# Analogy map and hazard briefing.

Name: Class: Date:

## SCREEN 1 Two eruptions

| | BUNBURY BASALT<br>about 137 to 130 million years ago | LEWOTOBI LAKI-LAKI<br>November 2024 |
|---|---|---|
| **How it erupted** | | |
| **What it did, and what it left behind** | | |

**The Bunbury lava flowed away quietly, but Lewotobi Laki-laki blasted ash into the sky. What do you think could make the difference? Tick all you think matter.**

- ☐ What the magma is made of
- ☐ How much gas is in the magma
- ☐ Whether it meets water
- ☐ How old the volcano is
- ☐ How hot the magma is
- ☐ How fast the magma rises
- ☐ How big the volcano is
- ☐ What kind of plate boundary it is on

**Why do you think one eruption flowed and the other exploded? Write your best idea now. You will come back to it at the end.**

## SCREEN 2 How big was it?

Give each eruption a VEI from the levels in the table below. Kīlauea in 2018 is there for comparison.

| ERUPTION | COLUMN | VOLUME | VEI |
|---|---|---|---|
| **Kīlauea, Hawai'i, 2018** | Lava fountains about 80 m high | About 1.4 to 1.5 km³ of lava | Not scored |
| **Mount St Helens, USA, 1980** | 24 km | About 1.1 to 1.3 km³ of ash (bulk) | |
| **Chaitén, Chile, 2008** | About 19 km, perhaps more than 21 km | 0.5 to 1.0 km³ of tephra (bulk) | |
| **Agung, Bali, 1963** | 19 to 26 km | About 0.4 km³ of lava and tephra (dense-rock equivalent) | |
| **Tambora, Sumbawa, 1815** | About 43 km | 30 to 50 km³ of magma (dense-rock equivalent) | |
| **Hunga Tonga–Hunga Ha'apai, Tonga, 2022** | About 55 to 58 km | About 1.9 km³ of tephra (Wikipedia) | |

| VEI | TEPHRA | COLUMN |
|---|---|---|
| **0** | Less than 10,000 m³ | Less than 0.1 km |
| **1** | More than 10,000 m³ | 0.1 to 1 km |
| **2** | More than 1,000,000 m³ | 1 to 5 km |
| **3** | More than 0.01 km³ | 3 to 15 km |
| **4** | More than 0.1 km³ | 10 to 25 km |
| **5** | More than 1 km³ | More than 25 km |
| **6** | More than 10 km³ | More than 25 km |
| **7** | More than 100 km³ | More than 25 km |
| **8** | More than 1,000 km³ | More than 25 km |

**From VEI 3 upwards, each level on the VEI means about ten times as much tephra as the level below. About how many times as much tephra does a VEI 7 eruption throw out as a VEI 5 eruption? _____ times**

**Explain to someone who hasn't done this lesson why Kīlauea erupted a lot of magma in 2018 but scores low on the VEI.**

SCREENS 3 TO 7

## My analogy map

For each analogy, write two ways the everyday thing is like the magma, and one way it breaks down. Then circle how much it helped you. The first row is done for you.

| SCREEN 3 | HONEY AND WATER | THE MAGMA<br>Why some lava flows further than other lava |
|---|---|---|
| **Like** | *Warm honey runs much faster than cold honey.* | *Hot lava flows further than cooler lava.* |
| **Like** | | |
| **Breaks down** | | |

**How much did it help?** ◯ Not at all ◯ A little ◯ Quite a lot ◯ A lot

| SCREEN 4 | PAPERCLIPS | THE MAGMA<br>Why silica makes magma sticky |
|---|---|---|
| **Like** | | |
| **Like** | | |
| **Breaks down** | | |

**How much did it help?** ◯ Not at all ◯ A little ◯ Quite a lot ◯ A lot

| SCREEN 5 | A BOTTLE OF SOFT DRINK | THE MAGMA<br>Where the bubbles in magma come from |
|---|---|---|
| **Like** | | |
| **Like** | | |
| **Breaks down** | | |

**How much did it help?** ◯ Not at all ◯ A little ◯ Quite a lot ◯ A lot

| SCREEN 6 | SOUP AND PORRIDGE | THE MAGMA<br>Why sticky magma explodes |
|---|---|---|
| **Like** | | |
| **Like** | | |
| **Breaks down** | | |

**How much did it help?** ◯ Not at all ◯ A little ◯ Quite a lot ◯ A lot

| SCREEN 7 | A HOT FRYING PAN | THE MAGMA<br>Why magma that meets water can explode |
|---|---|---|
| **Like** | | |
| **Like** | | |
| **Breaks down** | | |

**How much did it help?** ◯ Not at all ◯ A little ◯ Quite a lot ◯ A lot

**Choose one analogy. Explain its idea again without the analogy, for someone who hasn't done this lesson.**

SCREEN 8

## Build the rule

Use your rule to decide whether each eruption will be explosive. For each eruption, write Y if a rule says it will be explosive and N if it says it won't, then circle the ones the rule gets wrong.

