What's your plan? Saving Humanity One Natural Disaster at a Time

Unit: Unit 2 Patterns in Earth's History and Processes	**Utah SEEd Standard / NGSS Performance Expectation:** Evaluate **design solutions** that reduce the effects of natural disasters on humans. *Define the problem, identify criteria and constraints, analyze available data on proposed solutions, and determine an optimal solution.* Examples of natural disasters could include earthquakes, tsunamis, hurricanes, drought, landslides, floods, or wildfires. (ESS3.B, ETS1.A, ETS1.B, ETS1.C)	**Time: 2 - 3 days of 70 Minutes Sessions**

Access to all material for this lesson: Link to lesson folder

Anchor Phenomenon	Poor preparation in multiple cities causes large effects on life, property, and time.
Driving Question(s)	What are design solutions to minimize the effects caused by local natural disasters?
Performance Task	Students will research the effects caused by a natural disaster event and then communicate those design solutions to their peers through video.

Lesson Summary:			
	Time	**Guiding Question / Learning Objective** What are design solutions to minimize the effects caused by local natural disasters?	**How are students answering the guiding question or meeting the learning objective?**
Engage	20-25 Minutes	1. Hand out the student handout 2. Discuss the events that happened with Hurricane Katrina and the tsunami in Japan. 3. Students will use the handout to guide their inquiry into the effects caused by the natural disaster.	Students will use real-life figures to represent the devastation caused by natural disasters.

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 **Explore**	30-40 Minutes	4. Have students pick a Local Natural disaster in Utah (listed on the overhead slides) 5. Students will need to find the slide show for their specific natural disaster from the natural disaster slides. 6. On the student handout, the student will organize their research to find the causes and effects of their natural disaster.	Students will research to help them understand the true scope of their natural disaster and the realistic danger its effects can reach. The students will then brainstorm design solutions to minimize the effects caused by their natural disaster.
 **Explain**	15 Minutes Day 1 10-15 Minutes Day 2	7. Students will build solutions based on the scope they have found for their natural disaster. These solutions will focus on mitigating the effects of natural disasters in the key areas of loss of life, property, and money. 8. Students will use criteria and constraints to refine their ideas to the most realistic and cost-effective idea for their group.	Students will further research the area of those effected by the natural disaster if it were to happen in the area that they live. Students will use criteria and constraints to update their ideas for design solutions and make their ideas more realistic.
 **Elaborate**	15 Minutes	9. Students will create a short 45-second to 2-minute video showing their design solution to mediate the effects of their assigned natural disaster. 10. These videos will be shared with all others in the class.	Students will use video to communicate their design solution to others.
 **Evaluate**	45 Minutes	11. Students will watch other videos from their peers and evaluate them to improve their design solutions.	Students will have a chance to make revisions based on feedback for their design solution to minimize the effect caused by their natural disaster.

Three Dimensions Focused on in This Lesson		
Disciplinary Core Idea: (ESS3.B): Natural Hazards (ETS1.A): Defining and Delimiting an Engineering Problem (ETS1.B): Developing Possible Solutions (ETS1.C): Optimizing the Design Solution **NGSS Appendix E**	**Science and Engineering Practices:** **Designing Solutions (Evaluating)**: Students evaluate solutions to a problem related to reducing the effects of natural disasters on humans, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. **NGSS Appendix F**	**Crosscutting Concept:** Cause and Effect: Understanding the causes of natural events can allow us to reduce the impacts on human life. **NGSS Appendix G**
Learning Objectives 1. I can define a effect caused by local natural disaster		

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2. I can design a solution to the effect caused by a local natural disaster
3. I can improve my design with some critiques from peers to better my idea

Related Knowledge and Skills from Prior Grades

Disciplinary Core Idea:
Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.
NGSS Appendix E

Science and Engineering Practices:
Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
NGSS Appendix F

Crosscutting Concept:
Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.
NGSS Appendix G

Connections to Mathematics and ELA/Literacy Standards

ELA/Literacy Standards:

- **RST.11-12.1** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- **RST.11-12.2** Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- **WHST.9-12.1** Write arguments focused on discipline-specific content.
- **WHST.9-12.7** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- **SL.11-12.5** Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Mathematics Standards:

- **MP.2** Reason abstractly and quantitatively.
- **MP.4** Model with mathematics.
- **HSN-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- **HSN-Q.A.2** Define appropriate quantities for the purpose of descriptive modeling.
- **HSN-Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

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Materials

Handouts	Lab Supplies	Other Resources
Disaster Slide Folder Teacher Slides (pptx) Student Handout	Poster Markers Sticky Notes Other modeling type of items	Students will need to use their smartphones or other technology to record videos.

