Outreach Fair: Volcano Demonstrations from around the World!

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SCIENTIFIC ASSEMBLY
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CHRISTCHURCH NEW ZEALAND

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Welcome!

Thanks for coming along to Volcanofest's Outreach Fair: Volcano Demonstrations from around the World!

Today's event is meant to showcase activities, demonstrations, and resources that we love sharing with others. We are really lucky that we have scientists, emergency managers, and practitioners from around the world contributing to this unique event as part of the International Association of Volcanology & Chemistry of the Earth's Interior's Scientific Assembly.

Each contributer has been invited to showcase their favourite activities, demonstration, and/or resource at the outreach fair. Please feel free to find their table or display! We have also asked them to create an entry for this booklet so that you can use their demonstrations and resources in your future practice. We also welcome you to share this resource with your colleagues.

If you conduct educational outreach or have developed volcanic resources that you'd like to share, please feel free to contact Sophia. We would love to include your material in this booklet too!

We hope you find this booklet helpful and look forwarding to meeting you. If you have any questions or comments about this event or booklet, Sophia would love to hear from you.

Sophia Tsang (s[dot]tsang[at]gns[dot]cri[dot]nz) & Ben Kennedy

Hands-on Activities

Clocks in Rocks: Visualizing Diffusion With Gelatin

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Keywords

Add up to ten keywords to describe your activity; Keywords could include suggested educational levels, topics the activity is applicable for, or if the activity needs to be completed outside

Summary of the activity

This activity uses food coloring in gelatin to visualize the process of diffusion, which is important in the geosciences for determining the timescales of processes. Colored gelatin is layered on top of non-colored gelatin, and over the course of a few hours to a day, the once-sharp boundary between the two "blurs" as food coloring diffuses into the non-colored gelatin. Different parameters can be changed to investigate how they influence the speed at which the food coloring diffuses, such as the surrounding temperature (e.g., room temperature vs in a refrigerator), the color of the food coloring, and the concentration of the food coloring. The speed of diffusion can be qualitatively compared between experiments or quantitatively measured by using observations to solve diffusion equations.

Target Audience The qualitative comparison of diffusion speeds is applicable for all audiences, but the quantitative determination of diffusion speed is applicable for advanced high schoolers and above.

Learning Goal(s)

1. Visualize the process of diffusion to better understand how it works and how it can be used to calculate timescales of geologic processes

2. (Qualitative) Understand how different parameters change the speed of diffusion

3. (Quantitative) Understand and apply the diffusion equations

Required Materials and Instructions

Details of the needed materials, instructions, and relevant background for diffusion chronometry in volcanology can be found at: https://www.rldegraffenried.com/gelatin-diffusion.html

This document is intended to be only instructions to conduct the gelatin diffusion exercise. For more information on the equations of diffusion and the applications to volcanology, visit this website https://www.rldegraffenried.com/gelatin-diffusion.html.

Preparing the experiments

The experiments take approximately 1.5-2 hours to set up, though the majority of that time is devoted to allowing the clear gelatin to chill and solidify. This time period could be shorter or longer depending on the number of experiments to prepare, and this estimate is for 4-6 experiments with a maximum of 4 different colors.

Materials:

- Gelatin powder (gelatin or agar agar)
- Food coloring
- Containers for experiments (see Fig. 1 – 3-4 cm diameter, 20 cm tall)
- Equipment for boiling water and stirring
- Additional containers for mixing colored gelatin
- Ruler
- Camera

1. **Prepare the clear gelatin (Fig. 1).** Prepare enough mixture at this stage so that each container you are using is half-filled, so the total amounts of water and powder needed will vary for each experiment set. For gelatin, we recommend mixing the gelatin powder and water in a 5% mixture, and for agar agar, a 10% mixture.
    a. Start boiling half of the water and start mixing the gelatin powder into the other half of the water at room temperature.
    b. Once the water has started gently boiling, add in the gelatin-water mixture that has been pre-mixed at room temperature.
    c. Vigorously stir the hot mixture while it is gently boiling until the liquid is completely clear.
    d. A few mL of bleach can be added to prevent bubbles and mold from forming in the gelatin.
    e. Once the mixture is ready, pour it into the experiment containers until they are half-way full.
2. **Chill the clear gelatin.** Before proceeding, the clear gelatin needs to be as solidified as possible, which is achieved fastest with a refrigerator, though it can be just left out at room temperature. With a fridge, we have left experiments to chill for 45 minutes to 1 hour.
3. **Prepare the colored gelatin (Fig. 2).**
    a. Follow steps 1a-1d to make the gelatin solution – **stop before 1e**.
    b. Transfer the mixture to a different container (or containers if using multiple colors) and add food coloring in the desired concentration.
    c. Mix thoroughly so that the color is homogeneous.
    d. Cool the colored gelatin solution to avoid dissolution of the clear gelatin. Be careful not to let it cool too much, though, or gelatin will not pour smoothly because the viscosity increases quickly as it cools. The solution is cool enough to pour when the mixture leaves a film of a millimeter or so on the container for a second or two while swirling the liquid around, that is the optimum time to pour the colored gelatin solution on top of the clear gelatin.
    e. Once the colored gelatin is poured on top of the clear gelatin, make sure to immediately mark the interface with a thin-tipped marker and capture a photo (if interested in using photo data).

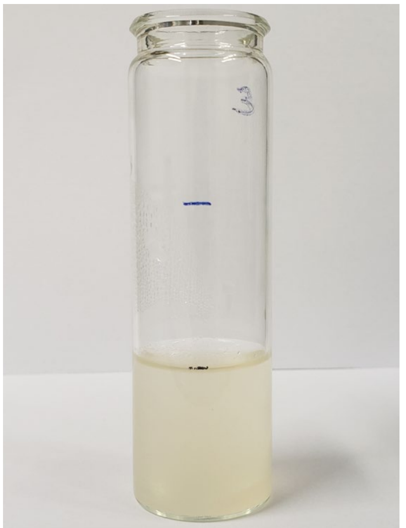

Fig. 1. Example of a container filled with clear gelatin after Step 1e. This example shows the level of clarity needed to see diffusion readily. Even clearer gelatin just makes measurements easier.

Measurement types

As we have envisioned the experiment, there are two possible measurements, though other ideas are possible and we encourage everyone to adapt this exercise to what best suits their students. First, the length of the diffusion front advancement can be measured relative to the interface using a ruler or something similar (Fig. 3). Second, photos can be taken and used for extracting color intensity profiles to approximate changes in concentration of food coloring. Measurements should be done at different intervals, with longer time periods in between measurements as total experiment duration increases. For the first couple of measurements, diffusion is rapid enough that there is measurable difference every 1.5-2 hours, but after that, several hours to a day may be needed.

Fig. 2. An example of an experiment with the colored gelatin poured in. Note that some of the gelatin has stuck to the walls in this case because the colored gelatin was close to being too cool to pour smoothly.

Extracting color profiles and converting the values

Color intensity has to be extracted from the photos to be used for modeling. We recommend using NIH ImageJ as it is free. However, the raw color intensity values are unintuitive for diffusion – the clear gelatin will have high color values and the colored gelatin will have low color values. If using just the raw values, it gives an erroneous view of the either uphill diffusion or the lack of color is diffusing. These values can be modified to fix the unintuitive scaling and relate the values to concentration of food coloring. To relate high color value to high concentration, just invert the scale by subtracting the raw values from 255 (the max color intensity value in RGB color space). To relate color value to concentration of food coloring, the maximum and minimum intensity values (after being corrected for the color scale) can be set to represent maximum and minimum concentration values and then a linear interpolation can be used to assign concentration values to all the other values in between.

Potential experiment modifications

We have a few suggested variables that can be changed to examine factors that influence diffusivity:

- Temperature – experiments can be left in different places (e.g., fridge, slightly warm drying oven) to examine how diffusivity changes
- Food coloring concentration – changing food coloring concentration by a factor of 10 changes diffusivity
- Color of food coloring – different food coloring colors have different diffusivities

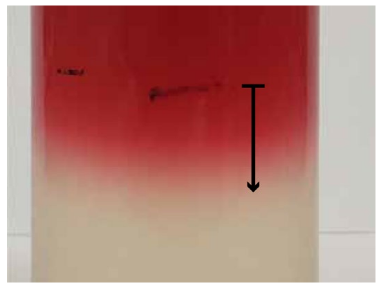

Fig. 3. Arrow denotes the measurement of the length to the diffusion front advancement.

Flows and bubbles!

