Natural Hazards

And the science and engineering practices of human adaptations

Developed and Written By:

Jessica Catson and Deanna Pinomaki

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Why Science and Engineering?

During our undergrad at Cal Poly, we were both drawn to to STEM (Science, Technology, Engineering, and Math) subjects and find them of high importance to integrate into elementary schools. We are both very passionate about the new change to the Next Generation Science Standards and its emphasis on incorporating engineering into elementary school classes. It is very important to allow students a pathway for hands on learning to develop their problem solving skills, as well as a platform to investigate and answer real life problems. For this reason, we teamed up with the 4-H Stem Outreach program to develop a curriculum for fourth graders that can be integrated into their in-school and after school programs.

About the Authors

We are two Liberal Studies students at Cal Poly both concentrating in Science. We have had a passion for teaching and learning since we were elementary school students ourselves, and love doing science and engineering activities. Our love of STEM education has driven us to complete this six week unit plan, in hopes that other educators can use our curriculum to further teach students that they *can* solve the world's problems through creativity, investigation, and collaboration.

Lesson 1

What is a Natural Hazard?

Standards

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1)	SS3.B: Natural Hazards A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2) (Note: This Disciplinary Core Idea can also be found in 3.WC.)	Interdependence of Science, Engineering, and Technology Knowledge of relevant scientific concepts and research findings is important in engineering. (4-ESS3-1)

Objective:

Students will be able to identify the difference between a natural hazard and a natural disaster. They will also develop a basic understanding of how earthquakes, volcanoes, tsunamis and floods work and affect the Earth.

Materials

1 Per Class:

- Computer (2)
- Earth Physical Feature Map*
- Plate Tectonic Map*
- Volcano Parts Poster and Matching Labels
- Blank Poster Boards (3)
- Copies of *Amazing Pictures and Facts About Tsunamis* Book* (3)
- Natural Hazard Powerpoint

1 Per Student:

- Natural Hazard Worksheet
- Sticky Name-tags
- Pens/Pencils

*link to purchase under "References"

Prep

1. Make sure room has a projector and computer that can access the internet for the powerpoint.
2. Gather materials for stations and set up:
    a. Volcano Station:
        i. video on a computer with sound: (http://video.nationalgeographic.com/video/101-videos/volcanoes-101) with volcano worksheet (one for each student at the station) .
        ii. Hang up Volcano Parts Poster and have the words cut out and placed on the table to use. Provide tape to stick the words to the poster.
        iii. Provide two "Volcano Station Directions".
    b. Earthquake Station:
        i. Hang up Tectonic Plate Map and Physical Feature World Map side by side on a wall.
        ii. Provide students with Earthquake Worksheet to fill out on a table.
        iii. Provide two "Earthquake Station Directions"
    c. Tsunami Station:
        i. Provide 2-3 copies of the book for students to read in pairs.
        ii. Provide students with paper and markers to create their Tsunami Warning Poster.
        iii. Provide two "Tsunami Station Directions".

Procedure

Opening Activity:

As each student walks in, they will sign in and then create a name-tag that will be worn throughout the lesson

7 Minutes: Introductions

1. Before starting the lesson, the instructor will introduce themselves to the class and how they relate to the topic.
2. The instructor will set up the rules and expectations for the lesson. For this lesson, remind the students to raise their hands if they have questions or comments and to use inside voices.
3. The instructor will then establish a call and response signal that will be used for the unit to get the entire group's attention
    a. I.e. Instructor says "Volcanoes erupting in 3-2-1" and students stop what they're doing, put their hand in the air say BOOM and look at the instructor.

Explanation:

13 Minutes: Hazards vs. Disasters

1. By following the powerpoint, the instructor will ask what the students think a natural hazard is. Students will brainstorm in groups for about one minute and then share out. The instructor will explain that a natural hazard is an "earth process that can eventually affect humans in a negative way". (*5 Minutes)*
2. The instructor will explain that the four natural hazards they will be learning about in this unit are earthquakes, tsunamis, volcanoes, and floods and that natural hazards can sometimes lead to natural disasters that affect humans' everyday life. *(3 Minutes)*
3. The instructor will then show a slideshow that has two hazards matched with its corresponding disaster (ei Tsunami and Volcano). The instructor will go over the first example to show the differences between the hazard and disaster and discuss.
    a. An actual Tsunami is the hazard, a boat on top of a house is the disaster
    b. The students will decide on the second slide on their own by holding up a one or two on their hands based upon which picture they think is the hazard. They will discuss as a class until there is a consensus. *(5 Minutes)*

Engagement:

35 Minutes: Stations

1. Introduce each station briefly. Below are overall details about what each station will encompass. (*5 Minutes)*
    a. <u>Volcano Station:</u> Students will watch a short video from National Geographic about Volcanos and fill out the corresponding worksheet. After the video students will work on

the Volcano Parts Poster where they will match parts of the volcano to the corresponding area and definition. *(10 Minutes)*

b. Earthquake Station: Students will look at the two maps provided and draw their observations on the map on the worksheet. *(10 Minutes)*
c. Tsunami/Flood Station: Read a short passage about how and what Tsunamis are. Make a warning sign about the information you read (i.e. what Tsunamis are) Include pictures and information from the text. *(10 Minutes)*

2. Students will rotate through the 3 different stations to introduce natural hazards in more detail. Each group will spend 9 1/2 minutes at each station filling out their worksheets and 30 seconds moving to each new station.

Closing:

