TRACKING ASH

INSTRUCTIONS
Grade 6

Science
Teacher
Education
Program

Science Concept:

Volcanic ash changes the surface of Earth through dispersion and deposition.

Objectives:

The student will:
- describe how volcanoes deposit ash on the surface of Earth;
- infer and generalize on how volcanic ash is dispersed and deposited; and
- create an illustration of a simulated volcanic ash cloud that includes labels and details.

GLEs Addressed:

Science

[6] SD2.3   The student demonstrates an understanding of the forces that shape Earth by describing how the surface can change rapidly as a result of geological activities (i.e., earthquakes, tsunamis, volcanoes, floods, landslides, avalanches).

[6] SA1.1   The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

Writing

[6] W2.2.4 The student writes for a variety of purposes and audiences by using diagrams, charts or illustrations with captions or labels in research projects or extended reports.

Vocabulary:

altitude - the height, or vertical distance, of a thing above sea level on Earth, or of anything above a given planetary reference plane

ash cloud - volcanic ash is created during explosive eruptions by the shattering of solid rocks and violent separation of magma (molten rock) into tiny pieces. Explosive eruptions are generated when ground water is heated by magma and abruptly converted to steam and also when magma reaches the surface so that volcanic gases dissolved in the molten rock expand and escape (explode) into the air extremely rapidly. After being blasted into the air by expanding steam and other volcanic gases, the hot ash and gas rise quickly to form a towering eruption column directly above the volcano, called an ash plume. Volcanic ash consists of tiny rock, mineral, and volcanic glass fragments. Volcanic ash is not the same as the soft fluffy ash that results from burning wood, leaves, or paper. It is hard and does not dissolve in water, is extremely abrasive, similar to finely crushed window glass, mildly corrosive, and electrically conductive, especially when wet

deposition - the accumulation of material dropped because of a slackening movement of the transporting medium, e.g., water or wind. Also, the transition of a substance from the vapor phase directly to the solid phase, without passing through an intermediate liquid phase, also referred to as "sublimation"

dispersion - a system of dispersed particles (particles separated uniformly throughout a solid, liquid, or gas) suspended in a solid, liquid, or gas

vulcanian eruption - a vulcanian eruption is a type of explosive eruption that ejects new lava fragments that do not take on a rounded shape during their flight through the air. This may be because the lava is too viscous or already solidified. These moderate-sized explosive eruptions commonly eject a large proportion of volcanic ash and also breadcrust bombs and blocks. Andesitic and dacitic magmas are most often associated with vulcanian eruptions, because their high viscosity (resistance to flow) makes it difficult for the dissolved volcanic gases to escape except under extreme pressure, which leads to explosive behavior

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Materials:

- Beans
- Chalk
- Fans (one per group or more)
- Flour
- Large sheets of dark colored paper (six per group)
- Powdered sugar
- Rice
- Rulers (one per group)
- Sand
- Spray adhesive (one can per group)
- Teaspoon measures (one per group)
- Computer with Internet access
- STUDENT WORKSHEET: "Projected Accident Report"

Activity Preparation:

Sort all materials into tubs for small groups, precut paper for the *Explore* activity, locate plug-ins for fans (Are power strips needed?).

Activity Procedure:

Please refer to the assessment task and scoring rubric located at the end of these instructions. Discuss the assessment descriptors with the class before teaching this lesson.

Gear up
Process Skills: inferring, observing, and measuring

Teacher's Note: Review safety procedures with the class. Make sure the classroom is well ventilated before using adhesive indoors.

1. Students watch as the teacher models simulated ash dispersion. Teacher drops a tablespoon of flour and blows it across dark colored paper coated with spray-on adhesive. The "dispersed ash" will fan out across the sticky paper. Compare the demonstration to how ash clouds are transported by wind. Trace the deposited flour shape on the paper. Discuss what happened.
2. Hand out 1 - 4" x 6" index card to each student. Ask: "What happened to the flour?" "How far did it travel from its source?" (Estimate and Measure) Students write down inferences on their index card. Have students answer each question on one side of the index card, along with student name.
3. Ask: "If I dropped a material with more mass, like rice or beans, what do you think will happen?" "Why do you think the heavier materials might fall out sooner than lighter materials?"
4. Collect the cards and review for understanding while students clean up from the activity (tables cleaned off, science journals, and pencils). Record understanding: 1 = answered 0-1 questions correctly; 2 = answered 2-3 questions correctly; and 3 = answered all 4 correctly. Group students according to understanding after reviewing the cards – include a 1,2,3 in each group if possible.

