

Hazard Literacy Center

Hazard Literacy Education Program

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The Invisible Danger in Puddles: The Science Behind Electric Shock



1. Program Overview

This program is a hazard literacy–based educational program designed to help students scientifically understand the causes of electric shock accidents that may occur in urban areas following torrential rainfall and apply this understanding to appropriate safety behaviors. The program is based on the Disasters and Safety section of Grade 9 Science in Korea's 2022 Revised National Curriculum. With climate change contributing to more frequent localized torrential rainfall and urban flooding, the risk of electric shock accidents caused by flooded electrical facilities, damaged electrical wires, and current leakage has become an important urban safety concern. In particular, water on flooded roads and in puddles is not simply pure rainwater; it may contain soil, dust, and various dissolved ions, creating conditions in which electric current can flow more readily. It is therefore important for students to scientifically understand these risks and develop the ability to respond appropriately. To introduce the problem, students examine an electric shock scene in a flooded area from the film Haeundae and explore the guiding question, "Why are puddles dangerous on rainy days?" Following the POE (Predict–Observe–Explain) model, students first predict the electrical conductivity of distilled water, tap water, and saltwater. They then directly compare their conductivity through an experiment using a low-voltage circuit. Based on their observations, students examine why water containing dissolved ions conducts electric current more readily than pure water and use the relationship between electric current and resistance to scientifically explain how electric shock accidents can occur in flooded areas. Finally, students analyze real-world hazardous situations, such as handling electrical devices with wet hands, approaching flooded roads or puddles, and walking near downed power lines, and discuss appropriate safety behaviors. Rather than learning electrical concepts in isolation, students apply scientific principles to assess hazardous situations and make appropriate safety decisions. The program can also be aligned with the Disasters and Safety achievement standards of Korea's 2022 Revised National Curriculum. At the high school level, it can be extended to more advanced learning by connecting the activities to concepts in electricity and magnetism, including Ohm's law, electrical power consumption, and power loss.

Grade Level	Grades 11 (High School)	Instructional Methods	POE (Predict–Observe–Explain) model, inquiry-based experiment, discussion, and presentation
Learning Environment	Science Lab	Duration	50 minutes
Required Materials	Batteries, switch, resistor, light bulb, stainless-steel rods (electrodes), four beakers, wires, multimeter, distilled water, tap water, salt, glass stirring rod, gloves, worksheets, and writing tools		

2. Learning Objectives (Hazards Literacy Framework)

① Students will be able to scientifically explain the causes of electric shock accidents in flooded areas during torrential rainfall and describe how ions dissolved in water affect electrical conductivity.

② Students will be able to predict the electrical conductivity of distilled water, tap water, and saltwater, compare and analyze experimental results, and scientifically explain the relationship between electric current and resistance.

③ Students will be able to connect experimental findings to real-world disaster situations, make appropriate safety decisions around flooded roads, puddles, and electrical facilities with current leakage, and develop a willingness to practice safe behaviors.

Learning Objectives	Knowledge & Understanding		Reasoning & Skills					Values & Attitudes			Psychology & Emotion			Behavioral & Practical Enagement		
	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									
Objective ③								O	O		O			O	O	

3. Key Concpets

· Urban Flooding Disasters and Electrical Safety Hazards (Risk of electric shock in flooded areas during torrential rainfall)

· Investigating the Relationship between Electric Current and Resistance through Ohm's Law (At a constant voltage: decreased resistance → increased current)

· Analyzing the Relationship between Electrical Conductivity of Water and Electric Shock Risk (More dissolved ions → lower resistance → greater current flow)

· Understanding Electrical Energy and Potential Harm to the Human Body through Electrical Power