20 Minutes: Recap Stations

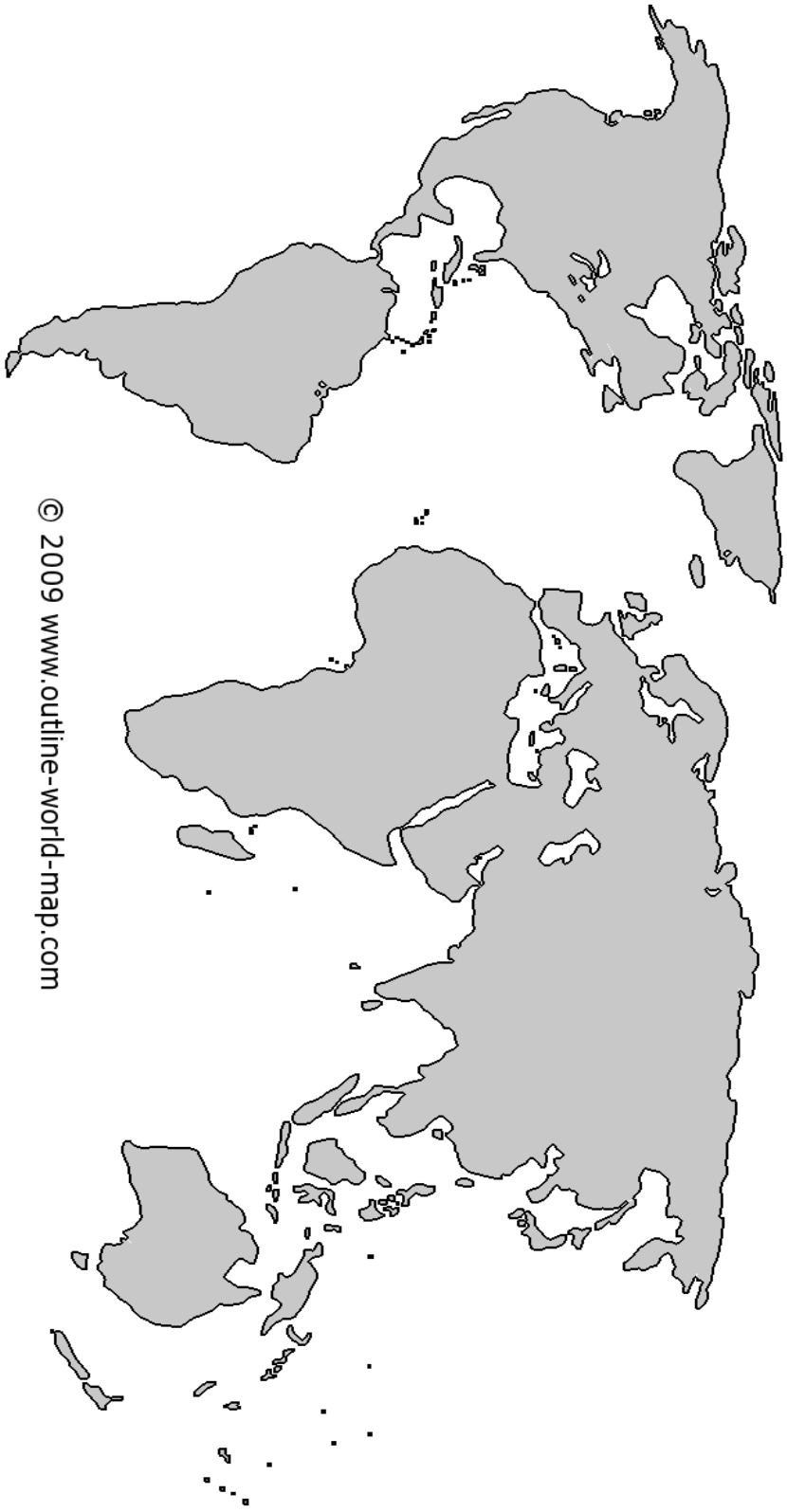
1. Bring class together and have students share with a partner what they learned and the answers to their worksheets to see if they got the same answers. *(5 Minutes)*
2. Have students share out what they want to know/have questions about and if they got different answers. *(5 Minutes)*
3. The instructor will have three posters titled, "Earthquakes", "Volcanoes", and "Tsunamis and Floods" in front of the class. Students will share out what they learned about each natural hazard and the instructor will write down their answers on the corresponding poster. *(5 Minutes)*
4. Instructor will then ask students to brainstorm how humans have "adapted" to these natural hazards as a precursor for the next lessons. Students share out. *(5 Minutes)*

References

1. Link to Amazing Pictures and Facts About Tsunamis book: https://www.amazon.com/Amazing-Pictures-Facts-About-Tsunamis-ebook/dp/B01H28S1D0/ref=sr_1_3?ie=UTF8&qid=1489005922&sr=8-3&keywords=tsunami+childrens+book
2. Link to purchase Tectonic Plate Map: https://www.amazon.com/This-dynamic-planet-earthquakes-cartography/dp/B011HHT2QC/ref=sr_1_1?ie=UTF8&qid=1489626788&sr=8-1&keywords=tectonic+plate+map

3. Link to purchase Earth Physical Feature Map: https://www.amazon.com/Reproduction-poster-presenting-Tectonic-Plates/dp/B019OWMTBM/ref=sr_1_5?ie=UTF8&qid=1489626788&sr=8-5&keywords=tectonic+plate+map
4. Link to "Natural Hazard" Powerpoint, Station Directions, and Natural Hazard Worksheet can all be found in Lesson 1 Google Drive: https://drive.google.com/drive/folders/0B16Gpot1lhG0ZUJEbnJyTkJRT2M?usp=sharing

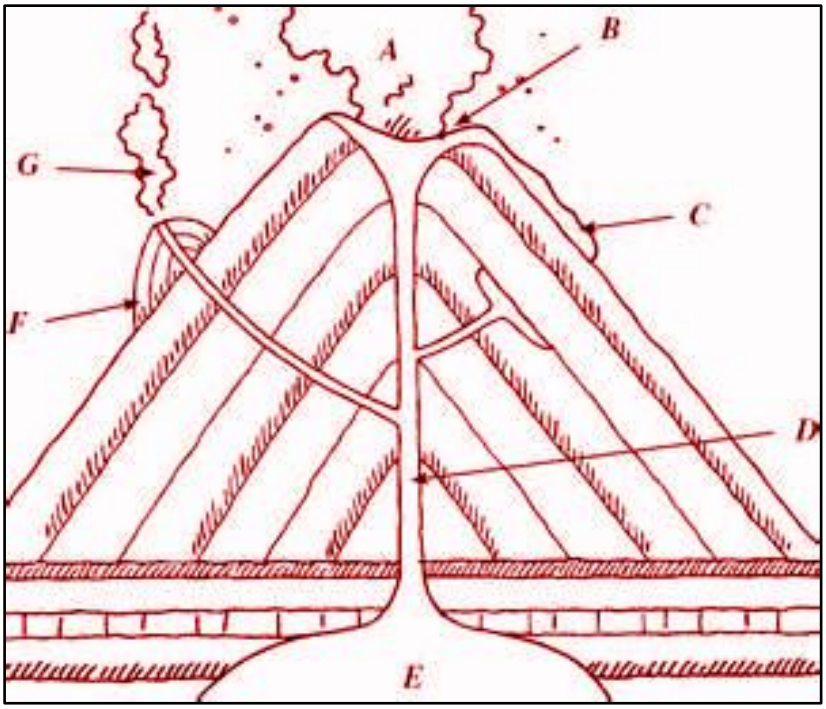
Earthquake Station Map



Volcanoes!

http://www.sanandreasfault.org/Volcanoes.html

1. At least _____ eruptions rock the Earth each year.
2. What makes up most of the Earth's interior? _____
3. Our planet is home to _____ active volcanos.
4. The vast majority of volcanoes occur on _____ _____ _____ where tectonic plates meet.
5. What is more deadly… Lava or Pyroclastic Flow? Circle one.



http://www.educationworld.com/sites/default/files/plate_techtonics_key.png

6. Lava creates _____ _____.

Earthquake Directions

Earth has a lot of physical features. Physical features are what make up the topography of Earth (mountains, lakes, oceans, valleys, rivers, etc). These physical features are a clue to where Earthquakes occur!

1. What are some **physical features** on Earth? Draw/label where the physical features are located on The Earthquake Station Map in blue (mountains, ocean, valleys, deserts etc.)

Mountains: ^^^ Ocean: ~~~ Valleys: ***

Tectonic Plate Boundaries are where Earthquakes occur. They are caused by movement of the Earth's crust that leads to the shaking and rumbling that we feel.

2. Look at the Tectonic Plate Map. Where are the **Tectonic Plate Boundaries**? Draw those on your Earthquake Station Map in black.
3. Are Tectonic Plate Boundaries located near or on any of Earth's physical features? Discuss with a partner and circle those features in red. Why do you think that is?