Rule 1 uses silica alone. It says an eruption is explosive if its magma has _____% silica or more. It gets _____ of the 9 right.

| ERUPTION | SILICA | GAS | MET WATER? | WHAT HAPPENED | RULE 1 | MY FINAL RULE |
|---|---|---|---|---|---|---|
| **Kīlauea, Hawai'i** 2018 | About 51% | Little | No | Effusive. Lava fountains about 80 m high and 1.4 to 1.5 km³ of lava flows (USGS). | | |
| **Kīlauea, Hawai'i** 1924 | Basalt, about 51% | Little | Yes | Explosive. Steam explosions that threw out rocks estimated at eight tons (Wikipedia). | | |
| **Mount St Helens, USA** 1980 | About 65% in the ash | A lot | No | Explosive. A 24 km column, VEI 5 (USGS). | | |
| **Chaitén, Chile** May 2008 | 75.3% | A lot | No | Explosive. A column of about 19 km and 0.5 to 1.0 km³ of tephra, VEI 4. | | |
| **Chaitén, Chile** 2008 to 2009 | 75.3% | Little | No | Effusive. The same rhyolite oozed out as a lava dome of about 0.8 km³ (Pallister and others, 2013). | | |
| **Agung, Bali** 1963 | 52 to 57% (basaltic andesite) | A lot | No | Explosive. Columns of 19 to 26 km, VEI 5 or a high VEI 4. | | |
| **Tambora, Sumbawa** 1815 | 56.7 to 58.5% | A lot | No | Explosive. A 43 km column and 30 to 50 km³ of magma, VEI 7. | | |
| **Hunga Tonga–Hunga Ha'apai** 2022 | 56 to 57% | A lot | Yes | Explosive. A plume about 55 to 58 km high, VEI 5. | | |
| **Lewotobi Laki-laki, Flores** 2024 | 58.44% | A lot | No | Explosive. A sideways blast and ash columns up to about 9 km above the summit. | | |

3% gas or more counts as a lot, as on screen 8. The sources for each value are on the cards on screen 8.

**Write your final rule in words. Which eruption made you change your rule, and why?**

**Tambora's magma had less silica than the magma at Mount St Helens, but Tambora's eruption was far bigger. What else decides how big an explosive eruption is?**