Explore
Process Skills: measuring, observing, and planning

5. Instruct groups to explore how various materials (flour, sand, powdered sugar, rice, and beans) respond when blown by the wind. Groups should try each material and document their findings by tracing the dispersion shapes on the paper. Groups may need to use more than one fan, if available, and try varying levels of wind. STudents must also measure the distance the materials traveled. Groups should follow the basic procedure modeled during the *Gear up*, but encourage creativity.

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6. Distribute materials (flour, sand, powdered sugar, rice, beans, fans, construction paper, and chalk). Circulate as students explore and check for understanding.
7. Instruct students to document their observations on each material type and results in their science journals and answer the following questions:
   a. How did each material disperse?
   b. How did each material behave?
   c. How did wind speed and direction affect the material dispersal?
8. Discuss the investigation as a class.

Generalize
Process Skills: inferring and generalizing
9. Ask the following questions and discuss as a class:
   a. How far did the *lightest* material travel?
   b. How far did the *heaviest* material travel?
   c. How did the material disperse when moved by the two winds?
   d. What did you try that surprised you?
   e. How would ash from a volcano be transported? (NOTE: This model uses particles dropped from the top. Volcanoes emit ash particles and other materials from the ground up.)
   f. What would happen to the heavier particles of ash?
   g. How would ash dispersal change the surface of Earth?
   h. If an airplane (jet) was passing near or in route of an ash cloud, what would you suggest the pilot do?
   i. If a village, town, or city was near an eruption, and it was covered with ash, what would you expect to see? What problems would develop? What would be different for a town or village that was further away, but still reached by the finer and lighter ash?

Apply
Process Skills: observing and making generalizations

   Basic Overview:
   A dispersory computer model, developed at the University of Alaska Fairbanks, called PUFF, is used to predict and track the movement of volcanic ash clouds. Introduce and model the basic workings of the PUFF model. Go through a simple simulation. Run one of the already configured samples, and then customize a new one by changing only a few parameters. Have students choose an Alaska volcano and run a simulation model.

   Demonstration Instructions:

   1. First run a previously configured PUFF simulation from http://puff.images.alaska.edu/index.shtml.

   2. Choose any of the following Alaska volcanoes and click on it: Kasatochi, Cleveland, Okmok, Shishaldin, Veniaminof or Redoubt. A white box will appear, showing a simulation of the predicted movement of volcanic ash if that particular volcano erupted today.

   3. Next to **Google Earth Displays**, select the icon labeled **Airborne**. Open the file with *Google Earth*.

   4. Open the *Google Earth* display and ensure that **Airborne Ash for Selected Volcano** is checked under **Temporary Places** in the sidebar. Once this option is selected, the color-coded PUFF cloud will appear. In the top left corner of the map section, a time box is displayed. The buttons in the box can be used to scroll through the simulation, play the simulation or slowly fast forward showing time elapsed data. Also the zoom in and out function of *Google Earth* shows labels for places, such as islands, villages, cities, airports and harbors. Using these two functions identify places the ash cloud affects (drifts over) in the 24 hour period simulated.

5. Point out the colored band at the bottom of the map section that represents altitude level of ash in tens of kilometers. Ask students which ash model color climbs the highest. Ask students to infer which ash model color represents the lightest material.

Activity Instructions:

1. Pair students up or allow them to work individually at a computer.

2. Direct students to the PUFF simulation website: http://puff.images.alaska.edu/index.shtml.

3. On the left side of the webpage is a menu. Ask students to click on the Webpuff icon and then select **Version II**, which will direct the students to a new website.

4. Have students input their first name(s) and first letter of their last name(s) in the ID box, and then click **Start A New Session**. The program keeps track of sessions so students can go back to configured simulations. If students need to return to the simulator, the **Resume an Old Session** button must be selected.