· Applying Scientific Principles to Urban Disaster Response and Safe Behavior

4. Program Sequence

Learning Activities	
Introduction	·Present a scene from the film Haeundae showing an electric shock accident in a flooded area. ·Introduce the guiding question: "Why are puddles dangerous on rainy days?" ·Examine real-world cases of electric shock accidents following torrential rainfall and identify the problem to be investigated.
Activity1	·Predict which of distilled water, tap water, and saltwater will have the highest electrical conductivity. ·Explain, based on students' initial ideas, why the electrical conductivity of these types of water may differ.
Activity2	·Conduct a low-voltage circuit experiment to compare the electrical conductivity of distilled water, tap water, and saltwater. ·Compare the brightness of the LED and measured current values, and record the experimental results.
Activity3	·Use the experimental results to explain the relationship between the presence of ions in water and electrical conductivity. ·Watch a demonstration video showing the risk of electric shock under flooded conditions. ·Use Ohm's law (V = IR) to interpret the relationship between resistance and current and scientifically explain why the risk of electric shock increases in flooded areas.
Wrap-up	·Discuss appropriate safety behaviors around flooded roads, puddles, and electrical facilities with current leakage. ·Present and summarize appropriate responses to disaster situations based on scientific principles.

5. Theoretical Background and Activity Design for Disaster Education

With the increasing frequency of localized torrential rainfall and urban flooding associated with climate change, the risk of electric shock accidents caused by flooded electrical facilities, current leakage, and damaged electrical wires has become an important urban safety concern. Water on flooded roads and in puddles is not simply pure rainwater; it may contain soil, dust, salts, and other substances that produce dissolved ions, allowing electricity to flow more readily than through pure water. Therefore, helping students scientifically understand the causes of electric shock accidents in flooded areas and make appropriate safety decisions in real-world disaster situations is an important aspect of hazard literacy education.

Pure water generally has very low electrical conductivity. In contrast, actual rainwater and floodwater contain various dissolved ions that increase their electrical conductivity. As the concentration of ions increases, the electrical resistance of the water decreases. According to Ohm's law (V = IR), when voltage is held constant, a decrease in resistance allows a greater electric current to flow. In addition, wet skin generally has lower electrical resistance than dry skin, which can allow more current to pass through the human body and thereby increase the risk of electric shock. These scientific principles are essential for understanding why flooded roads, puddles, and areas near electrical facilities with current leakage can be hazardous.

This program is designed around this theoretical background using the POE (Predict–Observe–Explain) model. Students first encounter the problem through an electric shock scene in a flooded area from the film Haeundae and predict the electrical conductivity of different types of water. They then conduct a low-voltage experiment using air, distilled water, tap water, and saltwater to directly observe differences in electrical conductivity. Based on the experimental results, students explain the relationships among dissolved ions, electrical resistance, and electric current.

Finally, students connect the scientific principles demonstrated in the experiment to electric shock hazards in real-world flooded environments. They discuss appropriate safety behaviors, such as avoiding puddles and flooded roads and staying away from electrical facilities with suspected current leakage and downed power lines. Through these activities, students move beyond treating electricity as a set of concepts and calculations and develop hazard literacy by using scientific evidence to assess risks and make informed decisions about safe behavior in disaster situations.

6. Instructional Considerations

Students often tend to oversimplify the concept by thinking that “water conducts electricity well.” However, pure water itself is a poor conductor of electricity. In real-world electric shock accidents, a key factor is that dissolved ions and impurities in water increase its electrical conductivity. Teachers should therefore avoid reinforcing the misconception that “water itself is a good conductor of electricity” and instead guide students to understand electric shock hazards by focusing on the relationship between ion concentration in water and changes in electrical resistance.

When explaining the risk of electric shock, teachers should also avoid limiting the explanation to the idea that “high voltage is dangerous.” Even when the same voltage is applied, a decrease in the electrical resistance of the human body allows a greater current to flow through it according to Ohm’s law. It is this electric current passing through the body that can cause harmful effects. In particular, students should understand through connections to real-life situations that wet hands and flooded environments can reduce the electrical resistance of the skin and thereby increase the risk of electric shock.

Teachers should clearly explain that the experiment does not reproduce an actual electric shock situation. Rather, it is a safe model experiment conducted under low-voltage conditions to investigate differences in the electrical conductivity of different types of water. Using a circuit with batteries and an LED, students compare current flow through distilled water, tap water, and saltwater and then connect their experimental findings to electrical safety issues in real-world flooding situations.