Tsunami/Flood Station Directions

1. Read the book **"Amazing Pictures and Facts about Tsunamis"** as a group. Pay attention to pictures!
2. Create a **Tsunami Warning Poster** that you can hang in your house, classroom, or on the streets to warn people about the dangers of Tsunamis and what causes them. Be sure to include drawings as well as words!
3. Include:
    a. *What* a Tsunami is
    b. What *causes* a Tsunami

c. *Where* Tsunamis occur
d. A *drawing* of a Tsunami or the effects of a Tsunami

4. Use the blank white paper and markers provided.

https://www.google.com/search?q=tsunami+warning+poster&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjJ7ZbdlpfYAhVOwmMKHdl_AfEQ_AUICigB&biw=1280&bih=646#imgrc=G79P7gkes5Xv2M:

Volcano Station Directions

1. Watch the video about Volcanoes on the computer. Fill out the first part of the Volcano worksheet as you watch the video! Make sure to reset the video to the beginning when it is over.

2. Next take a look at the Volcano Parts Poster. Using the definitions provided on the poster, work together to match the definitions with the word, and place the word on the poster. Once completed remove words

for the next group and fill out the rest of the Volcano worksheet.

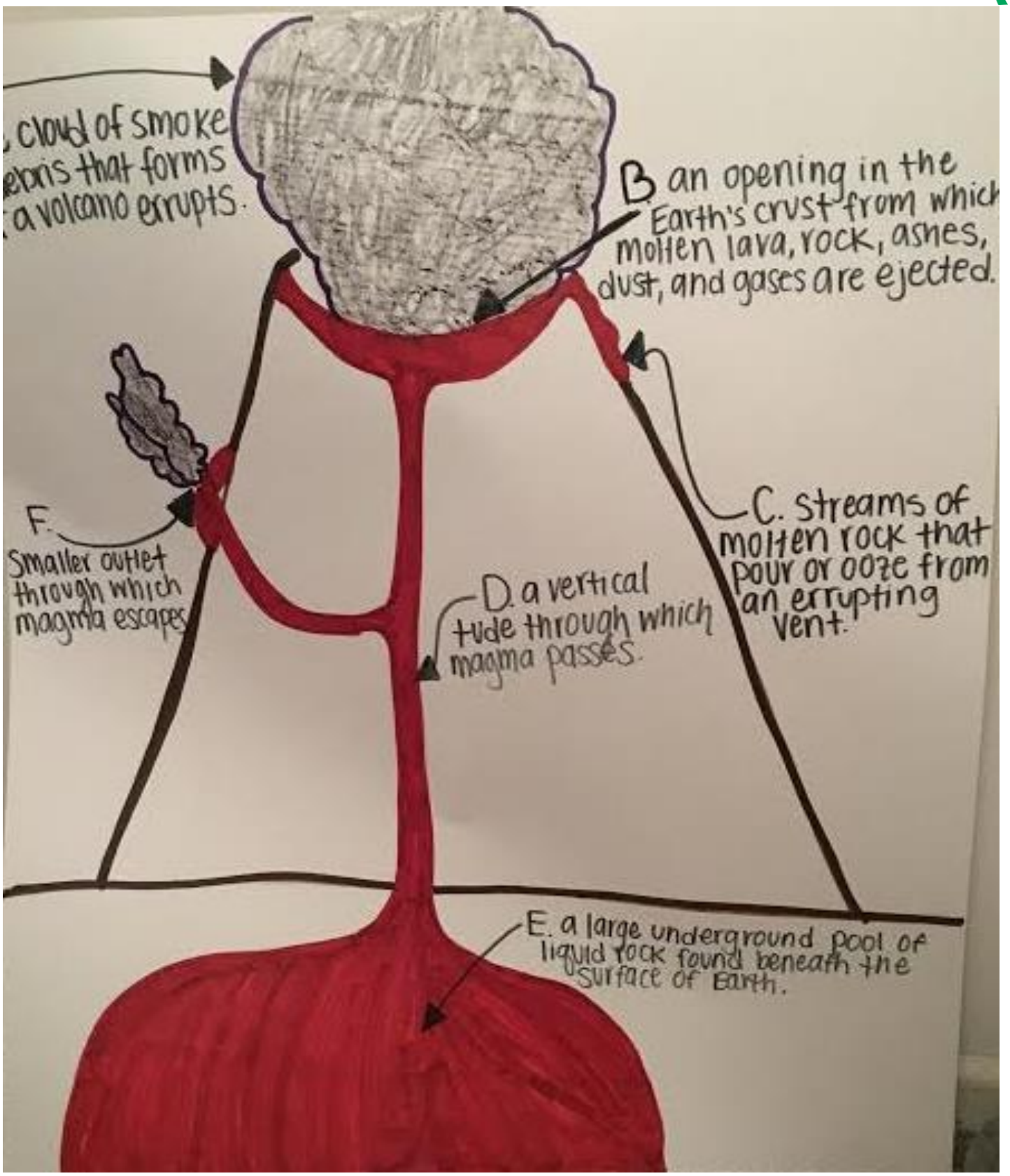
https://www.google.com/search?q=volcano+eruption&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjulp2_l5fYAhVN4WMKHS1hCKoQ_AUIDCgD&biw=1280&bih=646#imgrc=2YEnRTIgUDad0M:

Vent	**Ash Cloud**

Lava Flow	Pipe

Secondary Vent

Magma Chamber


, cloud of smoke
ebris that forms
a volcano erupts.
B. an opening in the Earth's crust from which molten lava, rock, ashes, dust, and gases are ejected.
C. streams of molten rock that pour or ooze from an erupting vent.
F.
Smaller outlet through which magma escapes.
D. a vertical tube through which magma passes.
E. a large underground pool of liquid rock found beneath the surface of Earth.

Lesson 2

Save Shake City!

Standards

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)	ESS3.B: Natural Hazards A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2) (Note: This Disciplinary Core Idea can also be found in 3.WC.) ETS1.B: Designing Solutions to Engineering Problems Testing a solution involves investigating how well it performs under a range of likely conditions. (secondary to 4-ESS3-2)	Influence of Science, Engineering and Technology on Society and the Natural World Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)

Objective:

Students will be able to explain what an earthquake is, what causes them, and why they occur. Students will use the Engineering Design Process to create an “Earthquake Resistant Building” in order to adapt to this natural hazard.

Materials

1 Per Group:

- Toothpicks (20)
- Large marshmallows (5)
- Small marshmallow (15)
- Spaghetti (10)
- Straws (10)
- Gelatin (1 pan)
- Earthquake Worksheets
- Wax Paper (13 in. x 9 in.)
- Cup to hold each material
- Disposable baking pans (13 in. x 9 in.)
- Scissor
- Ruler

1 Per Class:

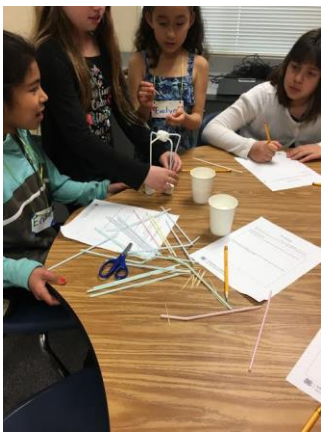
- Computer
- Earthquake Powerpoint

1 Per Student:

- Sticky Name Tag
- Pencil
-

Preparation

1. Make sure room has a projector and computer that can access the internet for the powerpoint.
2. Make Jello the evening before in the disposable baking pans.
3. Place about a handful of toothpicks in the cups (enough cups for each group to use if they chose)
4. Repeat above preparation step for marshmallows (big and small) and straws. Spaghetti can be in its own container.
5. At the classroom create a "supply table" where all the supplies will be located throughout the lesson.



