Volcanoes Unit

5th Grade

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Teacher: *Rachael Heidorn and Trevor Larson* ***Content Area:*** *Science*
Unit Topic: *Volcanos*
State Standard Strand (or Common Core Standard): *Earth Science*
Substrands: *Earth Structure and Processes*

5.3.1.2.1 Explain how, over time, rocks weather and combine with organic matter to form soil.
5.3.1.2.2 Explain how slow processes, such as water erosion, and rapid processes, such as landslides and volcanic eruptions, form features of the Earth's surface.

Units Objectives:

The student will KNOW: The general concepts and terms that do with volcanoes.
The student will UNDERSTAND: That many historical events have happened as the result of a volcanic eruption.
The student will DO: The construction of a volcano that erupts.

Materials for Unit:

- Notebook- one for each student
- World Map Without Volcanoes PDF Image (one for each small group)
- World Map With Volcanoes PDF Image (one for each small group)
- Removable Dot Stickers (optional)
- Lava Sampling on Kilauea Volcano, Hawai‘iQuickTime Video
- Dating Lava Flows on Mauna Loa Volcano, Hawai‘i QuickTime Video
- Mount Pinatubo: Predicting a Volcanic EruptionQuickTime Video
- Mount Pinatubo: The Aftermath of a Volcanic EruptionQuickTime Video
- Forecasting Volcanic Eruptions HTML Interactive
- Plate Tectonics: The Hawaiian ArchipelagoQuickTime Video
- Mount St. Helens: Before and After
- Small water bottle (or big if you want to make a bigger volcano)

- About 3" of clear tubing with 7/8" outer diameter (fits perfectly inside opening of water bottle)
- About 4 feet of smaller clear tubing (we used 5/16" outer diameter and 3/16" inner diameter, but actual dimensions are not critical)
- Brown play dough (*we used 4 times this recipe with about 1/4 cup of instant coffee replacing the 15 drops of food coloring. This made about 8 cups of dough.)*
- Tray to hold volcano (we used clear glass pie dish)
- Empty ketchup dispenser with skinny nozzle
- Baking Soda
- Vinegar
- Red food coloring
- Scissors
- Single hole punch
- Funnel
- Measuring Cup
- Clear sheet of thin plastic (we used a thermal laminated pouch, laminated with nothing inside)
- Sharpie or other marker for clear plastic
- Dish Soap (optional)
- Chopstick (for stirring, optional)

Vocabulary for Unit:

- **Volcano:** Any hole in the ground that allows lava to rise up to the earth's surface.
- **Crust:** Where the makings of a volcano can be found.
- **Magma:** Melted rock that is less dense than solid rock, pushing upward through cracks in the crust.
- **Plate Tectonics:** the lithosphere of the earth is divided into a small number of **plates** which float on and travel independently over the mantle and much of the earth's seismic activity occurs at the boundaries of these **plates**.
- **Active Volcano:** Any volcano that has erupted in the last thousand years.
- **Dormant Volcano:** Capable of erupting, but hasn't for many years.

- **Pahoehoe (Pa-hoy-hoy):** Smooth hardened lava. Looks like twisted rope when cooled.
- **A'a' (ah-ah):** Jagged and sharp cooled lava.
- **Shield Volcano:** Made up of very fluid lava and usually release rock or ash. Dome shaped
- **Cinder Cone Volcano:** Smaller and much steeper than shield. Form when globs of lava are thrown into the air by an eruption.
- **Stratovolcano:** Tall, towering cones. They form as layer upon layer of lava and ash build up over time.
- **St. Pierre:** City destroyed by the eruption of Mount Pel`ee on May 8, 1902.
- **Pompeii**: A hidden city destroyed by the eruption of Mount Vesuvius on August 24th, AD 79.
- **Volcanologists:** people who study volcanoes.

Pre-Assessment:

Pull up KWL on the board. Give them all their own copy. Tell them that they do not need to fill out the L area or last question until the end of the unit.

Lessons:

Lesson Number 1: Understanding Volcanoes

- Geography

- Lesson Objective
  - Students will learn about volcanoes and then apply their knowledge by exploring the physical characteristics of various types of volcanoes.
  - Students will have answers written in their notebooks that go along with the lecture.