5. After students have logged in, have them choose one of the following Alaska volcanoes: Cleveland, Korovin, Veniaminof, FourPeaked, Pavlof, Augustine or Okmok. (For locating a volcano quickly, highlight one volcano in the list under Volcano Name and then swiftly type the first three letters of the volcano you want to pick. The program will "jump" to it – or fairly close.)

6. Inform students that if they would rather have an **Eruption start date** different than the present day they can change the eruption start date to within 8 days before the present day as long as an error message doesn't appear. Simply move the start date closer to the present day if an error message does appear.

7. Students can also change the **Plume height** if they like to between 5,000 and 20,000 meters.

8. Once the students have adjusted their parameters, have them select **Run Puff here**. Wait for it to calculate the real wind data taken from satellites. (NOTE: Seeing the hourglass timer means it's working.) When it finishes, have students scroll down to the bottom of the window and select **Finished Puff**.

9. The PUFF simulation will be displayed below. Instruct students to click on the film reel located in the menu to the left of the map, just below the name of the volcano. This will play a time lapsed video of the simulation over a 12 hour period. Every frame is two hours apart (this can be changed in the set-up). Students can also display one image at a time.

10. Ask students to look at the images at hours 2, 4, 6, 8, 10 and 12 by selecting each time in the list to the left of the film reel. These will be used as references for the assessment.

Teacher's Note: Have students run their own models. ONLY change the parameters listed above for this activity. Simulation models will be used for the assessment. It is best to have a model that has ash deposited over land.

While students are running the models, circulate around the classroom and check for understanding.

Ask: Why is this PUFF model similar to the exploration with the fans and flour-like materials?

Document with a simple rubric: 1= no connection, 2= 1-2 connections, 3= 3-4 connections

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Assessment Task:

Students choose a volcano and use the STUDENT WORKSHEET: "Projected Accident Report" to record data from the PUFF Model. Students describe how Earth's surface is affected by volcanic ash, including two or three details on how it is affected. Students make two generalizations and two inferences on ash dispersal and deposition as it is affected by wind, altitude, and particle size. Students illustrate three ash dispersal images, and include color, labels and details (village, city, island names).

Rubric

Objective	GLE	Below Proficient	Proficient	Above Proficient
Student will describe how volcanoes deposit ash on the surface of Earth.	[6] SD2.3	The student may or may not describe how Earth's surface is affected by volcanic ash using one or no details on how it is affected.	The student describes how Earth's surface is affected by volcanic ash, including two or three details on how it is affected.	The student describes how Earth's surface is affected by volcanic ash, including four or more details on how it is affected.
Student will make generalizations and inferences on how volcanic ash is dispersed and deposited.	[6] SA1.1	The student may or may not make one generalization and one inference on ash dispersal and deposition as it is affected by wind, altitude, and particle size.	The student makes two generalizations and two inferences on ash dispersal and deposition as it is affected by wind, altitude, and particle size.	The student makes three or more generalizations and three or more inferences on ash dispersal and deposition as it is affected by wind, altitude, and particle size.
Student will create an illustration of a simulated volcanic ash cloud that includes labels and details.	[6] W2.2.4	The student may or may not illustrate two ash dispersal images.	The student illustrates three ash dispersal images, including labels, details, and colors for two of the illustrations.	The student illustrates three ash dispersal images, including labels, details, and colors for all three of the illustrations.

PROJECTED ACCIDENT REPORT

Directions: Illustrate the ash cloud at each hour. Use colors and labels for land features, villages, towns, cities, and airports. Answer the questions on the left on a separate sheet of paper.

Eruption date: _____   Time (start): _____   Location: _____

Volcano name: _____   Height at top (ash cloud): _____

1. Describe the projected path of the ash cloud (direction and height).

2. List the villages, towns, cities and airports that will be affected by the ash cloud.

3. How does volcanic ash affect these communities and environments? List three details.

4. Infer from your simulation model where air traffic will need to be routed, assuming it will be traveling between villages, towns, cities, and airports. Pose alternative air spaces.

5. Explain what causes ash to drift in more than one direction and make two inferences on how altitude affects the ash dispersion.

6. Make two generalizations on what would happen if the ash cloud changed direction and drifted the same distance over a new land area.

Hour 8   Time: _____

Hour 16   Time: _____

Hour 24   Time: _____