Researchers from INGVvulcani communication group
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Keywords

Experiment; Viscosity; Bubbles; Lava flows; Magma fragmentation

Summary of the activity

Using common fluids like water, syrups, ketchup and toothpaste we can investigate how fluid viscosity affects fluid motion, governing size, shape and velocity of the resulting "lava" flows. Viscosity also control bubble nucleation and propagation through the fluid, and hence the magma fragmentation process

Target Audience

Primary/Elementary, Primary/Intermediate/Middle School, Secondary/High School, General Public

Learning Goal(s)

1. Physical meaning of fluid viscosity, and its effect on lava flows and magma fragmentation
2. Implications for volcanic hazards

Required Materials

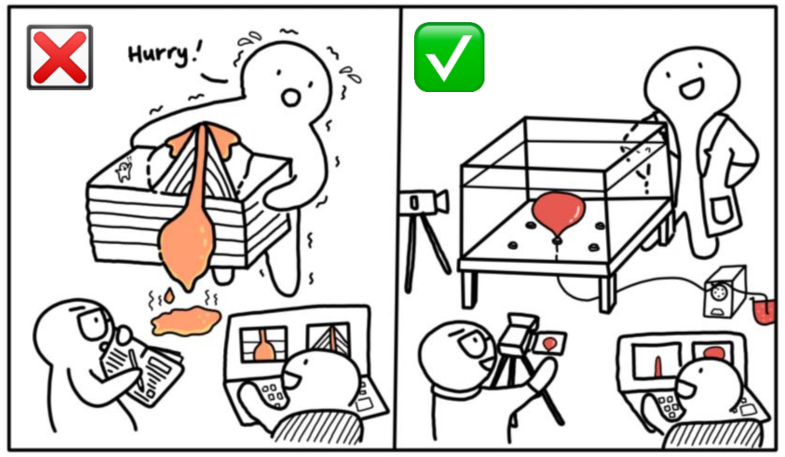
Three or four different, common fluids (typically water, ketchup, toothpaste)
A tray (to let fluids flow on them),
an object to keep the tray inclined (a box, a bottle). If more objects are available, we can test different slopes
an impermeable container (wide enough to host the tray and collect the fluids if they reach the bottom of the tray).
set of transparent glasses for each participant (as many as the fluids are)
sticks to stir the fluid in the glasses
powder to make fizzy water (do you still have that??)
If working with older student, it could be useful to have something to take measurements (lengths, weight, speed…)

Instructions

1. Set up the tray to represent the volcano slope and pour the fluids, one at a time from a given starting point. Observe the development of different types of "lava" flows, possibly taking measurements (invaded area, length, width, speed…)
2. Pour a small amount of the first fluid in a transparent glass. Start with the less viscous. Add the powder used to prepare fizzy water and watch bubble nucleation and propagation within the fluid. Notice the size of bubble, and how fast they propagate upward.
3. Proceed with another fluid with higher viscosity and compare size and behavior of the bubbles. Can you achieve fragmentation?

JELLY VOLCANOES

Suitable for teachers of school and college students (GCSE and A-Level)



Direct observation of physical processes in the Earth's crust can be challenging and comes with its own set of limitations. Laboratory modelling allows scientists to model, observe and reproduce complex processes in a safe and controlled environment.

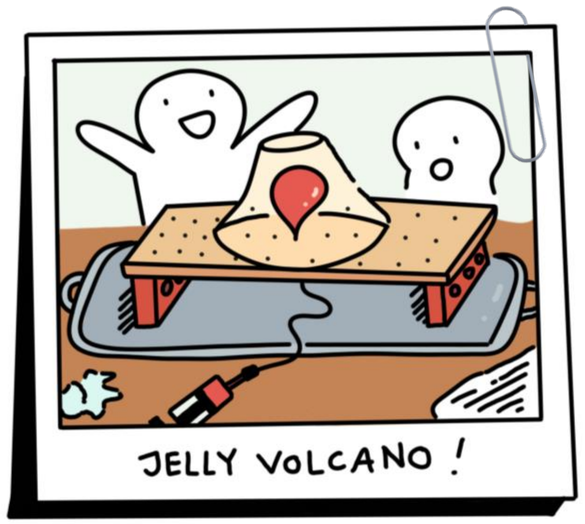
About jelly volcanoes:

Volcanic eruptions in nature are fed by magmatic intrusions in the Earth's crust. In these experiments, we will be using jelly as an analogue for the Earth's crust and coloured water as the analogue for magma. The use of clear jelly and brightly-coloured water allows us to observe the evolution and growth of the intrusion(s) in real time.


Demonstration at the University of Liverpool

What you will need:

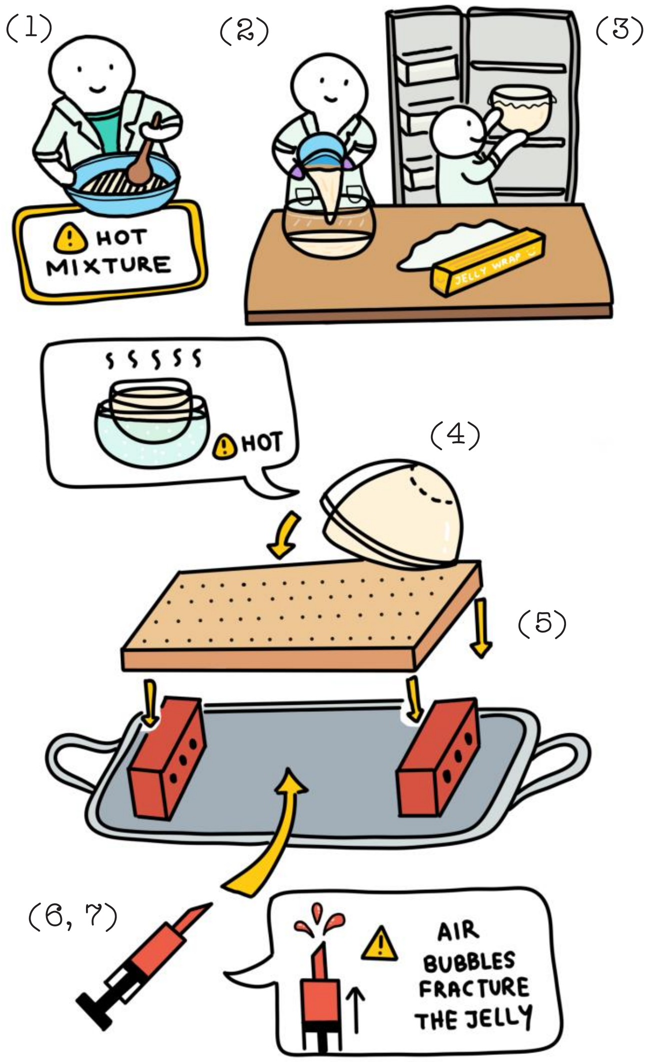
- Gelatine powder, unflavoured
- Hot water
- Mixing bowl
- 2 L clear plastic mixing bowl (to use as jelly mould)*
- Spoons for mixing
- Cling wrap
- Syringe (pipe optional)
- 30 x 60 cm Pegboard with 5 mm holes (or large aluminium tray with holes poked in using a 2B pencil)*
- Red food colouring
- Bricks for support
- Baking tray (to catch drips!)
- Video camera/ Mobile phone to record the experiment



*These are suggested sizes. Just make sure your pegboard/aluminium tray is big enough to hold your jelly, with holes large enough to insert the syringe

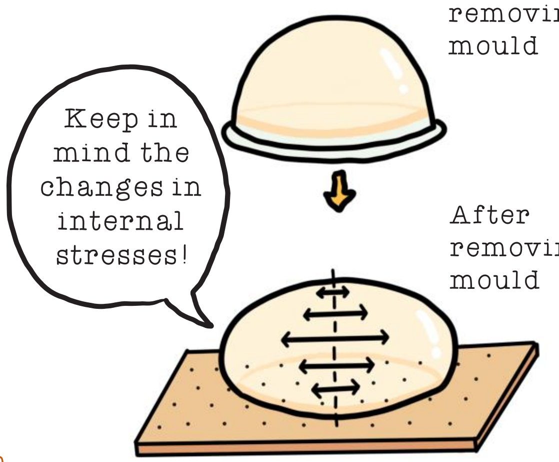
Instructions:

1) Make the jelly according to packet instructions (We recommend a 2.5 wt.% mixture. For a 2 L mixing bowl, this would be 50 g Gelatine powder and 1950 g Hot water)
2) Carefully pour the mixture into your chosen jelly mould. Spoon out any air bubbles for a smooth jelly surface!
3) Cover the mould with cling wrap and leave to set in the refrigerator
4) Once set, turn the jelly out onto your pegboard (Tip: Dip the jelly mould briefly in a bowl of hot water to loosen it up)
5) Position your bricks on your baking tray and carefully pick up your pegboard and place it on top of the bricks. Your jelly volcano is now in place!
6) Fill up your syringe with coloured water (water + food colouring) Hold the syringe upright and squirt out a bit of water to ensure it is bubble-free (Air bubbles can fracture the jelly!)
7) Insert the syringe through the centre of the jelly volcano and slowly inject the coloured water. Time to take notes!



What to observe:

- Did the surface of the jelly volcano change during the experiment?
- Note the shape and orientation of the intrusion throughout the experiment
- What type of intrusion did you get?
- As more coloured water is injected did you see any change in the shape or geometry of the intrusion?
- Can you account for the direction of intrusion growth?
- Can you predict what would happen if a different type of fluid is injected? For example: Custard or golden syrup. (You can also try this to find out!)
- Did your jelly volcano erupt?
- Could you identify what type of eruption it was?



Before removing mould

After removing mould

MY VOLCANO

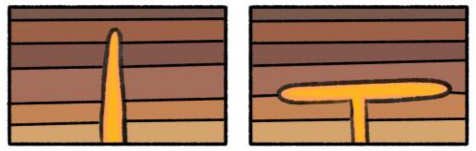
(Use this space to sketch or stick photos of your jelly volcano!)

