

Hazard Literacy Center

Hazard Literacy Education Program

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Wildfire Education Program Using ZEP



1. Program Overview

This program is competency-centered education in which students experience the entire process of disaster management(PPRR) within ZEP, a web-based metaverse platform developed in Korea, integrating scientific principles with social systems learning in response to wildfire disasters that have become larger in scale and more frequent due to the recent climate crisis. In the Prevention and Preparedness stages, students analyze the three elements of combustion and weather data to predict wildfire risk levels and assemble their own survival backpacks. In the Response stage, they investigate spread mechanisms such as convection phenomena driven by slope gradient, write real-time reports from a virtual field site, and establish optimal firefighting strategies. Finally, in the Recovery stage, students precisely assess the ecological, social, and economic damage following the wildfire's end and carry out policy-proposal activities?together helping students comprehensively cultivate both scientific inquiry ability and the problem-solving competencies of democratic citizens who protect community safety.

Grade Level	Grades 4–6	Instructional Methods	Lecture, Discussion, Game-based Activities
Learning Environment	EnvironmentA classroom equipped with computers or tablets (internet access required; a screen-sharing device is recommended)	Duration	220 minutes total (4 sessions × 55 minutes)
Required Materials	A computer or smartphone capable of accessing the metaverse platform, and activity worksheets		

2. Learning Objectives (Hazard Literacy Framework)

① Understand the natural and anthropogenic causes of wildfires, as well as the spread mechanisms driven by weather and topographic conditions.
② Develop the ability to analyze information necessary in disaster situations (location, weather data, risk factors, etc.) and determine appropriate response actions.
③ Experience the process of dividing roles and collaborating to solve problems through group activities, thereby understanding the importance of community-based disaster response.

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													
Objective ②		O	O						O							
Objective ③					O				O					O		

3. Key Concepts

- Combustion conditions and ignition principles
- Fire spread patterns by weather condition
- Topographic effects on fire progression speed
- Combined natural and human causes of disaster
- Threshold effects: small changes, large damage
- Cause–process–outcome relationships in disasters
- Principles of safe decision-making in disasters

4. Program Sequence

Learning Activities	
Prevention	Students learn that 99% of wildfire causes are human-induced, and watch an experimental video generated through AI simulation, illustrating the differences in ignition between pine and oak trees as well as how combustion conditions vary with humidity. Based on the data they have investigated, students design their own set of prevention guidelines tailored to the characteristics of their local community.
Preparedness	Students assemble their own "personal survival backpack" to protect their family's safety during a wildfire crisis, deciding on the priority order of essential items. They also locate the nearest shelter in their neighborhood using a disaster map and carry out a virtual evacuation drill.
Response	● Through a virtual wildfire reporting simulation and an O/X quiz, students learn correct response procedures, and collaborate with the fire authorities to carry out an emergency response strategy for safely rescuing isolated residents. ● Students analyze real-time wind direction and speed data from the meteorological authority together with topographic information from the forestry authority to predict the fire's spread path, then report on-site conditions to the fire authorities and relevant agencies while establishing an efficient firefighting strategy.
Recovery	Following fire suppression, students conduct a detailed investigation of the ecological, social, and economic damage to diagnose issues of "recovery inequality," and plan and present sustainable recovery policies that national and local governments should implement to support the community's swift return to normal life.

5. Theoretical Background and Activity Design for Disaster Education

Approximately 70% of South Korea's land area is forested, and in recent years, the climate crisis has intensified strong seasonal winds, such as the "Yanggang-jipung" (a local downslope wind pattern characteristic of Korea's east coast), along with prolonged periods of drought, causing wildfires to become larger in scale and to occur year-round regardless of season. Scientifically, wildfires occur when fuel, oxygen, and a heat source above the ignition point are present simultaneously; severe drought lowers the effective humidity of forests, allowing even a small spark to easily reach the ignition point. In addition, on sloped terrain, convection causes heat to rise, allowing flames to spread rapidly upward, while strong winds scatter embers and rapidly expand the range of fire spread.