- Lesson Materials
  - Student notebook
  - World Map Without Volcanoes PDF Image (one for each small group)
  - World Map With Volcanoes PDF Image (one for each small group)
  - Removable Dot Stickers (optional)

- Lesson Steps

1. Before beginning the media-based activities, divide the class into small groups (3-5 students each) and distribute a copy of the World Map Without VolcanoesPDF Image to each group. (If copies cannot be made, use a map in a textbook or one in the classroom and distribute removable dot stickers.) Mention that Hawai'i is one place that is well known for its volcanoes. Now ask the groups to list as many other states and countries as they can that have volcanoes. You may want to suggest that they think about major eruptions that have appeared in the news recently, or famous ones that have happened in history (e.g., Vesuvius and Krakatau). Next, have them mark the locations of the volcanoes on their maps. Before moving on, ask the students the following:

a. Do you see any patterns?

b. Can you think of any possible explanations for the patterns you see?

2. Now hand out copies of the World Map With Volcanoes PDF Image marked and have the groups look at both maps. Ask about the distribution of volcanoes, and have students hypothesize why they are where they are and why certain areas are more active than others. If there is time, have the groups share their lists and other findings with the class.

3. Ask students to explore the Volcanism HTML Interactive and record in their notebooks answers to the questions below. Students will use the recorded information in the case study activity that concludes the lesson plan. As an optional activity, have the students check out the Mountain Maker, Earth ShakerFlash Interactive to review the basics of plate tectonics.

a. How do volcanoes form?

b. What are the four primary types of volcanoes? Name and describe each type in detail. Encourage students to sketch the shape of each type and note its plate tectonic setting (i.e., over hot spots, spreading centers, or subduction zones).
c. Where do volcanoes form?
d. Rocks are classified by what they are made of and how they form. Igneous rocks always begin as magma. What are the two main types of igneous rocks, and what is the main difference between them? How does each type form into solid rock?

4. Next, ask students to check out the Volcanic Eruptions and Hazards HTML Interactive and record in their notebooks answers to the following questions:

a. Will an effusive eruption have more gas and be more dense (viscous) than an explosive flow, or will it be less gaseous and less viscous? How does each type of eruption cause damage?
b. Which type of eruption appears to be the more hazardous to humans? Explain your answer.
c. Of the numerous hazards caused by volcanic eruptions, list and describe at least three that cause damage on a local level, and at least one that has global implications.

5. Now ask the students to look at the dynamic landforms and features in theAnatomy of a Volcano Flash Interactive and Volcanic Features HTML Interactive . Have them write down the following vocabulary list of features and describe each one: lava, tephra, lava lake, vent, fissure, dike, magma, caldera, crater, geyser, spring, `a`a flow, pahoehoe

flow, and lava tubes. As an additional, optional activity, ask students to explore the Virtual Lava Tube Flash Interactive and address the following questions using the resource:

a. How do lava tubes form, and where are they most likely to be found?
b. What is the difference between how two common cave features -- stalactites and stalagmites -- form in limestone caves and how they form in lava tubes?
c. Besides stalactites and stalagmites, choose three lava tube features that interest you, and explain how they form.

Here is the questions in a document for the students who need the sheet close to them or need extra writing time.

- Formative Assessment(s): The students will hand in their notebooks so the teacher can check off if they have been filling out the questions. Or the teacher can walk around and make sure they are writing answers.
- Differentiated elements of lesson:
    - Differentiated for: ____content __x__process ____product
      _x__readiness ____interests ____learning profile

      ____materials/environment
    - Differentiated elements: ____Tiers ____ Tic-Tac Toe
      ____Menu Board _X__Flexible grouping
      ____Learning Statio __x__Graphic Organizer
      Other:

- **Lesson Number 2**
    - Social Studies (Geography)
- Lesson Objective
    - Students will be learning and applying their knowledge by identifying the types of volcanoes featured in several case studies in their notebooks by answering questions.
- Lesson Materials
    - Notebooks
    - Lava Sampling on Kilauea Volcano, Hawai‘iQuickTime Video
    - Dating Lava Flows on Mauna Loa Volcano, Hawai‘i QuickTime Video
- Lesson Steps