Date:
Time:

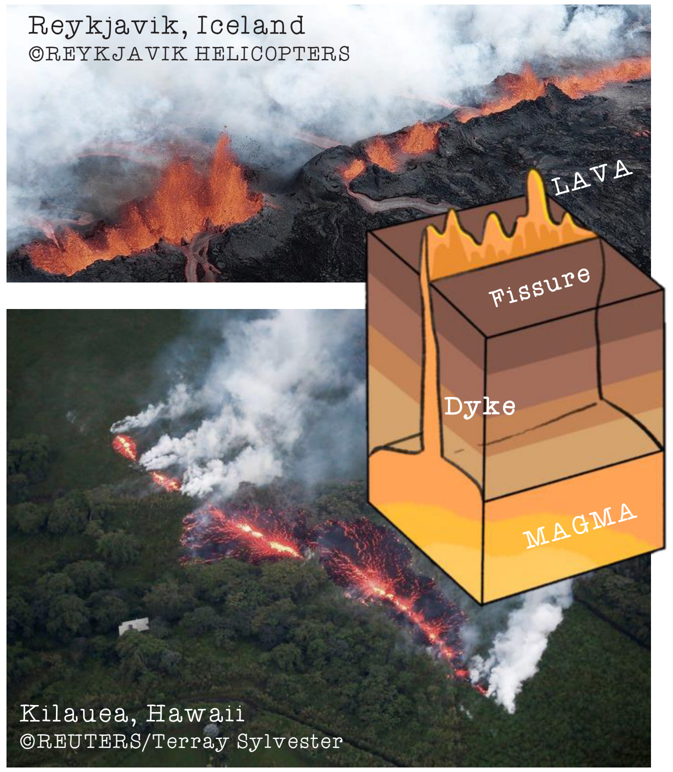
Notes:

Useful terms:

MAGMA:	Molten rock contained beneath the Earth's surface
LAVA:	Erupted magma
DYKES:	Magma-filled fractures in the Earth's crust that cut across the layering of the host rock
SILLS:	Magma-filled fractures in the Earth's crust that intrude along the layering of the host rock
CONDUIT:	Channel in which magma travels through
FISSURE:	A linear fracture on the Earth's surface through which lava erupts



DYKE SILL



Questions? @MAGMA_lab GeoHub Liverpool geohubliverpool.org.uk

Making 'Volcanic' Foam

Dr. Janine Kavanagh, University of Liverpool

Instructions

You will now carry out an experiment to create 'volcanic' foam as an analogue to study the impact of bubble formation in magma and its impact on volcanic eruption style. You will work in **groups of three**. Once you have found your group, place yourselves next to a set of apparatus and start reading through these instructions.

Read all these instructions carefully before starting your experiment!

Safety first!

Before starting the experiment, you must put on your personal safety equipment:

- Lab coat
- Safety glasses
- Latex gloves

Apparatus

1 x small conical flask
Small amount of washing up liquid
Liquid food colour
Plastic tray
2 x plastic beakers
50 ml 6% hydrogen peroxide (will be provided)
Yeast and warm water mixture (will be provided)

Experiment method

1. Working in groups of 3, place your conical flask on the tray provided.
2. Raise your hand and a demonstrator will come and check your safety equipment, and then they will provide you with the hydrogen peroxide and the yeast mixture.
3. Pour the hydrogen peroxide into the conical flask
4. Add a small amount of washing up liquid and a small amount of food dye to the mixture. Shake the container carefully (try not to spill the contents) to mix together the ingredients.
5. Now you will add the catalyst which will start the 'volcanic' foam production. Be ready to look carefully at what happens as you will be asked to draw pictures and makes some notes on what you observe afterwards. If you have a camera you may want to take photographs. To start the reaction, quickly add the yeast mixture to the conical flask.

After the experiment has finished, **use the space on the back of this page** to draw what you observed with labels pointing out key features you saw. You will use these observations later to inspire you.

<u>Outreach event – Kit list</u>

<u>Explosive volcanic eruptions</u>
<u>Student activity</u>
Assuming 20 students
Equipment list for students

- 2 litres - 6% hydrogen peroxide
- 1 litre liquid food dye - Red
- 1 litre Washing up liquid
- 4 x 2-litre plastic beakers
- Bucket for waste
- 3 x Trays to catch foam eruption
- 40 x Small conical flask – 100 ml
- 40 x Small beaker – 100 ml
- Powdered yeast
- lab coats
- safety glasses
- latex gloves
- *Plentiful blue roll*

Should I FLOW or should I BLOW?

That's important to KNOW!

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Keywords

Volcano, magma, lava flow, viscosity, volcanic explosion, impact of eruptions on houses, 3 outdoors/indoors activities, 8-99 years old activity

Summary of the activity

The aim of this educational activity is to understand why certain volcanoes (and magmas) will flow producing lava flows and why some magmas will blow producing an explosion of rock fragments. The activity consists of three experiments: 1) effusive eruptions: ketchup and other viscous flows, 2) explosive eruptions: degassing coke, and 3) impacts of volcanic eruptions: will house models resist?

1) **Effusive eruptions: ketchup and other viscous flows:** This experiment consists of a slope simulating a volcano onto which various liquids (e.g., toothpaste, gel, soap) are spilled, creating different type of flows. This introduces the physical concept of *viscosity* and its importance for lava flows. In fact, liquids will behave differently, principally because of their various viscosities, resulting in different analogue lava flows.
2) **Explosive eruptions: degassing coke:** This experiment consists of producing a jet explosion by dropping candy Mentos inside a coke bottle. This is analogue to the processes of fragmentation at the origin of explosive eruptions. It has been demonstrated by Shea Coffey (2008) that the ingredients present in both the coke and the Mentos favor the formation of bubbles and hence the rapid release of CO_2 dissolved in the coke. We will experience different eruption sizes (i.e., height of the jet) depending on the number of Mentos used.
3) **Impact of volcanic eruptions: will house models resist?:** In this last activity, we will compare the impact on houses and people living around an effusive and an explosive volcano. For this, we will discuss the effects of the different "lava flows" produced with the experiment 1) on the surrounding houses; and the impacts of accumulation of explosive products (i.e., tephra) on the roof of cardboard houses with different built-qualities. With this activity we introduce the concept of vulnerability of houses, which depends on the intrinsic characteristics of building construction in relation with a given volcanic phenomena.

Reference:

Shea Coffey, T. (2008). Diet Coke and Mentos: What is really behind this physical reaction?. American Journal of Physics 76, 551 (2008); doi: 10.1119/1.2888546

Target Audience

This activity is intended to be of interest of children >8 years old, namely Intermediate/Middle School, Secondary/High School and General Public who is interested in the physics of volcanic processes, their consequences on eruptive styles and the products that volcanoes can produce.

Learning Goal(s)

1. Learn how to differentiate effusive and explosive volcanic eruptions.
2. Understand the concept of viscosity (i.e., resistance to flow) and its importance for volcanic eruptions and lava flows
3. Discover how explosive volcanic eruptions are triggered and the associated products
4. Identify potential damages caused by eruptions on houses and people living around volcanoes.

Required Materials

1) Effusive eruptions: ketchup and other viscous flows:

- A surface that can be used as a slope (ideally a wedge) of about 30X42cm^2 (A3).
- 4-5 liquids of different viscosity: toothpaste, hair gel, soap, ketchup, honey

2) Explosive eruptions: degassing coke:

- 2-3 bottles of coke (500 ml each)
- 1 pack of Mentos (previously perforated with a small hole in the middle)
- 1 bottle cap previously perforated with a small hole in the middle
- Few metallic clips or a thin metal wire

3) Impact of volcanic eruptions: will house models resist?:

- Few small houses and dolls for the experiment 1) → could be made with modeling clay or small plastic toys
- Cardboard houses of some 5x5cm^2, 10x10cm^2 and 20x20cm^2 for the experiment 2).
- Paper of different qualities (silk paper, tracing paper, cardboard)
- 500 g of *tephra* or *volcanic ash* (sand could be also be used in case is difficult to find tephra - shouldn't be a problem in NZ right? 😉-). The particles coming from an explosive eruption with different sizes and compositions is called *tephra*. And ash corresponds to the fraction of tephra below 2 mm.
- Optional: a sieve, mesh or strainer!

Instructions

1) Effusive eruptions: ketchup and other viscous flows:

a) Place the surface or wedge with an angle > 40°
b) Place the small houses and dolls on the slope and/or the basement of the wedge
c) Distribute the surface according to the number of liquids (4 for example)
d) Start with the more viscous, i.e., the tooth paste forming a "tiny" volcano on the higher part of the wedge
e) Progressively create the second, third and fourth flows with the different liquids by explaining step by step what is the difference in viscosity

2) Explosive eruptions: degassing coke:

a) Previously prepare the Mentos by making a hole in the middle of the candy. Try to do it carefully with a thin screwdriver in order to do not break the surfaces of the candy
b) Prepare the coke cap with a hole in the middle
c) You will need a new coke for each experiment and a different number of Mentos: start with ~5-6 that you will thread in a metallic wire or a clip
d) Open the coke and carefully empty 1/3 of the bottle
e) Introduce the tip of the metallic wire inside the hole of the cap
f) Close carefully the cap by taking care of not touching the liquid with the Mentos (still…)

g) Once everything is in place, drop the wire inside the bottle. The explosion will take place
h) Repeat the experiment with a new bottle and take care of retaking the cap with the hole each time!

3) Impact of volcanic eruptions: will house models resist?:

a) Previously prepare the carboard houses with different sizes and materials
b) Sprinkle the tephra with the mesh or strainer if you have it, otherwise, just with the hands.
c) Try to accumulate more material on the roof of the houses
d) Ideally the roofs made in silk or weaker materials would collapse whilst strong roofs will stay safe.
e) Discuss the results according to the quality of roofs and the amount of tephra that you have accumulated.
f) Concerning the houses and dolls that were located on the wedge of the experiment 1) have been progressively touched by the different lava flows (i.e., different liquids) according to their viscosity or the rapidity that each liquid flew down. Discuss the results
g) Have a general discussion with both the effusive eruption (experiment 1) and the explosive eruption (experiment 2) results in terms of the concepts learned during this experience:

In a nutshell:

→ Viscosity of magmas and the consequent rapidity of flowing produce different behavior of lava flows
→ Formation of bubbles and release of volcanic gas to produce explosive eruptions
→ Impact of lava flows: people can escape but houses are lost
→ Impact of tephra on the roof of houses depends on the amount of the accumulated material and the quality of the roof. Clean-up of roofs is a key in the mitigation of these impacts!