During the POE (Predict–Observe–Explain) activities, the emphasis should not be on whether students’ initial predictions are correct or incorrect. Instead, students should compare their predictions with the experimental results and develop explanations based on scientific evidence. After the experiment, teachers can use questions such as “Why does electric current flow more readily through saltwater?” and “Why should people stay away from electrical wires in flooded areas?” to help students connect scientific concepts with real-world disaster situations. Through this process, students should be guided to use physics concepts not simply as formulas to memorize, but as tools for anticipating hazards and making informed safety decisions in everyday life.

7. References

- Ministry of Education. (2022). 2022 revised national curriculum for science [In Korean]. Ministry of Education.
- National Fire Protection Association. (2023). Electrical safety foundation resources.
- National Disaster Management Research Institute. (n.d.). Demonstration experiment on electric shock during flooding [Video; in Korean]. YouTube.
- Yoon, J. K. (Director). (2009). Haeundae [Film]. CJ Entertainment. [Excerpt of an electric shock scene in a flooded area used for educational purposes.]

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Electric Shock Accidents — POE Experiment Worksheet

Topic	Electric Shock Accidents and Electrical Safety in Flooded Areas Caused by Heavy Rain
What Will We Learn?	① Understand why electric shock accidents occur in flooded areas and explain how ions in water affect electrical conductivity. ② Predict the electrical conductivity of distilled water, tap water, and salt water, and compare and analyze the results through an experiment to explain the relationship between electric current and resistance. ③ Connect the experimental results to real-life situations and develop an attitude of making and practicing appropriate safety decisions.

1 Predicting the Problem Situation

"Why are puddles dangerous on rainy days?"

• Watch a scene of an electric shock accident in a flooded area from the movie Haeundae and examine recent cases of electric shock accidents during periods of heavy rain. Then, predict why puddles can be dangerous.

• Which liquid do you think has the highest electrical conductivity: distilled water, tap water, or salt water? Explain why you think so.

• Prediction

Rank	Distilled Water	Tap Water	Salt Water
Predicted Rank			

2 Comparing Electrical Conductivity

Experiment Objective

Use a low-voltage circuit to compare the electrical conductivity of distilled water, tap water, and salt water by observing the brightness of an LED.

Materials Battery, LED, wires, distilled water, tap water, salt water, beakers

Experimental Procedure

① Pour distilled water, tap water, and salt water into separate beakers.
② Set up a battery–LED circuit and place the electrodes into each liquid.
③ Observe and record changes in the brightness of the LED.

Observation Table

Type of Liquid	My Predicted Brightness (Low/Medium/High)	Observed LED Brightness	Amount of Current (Low/Medium/High)
Distilled Water			
Tap Water			
Salt Water			

3 Explaining the Experimental Results

Based on the experimental results, explain the relationship between the presence of ions in water and electrical conductivity (resistance).

Using Ohm's law (V = IR), explain what happens to the current when resistance decreases.

Watch the electric shock demonstration video about flooding and write down something new you learned. *(youtu.be/gQlLCJBg3r0)*

Using the concept of electric power ($P = IV$, $P = I^2R$), explain how an increase in current can affect the human body.

4 Situation-Based Decision-Making Activity What Would You Do?

Discuss the following three situations with your group members. Choose one situation and discuss how you would respond. Explain your reasoning by connecting your decision to the scientific principles you learned today.

Group ( ) / Selected Situation: Situation ( )

Situation 1It has been raining heavily, and you need to pass a puddle near a crosswalk.
① What would you do?
② Explain your decision using scientific principles (ions, resistance, and electric current).

Situation 2In a flooded alley, water has risen underneath a streetlight. Your friend wants to walk through the water.
① What would you do?
② Explain your decision using scientific principles (ions, resistance, and electric current).

An electrical distribution box near your house is surrounded by floodwater. What should you do?
① What would you do?
② Explain your decision using scientific principles (ions, resistance, and electric current).