1. Volcanoes vary greatly in terms of the composition and temperature of the magma they produce, and these characteristics affect how they will erupt. Scientists study lava, fresh from Earth's mantle, to learn more about the inner workings of volcanoes. The Lava Sampling on Kilauea Volcano, Hawai‘iQuickTime Video demonstrates the simple, yet risky, technique one researcher uses to access lava just as it reaches Earth's surface. Show this video to the class, or have them watch it on their own computers, and ask them to answer the following questions in their notebooks:

a. Why does scientist Michael Garcia refer to the basalt he is walking on as "the youngest real estate on Earth"?
b. What does viscous mean?
c. For what scientific reason does Dr. Garcia quickly quench the hot lava with water?
d. What has careful study of the composition of the lavas from Kilauea and Mauna Loa revealed about their origins and relationship?

You can continue this line of volcanic study by showing the Dating Lava Flows on Mauna Loa Volcano, Hawai‘i QuickTime Video , which provides further insight into the Hawaiian volcanoes and describes the effective method one scientist has found of dating prehistoric lava flows.

Here is the questions in a document for the students who need the sheet close to them.

- Formative Assessment(s): The students will hand in their notebooks so the teacher can check off if they have been filling out the questions. Or the teacher can walk around and make sure they are writing answers.
- Differentiated elements of lesson:
    - Differentiated for: ____content __x__process ____product ____readiness ____interests ____learning profile

      ____materials/environment
    - Differentiated elements: ____Tiers ____ Tic-Tac Toe ____Menu Board ____Flexible grouping ____Learning Station _x___Graphic Organizer

      Other: videos

- # Lesson Number 3
    - Social Studies
- Lesson Objective
    - Students will be able to identify specific volcanoes and volcanic eruptions. writing notes.
    - Students will be taking notes and answering specific pre made questions.
- Lesson Materials
    - Student notebook
    - Mount Pinatubo: Predicting a Volcanic EruptionQuickTime Video
    - Mount Pinatubo: The Aftermath of a Volcanic EruptionQuickTime Video
    - Forecasting Volcanic Eruptions HTML Interactive
    - Plate Tectonics: The Hawaiian ArchipelagoQuickTime Video
    - Mount St. Helens: Before and After
- Lesson Steps

1. Mount Pinatubo

Ask the students to view the Mount Pinatubo: Predicting a Volcanic EruptionQuickTime Video and the Mount Pinatubo: The Aftermath of a Volcanic EruptionQuickTime Video . Using the notes they have taken during the lesson, have them answer the following questions in their notebooks. Engage them in a class discussion before proceeding to the next case study.

a. Was the Mount Pinatubo eruption an effusive or explosive eruption?
b. Based on your observations, what type of volcano is Mount Pinatubo? On what evidence do you base your answer?
c. Over what type of plate boundary is this volcano located? Is this tectonic setting consistent with your answer to the first question?

d. Because volcanologists were able to accurately predict the timing of this eruption, the lives of hundreds of people who evacuated the nearby area were probably saved. What evidence did the scientists observe that prompted them to call for an evacuation?

2. Tungurahua

Ask the students to think about what might make predicting a volcanic eruption difficult and what problems might result from inaccurate (false-positive or false-negative) predictions. Have them record their ideas in their notebooks and then explore the Forecasting Volcanic Eruptions HTML Interactive. When they're finished, have them consider their previous notebook entries and ask them to record their answers to the following questions. Engage them in a class discussion before proceeding to the next case study.

a. What problems did the inaccurate eruption forecast of the Tungurahua volcano cause for the people of Ecuador and what difficulties might this cause for community officials in the future?
b. What three variables do scientists monitor when attempting to forecast volcanic eruptions?
c. What are some of the hurdles that volcanologists face when trying to make accurate eruption forecasts?

3. Kilauea

Next, have students view the Plate Tectonics: The Hawaiian ArchipelagoQuickTime Video and respond to the following questions.