Typecasting Tsunami

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Keywords

Tsunami, earthquake, volcano, meteorite

Summary of the activity

While most tsunami are generated by earthquakes, other events such as meteorites landing in a large body of water, underwater volcanic eruptions, and landslides can also cause tsunami. This activity allows us to play with several different processes that can cause tsunami to observe and compare different types of waves. By changing the weights used, amount the balloon is blown up, the force when tapping or jabbing the container, etc., this activity could be turned into a longer investigation task in a class. Alternatively, this activity could create an opening to discuss emergency management plans (e.g., tsunami hikoi) or introduce some of the processes that could cause tsunami.

Young children should be supervised when popping the balloon (and may not have long enough arms if you have a big container!)

Target Audience

Primary School, Secondary School, Tertiary, General Public

Learning Goal(s)

1. To illustrate and compare different causes of tsunami

Required Materials

Bucket or large container ideally with thin enough sides that a magnet will anchor things
Balloons (thin is good!)
Pin(s)
Pair of strong magnets
Waterproof weight
Water
Table to set bucket or large container on
Towels for cleaning up!
(optional) timer
(optional) waterproof ruler
(optional) a rain jacket or poncho to stay dry
(optional) video camera to make observations after the experiments
(optional) fishing floaters

Board Games & Books

Hazagora: will you survive the next disaster?

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Keywords

Natural disasters, Awareness-raising, Secondary schools, Educational board game, Resilient community, Eastern DR Congo

Summary of the activity

Often, hazards are not one of the primary concerns of a population at risk. In addition, knowledge about these phenomena, their consequences, and the coping mechanisms remain poorly known. However, the integration of simple strategies on a daily basis could considerably reduce the impact of these hazards.

HAZAGORA is an island, regularly affected by natural hazards of various origins and varying intensity.

Tephra clouds, lava flows, landslides, floods, earthquakes

Five characters evolve on **Hazagora**. Each is characterized by a particular way of life, adapted incomes and privileged settlement areas.

Each year, they receive a salary that they then use to feed and develop their families. Huts, houses and roads can be built. And since the island can be affected by natural hazards at irregular intervals, players can also invest in protection measures.

Hazagora allows players to experience the impacts of hazards through their characters and to be confronted with the consequences of their choices during the game.

When a hazard occurs, players are invited to discuss it before watching a short film presenting the main hazard characteristics and its potential impacts. The game leader encourages them to describe and explain recent known events related to the type of hazard that occurred on **Hazagora**. In group, and with the help of the game leader, players try to find answers to the following questions:

- What is the physical process?
- What can be the triggering factors?
- What can be the spatial extension?
- What can be the impacts?

In the game, this discussion period is an important moment, because the game leader has the opportunity to transfer knowledge related to the hazard.

After playing **Hazagora**, players have a better knowledge of the different hazards and they can also understand the importance of integrating prevention and protection measures into their daily lives because what they have experienced during the game reflects reality.

Target Audience

Hazagora is mainly aimed at **secondary/high school students**, but it can also be played with **adults** who would like to see their knowledge about natural hazards reinforced.

By playing **Hazagora**, everyone learns in a fun way essential information about hazards (characteristics, spatial extension, impacts), while experimenting different strategies to cope with them. Moreover, each player becomes a character with whom he/she can easily identify; his/her objective is to protect his/her character. Will he/she not be more attentive to the information available to support his/her character and ensure the protection of his/her property?

Learning Goal(s)

Hazagora is a serious game whose objective is to develop a resilient community.
More specifically, **Hazagora** will enable you to:

1. provide key scientific information about specific natural hazards;
2. highlight the factors that influence a disaster;
3. generate discussions on the strategies to be implemented to develop a resilient society.

Required Materials

MATERIAL AVAILABLE IN THE HAZAGORA KIT

- Rules
- 5 livelihood cards
- 1 board game
- 1 volcano
- 150 resources cards (bread, water, bricks)
- 2 resources dice
- 5 survival and cost cards
- 20 rounded plastic chips per livelihood (20x5=100)
- 20 families per livelihood (20x5=100)
- 20 roads per livelihood (20x5=100)
- 33 markets and water wells
- 1 timer
- 1 hazard wheal/hazard tree with a ball and rubber
- 1 island wheal
- 27 impact cards
- 4 hazard impact tables
- 45 protection cards (survival, preparedness, adaptation)

OPTIONAL ADDITIONAL MATERIAL

- 1 laptop
- 1 projector

Instructions

How to set up the game?

- Place few markets (on yellow hexagons), few water wells (on blue hexagons) and the volcano on the board game. *N.B.: Not all hexagons will be occupied because this will allow moving markets if they are affected by a hazard in a region or allow players investing in a new market or a new water well if they decide so during a council meeting.*
- Group the players in maximum 5 groups. It is possible to play alone or by group of 2.
- Randomly distribute the livelihood cards between (group of) players.
- Distribute to (group of) players the following cards to help them for their first year on the island. The chips (roads, huts and families) will allow the players developing their families on the island.

2x

Resource card water

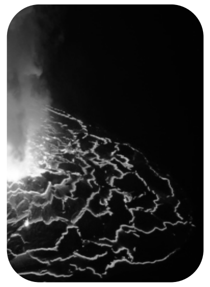
2x

Resource card bricks

2x

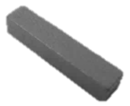
Resource card bread

1x



Protection card

2x



Roads
(with color corresponding to the livelihood of the player)

2x

Huts and families
(with color corresponding to the livelihood of the player)

- To start colonizing the island (which is for the moment empty), players will establish the huts and roads they received. The mayor starts. He/she places one hut and one road anywhere on the board game. The road has to be connected to the hut. Once placed, the hut location cannot be changed. This is valid for all the players. Once the mayor is done, the player to the left of the mayor starts the game by also placing one hut and one road on one of the spot corresponding to the color of his livelihood. This goes on, until the last player who can place directly two huts and two roads. Then, the round starts counter clockwise from the last player. The second round will thus finish with the mayor. *N.B: it is not mandatory to connect the two huts together during the game set up.*
- You are now ready to start!

Playing the game

It is recommended to play the game in a minimum of "3 years". One year corresponds to three rounds after which discussion takes place between players. The rounds are played clockwise, always starting from the mayor. When starting the game, the game master starts the timer.

FIRST ROUND

During the first round, players collect resource cards. The game master is progressively distributing to each player a certain amount of resource cards which corresponds to:

SALARY
=

+	+	+
The resources related to the livelihood salary of the player multiplied by the number of the character's families living on the island.	The two resources indicated by the resource dice that the player rolled.	Possible additional resources related to an advantage that the character of the player may have (see advantage of the tour guide).

SECOND ROUND

Once the resources cards are distributed, the players have to give food, water and have to provide a lodging to each of their families living on the island picking one of the below options.

<u>The number of bread and water depend on the number of family</u>. For example, if a player has 2 families, he/she has to give 2 resource cards « bread » and 2 resource cards « water » to the game master. If a family has a direct connection to a market or a water well, the player does not need to give respectively a resource card « bread » or « water » to the game master. If a player does not have, for example, enough resource card "bread" to feed his family, he/she can exchange resources with another player.

At anytime, players can exchange 3 random resource cards against 1 chosen resource card with the game master.

<u>FEED A FAMILY</u>

1/ To give to the game master a resource card « bread» per family.

2/ To have a road connection between a hut/house and a market. It is also possible to use the road network of another player to get access to the market.

<u>WATER A FAMILY</u>

1/ To give to the game master a resource card « water » per family.

2/ To have a road connection between a hut/house and water well. It is also possible to use the road network of another player to get access to the water well.

<u>LODGING A FAMILY</u>

1/ Families should be able to protect themselves in a hut or a house.

2/ Families can stay in a tent (see protection card). Only one family can be sheltered in a tent.

3/ It is possible for a player A with a homeless family to ask for shelter to another player B, who has available space (for example a hut/house without a family). Player B is free to refuse or to accept. Player B can ask for a rent, but it is not compulsory. Players can discuss and make agreement among themselves.

THIRD ROUND

During the third round, the players can develop and/or protect their families against hazards.

DEVELOPMENT

Using their remaining resource cards, the players can build roads, huts, or houses (see cost cards). The players can only build on the colored spot corresponding to the color of their community, except for the mayor and the tour guide. Unlike during the game set up, the new build houses/huts have to be connected to a house/hut of the same color via the number of roads indicated on the board game. The roads have first to be built before building a hut/house. To build a house, the player has to have first built a hut during the previous round (we consider that the player upgrade the hut to a house). This rule does not apply to the mayor.

PROTECTION

It is possible to buy protective cards (survival, preparedness or adaptation cards). The player chooses the protection card he/she wants to buy.

END OF THE YEAR: ANNUAL COUNCIL MEETING

At the end of each year, a council meeting is organized, and the timer is stopped. The players have the opportunity to discuss the difficulties they met during the year and to propose solutions. Community or individual strategies can then be organized. The mayor takes the leadership of this conversation and tries to find solutions to their problems with the whole community. All players have to agree on how each player participates to implement new strategies and how to use it.

If the strategy is associated to a cost, the game master defines objectively the price that the community has to pay to implement the strategy on the island.

EXAMPLES

- Community protection cards: The players can buy a protection card all together. This card will be use only once for all the families leaving in the impacted area. The game master defines the price (e.g. 3 resource cards "bread", 3 resource cards "water" and 3 resource cards "bricks"). The players will have to find among themselves an agreement on how to collect the resource cards.
- Community investement such as road network, new markets, new water wells, shelters,…
- Insurance
- Game master loan: the player has to reimburse twice the loan.
- Create new protection card
- Humanitary camps
- Relocation of some communities in the island.
- Build protective infrastructures (tsunami dams, lava flow deviation…): very expensive et apply only in one place.