Procedure

Opening Activity:

As each student walks in, they will sign in and then create a name-tag that will be worn throughout the lesson.

5 Minutes: Review

1. Review Natural Hazards vs. Disasters on Powerpoint. Ask the students which picture they believe is a natural hazard. Have them raise a finger or two for their answer, and then review that a natural hazard is an Earth process that leads to a natural disaster. This example is from an Earthquake causing a freeway overpass to collapse. *(5 Minutes)*

Explanation:

15 Minutes: Plate tectonics

1. On the Powerpoint, go through each slide and explain how each tectonic plate works. Discuss why Earthquakes occur on plate boundaries. *(5 Minutes)*
2. With each plate tectonic show the hand movement that correlates with the movement of that plate. Have the students do the hand movements with you and say the movement outloud. *(5 Minutes)*
    a. "Transform, Slide!" Slide hands next to each other
    b. "Convergent, Together!" Bring hands together with one hand sliding over the other
    c. "Divergent, Apart!" Slide hands apart
3. After learning the plate boundaries, do the Plate Boundaries Dance (see References). Have the students stand up and all will participate in the song and dance. *(5 Minutes)*

Engagement:

15 Minutes: Earthquake Adaptations

1. Introduce Earthquake Adaptations by discussing how buildings, especially those built on plate boundaries, are structured to withstand the shaking of the Earthquake. This is an adaptation engineers have developed in order to be able to live where Earthquakes occur. *(5 Minutes)*
2. Introduce the Engineering Design Challenge on the powerpoint *(5 Minutes)*
3. Introduce student roles and explain that each student will be assigned a specific role in order to complete the engineering task. Teams will be made in groups of three. *(5 Minutes)*
    a. Design Scribe: writes/draws what the groups are brainstorming to create
    b. Materials Engineer: writes the three materials the groups are going to use and then is responsible for gathering those materials
    c. Presenter: presents to the other groups what they did, their thought process and why they chose the materials

5 Minutes: Brainstorm

1. Break students up into teams of three. Give each student a worksheet either titled “Design Scribe” “Materials Engineer” or “Presenter”. This will be their role for the activity.
2. Introduce students to the materials they can use to build their structures. Inform students that they can only pick *three* materials to use.
3. Students will sit with their teams and start brainstorming their design. The Design Scribe is responsible for drawing their ideas on the worksheet.
4. Show students how large the jello pans are, so that they see an estimated size that their structures should be.
5. The team can only collect their materials once they have completed the brainstorm. It is the responsibility of the Materials Engineer to bring the brainstorm worksheet up to the Supply Table in order to collect the materials.

40 Minutes: Earthquake Resistant Building

1. Build
    a. Students will take this time to build their structures. A timer will be put on the powerpoint so that students can see how much time they have left. (*25 Minutes)*
2. Present
    a. Once the structures are finished, the “Presenter” will present to a partner group about their structure and why they built it the way they did, and why they used certain materials. Give each presenter 1 minute then switch! (*5 Minutes)*
3. Test
    a. For every two groups there will be one “Earthquake Tester” which is the jello in a 13in x 9in. pan. Groups will take turn testing their Earthquake proof structures to see if they survive the shaking of an Earthquake. Students will place the structure on the jello (have wax paper over jello to avoid sticking) and lightly shake it for 20 seconds. *(8 Minutes)*
    b. Congratulate teams who survived the shaking and all teams who worked hard and had a good effort. “Mail” all structures to Shake City (clean-up and throw away in plastic bags). *(2 MInutes)*

Closing:

10 Minutes: Recap

1. Introduce Engineering Design Cycle. When did we do some of the steps in this cycle in our lesson? Discuss what worked and what didn’t with the structures. Have a few students share out loud.

References

1. Link to music for Plate Boundaries Dance: https://youtu.be/MIvbL01uqpU
2. Like to Plate Boundaries Dance Video: https://youtu.be/HJ_9goavMBM

3. Link to Earquake Worksheets and Earthquake Powerpoint is located in Lesson 2 Google Drive: https://drive.google.com/drive/folders/0B62kC-Cuwa-hY1M4ZmNVNmxuWFU?usp=sharing

Materials Engineer

My name is _____ and my job as *Materials Engineer* is to decide what three materials my group will be using and why. I will also be the person who retrieves the materials from the table when needed.

What three materials did your group decide to use?

1.

2.

3.

Why did you chose these materials?

Did you end up changing any materials and choosing others? If so, why?

Presenter

My name is _____ and my job as ***Presenter*** is to explain to others what materials we used and why and how we designed our building and why.

Answer these questions!

1.What materials did you use? Why did your group decide to use these materials?

2. Why did your group decide on the design for the building? What ideas/techniques helped you design the building and why?

Design Scribe

My name is _____ and my job as a ***Design Scribe*** is to draw the building my group is going to be building for Shake City that can withstand an Earthquake.

BRAINSTORM!

Lesson 3

Volcanologists Need Our Help! Part 1

Standards

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems	ESS3.B: Natural Hazards A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2)	Influence of Science, Engineering and Technology on Society and the Natural World Over time, people's needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1) Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)

Objectives

Students will be able to identify where volcanoes occur and be able to name and describe the different parts of a volcano. They will then brainstorm ideas for a shoe that volcanologist can wear to protect their feet by being waterproof, insulated, and durable.

Materials

1 Per Foot Model:

- Styrofoam (10 in. x 3 in.)
- Duct Tape
- Cardboard Cone
- Hot Glue
- Hot Glue Gun

1 Per Group:

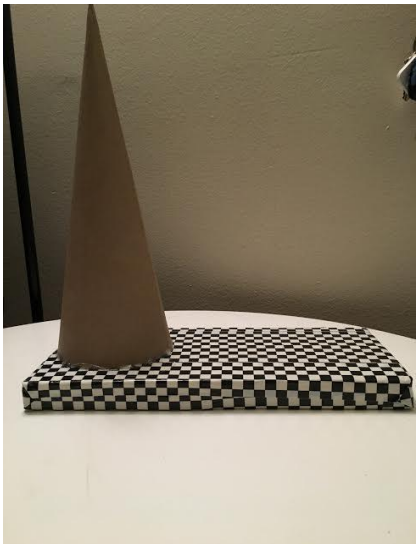
- Volcano Worksheets

1 Per Class

- Volcano Poster
- Parts of a Volcano Cards- Velcro on Back (see Lesson 1)
- Volcano Powerpoint

Preparation

1. Make sure room has a projector and computer that can access the internet for the powerpoint.
2. Prepare Poster
    a. Cut out terms and velcro the back of them
    b. Make volcano poster
3. Build at least one foot (for demonstration)
    a. Cut styrofoam into about 12 inch by 3 inch pieces for the “foot”
    b. Cover styrofoam with duct tape to stop it from shedding
    c. Hot glue cardboard cone to act as ankle and calf
    d. Make enough feet for each group



Procedure

Opening Activity:

As each student walks in, they will sign in and then create a name-tag that will be worn throughout the lesson.