Again, engage them in a class discussion before proceeding to the next case study.

a. Based on your observations of this video and previous videos you have seen, what type of volcanoes are Kilauea and the other Hawaiian volcanoes? On what evidence do you base your answer?
b. Does Hawai'i experience effusive or explosive eruptions?
c. Explain Hawai'i's setting in terms of plate boundaries. What makes it so unusual?

4. Mount St. Helens

Finally, have students view the Mount St. Helens: Before and After Flash Interactive and respond to the following questions. Discuss their responses.

a. Describe what is happening throughout the eruption. What kind of material is being ejected by the volcano? Do you see lava? What happens to all of the ash?
b. Based on your observations, what type of volcano produced this eruption? On what evidence do you base your answer?
c. Based on the before and after images, identify ways in which both the volcano and surrounding area were changed by the 1980 eruption.
d. Based on the satellite images, how has the affected area changed in the time since the eruption?
e. What are some similarities and differences in the destruction caused by effusive and explosive eruptions? What, if anything, was

surprising to you about the blowdown, lahar, and pyroclastic flow images?

f. What factors play a part in the recovery of vegetation (and wildlife) in areas affected by volcanic eruptions?

Here is the questions in a document for the students who need the sheet close to them.

- Formative Assessment(s): The students will hand in their notebooks so the teacher can check off if they have been filling out the questions. Or the teacher can walk around and make sure they are writing answers.

- Differentiated elements of lesson:

  - Differentiated for: ____content __x__process ____product ____readiness __x__interests ____learning profile

    ____materials/environment

  - Differentiated elements: ____Tiers ____ Tic-Tac Toe ____Menu Board ____Flexible grouping ____Learning Station __x__Graphic Organizer

    Other:

- **Lesson Number 4**
    - Reading

- Lesson Objective
    - Students will get a review of many terms that have already been explained through a comic book.
    - The students will be defining terms either in picture or sentences as we go through the book.

- Lesson Materials
    - *The Explosive World of Volcanoes with Max Axiom Super Scientist*
    - *Worksheet*

- Lesson Steps
    - Put the book up on the SmartBoard or some other type of projection. Maybe an Elmo.
    - Pass out the worksheets.
    - Explain to the class that the worksheet follows along with the book.
    - As a class read the book together. They have to read it dramatically.

- Formative Assessment(s):turn in worksheets for grading

- Differentiated elements of lesson:

The worksheet has two options that the student can do. They can either draw the definition or write sentences describing the definition. They do not have to do both.

    - Differentiated for: ____content __x__process ____product
      ____readiness ____interests ____learning profile

      ____materials/environment

    - Differentiated elements: ____Tiers ____ Tic-Tac Toe
      ____Menu Board ____Flexible grouping

____Learning Station __x__Graphic Organizer
Other:

Summative Assessment:

- Lesson Number 5: Look Inside a Volcano Activity
  - Math, Fine Arts

- Lesson Objective
  - Students will be constructing and appropriately labeling the volcano with 100% accuracy.

- Lesson Materials
  - Small water bottle (or big if you want to make a bigger volcano)
  - About 3" of clear tubing with 7/8" outer diameter (fits perfectly inside opening of water bottle)
  - About 4 feet of smaller clear tubing (we used 5/16" outer diameter and 3/16" inner diameter, but actual dimensions are not critical)
  - Brown play dough (*we used 4 times this recipe with about 1/4 cup of instant coffee replacing the 15 drops of food coloring. This made about 8 cups of dough.)*
  - Tray to hold volcano (we used clear glass pie dish)
  - Empty ketchup dispenser with skinny nozzle
  - Baking Soda
  - Vinegar
  - Red food coloring
  - Scissors
  - Single hole punch
  - Funnel
  - Measuring Cup

- Clear sheet of thin plastic (we used a thermal laminated pouch, laminated with nothing inside)
- Sharpie or other marker for clear plastic
- Dish Soap (optional)
- Chopstick (for stirring, optional)
- Link to website that has pictures of each step.

- Lesson Steps: Put students into groups of three or four. The students have certain jobs that they will delegate between each other.