Figure 1. ZEP-based wildfire response strategy briefing and collaborative simulation space

This program is designed to integratively recreate the scientific principles of wildfires and the social response system within ZEP, a web-based metaverse platform developed in Korea. As shown in Figure 1, the virtual space includes a wildfire response strategy briefing room, a drone surveillance system, a firefighting equipment storage area, and characters representing relevant agencies, allowing students to simulate real disaster response situations. Students analyze weather data and topographic information to predict the fire's spread path, understand the role of drone-based surveillance systems, and experience the collaborative structure among firefighting, military, and medical personnel. Through this process, students come to recognize that wildfires are not simply natural phenomena, but complex disasters in which scientific conditions and social systems interact. From a social studies perspective, wildfires are a critical safety issue that extends beyond loss of life and property to affect local communities and even the national economy. By incorporating role division and strategy development, ZEP-based activities help students experientially understand the importance of ICT-based public response systems and collaborative structures. This activity is designed to provide an integrated experience of the entire prevention, preparedness, response, and recovery process, and to help students learn that sustainable land conservation is possible only when individual safety behavior is combined with community-based response capacity.

6. Instructional Considerations

Instruction is organized to help students recognize wildfires not as isolated fire incidents but as national disasters connected to the climate crisis, and to organically guide them through the process by which scientific principles (combustion, heat transfer) are applied within actual social response systems (wildfire forecasting, firefighting strategy). The metaverse is used not as a simple game but as a venue for virtual simulation training, encouraging students to make decisions based on objective data and to write situational reports. In particular, instruction emphasizes the importance of prevention and preparedness alongside response, and guides students to precisely assess the ecological and economic damage that occurs during the recovery stage and to think critically about sustainable recovery policies, thereby cultivating practice-oriented disaster resilience.

7. References

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Session 1: Exploring Wildfires in the Metaverse

Topic	Why Do Flames Spread?
What Will We Learn?	• Analyze and explain, using scientific data, the topographic and climatic conditions that influence the occurrence and spread of wildfires. • Understand the rationale behind wildfire prevention behaviors and policies, and establish safety guidelines for our community. • Select survival items needed for emergency situations and identify shelter locations to prepare for an actual wildfire.

1 Think About It

- A "Wildfire Risk Warning" has been issued for the mountain behind your neighborhood. Let's check the current weather conditions.

> The wind is blowing fiercely, and the leaves underfoot are so dry they crackle with every step.

- If you think our village is currently (dangerous / safe) for a wildfire to occur, what is your reasoning? How well prepared are we for a wildfire?

2 Think Ahead

- Choose which of the two terrains below you think a wildfire would spread through more quickly and extensively, and write down your reasoning.

  - Terrain (A): A very steep slope with a dense pine forest
  - Terrain (B): A flat, open area with few trees
  - My Choice: I think Terrain ( ) is more dangerous.
  - Reason:

3 Explore

[Activity 1] Discovering Wildfire Prevention Methods for Our Village

1. What is the name of the system operated by the USDA Forest Service that forecasts the likelihood of wildfire occurrence? (Hint: the National Fire Danger Rating System, NFDRS) What are the main weather data (temperature, humidity, wind, etc.) used in this system?

2. Find three items that should NOT be brought into the forest, and explain, using scientific reasoning, why each one is dangerous. (e.g., flammable substances, lighters, etc.)

3. What is the name of the special system that restricts public access to forests in order to protect them on days of extremely high wildfire risk? How does this system help prevent wildfires? (Based on the US system)

[Activity 2] Why Does Wildfire Spread So Quickly?

▶ **Experiment Record 1**: How does the direction of the flames change when wind is blowing? How does the area covered by the fire change?

▶ **Experiment Record 2**: Based on your results, explain why wildfire spread accelerates.
(Hint: heat transfer, ember transport, oxygen supply)

▶ **Experiment Record 2**: What are the important topographic and weather conditions that determine wildfire spread?
(Hint: wind strength, slope of terrain, air humidity)

[Activity 3] Creating a Scientific Wildfire Prevention Guide

1. Using the criteria below, calculate the wildfire risk score for each zone and determine the top-priority monitoring area.