15 Minutes: Plate Boundaries

1. The instructor will discuss with the class that last session we talked about Earthquakes and where they occur. The instructor will ask, "what other natural hazard might occur along plate boundaries?" *(4 Minutes)*
2. Open the Powerpoint and go to the link to a website that explains where volcanoes occur.
3. Go through the link
    a. Click the "Plate Boundaries" box and the plate boundaries will appear. Ask students to remind you what the three different plate boundaries are and what hand movement and action word they were associated with in the previous lesson (convergent-together, divergent-apart, and transform-slide). *(4 Minutes)*
    b. Ask what natural hazard occurs at these plate boundaries (earthquakes) and click the "earthquakes" box on the website. *(3 Minutes)*
    c. Ask students where they think volcanoes might occur and click the "volcanoes" box and explain that volcanoes occur at plate boundaries. *(2 Minutes)*
    d. Ask if there are other places they see yellow triangles that is not along a plate boundary. Explain volcanoes not on plate boundaries are located on hotspots, like in Hawaii. *(2 Minutes)*

Explanation:

35 Minutes: How Do Volcanoes Work?

1. Continue going over the powerpoint and introducing where volcanoes erupt and how they work. *(5 Minutes)*
2. Explain the different parts of a volcano and its function. Don't forget to pull up videos along the way! *(20 Minutes)*

3. Choose students to come up and place the parts of the volcano on the large poster in the front of the room in the correct locations. *(5 Minutes)*
4. Do the following dance that connects all the parts. The instructor will talk through the process an erupting volcano goes through and students will act it out. *(5 Minutes)*
    a. Pressure builds up in the **magma chamber**"- Get down in a ball and shake left to right.
    b. "The magma then begins to move up the volcano through the **pipe**"- Start to stand up hands together and arms extending towards the sky.
    c. "Pressure is released through the **vent** and the volcano erupts"- Separate hands
    d. "Very small pieces of magma are released and a dangerous **ash cloud** forms in the sky"- Wave hands right to left.
    e. "The magma reaches the surface and becomes **lava** as it moves slowly down the volcano"- Put hands together in front of body, and touch toes and take a seat.

Engagement:

25 Minutes: Volcano Adaptations

1. Continue the Powerpoint. Explain how there are not many adaptations humans have discovered for volcanoes, except not live near them. Explain to the students that that is why we still need scientists and engineers to solve our world's challenges; there are still problems that have not been answered. *(5 Minutes)*
2. Explain that as we could see in the videos, volcanologists need to wear a lot of protective clothing. Although they have developed great protective clothing, there are no great shoes designed for Volcanologists to wear while studying volcanoes. It is the class' job to create a model of a shoe that is waterproof, durable, and heat resistant/insulated. *(5 Minutes)*
3. Split students into groups of three and assign a Design Scribe, Materials Engineer, and Presenter. *(3 Minutes)*
4. Show materials that students will have, and even bring in an example of the bag each group will be receiving filled with all the available materials. *(2 Minutes)*
5. Have students brainstorm how they might make a shoe that fits all the criteria. *(10 Minutes)*
    a. The design scribe of the group will take notes and record ideas.

Closing:

10 Minutes: Recap

1. Have groups turn to the people closest to them and share out their ideas. *(5 Minutes)*
2. Bring group together as a whole and pick a few groups to share out. Remind students that next session, they will have the opportunity to design a model of a shoe that is durable, heat resistant, and waterproof for the volcanologists. *(5 Minutes)*

References

1. Link to “Earthquake Location” Websight: http://d3tt741pwxqwm0.cloudfront.net/WGBH/conv16/conv16-int-tectonic/index.html
2. Links to Volcano Eruption Video: https://www.youtube.com/watch?v=R0Zbj7S22zs and https://www.youtube.com/watch?v=MoDrrEb1Tf0
3. Link to Volcano Powerpoint and Worksheets: https://drive.google.com/drive/folders/0B62kC-Cuwa-henlBc1RxZkVmR0k?usp=sharing

Design Scribe

My name is _____ and my job as a ***Design Scribe*** is to draw the boot/shoe my group is going to be designing and creating for the Volcano Explores that needs to survive the hazards of a Volcano.

BRAINSTORM!

Materials Engineer

My name is _____ and my job as *Materials Engineer* is to decide what materials my group will be using and why. I will also be the person who retrieves the materials from the table when needed.

What materials did your group decide to use?

Why did you chose these materials?

Did you end up changing any materials and choosing others? If so, why?

Presenter

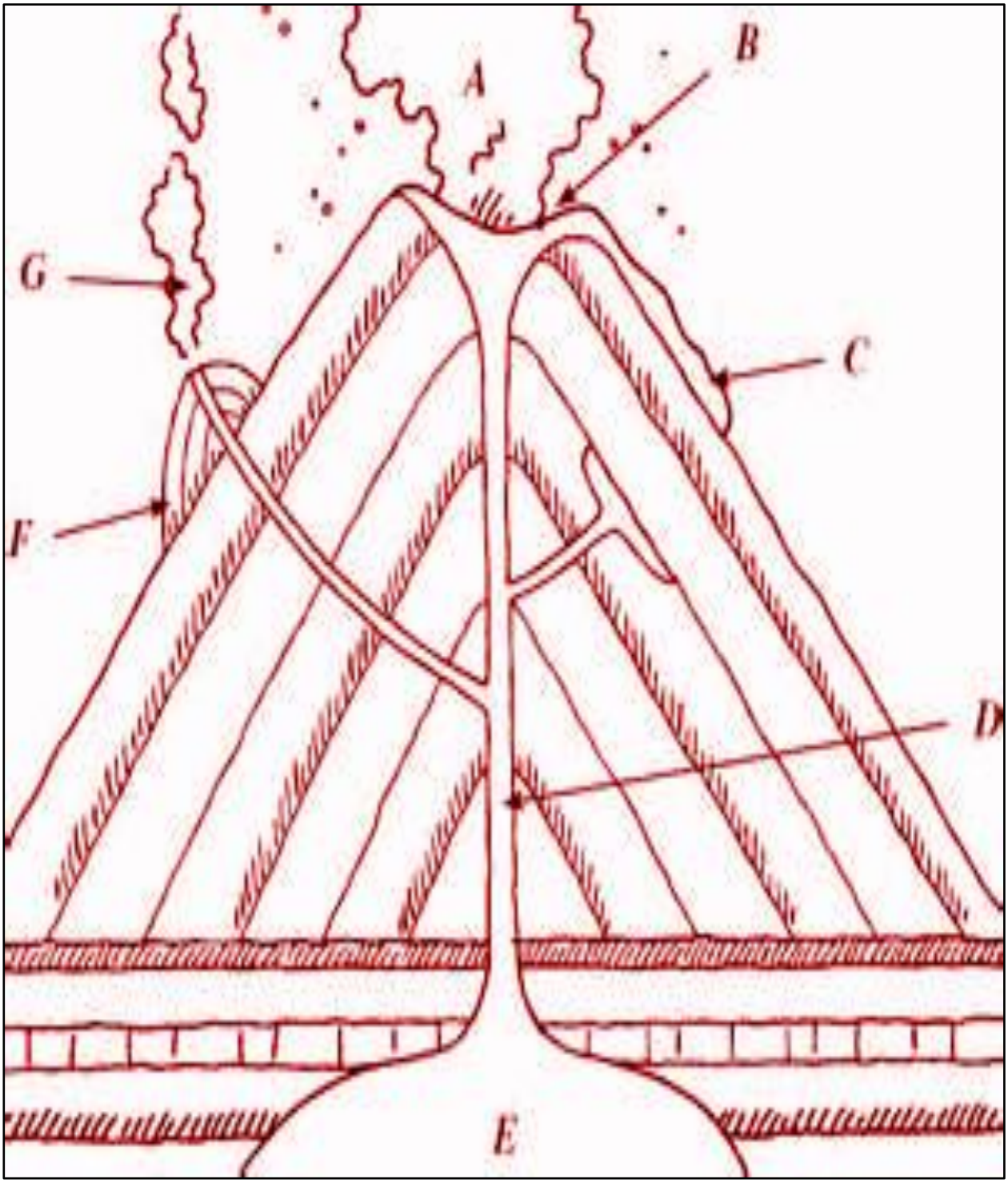
My name is _____ and my job as ***Presenter*** is to explain to others what materials we used and why and how we designed our boot and why.