1. **The first step is to insert the smaller tubes into your water bottle.** You want to end up with two 6" tubes directly across from each other on the left and right of the bottle (the secondary vents) and one long 3 foot tube between them at the back (play dough side) of the bottle (the tube for inserting vinegar). To insert these tubes, first trace around the tube at these 3 locations near the opening of the water bottle. Then use the single hole punch to cut out the interior of your drawn circles. You may need to punch 3 or 4 times for each hole. Then insert the tubes as shown.

   The teacher may need to have this step done for some groups.

2. **Next, cover half of the magma chamber (water bottle), secondary vents, and vinegar tube with brown play dough.** Add the 3" larger tube to the opening of the water bottle to form the central vent or throat of the volcano and cover that with brown play dough as well, as shown. Make sure you form a crater near the top. When you are done, you can cut off the excess length of the secondary vents. (Note: While you are doing this, you may want to skip ahead to Step 4 and fill your water bottle with "magma". I waited until my volcano was fully formed before adding the baking soda, food coloring, and water, but it might have been easier before covering the bottle with play dough.)

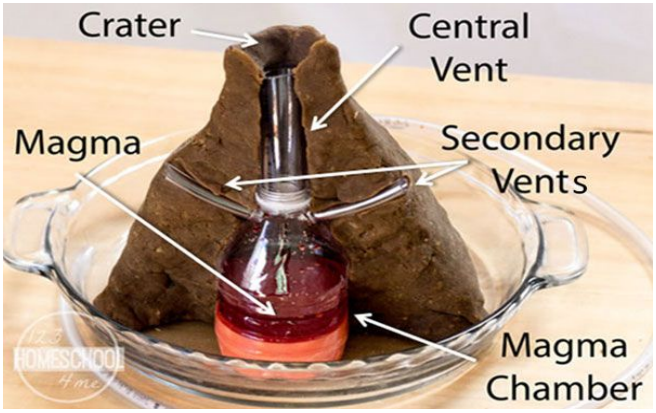
3. **Next use your marker to mark the edges of your crater on a thin piece of clear plastic**. Use your lines as a guide to cut out a small piece of plastic which will contain the escaping lava and force it to go down the volcano side and not the cutaway side of your model. Attach the plastic to the volcano using play dough as shown.

4. As mentioned earlier, at this point I **filled my water bottle with the baking soda solution**, but I had to remove my clear plastic shield and add it back at the end. It would have been easier to fill my bottle in Step 2 before even adding the large tubing for the central vent. Using the funnel, I added 1/4 cup of water with 20 drops of red food coloring. To that, I added about 1/2 cup of baking soda to the water bottle. The baking soda quickly settled to the bottom of the bottle. You could likely try using less water and a chopstick to stir up the mixture in order to make it look like more uniform "magma," but I just left it as is.

5. **To make the vinegar solution, simply fill your ketchup bottle most of the way with vinegar and add some red food coloring.** You could also add a little dish soap to make the lava more foamy. I used about 20 drops of food coloring and a tablespoon of dish soap.

6. Now you are ready to **start your volcanic eruption**! Our "lava" was fully contained, but unless you're braver than me, I might recommend taking your volcano outside. To start the lava flow, simply insert your ketchup bottle tip into the long tube and squeeze the vinegar into volcano.

7. If after awhile the chemical reaction seems to stop, insert a chopstick down the central vent of the volcano to stir up the baking soda.
8. Students will finally label the crater, central vent, secondary vent, magma , magma chamber. This is where it will be located. They can either make toothpick flags or tape that is labeled.



Criteria	3	2	1	N/A
Volcano will have all the elements.				
Volcano will be labeled will all the elements.				
Students worked well with group members.				

- Differentiated elements of lesson:

The students will be picking their own groups and delegating the jobs themselves. The first step may need to be done prior to the experiment for some groups.

- Differentiated for: ____content ___process __x__product ____readiness __x__interests ____learning profile

  ____materials/environment

- Differentiated elements: ____Tiers ____ Tic-Tac Toe ____Menu Board __x__Flexible grouping ____Learning Station ____Graphic Organizer

  Other: