster Statistical Map is a service that allows users to explore the potential impact areas of natural hazards, including floods, together with spatial statistical information (Ministry of Data and Statistics, n.d.).

Finally, students use the heavy rain safety guidelines provided by KMA Weather Nuri to examine appropriate actions before, during, and after heavy rain and learn which places to avoid and how to evacuate safely during flooding. The KMA recommends checking disaster risk factors, evacuation locations, and evacuation routes before heavy rain; avoiding hazardous areas such as flooded roads, underpasses, and rivers during heavy rain; and moving to higher ground or a nearby evacuation area if water begins to enter a building (KMA, n.d.).

6. Instructional Considerations

When teaching this program, avoid describing flooding simply as a "natural phenomenon caused by heavy rain." Guide students to understand that flooding is a disaster caused by the combined effects of rainfall, landforms, the location of rivers, urban environments, drainage conditions, and other factors. Students should also avoid simple conclusions such as "all low-lying areas are dangerous." Encourage them to assess flood risk by considering multiple environmental and spatial conditions together.
During the data exploration activities, remind students that areas shown on the SGIS Flood Risk Map are not necessarily areas that will actually flood. Guide students to compare the expected flood extent and depth shown on the map and use online maps to examine surrounding conditions, including distance from rivers, landform characteristics, the distribution of roads and buildings, underground spaces, and green spaces. Students should also avoid viewing a particular area or type of housing simply as "dangerous." Explain that flood risk can vary depending on a range of conditions.
Toward the end of the activity, use questions such as "Why does flood risk vary from place to place even when the same amount of rain falls?" and "Why is flood risk concentrated in certain areas?" to help students synthesize what they have explored. Finally, use the heavy rain safety guidelines from KMA Weather Nuri to distinguish between actions needed before, during, and after heavy rain and help students determine appropriate safety actions in real situations, such as avoiding flooded roads, underpasses, and rivers.

7. References

- Ministry of Data and Statistics. (n.d.-a). SGIS Natural Disaster Statistical Map. Statistical Geographic Information Service (SGIS). https://ndsm.mods.go.kr/ndsm/srv/map/intMap.do
- Ministry of Data and Statistics. (n.d.-b). Natural Disaster Statistical Map: Flood. Statistical Geographic Information Service (SGIS). https://ndsm.mods.go.kr/ndsm/srv/map/intMap.do?type=flud
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- Kyunghyang Shinmun. (2025, August 6). Three years after the Gwanak-gu semi-basement flooding tragedy: As extreme heat and heavy rain continue, calls grow for climate crisis response and housing rights. https://www.khan.co.kr/article/202508061359001
- The Korea Transport Institute. (2023). Institutional improvement measures for underpass flood management: The case of Osong Station in Cheongju. https://www.koti.re.kr/user/bbs/anytmRsrchReprtView.do?bbs_no=62905

Session 1: Why Does Flooding Occur During Heavy Rain?

Topic	Understanding the Causes of Heavy Rain and Flooding
What Will We Learn?	① Understand the concepts of heavy rain and flooding and the relationship between them. ② Identify different factors that can cause flooding. ③ Explain the characteristics of places that are more likely to flood.

1 Think about it

- Have you ever seen roads or buildings flooded after heavy rain, either in person or in photos or videos?

- Why do some places flood while others do not, even when they receive the same amount of rain?

2 Understanding Heavy Rain and Flooding

- **Heavy Rain**
  A large amount of rain that falls over a small area within a short period of time.
- **Flooding**
  A situation in which roads, buildings, or other areas become covered with water because heavy rainfall cannot drain away quickly enough or because rivers overflow.

1) Why does the risk of flooding increase during heavy rain?

2) Besides heavy rainfall, what other factors can contribute to flooding?

3 Which Places Are More Likely to Flood?

- Look at the characteristics of the places below. Put a ✓ next to the places you think are more likely to flood during heavy rain.

Place	Characteristics of the Surrounding Area
☐ High Hill	Higher than the surrounding area
☐ Near a River	A place where river levels may rise or overflow
☐ Road Lower Than the Surrounding Area	Rainwater can easily collect in lower areas
☐ Underpass / Underground Space	Water may be difficult to drain once it flows in
☐ Area With Many Roads and Buildings	Rainwater has difficulty soaking into the ground
☐ Area with Many Parks and Green Spaces	An area with relatively more soil and vegetation

1) Choose two places above that you think are most likely to flood.

2) Briefly explain why you chose these two places.

4 Identifying Factors That Affect Flood Risk

- Flood risk is influenced not only by the amount of rainfall but also by a variety of other factors.
- Use the words in the box below to identify factors that can affect flood risk.

〈Word Bank〉

Amount and Intensity of Rainfall / Elevation / Distance from Rivers / Surrounding Environment such as Roads and Buildings / Drainage Conditions

Session 2: Which Areas Are More Vulnerable to Flooding?

Topic	Exploring Flood-Risk Areas Using the SGIS Natural Disaster Statistical Map
What Will We Learn?	① Use a flood risk map to identify areas where flooding is expected. ② Compare the distribution of flood-risk areas and expected flood depths. ③ Use maps to explain the spatial characteristics of flood-risk areas.

1 Understanding the SGIS Flood Risk Map

- **Flood Risk Map**

  A map showing the areas and depths of expected flooding under conditions such as a flood exceeding the capacity of river embankments or heavy rainfall exceeding the capacity of drainage facilities such as stormwater pumping stations.



* Areas shown on the map are not necessarily areas that will actually flood.

2 Exploring Heavy Rain and Flooding

- On the SGIS Natural Disaster Statistical Map, select the province/metropolitan city and city/county/district where your school is located, and examine the Flood Risk Map.

1) Are there any areas near your school that are expected to flood?

☐ Yes ☐ No ☐ Difficult to determine

2) If there are areas expected to flood, where are they mainly located?

3) Select the expected flood depths shown on the map.

☐ Less than 0.5m ☐ 0.5~1.0m ☐ 1.0~2.0m ☐ 2.0~5.0m ☐ 5.0m or more

3 Finding Flood-Risk Areas in Seoul

- Use the Flood Risk Map to identify areas in Seoul that are especially vulnerable to flooding.

1) In which parts of Seoul are flood-risk areas most commonly found?

2) Which district has the largest area at risk of flooding?

3) What evidence supports your answer?

4) What characteristics do the flood-risk areas have in common?

4 Why Are These Areas at Risk of Flooding?

- Based on the maps you have examined so far, think about why flood risk is concentrated in certain areas.

Session 3: Why Is This Area Vulnerable to Flooding?

Topic	Exploring the Landforms and Surrounding Environment of Flood-Risk Areas
What Will We Learn?	① the landforms and surrounding environment of flood-risk areas. ② Identify different factors that contribute to flood risk. ③ Use evidence from your investigation to explain why an area is at high risk of flooding.

1 Analyzing a Flood-Risk Area

- Choose one district from the flood-risk areas in Seoul that you explored in Session 2 and investigate it in more detail.

1) Which district did you choose?

2) Why did you choose this district?

3) Use an online map (Naver Map, KakaoMap, Google Maps, etc.) to investigate the landforms and surrounding environment.

Factor	What to Investigate	Findings
Elevation	Is the area lower or higher than its surroundings?	
Rivers	Is it close to a river?	
Roads /Buildings	Are there many roads and buildings?	
Underground Spaces	Are there underpasses, subway stations, or other underground spaces?	
Green Spaces	Are there parks or other green spaces?	

4) Based on your investigation, select all the reasons why the area may be at high risk of flooding.

- ☐ Lower elevation than the surrounding area
- ☐ Close to a river
- ☐ Many roads and buildings
- ☐ Presence of underground spaces
- ☐ Limited green space where water can soak into the ground
- ☐ Other: _____

Session 4: How Can We Prepare for and Respond to Flooding?

Topic	Learning Safety Actions Before, During, and After Heavy Rain
What Will We Learn?	① Distinguish between actions needed before, during, and after heavy rain. ② Explain places to avoid and safe actions to take during flooding. ③ Decide on appropriate safety actions for different situations.

1 Learning Safety Guidelines for Heavy Rain

- Go to KMA Weather Nuri → Weather Hazards → Natural Disaster Safety Guidelines → Heavy Rain.
- Review the safety guidelines for heavy rain and fill in the blanks.

Stage	Safety Guidelines
Before Heavy Rain	· Check potential ( ) in your area in advance. · Find out where safe evacuation areas and ( ) are located. · Prepare ( ), such as drinking water, emergency food, and flashlights.
During Heavy Rain	· Stay away from ( ), such as flooded roads, underpasses, and rivers. · If water begins to enter a building, immediately move to ( ) or a nearby evacuation area. · Continue checking ( ), including weather conditions and hazards in the surrounding area.
After Heavy Rain	· Flooded roads and bridges may be damaged, so do not ( ) them. · Before returning home, check the building for ( ). · Check whether flooded drinking water or food is ( ).

2 Where Should You Go During Heavy Rain?

- Sort the places in the 〈Word Bank〉 into the appropriate categories.

〈Word Bank〉
Flooded Road / Near a River / Underpass / School / Community Service Center / Near Utility Poles / Flooded Underground Space / Safe High Ground

Places to Avoid	Places to Consider for Evacuation