Answer these questions!

1.What materials did you use? Why did your group decide to use these materials?

2. Why did your group decide on the design for the boot/shoe? What ideas/techniques helped you design the boot/shoe and why?

http://www.educationworld.com/sites/default/files/plate_techtonics_key.png



Lesson 4

Volcanologists Need Our Help! Part 2

Standards

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)	ESS3.B: Natural Hazards A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2) (Note: This Disciplinary Core Idea can also be found in 3.WC.) ETS1.B: Designing Solutions to Engineering Problems Testing a solution involves investigating how well it performs under a range of likely conditions. (secondary to 4-ESS3-2)	Influence of Science, Engineering and Technology on Society and the Natural World Over time, people's needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1) Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)

Objective

Students will be able to solve an Engineer Design Challenge by building a model of a boot that is durable, waterproof, and insulated. Students will know the Engineering Design Cycle and how it relates to their challenge by building, testing, and redesigning their boots.

Materials

1 Per Group:

- Bubble Wrap (12in. x 12in.)
- Blue Painters Tape (3 ft.)
- String (2 ft.)
- Brown Paper Bags
- Scissor
- Rubber Bands (10)
- Construction Paper (14 in. x 18in.)
- Foil (12in. x 12in.)
- Cotton Balls (10)

1 Per Class:

- Water Cup
- Water Droppers (6)
- Infrared Temperature Pointer* (4)
- Hot glue and glue gun
- Space Heater (1)
- Sticker booklet for Certifications (3 different stickers)

1 Per Student:

- Pencils

*link to purchase under "References"

Preparation

1. Make sure room has a projector and computer that can access the internet for the powerpoint.
2. Prepare Foot Model 1:
    a. Cut styrofoam into about 12 inch by 3 inch pieces for the "foot"
    b. Cover styrofoam with duct tape to stop it from shedding
    c. Hot glue cardboard cylinder to act as ankle and calf
    d. Make one foot for each group
3. Prepare Materials: Each group will receive a brown paper bag of limited supplies.
    a. Rubberbands
    b. Bubblewrap
    c. Foil
    d. String
    e. Construction Paper
    f. Scissors
    g. Blue Painter's tape
4. Prepare Stations:
    a. Water Proof Station
        i. Cup of water
        ii. Lay out paper towels
        iii. Water droppers
    b. Heat Resistant/Insulated
        i. Space Heater
        ii. Infrared Temperature Pointer

Procedure

Opening Activity:

As each student walks in, they will sign in and then create a name-tag that will be worn throughout the lesson.

12 Minutes: Who and What Are Engineers?

1. Students will begin the discussion by talking about where they have heard the word "engineer" before and what they think that word means. They can pair share or discuss with a neighbor. Then the instructor will call on a few students to share ideas and write those ideas on the board. The instructor will then give the definition of an engineer on the powerpoint slide to the class. (5 Minutes)
2. Students will brainstorm different types of engineers and what they do. All these ideas will be added to the board as well. *(3 Minutes)*
3. The instructor will introduce the Engineering Design Cycle to the class. The instructor will discuss what parts of the cycle the class has already accomplished from the previous lesson (ask, imagine, plan) and how they accomplished those tasks. Also discuss what the other parts of the cycle mean and how those relate to our engineering design challenge of making boots. *(4 Minutes)*

Explanation:

15 Minutes: Review

1. Recap what the students remember about volcanoes from the last lesson and follow the Powerpoint. *(5 Minutes)*
2. Reintroduce the Engineering Design Challenge. Remind them that the boot must be durable, water resistant and heat resistant/insulated in order to be able to be used around volcanoes. *(5 Minutes)*
3. Release groups to go to their tables with their worksheets and jobs from last class, along with their bag of supplies. *(5 Minutes)*
    a. Have the Design Scribe review the brainstorm and previous ideas before starting.
    b. Have the Materials Engineer write down the materials they will be using, by looking through the materials bag. Remind students that they will only be receiving the supplies in their bags, plus tape, in order to make their shoe.
    c. Once designs are reviewed the Materials Engineer can come to an instructor and receive a foot model and tape.

Engagement:

40 Minutes: Building and Testing Volcanologist Shoes

Build *(20 Minutes)*

1. Begin building boots.
2. Once the 20 minutes are up, stop everyone for a brief moment to explain stations.

Stations *(20 Minutes)*

a. Inform students that they there are two stations and one test they can do at their tables (see powerpoint for station directions). Their boot will go through these tests to see if it will be "certified". If their boot is certified they will receive a sticker to place on their boot to prove that it has passed the test.
b. Once the stations are explained students can either continue working or start testing their boot. If improvements need to be made, students will go back to their tables, redesign, and test again until the task is completed.

Closing:

10 Minutes: Recap

1. Students will return to their tables and the Presenter will prepare what they are going to present. *(5 Minutes)*
    a. While the presenter is preparing, the other group members are cleaning up the leftover materials and making sure that all materials are returned to the designated area.
2. Groups will the turn to a buddy group and each Presenter will get 45 seconds to share their design and boot. Then the instructor will yell 'Switch!' and the other group's presenter will be given the opportunity to explain their design. *(5 Minutes)*

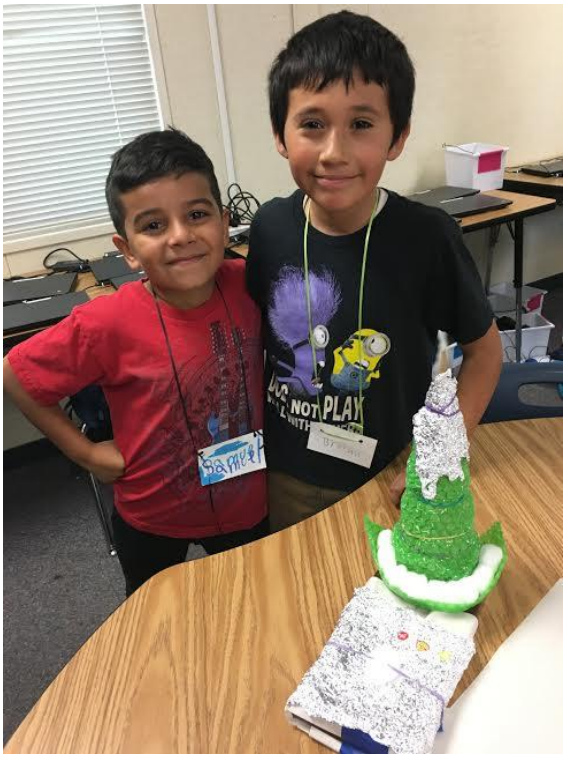
10 Minutes: Engineering Design Cycle

1. Students will be brought together and the Engineering Design Cycle will be displayed once again in front of the class.
2. The instructor will ask students to explain how their Volcanologist Boot Design Challenge fits into the Engineering Design Cylce. *(5 Minutes)*
3. Students will talk/pair share with a neighbor and then share in front of the class what they think. *(5 Minutes)*

References

1. Link to Infrared Temperature Pointer: https://www.amazon.com/Leegoal-Non-Contact-Infrared-Temperature-Thermometer/dp/B00I74I300/ref=pd_lpo_263_lp_t_4?_encoding=UTF8&psc=1&refRID=QBEQTE90XHNH4V1GZHTG
2. Link to "What is an Engineer?" Powerpoint can be found in Lesson 4 Google Drive: : https://drive.google.com/drive/folders/0B62kC-Cuwa-heUl2MmVMUGZ4QlU?usp=sharing


MARVEL



Lesson 5

Floods, Tsunamis and Landslides Oh My! Part 1

Standards

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods. Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1)	ESS3.B: Natural Hazards A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2) (Note: This Disciplinary Core Idea can also be found in 3.WC.) ETS1.B: Designing Solutions to Engineering Problems Testing a solution involves investigating how well it performs under a range of likely conditions. (secondary to 4-ESS3-2)	Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology Knowledge of relevant scientific concepts and research findings is important in engineering. (4-ESS3-1)

Objective

Students will know and be able to explain what floods and tsunamis are, the effects of flooding, and adaptations to flooding by researching and presenting a poster in teams. Students will also learn how to run a Stream Table.

Materials

1 Per Group: Foss Stream Table Kit*

- Basins, 8-liter*
- Tray*
- Clay, powdered (1 cup.)*
- White Plastic Container*
- Sand (6 cups)*
- 30 cm Ruler*
- Water Source Cup (flood/standard)*
- Wood Angle (1-2 depending on slope)*
- Tape Measure
- Painters Tape
- Timer
- Newspaper
- Posterboard
- Technological Device (computer, ipad, Chromebook, etc.)

1 Per Class

- Water Pitchers (2-3)
- Water
- Computer

1 Per Student

- Pencil
- Nametag
- Stream Table Observation Worksheet

*link to purchase under "References"

Preparation

1. Make sure room has a projector and computer that can access the internet for the powerpoint.
2. Steam Table Set Up
    a. Gather newspaper to lay down at the workstation and chair
    b. Make landform material
        i. Tape closed tray hole
        ii. Mix one cup powdered clay to 6 cups of sand
        iii. Pour in one cup of water and mix with wood angle
        iv. Place stream table hanging off the end of a table with a basin on top of a chair to catch the excess water from the tray hole
        v. Place a ruler, a white plastic container full of water, a wood angle, a water source cup, a timer, tape measure, and a 6 inch piece of tape at the workstation

Procedure

Opening Activity/Intro:

As each student walks in, they will sign in and then create a name-tag that will be worn throughout the lesson.

10 Minutes: Review

1. Using the powerpoint, review the major parts of the two previous lessons.
    a. Earthquake Lesson: review the plate tectonic songs and review that students found a way to adapt to earthquakes by building a model building and seeing if it could withstand a shake. *(5 Minutes)*
    b. Volcano Lesson: act out the Volcano parts and Eruption demonstration and review the Volcanologist Engineering Design Challenge *(5 Minutes)*

Explanation:

5 Minutes: Flooding Brainstorm

1. Use the powerpoint to prompt discussion and to start talking about floods and tsunamis. Instead of having this lesson being purely instructor lead, encourage the students to brainstorm about floods to a partner and tap into their prior knowledge, then share out to the whole group.

30 Minutes: Poster of Floods and Tsunamis

1. Divide students into 4 groups of 3: floods, tsunamis, effects of flooding, and adaptations to flooding. Have multiple groups of each topic if there are more than 4 groups of 3.
2. Students will be preparing a poster that has important information about each of their topics and be prepared to present their ideas. (15 Minutes)
3. Assign jobs within the groups
    a. Researcher: In charge of using technology (laptop/tablet) to get information
    b. Designer: Creates poster
    c. Presenter: Explains what is on poster to the whole group
4. Allow students to use technology to find information for their posters (Chromebooks, ipads, computers etc.)
5. The poster should include a definition of the topic, examples, and a picture.
6. Have each group present their poster to the class. As students present, the teacher will highlight the important parts (see Lesson 6 Slides 2-6 for guidance). *(15 Minutes)*

Engagement:

40 Minutes: Stream Table Background and Demonstration

1. Explain what a dam is and go through the Powerpoint *(5 Minutes)*
2. Pose their scientific challenge, as explained in the Powerpoint *(5 Minutes)*
3. Explain to the students that today, the instructor will be talking through a demonstration of what all of the students will be doing the next lesson. *(5 Minutes)*
4. The instructor will choose three other helpers and describe the roles of each member.
    a. Measuring Expert: Measure the landform (before and

after) and time how long the landform takes to move
   b. Water Expert: Pour water and present at end
   c. Materials Expert: Retrieve materials and hold cup
5. Run the stream table (see directions on Slide 10 of the Powerpoint) and have the entire class fill out the top of their worksheets, "teacher demonstration" box.
6. Pull up the stream table drawing slide from the Powerpoint for guidance. *(15 Minutes)*
7. Clean up! Follow the powerpoint slide *(10 Minutes)*

Closing:

5 Minutes: Looking Ahead

Collect worksheets, and explain that next week students are going to get the chance to put on their scientist hats. They will test out stream tables on their own to help Mr. Rio and his neighbors with their dam and flooding problem

References

1. Like to Plate Boundaries Dance Video: https://youtu.be/HJ_9goavMBM
2. Link to Foss Stream Table Kit: http://www.deltaeducation.com/how-to-order/replacement-parts-refills
3. Link to "Floods, Tsunamis, and Landslides Oh My!" Powerpoint and "Stream Table Observation" Worksheet: https://drive.google.com/drive/folders/0B62kC-Cuwa-hQWJpNTg3T0RtMW8?usp=sharing

University of California
Agriculture and Natural Resources

Name:_____
_____

Stream Table Observation Form

Investigation Question: How does slope and amount of water affect the movement of land?

Teacher Trial

Water Source:_____

Slope: _____

Land Start: _____

Land End: _____

Time: _____

10 20 30 40 50

Cen

timeters

Student Trial

Water Source:_____

Slope: _____

Land Start: _____

Land End: _____

Time: _____

10 20 30 40 50

Cen

timeters

Lesson 6

Floods, Tsunamis and Landslides Oh My! Part 2

Standards

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

Science and Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Constructing Explanations and Designing Solutions Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)	ESS3.B: Natural Hazards A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2) (Note: This Disciplinary Core Idea can also be found in 3.WC.) ETS1.B: Designing Solutions to Engineering Problems Testing a solution involves investigating how well it performs under a range of likely conditions. (secondary to 4-ESS3-2)	Cause and Effect Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1) Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS3-2) Influence of Science, Engineering and Technology on Society and the Natural World Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)

Objective:

Students will be able to manipulate stream tables and run tests to compare/contrast their findings and make an informed decision to solve a scientific problem.

Materials

1 Per Group:

- Lego Blocks (6)
- Stream Table setup (see Lesson 5)
- Scenario Card

1 Per Class:

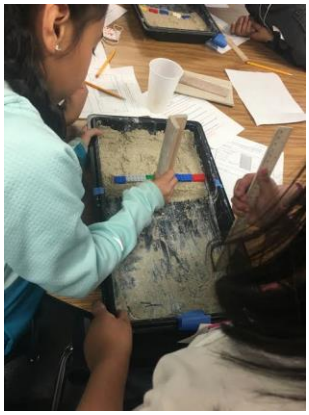
- Computer

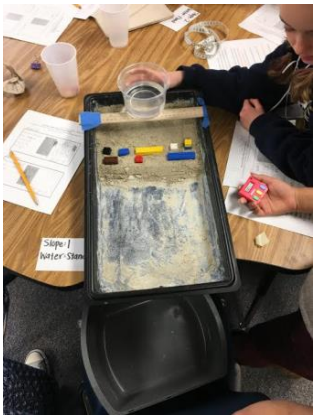
1 Per Student:

- Blue, Green, and Orange Dot Stickers (1 dot/student, split evenly)
- Sticky Name Tags
- "Stream Table Observations" Worksheets (continued from Lesson 5)
- "Certified Natural Hazard Engineer" Certificates

Preparation

1. Make sure room has a projector and computer that can access the internet for the powerpoint.
2. Prepare end of lesson certificates, by filling out each student's name and signing the names of all the people they have helped and worked with along the way
3. Prepare Steam Tables
    a. See Lesson 5 Preparation (i-iv)
    b. Place a ruler, timer, tape measure, a 6 in. piece of tape, direction sheet and a Scenario Card at each station
4. Set Up Supply Table
    a. Fill white plastic pitchers with water (1 per group)
    b. Seperate "flood" and "standard" water source cups
    c. Lay out wood angles (give each table group one wood angle to make the landform with, leave rest at the supply table)
5. Print Scenario Cards with slope and water source





Procedure

Opening Activity:

10 Minutes: Review

1. Open the Powerpoint and review Lesson 5.
2. Have students pair share with a nearby partner and choose a few student to share out their answers. *(5 Minutes)*
3. Review the next slides to refresh students memories *(5 Minutes)*

Explanation:

10 Minutes: Mr. Rio's Challenge

1. Remind students of their challenge that Mr. Rio has proposed. *(5 Minutes)*
2. Quickly go over the directions explaining the jobs of each member (Material Expert, Water Expert, and Measuring Expert) of the group *(5 Minutes)*
    a. Be sure to have extra copies of these directions on the tables while students are completing their testing.

Engagement:

50 Minutes: Stream Tables

1. Split groups into 3 and assign roles by giving each student a colored sticker that corresponds to each of the color coded roles. *(3 Minutes)*
2. Have groups look at their Scenario Card to determine which slope and water flow they will be investigating.
3. Have students follow the directions at their tables and begin to fill out their worksheets *(15 Minutes)*
4. Run Stream Tables *(7 Minutes)*
    a. Measuring Expert: Measure the landform (before and after) and time how long the landform takes to move
    b. Water Expert: Pour water and present at end
    c. Materials Expert: Retrieve materials and hold cup
5. Once groups have finished, remind them to draw what their situation ended up looking like. Refer to the powerpoint slide that explains the proper direction to record their drawings. *(15 Minutes)*
6. Have students present their findings to the group, walking around the room to see and hear what worked well and what didn't. Be sure to have students pick the best location (slope and water supply) for the new spillway and be able to explain why they think it is the best location. *(20 Minutes)*

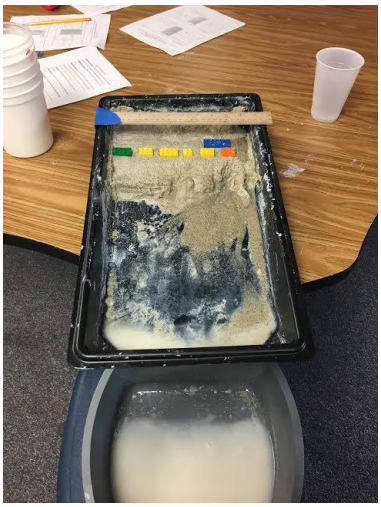
Closing:

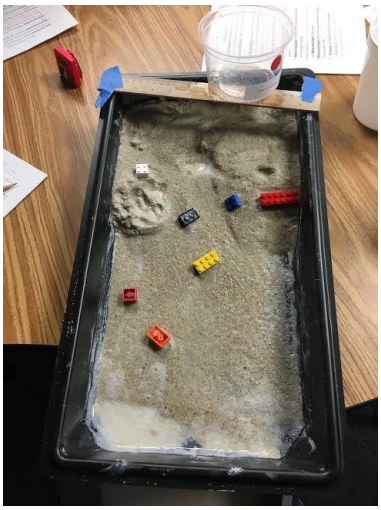
20 Minutes: Recap

1. Clean up! Follow the clean up slide of the powerpoint *(10 Minutes)*
2. Bring class together as a whole and come to a consensus about what the best slope and water flow is most ideal for Mr. Rio and his neighborhood *(5 Minutes)*
3. Since this is the last lesson of the unit, thank students for participation and hand out "Certified Natural Hazard Engineer" Certificates *(5 Minutes)*

References

1. Link to "Floods, Tsunamis, and Landslides, Oh My, Part 2" Powerpoint, Engineer Certificate" Worksheet, "Stream Table Directions" Worksheet, and "Stream Table Observation" Worksheet can all be be found in the Lesson 6 Google Drive Folder https://drive.google.com/drive/folders/0B62kC-Cuwa-hY1NvSHJPeDJVR2M?usp=sharing
2. Link to Stream Table Set Up in Lesson 5 Preparation section https://docs.google.com/document/d/1qp3AXwI6HktAXWCAQYvGSP6gnuNntklz6p8LX-r3hl0/edit?usp=sharing





Stream Table Directions

1. **Materials Expert:** Using the angle, make the land flat and 20 cm. long. Do this on the opposite side of the hole.
2. **Measuring Expert**: Check to be sure the landform is 20 cm long.
3. **Materials Expert:** Gently place the houses across the land at 19 cm. and put the wood angle under the stream table.
4. **Water Expert:** Place the ruler along the stream table and tape it down. Place water source cup on top.
5. **Everyone:** Write the slope and water source on your worksheet
6. **Water Expert:** Raise hand and wait for instructor approval
7. **Materials Expert:** Hold the clear cup between the ruler and the edge of the tray for the entire time water is in the cup.
8. **Water Expert:** Begin to pour the water into the water source and **Measuring Expert:** Start timer.
9. **Measuring Expert:** Stop timer when the landform begins to move. Record Time. At the end, record how far the landform has moved
10. **Everyone:** Complete the rest of your worksheet.
11. **Water Expert:** Prepare what your are going to tell the class, how was the city affected?

Slope:1 **Water: Standard**	**Slope: 1** **Water: Flood**
Slope: 2 **Water: Flood**	**Slope: 2** **Water: Standard**