ENGAGE

Teacher Slides 1-3

1. Hand out the student handout.
2. Read this description of Katrina: “The city of New Orleans was once a bustling metropolis, but Hurricane Katrina changed everything. In 2005, the hurricane hit, breaking the levees that carried water from the Mississippi River to the ocean. The city of New Orleans has elevations lower than sea level, causing the water from the Mississippi River to flood the city. The storm caused widespread damage and loss of life, leaving the city in ruins. In the storm’s aftermath, thousands were displaced and forced to flee their homes. The official death toll was listed at 1,833 people; however, some theories suggest as many as 10,000 people actually died. The city’s infrastructure was also severely damaged, costing around $100 billion, which took years to rebuild. Despite the challenges, the people of New Orleans have shown remarkable resilience. They have come together to rebuild their city and restore their pride. Today, New Orleans is once again a thriving community, and its residents are determined never to forget the lessons of Hurricane Katrina.”
3. Turn slides to **slide 2** and show the video showing images of the result from Hurricane Katrina in 2005.
4. Students should answer questions 1-2. Discuss issues in Louisiana without discussing how they have changed New Orleans to prevent the same disaster.
5. Read the Japan tsunami description: “On March 11, 2011, a magnitude 9.0 earthquake struck off the coast of Japan, triggering a massive tsunami that devastated the country’s northeastern coastline. The tsunami reached up to 40 meters (130 feet) in some areas and swept away entire towns and villages. The tsunami also caused a nuclear disaster at the Fukushima Daiichi Nuclear Power Plant. The plant’s cooling systems were overwhelmed after the flood stopped a pump, and three of its reactors melted down. The disaster released large amounts of radioactive material into the environment, forcing hundreds of thousands of people to evacuate. The official death toll was 15,899 people, with the unofficial number being much higher.

Teacher Tips

Teachers can choose how they would like to present the video. Ideas include showing just the video and listing key statistics, reading the script with the video muted, or performing the videos as they are written.

Students may need to have the term “infrastructure” defined for them.

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The cost of fixing Japan was estimated to be $1 trillion." 6. Turn to **Slide 3** and watch the video describing the 2011 Tsunami in Japan. 7. Students should answer questions 3-4. Discuss issues in Japan without discussing how they have changed Japan and nuclear reactors to prevent the same disaster.	

EXPLORE

Slide 4

8. Split students into groups of 2-3 students

9. Turn to slide 4 and have students pick a Local Natural disaster in Utah that they will be studying to find the cause of the natural disaster and what the effect is. Have each student fill in the student paper Question 3 for their chosen natural disaster.

10. Have students find the slide show for their specific natural disaster from the natural disaster slides.

11. Students should fill in answers to questions 5-6 on their student worksheet while going through the natural disaster slides.

12. Stop the class to discuss the directions for question 7 on the student handout.

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EXPLAIN

Slide 4

13. Students should use the box for question 7 to draw the area around where they live. If the student doesn't know the general layout of their town/neighborhood, they should use Google Maps/Earth to help them with their picture. The picture should include whatever would be affected by their specific natural disaster, so they could be large or small in scale.

14. Question 8 will require the students to draw the affected area in their picture and have the students write out what would happen in the worst-case scenario of their natural disaster. They should use what they learned from the disaster slides to describe what could reasonably happen.

15. Question 9 requires the students to conduct some quick research to find how many people live in their affected area to get a scope of what could happen if this scenario were to come to life.

Slide 5

16. Turn the slide show to slide 5, and discuss that solutions for natural disasters have some constraints. List off the constraints on the board and tell the students they must keep these in mind while creating a design solution for their natural disaster.

17. Tell the students, "The goal of your design solution is to minimize the effects seen by their chosen natural disaster."