WHEN THE TIMER RINGS, A HAZARD MAY HAPPEN

When the game starts, the game master has to start the timer. When the timer rings, a hazard may strike the island. The game master does not show to the players the remaining time before the next hazard. The timer can be stopped if players decide to organise a council meeting.

Depending on the game master choice, a hazard can take place every 5 to 15 minutes (with the exception of the first hazard, which is recommended to occur approximately 30 minutes after the start of the game). To define to which hazard the alert is related to:

- A player turns the hazard wheal.
- The players try to make a list of similar and recent events they are aware of.
- Game master leads a discussion where players have to answer the following questions:
  - *What are the mechanisms of the hazard?*
  - *What are the consequences of this hazard on the populations and building?*
    The players are requested to fill up the hazard table by placing the corresponding impact cards.
  - *What can a community do to protect herself against this hazard?*
- OPTIONAL: The game master shows the movie associated to the event.
- A player turn the island wheal to determine where/in which direction the hazard will happen.
- Players can play their own protection cards if relevant for the hazard or use strategies established during previous council meetings.
- The game master removes the buildings and families, move the markets to new locations on the island and lay down the water wells impacted by the hazards (see impact cards).
  Markets affected by the hazard are moving to a new place of the board game. To define the new region, a player turns the island wheal and the game master puts the market on the closest market place available.
  The buildings and families removed from the board game have to be put aside (the number of destroyed huts, houses and deceased families are used to calculate the resilience factor at the end of the game).

At the end of the hazard phase, the game master starts again the timer with a new interval. It is recommended to adapt the variate the time between hazards. However, a balance has to be found to have a good dynamic in order to see several hazards during a same game session and to give players enough time to develop their families and their protection system.

On-going research activities

Disasters induced by natural hazards are increasing globally and have severe impacts. Risk mitigation is recognized as the best strategy for reducing their impacts, occurring in densely populated areas. The population should be prepared to respond to disasters, such as volcanic crisis, by having a high state of awareness, anticipation, and readiness. "*Living with a volcano*" should be one of the life skills all children living in volcanic eruption prone area acquire during their schooling.

The North Kivu, located in eastern DR Congo, hosts the two active volcanoes of the Virunga volcanic province, namely Nyamulagira and Nyiragongo. While Nyamulagira is located in the Virunga National Park and is not a direct danger to the population of the region, Nyiragongo represents a real threat for the one million inhabitants city of Goma.

In this context, the Civil Protection, whose mandate includes raising awareness about disaster risks, has introduced **HAZAGORA** in 65 secondary schools of Goma (DR Congo). Together with scientists and an NGO working on Disaster Risk Reduction (DRR), they have sensitized the school directors to raise awareness on DRR; they have then trained the geography teachers, who themselves have played **HAZAGORA** with several groups of students.

The learning outcomes of the game were tested using pre- and post-questionnaires. Based on the feedback of the trained students compared to students who had not benefit from playing the game, **HAZAGORA** appears to positively enhance the players' insights into processes involved in disasters, as well as their risk perception, while being fun to play and generating the active engagement of the player.

As such, **HAZAGORA** is an efficient learning tool to introduce participants to the concepts of hazards, risks and disasters, including volcanic eruptions. Moreover, **HAZAGORA** aims to induce a better understanding and implementation of appropriate protective measures against natural hazards they might face in their daily life.

The Kid who cried Supervolcano

Sriparna Saha[1,2] Ben Kennedy[1], Sara Tolbert[2], Elizabeth Mordensky[3]
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Keywords
Caldera volcanoes, earthquakes, ground shaking, primary and secondary schools

Summary of the activity

The kid who cried super volcano is a short story that uses storytelling elements to teach students about different aspects of caldera volcanoes. The book is accompanied by an activity sheet that can be used by the teachers to guide the lesson. The activity can start with a brief warm up where students are asked to draw the personality of their local volcano. Then the students read the kid who cried supervolcano book. The different storytelling elements address each of the learning goals that are listed below. For example, in the story the main character Ash did not listen to signs about dangers when she was young but learned to read and respect the signs later as she grew up.

The activity comes with a teacher resource page that explains how different storytelling elements were used. After reading the book, students fill out the activity sheet which can be modified depending on the age group.

Target Audience Primary and Secondary students

Learning Goal(s)

1. Caldera volcanoes are beautiful but can be dangerous- when visiting, follow signs to stay safe

2. Steam, smells, boiling water, and earthquake (unrest) activity is normal for caldera volcanoes.

3. Caldera volcanoes although often called supervolcanoes, usually have small eruptions which can be dangerous in our lifetimes.

4. Very big eruptions (super eruptions) are unlikely in our lifetimes.

5. Anyone can be a scientist and better outcomes are achieved when science considers people and their cultures.

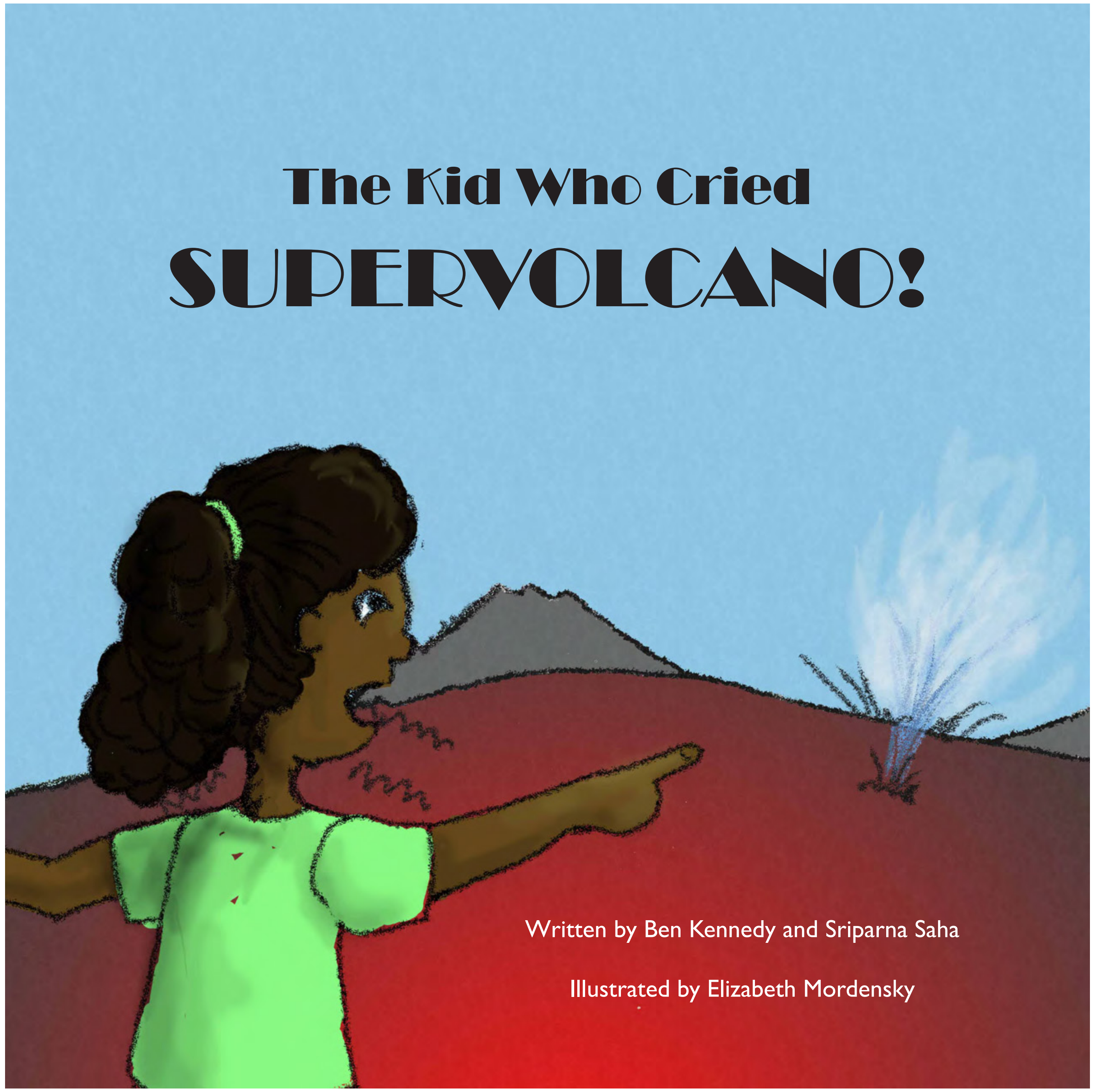
6. Understand your relationships with your local caldera volcano.

Required Materials

A3 sheets; Colored pens

Instructions

1. Draw the personality of your local volcano
2. Read the kid who cried supervolcano story.
3. Revisit your drawing and reconsider how the story changed your understanding.



Teacher Resource: The Kid who cried Supervolcano

Learning Goals (L):

1. Caldera volcanoes are beautiful but can be dangerous- when visiting, follow signs to stay safe
2. Steam, smells, boiling water, and earthquake (unrest) activity is normal for caldera volcanoes.
3. Caldera volcanoes although often called supervolcanoes, usually have small eruptions which can be dangerous in our lifetimes.
4. Very big eruptions (super eruptions) are unlikely in our lifetimes.
5. Anyone can be a scientist and better outcomes are achieved when science considers people and their cultures.
6. Understand your relationships with your local caldera volcano.

This was how we introduced storytelling elements in the Kid who cried Supervolcanostory to achieve them, (L1 addresses the learning goal 1 and so on)

L1. The main character Ash did not listen to signs about dangers when she was young, but learned to read and respect the signs later as she grew up.