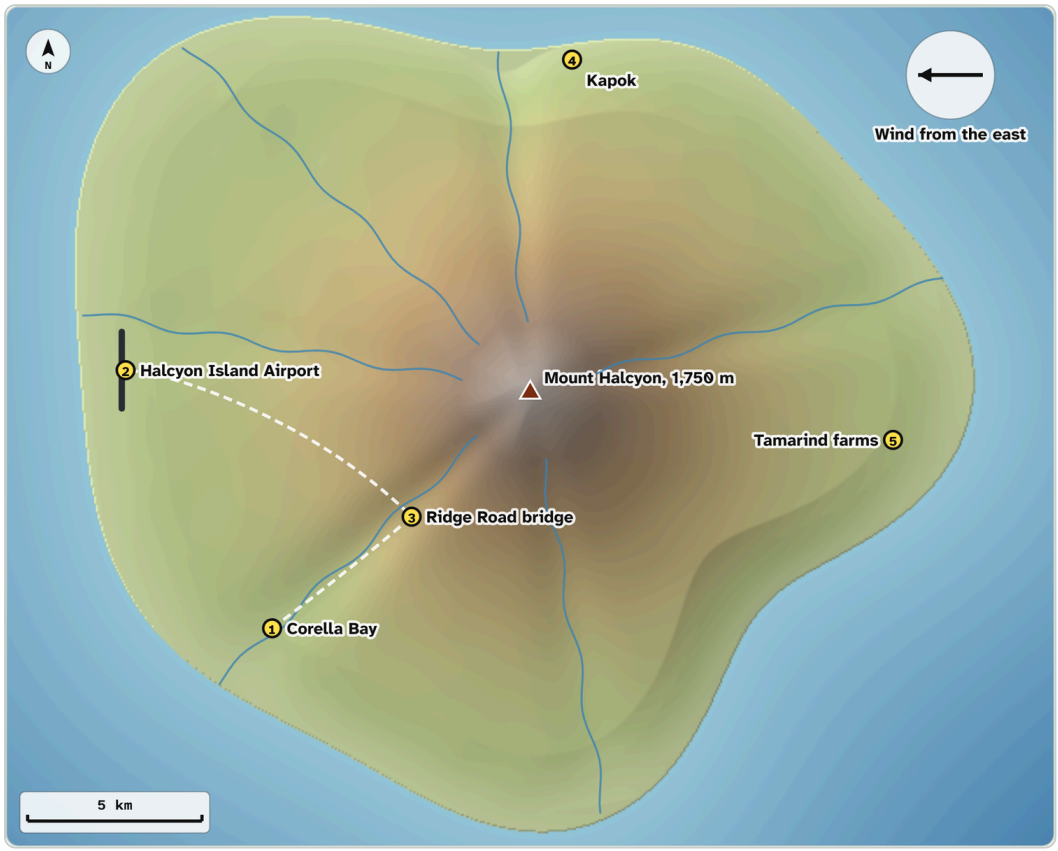
SCREEN 9

## Hazard zones

Halcyon Island is made up for this lesson. Use the trench, the monitoring data and the map on screen 9.

**What kind of eruption is most likely next? Give two pieces of evidence for it.**

On the map, shade in red where pyroclastic flows could reach, and in orange where lava could reach. Then shade in grey where 1 cm or more of ash could fall on Day 1, when the wind blows from the east.




**Tick the hazards that could reach each place on Day 1.**

| PLACE | LAVA | PYROCLASTIC FLOWS | ASHFALL OF 1 CM OR MORE |
|---|---|---|---|
| **Corella Bay**<br>The island's main town, where the south-west valley opens onto the coastal plain | ☐ | ☐ | ☐ |
| **Halcyon Island Airport**<br>The airport, on the flat west coast | ☐ | ☐ | ☐ |
| **Ridge Road bridge**<br>Where the road to the airport crosses the south-west valley | ☐ | ☐ | ☐ |
| **Kapok**<br>A fishing village on the north coast | ☐ | ☐ | ☐ |
| **Tamarind farms**<br>Farms on the east slopes | ☐ | ☐ | ☐ |

**Explain why Corella Bay is in the pyroclastic flow zone, using the trench and the shape of the land.**

**The trench shows four explosive eruptions in the last 2,000 years. On average, that is one explosive eruption every how many years? _____ years**

SCREEN 10

## The hazard briefing

Your briefing is for the town council of Corella Bay and for Halcyon Island Airport.

**Who needs each message? Circle one for each.**

| MESSAGE | TOWN COUNCIL | AIRPORT | BOTH |
|---|---|---|---|
| Keep people out of the south-west valley and off Ridge Road while the volcano is restless. | ◯ | ◯ | ◯ |
| Expect ash on the runway on Day 1, with the wind from the east. | ◯ | ◯ | ◯ |
| Follow the ash advisories from the Volcanic Ash Advisory Centre in Darwin. | ◯ | ◯ | ◯ |
| Get ready for ashfall in Corella Bay on Day 2, when the wind comes from the north-east. | ◯ | ◯ | ◯ |
| The next eruption is likely to be explosive, VEI 3 to 4, with a lava dome as its gas runs out. | ◯ | ◯ | ◯ |
| Wet ash weighs about twice as much as dry ash, so clear it from roofs before it rains. | ◯ | ◯ | ◯ |

### My hazard briefing

**1. The eruption we expect. What kind of eruption is most likely, and what in the magma and the monitoring data tells you so?**

**2. The danger zones. Where could pyroclastic flows, lava and ash reach, and who lives or works there?**

**3. The airport. What should the airport do on each of the three days, and whose ash warnings should airlines follow?**

**4. What would change the forecast? Name the data you would keep watching, and what each change would mean.**

**5. What are you least sure about, and why?**

**6. Looking back. Read your idea from screen 1 about the two eruptions. What would you say now? Which analogy helped you most, and where did it break down?**