18. Students should use question 11 on their student sheet to brainstorm ideas (they do not have to all be reasonable) to minimize the effect of their natural disaster.

PROPOSED END OF TEACHING DAY 1

Teacher Tips

Assigning group roles may allow for student engagement through research and presentations.

Help students recognize that many of these natural disasters have causes that we cannot stop.

ELABORATE

Slide 6

19. Students will follow directions on the student worksheet question 12 to create a short 45-second to 2-minute video describing their design solution and how it would minimize the effect of their natural disaster.

20. Students should use any video creator they have, including TicToc, Instagram, Stop Motion Studio, or others. The student should not need to download anything to create the video. It is up to each teacher and

Teacher Tips

To start day two, find a recent natural disaster. Look up a news article or video of the disaster.

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their cell phone policy to the extent they let the student use their non-school-district device.

21. Discuss directions on how you would like to share the videos created by the students. Ideas include having the students email them to you, save them to a Google folder, airplay from their device, etc.

EVALUATE

Slide 6

22. Once all groups have submitted their video, start playing each video on the class projector or assign it out if you are using a shared folder.

23. After each video, give the students 1 minute to write their thoughts and opinions on the video (question 13) and the proposed solution keeping in mind the constraints on slide 5.

24. Call on at least two students to give feedback and ask the group to consider the feedback so they can update their design solutions.

25. Repeat steps 23-25 for each of the videos that you received. Allow each student to consider feedback on their design solution.

26. Students should consider their feedback and update their ideas for question 14 on their student sheet.

POSSIBLE EXTENSION / ALTERNATIVE ADAPTATIONS

- Look into specific structural changes in buildings in Alaska.
- Structure changes to the Salt Lake City Latter-day Saint Temple.

Slide 7

27. Read the following, “An earthquake struck Haiti on January 12, 2010, with a magnitude of 7.0, and its epicenter was 78 miles from the capital city Port-au-Prince. The city’s buildings were not designed to withstand such a powerful earthquake, and many collapsed, trapping people inside. The earthquake also triggered a tsunami that caused further damage along the Haitian coast. The Haitian government estimated that the earthquake killed between 220,000 and 316,000 people, making it the deadliest earthquake in Haitian history. The earthquake also injured over 300,000 people and left over 1.5 million people homeless. It caused an estimated $8.7 billion in damage to Haiti’s infrastructure, including roads, bridges, hospitals, and schools.

Slide 8

28. Read the following, “The Anchorage earthquake was a major natural disaster that struck November 30, 2018. The earthquake occurred about 10 miles north of the city. The earthquake was felt throughout Southcentral Alaska and as far away as Fairbanks. The earthquake caused widespread damage to

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Anchorage, including collapsed buildings, broken roads, and power outages. The earthquake caused an estimated $3 billion in damage, making it the most costly earthquake in Alaska's history."

29. Discuss what caused so much loss of life in the Haiti earthquake vs the Alaska Earthquake. Students should notice that the Haiti earthquake had a lot of cement, which does not hold up well in natural disasters. They may also point out that the GDP of the two countries is drastically different, and the expense may have caused the use of cheaper building materials.

30. Allow students to summarize the information talked about in question 15.

31. End with the question of why Alaska was so prepared.

Slide 9

32. Read the following, "The 1964 Alaska earthquake, also known as the Great Alaskan earthquake, was a magnitude 9.2 megathrust earthquake that struck Southcentral Alaska on March 27, 1964. The earthquake's epicenter was near Valdez, about 75 miles east of Anchorage. It was the most powerful earthquake ever recorded in North America and the second-most powerful ever recorded worldwide. The earthquake lasted four minutes and thirty-eight seconds and caused widespread damage throughout Southcentral Alaska. The earthquake killed 131 people and injured thousands more. It also caused an estimated $311 million (1964 USD) in damage, equivalent to over $2.5 billion today. The earthquake profoundly impacted Alaska, and it took many years for the state to recover. **The earthquake led to the development of new earthquake-resistant building codes, and it also helped to raise awareness of the dangers of living in an earthquake-prone region."**

33. Ask the students what Alaska officials did between 1964 and 2018 that caused much less loss of life.

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