Zone	Area Characteristics	Risk Factor	Risk Score
Zone A	Forest on a gentle slope	Affected by wind	
Zone B	Very steep slope + dry forest	Rapid heat transfer	
Zone C	Forest near residential housing	Risk of human-caused ignition	

2. Based on the top-priority monitoring area you selected, write a prevention guide by answering the following questions.

1) What is the scientific reason this area is judged to be at high risk of wildfire?
2) What measures are needed to prevent wildfires or detect them early in this area? (e.g., access control, installation of monitoring equipment, removal of fallen leaves, etc.)

[Activity 4] Creating a Regional Risk Map and Preparedness Plan for Four Regions (Code Collection)

Region	Risk Factor	Preparedness Method	Code
Colorado	If the slope is 30 degrees, fire spreads (___) times faster.		
Texas	During strong winds, embers can fly up to (___) mile(s).		
California	The required defensible space distance between a house and surrounding vegetation is (___)0 feet.		
Virginia	Open burning is prohibited within (___)00 feet of woods or dry grass.		

[Activity 5] Packing My Survival Backpack

- Just in case, you need to pack a survival backpack. Choose three of the preparedness items you collected in the metaverse, and explain your reasons for selecting each one using scientific reasoning.

- Where is the shelter closest to your home?

Session 2: Responding to and Recovering from Wildfire

Topic	Can We Respond to a Wildfire?
What Will We Learn?	• Analyze wildfire situations and develop response strategies. • Carry out the actions that must be taken within the golden hour when a wildfire occurs. • Understand the various forms of damage caused by wildfires and propose response measures for community recovery.

1 Think About It

- Imagine that a wildfire has actually broken out. How do you think you would act? What should be the very first action you take?



2 Think Ahead

▪ What actions should you take, and what actions should you avoid, when a wildfire occurs?

Actions You Should Take	Actions You Should Avoid

▪ What kinds of damage can wildfires cause? Match the correct pairs.

Ecological Damage	•	• Timber and livestock losses, farm and village fires
Economic Damage	•	• Destruction of wildlife habitats, loss of biodiversity, landslides
Social Damage	•	• Resident health effects from smoke and fine dust, decline in tourists

3 Explore

[Activity 1] Deployed to the Wildfire Site

▪ From the earliest stage of a wildfire, deploying more suppression personnel and equipment than the fire's strength can minimize damage. This strategy of extinguishing a wildfire quickly in its early stage is called ( ) wildfire suppression. Forest Service helicopters begin suppression within ( ) minutes of receiving a report, while helicopters leased by local governments begin suppression within ( ) minutes.

- A wildfire has broken out! We need to check the current weather conditions and respond quickly. Record the current temperature, humidity, and wind direction.





- A wind's name is determined not by where it is blowing toward, but by where it is blowing from. For example, a "west wind" is a wind blowing from the west — meaning it travels from west to east. (West → East)
- So, from which direction do an east wind, a south wind, and a north wind blow, and toward which direction do they travel? Keeping the wind direction in mind, mark the safe evacuation direction with an arrow

Temperature	
Humidity	
Wind Direction	
Evacuation Direction	

West Wind	➔
East Wind	➔
South Wind	➔
North Wind	➔

▪ What are the 3 steps of the national wildfire action program in the United States?

< 3 Steps of the "Ready, Set, Go!" Program >

1. ( ) ⇨ 2. ( ) ⇨ 3. ( )

1. Ready

① Have you already created defensible space around your home?

② Have you already assembled an emergency supply kit and a family evacuation plan?

2. Set

① Monitor local news and alerts for wildfire updates and evacuation orders.

② Identify your evacuation route on the map and load your emergency kit into the car.

③ Solve the O/X quiz on wildfire safety to check how ready you are to leave.

3. Go

① Evacuate immediately using the route you identified.

② Which locations are suitable for evacuation? Mark ○ on all the safe locations.

③ What kinds of emergency situations could occur during the evacuation process?

A valley with water	A wide road	An uphill path on the mountain
An area that has already burned	A place where trees are actively burning	A wide open field
An area with dense trees	An area with no fuel	Behind a rock

[Activity 2] Reporting After the Situation Is Resolved

▪ Which agencies responded to the wildfire scene?

▪ What kinds of personnel and roles are needed at a wildfire response scene?

▪ What supplies and equipment are needed for wildfire response?

< Wildfire Incident Report >

1. Location and Time of the Wildfire
· Location:
· Time:

2. Weather Conditions at the Time
· Temperature: · Humidity: · Wind Direction:

3. Description of the On-Site Situation:

4. My Assigned Role:

5. Current Status:

[Activity 3] Investigating the Damage Suffered by Our Community



As a member of the Wildfire Exploration Team, you have been given the mission of investigating the wildfire damage sustained by our community's forest. Based on what you find, you will help develop policies to restore the forest. Head to the mountain behind our village in the metaverse to investigate the damage and record your findings on the activity sheet.

1) What kinds of damage did residents experience?

2) Which groups of people were affected more severely?

3) What kind of support should be provided to help residents?

[Activity 4] Developing a Recovery Policy for Our Community

- Now it's time to use what you've investigated to create a policy for recovering our community. Choose one of the two options below, either supporting residents or restoring the forest, and create a recovery policy poster.

Option 1: Create a policy to support community residents	Option 2: Create a policy to restore the forest
Must-Have Content for the Poster!	
☐ Title	☐ Title
☐ Damage suffered by community residents	☐ Damage suffered by the forest
☐ Ways to support residents (psychological, material support, etc.)	☐ Ways to restore the forest (trees, wildlife, ecosystem, etc.)
☐ Expected outcomes of the support	☐ Expected outcomes of the restoration

Let's install the finished poster at our community center in the metaverse.
Look at your classmates' posters, vote for the policies you think would be effective, and leave comments.

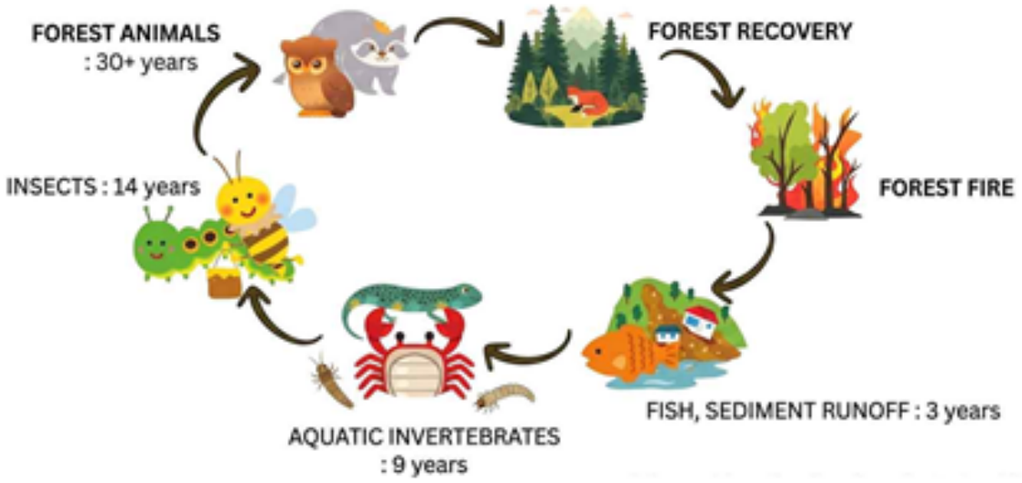
- **What kinds of secondary damage occur as a result of forest fires?**

- **What methods can be used to restore a burned forest?**

- **What kinds of trees should be planted in wildfire-damaged areas?**

4 Wrap-up

■ Ecosystems damaged by wildfire are said to take a very long time to recover. The psychological and economic damage suffered by community residents will likely take a long time to heal as well.



▪ Take a look at how our community has recovered in the metaverse, and share your thoughts on today's lesson. ☺