L2. In the pictures and the scientists' explanation in the text we showed and explained that unrest-steaming and earthquakes was normal, and even changes in these activities were not necessarily something to worry about but something to pay attention to.
Ash also imagined the scary monster, and cried supervolcano twice but there was no eruption.

L3 and L4. Although we use the word Supervolcano in the text, the scientist explains that these big eruptions from the caldera are rare compared to small eruptions and at the end of the story (i.e. within the life time of Ash), she convinces people of the real risk of a small eruption and saves people as a result of good science.

L5. Ash, the main character grows up to become a scientist and we are careful to depict diverse scientists during the story

L6. Ash first imagines the volcano as an angry scary monster, but by the end she imagines the sleeping giant, with his occasional burps and farts. It would be nice to incorporate some ancestral spirits, or even some examples from kids.

5 Minute Volcano-A Serious Game Design in Geological Hazards For Children

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[3]School of Product Design, University of Canterbury

Keywords

Hazards, Risk Communication, Evacuation, Serious Games, Māori, Children, Learning, Co-Design

Summary of the activity

This activity is a part of a Master's thesis at the HITLab, UC, as part of the GNS-run Beneath the Waves project. As a part of this outreach education, the game '*5-minute volcano'* has been developed into a prototype based on the card game '*5-minute dungeon*' by Wiggles 3D. The design of the game was to incorporate both an educational and engaging aspect to teach 10-12 year old children more about volcanic eruptions and other geological hazards. Teams of 2-5 players must work together to overcome obstacles, people and taniwha using their card hand (also known as their knowledge), before stopping the final boss; a volcano.

There are currently 2 bosses in the game, and a high-fidelity prototype has been created for you to game test. Using this game, we intend to further develop a game which can incorporate geological hazard learning, Māori knowledge, and mechanics which allow children to learn in new, creative, and exciting ways.

Target Audience Māori Children between the ages of 10-12

Learning Goal(s)

1. Communities need to work together with scientists to mitigate hazard impacts?

2. That volcanoes generate tsunamis and present a hazard to communities on the coast ?

3. Cultural knowledge and values have an important role in hazard mitigation.

4. Learning about volcanoes is fun !

has an important

Required Materials

The game '*5-minute Volcano*', 2-5 players, a timer.

Instructions

5 Minute Volcano!

WELCOME!!!

Kia Ora, and welcome to *Run for the Hills!* In this game, you must work together using your character's knowledge to help you against obstacles, people, and even taniwhas!

There are no turns. Everyone needs to use their own cards in the time limit to match the symbols on the people, obstacle and taniwha cards.

Setting up the game:

- You will play as one of the characters created. Place the character in front of you.
- Take the cards with you characters colour, shuffle it, then place it on the 'draw pile' face down.
- Draw the starting number of cards from the deck. This will change depending on how many people are playing:

Number of Players	Starting Hand Size
2 Players	5 Cards
3 Players	4 Cards
4 or 5 Players	3 Cards

Preparing the Hazards

- Place the volcano you want to verse in the middle of the table. Start with the first volcano, then if you win, move onto the next one.
- Count out the number of hazard cards equal to the number on the bottom of the volcano card (starting at 20).
- Add 2 challenge cards (the hazard cards with a warning sign on) for each person playing.
- Shuffle the cards and pace them face down on the Volcano.

You need a timer that can count from 5 minutes. This needs to be easily paused and restarted. Start the time when you turn over the first hazard card.

How to Play

There are 3 ways to deal with the hazard cards:

1) **MATCH THE SYMBOLS:** Use the coloured cards to match the colours on the hazards. Anyone can help and the cards do not have to come from the same person. The coloured cards are: BOOK, RUN, TEACH, HELPING HANDS, and LEAF
2) **USE ACTION CARDS:** Some characters have cards which can be used to quickly stop a hazard. Do not place these in your discard pile once you play this. If your card can instantly defeat an obstacle, it can only be used to defeat an obstacle, not a taniwha or person.
3) **USE SPECIAL ABILITIES:** Each character has a special ability on the bottom of their card. To use it, discard 3 of your cards face up in your discard pile. You cannot do this if you do not have 3 cards. This does not count as using your cards, so you can do this even when time is paused!

Getting More Cards

When you play or discard cards, refill your hand back to the starting size. If you have more cards than your starting size, do not refill your hand until you have fewer cards than your starting size.

If you run out of cards, you can't do anything until someone plays a card which allows you to bring cards back into the game!

Winning

If you can win against all the hazards and the volcano, then you win! Ka Pai!! However, there is still another to play, so when you are ready, you can start that one too!

To start again, sort all the cards back to their proper piles, put the new volcano down, then restart the game. You can even try out some of the other characters!

Losing

There are 3 ways you can lose the game:

- If the time runs out!
- If all players run out of cards!
- If you cannot match any symbols or play any cards to stop the hazard.

If you do lose, reset the game and try again!

What Hazards are there?

There are 3 types of cards you will see in the game:

1) **VOLCANOES:** These are the 'bosses' of the game. The card will show the boss number, what symbols are needed to defeat it, and the number of cards you'll need to verse it.
2) **HAZARD CARDS:** These cards need to be stopped before you can get to the volcano at the end. The card shows the symbols needed to stop it, and the type of hazard it is. This includes obstacles, people and taniwha.
3) **CHALLENGE CARDS:** These are the cards with a warning symbol on the back. There are two types. *UNREST* cards are 'mini bosses' that have more symbols on them than standard hazards. These can't be stopped by using a character's ability! *EVENTS* are cards where you must immediately do what the card says. Only the '*Saw That Coming*' and the '*Aid from the Prime Minister*' cards can stop these cards.

Quick Play:

- Pick a character and collect your cards. Set up the volcano with the hazards.
- In 5 minutes, work together to stop the hazard cards!
- Match the colours, use action cards or use your character abilities to help your team or stop the hazards.
- Remember to work together, communicate, and have fun!

Virtual Activities

A virtual reality (VR) experience by *GNS Science and Metaverse Engineering.*

Keywords :

Mobile VR, Volcanology, Geology, Oceanography, Science, Exploration, Education, Social, Virtual Classroom

Summary of the activity :

Brothers Volcano is a social VR experience for standalone mobile headsets that allows users to explore a vast 20km² underwater landscape together, while learning about geology, geophysics and oceanography.

The virtual park is based on real high-resolution 3D scans of Brothers Volcano, located along the Pacific Ring of Fire, and includes hiking trails, information boards & slideshows, plus many scenic places to read related scientific journals. There is also an optional key search quest, to unlock a 1.3km fortress tower built on top of the volcano *(used to visualize depth below sea level & currently the tallest structure in the Metaverse).*

The Virtual Experience supports multiplayer, lecture pointers and superman flying abilities, so anyone can join the educational adventure & zoom around the deep sea experience as a fellow tuna fish.

Target Audience : Secondary/Tertiary Education and General Public

Learning Goals :

1. To understand the geology and geophysics of an underwater volcano
2. To learn about the oceanography and marine life surrounding an active undersea volcano
3. To explore virtual reality and its potential as a deeply immersive educational tool

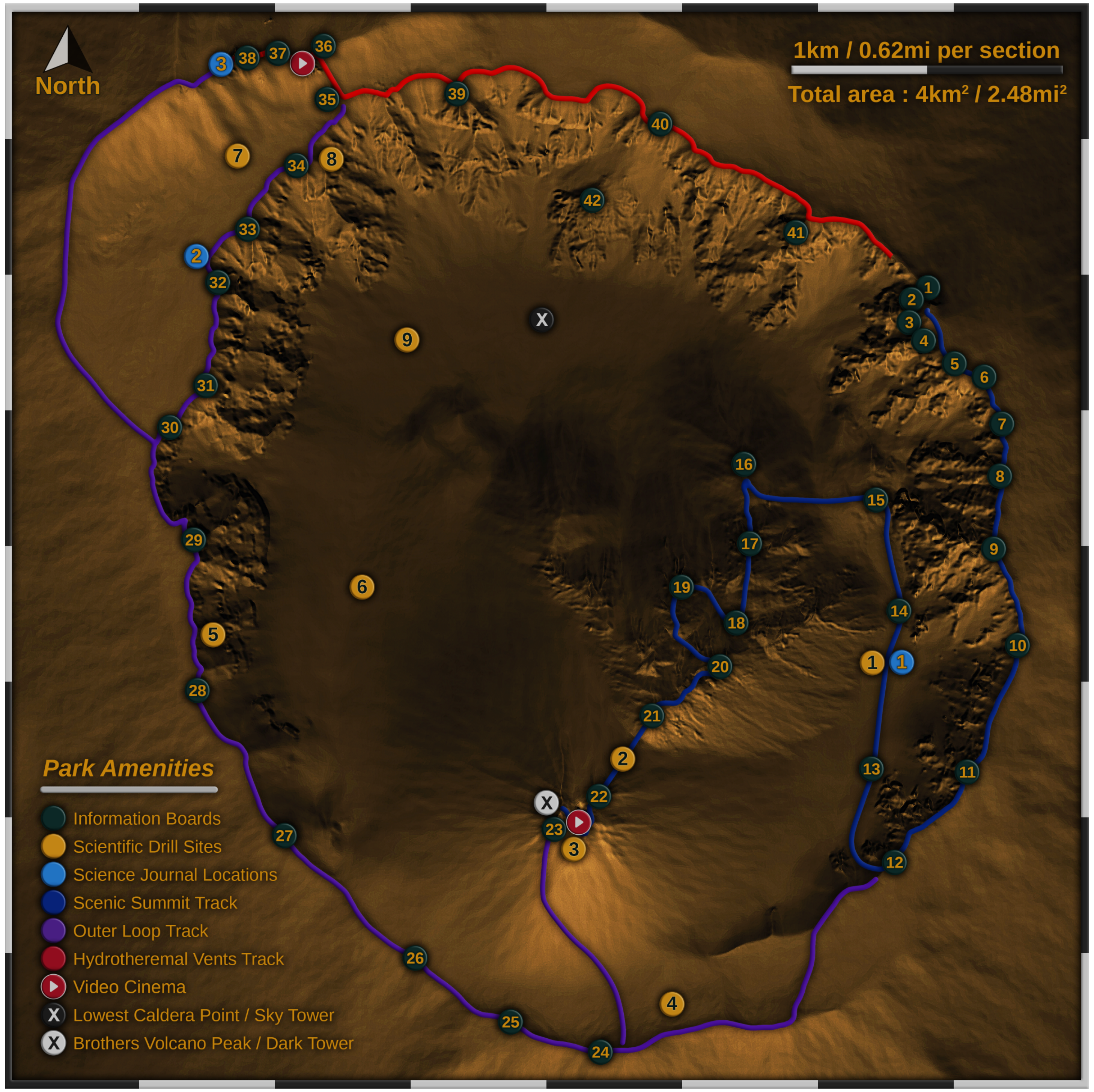
Required Materials :

1. A standalone Meta VR headset (only Quest 1, Quest 2 and Quest Pro are supported)
2. The Brothers Volcano App (to install search 'Brothers Volcano' on the App Store within headset)

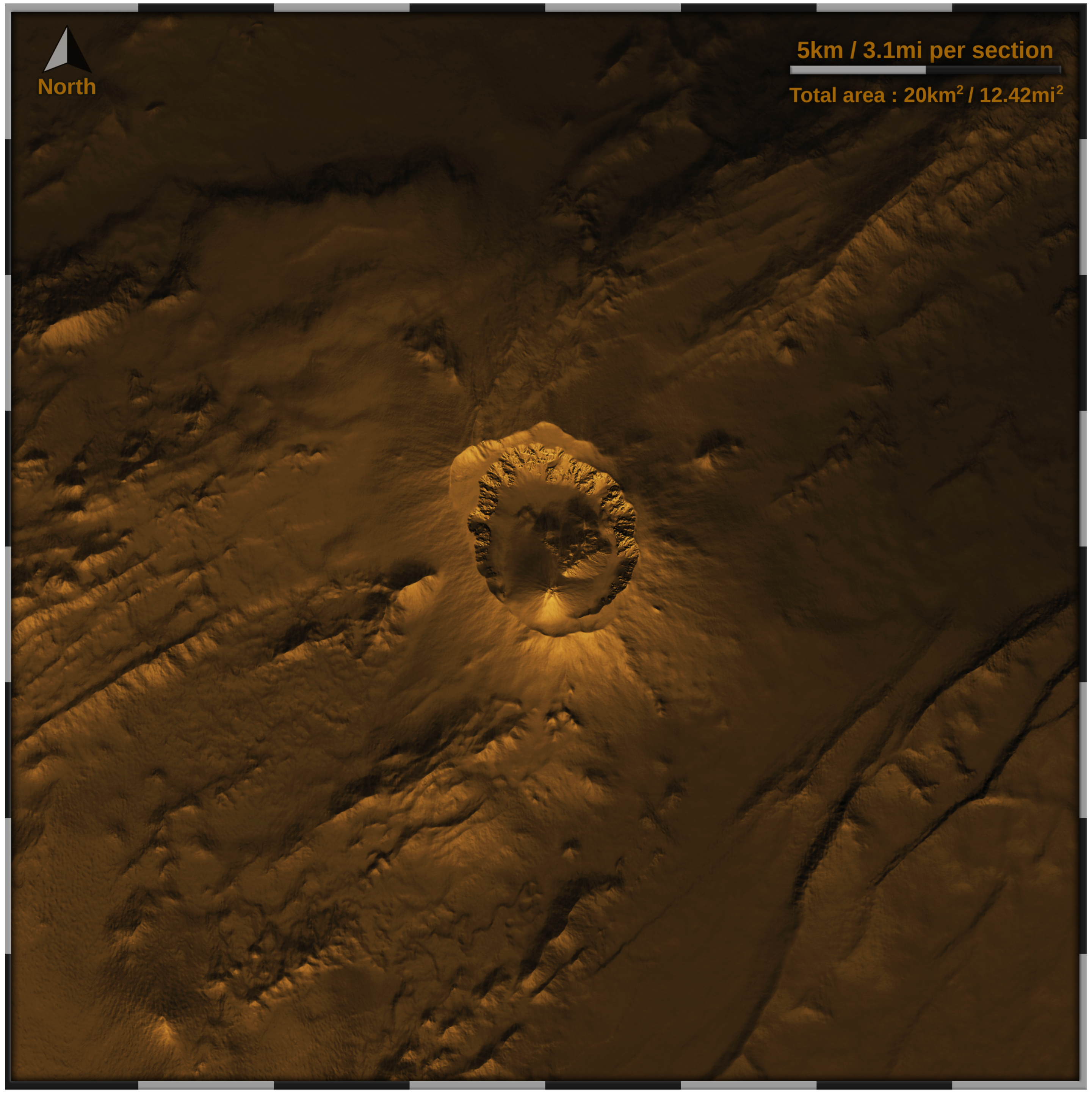
Instructions :

1. Install and explore at your own pace, tutorial included (full experience usually takes ~1-2 hours)
2. Leave us a rating and some feedback if you want to see more like it in future 👍
3. Visit us during the conference for a live demo (open all week / groups no larger than 8 for now)

Brothers Volcano - Amenities Map



Brothers Volcano - Outer Boundary Map



Exploring a bicultural virtual field trip to teach about volcanoes

Sriparna Saha[1,4] Ben Kennedy[1], Sylvia Tapuke[2], Kelvin Tapuke[2], Shelley Hersey[3], Graham Leonard[2] ,Sara Tolbert[4]
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Keywords
New Zealand volcanoes, experts, volcanic hazards, volcano monitoring, primary and secondary schools, citizenship, earth processes, earth science, earthquake research, earthquakes

Summary of the activity

The LEARNZ "Our Supervolcano" virtual field trip is a collection of archived videos that can be used to teach students about different aspects of volcanoes. The videos bring worldviews from the Indigenous science of Matauranga Maori and Western Geology to teach about the volcanic landscape around Lake Taupo, which is an are of active unrest in Aotearoa NZ. There are different videos that where experts share insights on how to live well within a volcanic landscape. In addition to these archived videos, the LEARNZ site hosts various background activities that can be used by the teachers in their classroom as is or can be modified depending on the specific needs of the classroom. The resource also addresses curricular areas across science, social studies and planet earth and beyond.

Target Audience Primary and Secondary students

Learning Goal(s)

- Understand how time and change affect people's lives
- Understand how places influence people and people influence places
- Understand how people participate individually and collectively in response to community challenges Explore and act on issues and questions that link their science learning to their daily living.
- Appreciate that scientists ask questions about our world that lead to investigations and that open-mindedness is important because there may be more than one explanation.
- Explore and describe natural features and resources

Required Materials

Printed workout sheets, laptop (1) or device to play the videos

Instructions

1. Go to the LEARNZ homepage (https://www.learnz.org.nz/naturalhazards193)
2. Play the introduction video to get familiar with the context of the resource.
3. Watch any two videos and list at least two new things you learnt about volcanoes in Aotearoa NZ.

Note: Teachers are invited to explore the LEARNZ homepage for additional notes on curriculum and background material.

Magma Drillers Save Planet Earth

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Keywords

Geothermal drilling, university, K12, high school,

Summary of the activity

Magma Pop enables students to explore links between temperatures, mineral crystallization, and changes in magma composition based on the M and M magma chamber some instructors may be familiar with. It aims to re-enforce the common elements and minerals that make up the Earths crust and the implications of temperature-driven changes to magma chemistry. Students learn the formula of common minerals in volcanoes and at what temperatures they crystallise. We also incorporated a tsunami hazard education component in the game targeting students aged between 6-17 years (tamariki edition) who live on the east coast of New Zealand to teach concepts around chemistry and geology. University students can learn about Harker diagrams and fractional crystallisation.
Magma Pop's gameplay takes place in a digital magma chamber and can be played with a keyboard, mouse, or touchscreen PC. The user interface is simple and students without prior gaming experience can play Magma Pop especially if they follow the tutorial levels. Most students in the focus groups found Magma Pop very effective for teaching mineral formula. Depending on the age of the student can also be useful to illustrate that volcanoes can erupt unexpectedly

Target Audience Primary to High School, and university level (two different versions of the game)

Learning Goal(s)

For university level

(1) know common mineral formula (2) describe the role of fractional crystallization in generating igneous rock compositions and (3) discuss the interplay between temperature and composition of solid solution minerals, crystallization, and residual magmas

For school age students

(1) know what elements and minerals the magma is made of. (2) realise that volcanoes can erupt unpredictably, (3) different crystals form at different temperatures.

(For high school students these learning goals can be adapted)

Required Materials

Trestle table
4 chairs
Poster board

Instructions

1. Choose which version is most appropriate university of tamariki
2. Click home button then click Start on home screen,
3. All instructions are provided in tutorial, use mouse cursor to navigate

Magma Pop- Magma chamber crystallization computer game

Ben Kennedy[1], Nikita Harris[2], Alex Nichols[1], Simon Hoermann [2], Sriparna Saha [1]
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[2]School of Product Design, University of Canterbury

Keywords

Magma, crystallization, chemistry, K12, University, fractional crystallization, mineral formula

Summary of the activity

Magma Pop enables students to explore links between temperatures, mineral crystallization, and changes in magma composition based on the M and M magma chamber some instructors may be familiar with. It aims to re-enforce the common elements and minerals that make up the Earths crust and the implications of temperature-driven changes to magma chemistry. Students learn the formula of common minerals in volcanoes and at what temperatures they crystallise. We also incorporated a tsunami hazard education component in the game targeting students aged between 6-17 years (tamariki edition) who live on the east coast of New Zealand to teach concepts around chemistry and geology. University students can learn about Harker diagrams and fractional crystallisation.
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Trestle table
4 chairs
Poster board

Instructions

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Volcano Films in the Earth Futures Festival

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Keywords

Film, Video, Geoscience for society, Sustainability, Volcanoes, Women in Geoscience, SDGs, Communication

Summary of the activity

The Earth Futures Festival is an international film and video event showcasing the important role geoscience plays in tackling our most pressing global challenges; climate change, the management of our natural resources (water, minerals, energy, soils), transitions to cleaner energy, mitigation of the risks from natural hazards such as volcanic eruptions and building sustainable cities. A staggering 972 films from 89 countries were submitted to the inaugural Earth Futures Festival in 2022. Over several months these were assessed and carefully considered by a team of expert judges to select the top 50 Films, consisting of 21 Finalist Films (nominated for category and theme awards) and 29 Official Selection Films.

We have put together a compilation of volcano-related Earth Futures Festival films to screen especially for the IAVCEI 2023 Volcanofest. The films can also be accessed via the website.

The Earth Futures Festival is in collaboration with the UNESCO International Geoscience Program and supported by the International Union of Geological Sciences.

Target Audience Secondary/High School, General Public

Please review films before showing to under 18s for any topics and content that might be sensitive or inappropriate for a young audience.

Learning Goal(s)

1. Understand volcanic hazards and how to monitor and prepare for volcanic eruptions

2. Explore how geoscience contributes to society and sustainable development

Required Materials

Access to the internet and the website link: https://www.earthfuturesfestival.com

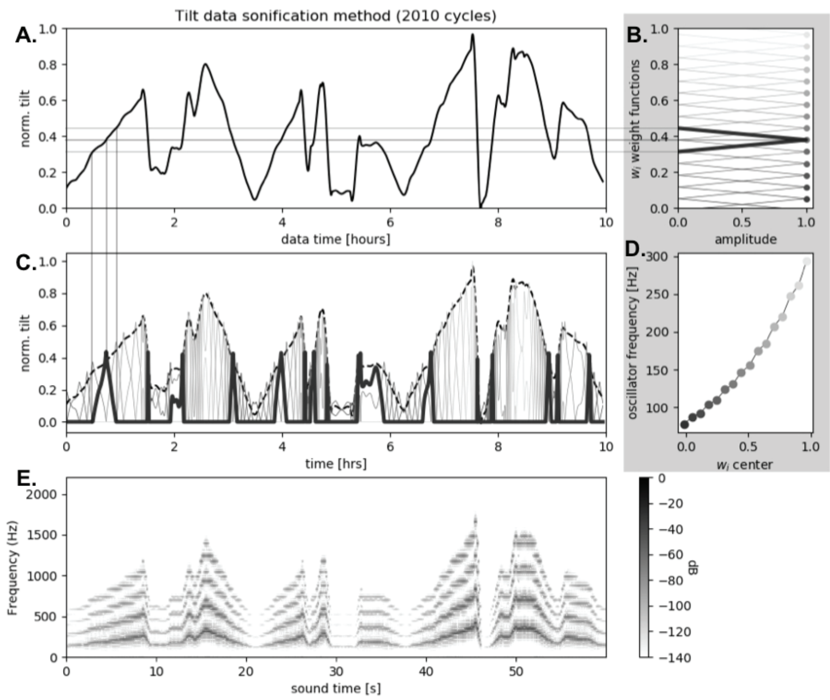
Instructions

1. Go to https://www.earthfuturesfestival.com
2. Select "The Films"

3. Sort by theme or category of interest tabs
4. Select 'volcanoes' to watch volcano-themed films in the festival
5. Watch and enjoy the films

Listening to data is not common practice. But we think it should be.

Why sonification? Scientists are traditionally trained visually. But humans (scientists or not) are innately capable of recognizing patterns and events in noisy environmental sounds. There are opportunities for discovery by engaging with data in new ways. And sonification, particularly when paired with visualization, is a powerful outreach tool.



Barth, Anna, et al. "Sonification and Animation of Multivariate Data to Illuminate Dynamics of Geyser Eruptions." Computer Music Journal 44.1 (2020): 35-50.

An example workflow for ‘chord sweep’ tilt sonification, from Barth et al., 2020. (A) Normalized tilt data from the Lone Star Geyser, Yellowstone NP, USA. (B) Triangular weight functions are mapped to envelopes (C) to which are assigned audio frequencies (D). The resulting audio spectrogram is shown in (E).

The Volcano Listening Project is an informal group of scientists and musicians. We are developing python-based software for data sonification. We run workshops and generate “data movies” as outreach tools.

Please reach out to Leif Karlstrom (leif@uoregon.edu) if you want to get involved, check out the website for examples of datamovies, and read the papers for technical details.

Workshops & Subscription Services

House of Science

www.houseofscience.nz

Keywords
education, hands-on, bi-lingual, engaging, interactive, fun

Summary of the activity

House of Science provides hands-on, bi-lingual science resource kits for use in the classroom. All the equipment, consumables and documentation required to perform the activities in the kit are provided.

Our 'Volcanoes' resource kit explores what is happening beneath our feet that gives rise to the powerful and spectacular forces that cause constant movement and changes in the Earth's landscape. What causes the Earth's crust to fracture and break, releasing waves of energy and molten rock (lava) from its interior?

To understand why the surface of the Earth is constantly moving and changing, students are first introduced to the composition of the Earth and its crust. They model the movement of the huge slabs of rock (tectonic plates) that fit together like puzzle pieces to form the surface of the Earth. Students are given the resources to create, and discuss, different types of volcanoes, volcanic eruptions and identify volcanic rocks.

Great resources for student observation, discussion and wonderings.

Target Audience Primary/Intermediate

Required Materials

Access to this resource requires membership with the House of Science.
Currently the following House of Science branches have access to the 'Volcanoes' resource kit:

- West Auckland
- Far North
- Rotorua
- Hutt Valley
- South Auckland
- Mid North
- Ruapehu
- Central waikato
- Wellington
- Hawkes Bay
- Taranaki
- Eastern Bay of Plenty
- Christchurch
- Western Bay of Plenty
- Horowhenua
- South Waikato

For sponsorship opportunities contact: Sandra Kirikiri sandra.kirikiri@houseofscience.nz

Improving volcano and earthquake resilience in the Taupō Volcanic Zone (TVZ) using school-based seismometers and other connected education activities

David Johnston[1], Marion Tan[1], Kelvin Tapuke[1], Lucy Kaiser[1], Carol Stewart[1], Raj Prasanna[1], Julia Becker[1], El Mestel[2], Finn Illsley-Kemp[2], Bubs Smith[3], Graham, Leonard[4], Brandy Alger[5], Joshua Stewart[6]

[1]Massey University; [2] Victoria University of Wellington; [3]Tuwharetoa; [4]GNS Science; [5]University of Canterbury; [6]University of Otago

Keywords

seismometers in schools, citizen science

Summary of the activity

Over the past decade several "seismometers in schools" programmes have been developed in Aotearoa New Zealand and overseas. These have been coordinated by a range of organisations, for a variety of reasons and aiming to achieve a range of outcomes. With the enhancement of digital seismic networks, the decreasing cost of sensors, cheaper and faster internet, and the increasing interest in "citizen science", a range of opportunities exist to further expand participation of schools and other institutions in this space. We will demonstrate a range of school-based citizen science activities developed as part of the MBIE-funded ECLIPSE Programme (Eruption or Catastrophe: Learning to Implement Preparedness for future Supervolcano Eruptions), a multidisciplinary research project which aims to reduce the uncertainty around future volcanic eruptions or unrest from caldera volcanoes in New Zealand.

Target Audience Primary/Elementary, Primary/Intermediate/Middle School, Secondary/High School, General Public

Learning Goal(s)

The objectives of this component of the Programme are to involve and educate school and wider community members about the TVZ and its hazard, as well as improving science understanding, through:

• Exploring and developing co-production methods with iwi for citizen science, education and graphical communication.

• Paralleling the synergy of mātauranga Māori and science.

• Including school students in the collection and interpretation of seismic and other data from the TVZ, conducting citizen science, and building interest in and understanding of volcanoes, earthquakes and seismic engineering and safety.

• Preparing Iwi co-produced graphical communication and education resources related to understanding the TVZ and risks from it, for students and the public.

Let's Make A Landscape!

Jenny Stein[1]
[1]Beneath the Waves| Raranga Whāriki Papa Moana, Te Pū Ao GNS Science

Keywords

Interactive, Landscapes, Landforms, Rivers, Lakes, Geography, Augmented Reality, All Ages

Summary of the activity

Come and play in the Augmented Reality Sandbox and use your imagination to make your very own landscape! Build a mountain, carve a valley, make a volcano with a crater… Where will lakes and rivers form when it rains? Then find out what happens to all that water when you make a landslide or tsunami.

Target Audience

Primary/Elementary, Primary/Intermediate/Middle School, Secondary/High School, General Public

Learning Goal(s)

1. Create and identify different landforms and features.

2. Understand how rainfall interacts with landscape features and how water bodies respond to landscape changes.

Required Materials

On site:
Power
Preferably placement in an area with low light (e.g. away from ceiling lights and windows)

By visitors:
(None)

Instructions

1. (The sandbox will always be supervised and instructions provided)