

Is Mount Corva Waking Up? A Claim-Evidence-Reasoning Case

Learning target: I can use monitoring data and a volcano's eruption history to argue how likely an eruption is becoming and what a nearby town should do, without claiming to know the exact day.

Claim, evidence, reasoning About 45 min Individual MS-ESS3-2 · assesses data analysis writing

Name

Date

Period

Directions

Mount Corva and the town of Pine Hollow are invented, and the monitoring data are a teaching dataset. The table of alert levels is real: it is the system the U.S. Geological Survey uses for American volcanoes. Study the data before you write. Your Claim-Evidence-Reasoning answer should use numbers from the tables, and your claim should be a forecast, not a prediction of a date.

You will need: This worksheet, Pencil, Calculator

The situation

Mount Corva is a tall, steep volcano in a chain of volcanoes above a subduction zone. Its magma is thick and sticky. The town of Pine Hollow, home to 4,000 people, sits in a river valley 12 km downhill from the summit. Scientists at a volcano observatory keep three kinds of instruments on Corva: seismometers that count small earthquakes and find their depth, gas sensors that measure sulfur dioxide (a gas released by magma), and GPS stations that measure whether the ground is rising. Twelve weeks ago, the numbers began to change.

Weekly monitoring data for Mount Corva (teaching dataset)

Simulated teaching dataset: the numbers are invented to be realistic, not measured.

Week	Small earthquakes that week	Average quake depth (km)	Sulfur dioxide (tonnes per day)	Summit uplift since week 1 (mm)
1	4	9.5	40	0
2	5	9.2	35	1
3	3	9.6	45	0
4	6	9.0	40	2
5	14	8.1	60	5
6	22	7.4	95	11
7	31	6.5	160	19
8	47	5.8	240	30

Week	Small earthquakes that week	Average quake depth (km)	Sulfur dioxide (tonnes per day)	Summit uplift since week 1 (mm)
9	66	4.9	380	44
10	90	4.1	560	62
11	118	3.3	790	85
12	151	2.6	1050	112

Simulated data for teaching. Earthquake depth is the average depth below the summit of that week's quakes. Uplift is how much the summit has risen since week 1.

Two more pieces of evidence — The 2009 swarm. In 2009, earthquakes under Corva rose to about 40 per week for three weeks, all near 10 km deep. Sulfur dioxide stayed below 50 tonnes per day and the summit did not rise. The swarm faded and no eruption followed. **The deposits.** Layers of ash and pyroclastic-flow rock show that Corva has erupted explosively 6 times in the last 4,000 years. In 4 of those eruptions, pyroclastic flows rushed at least 15 km down the valley where Pine Hollow now stands.

Real reference: U.S. Geological Survey volcano alert levels (summarized)

Alert level	What it means
Normal	The volcano is in its typical background, non-eruptive state.
Advisory	The volcano shows signs of unrest above its known background level.
Watch	Unrest is heightened or escalating and the potential for eruption has increased, but the timeframe is uncertain; or a minor eruption is under way.
Warning	A hazardous eruption is imminent, under way or suspected.

Summarized from the USGS Volcano Hazards Program alert-level definitions for ground-based hazards.

Part A: Read the data

- Compare week 4 with week 12 for each measurement. For earthquakes and sulfur dioxide, find how many times larger the week 12 value is. For depth and uplift, find the difference. 4 pts

Week 4 value	Week 12 value	Change (show the subtraction or division)
Earthquakes per week		
Average quake depth (km)		
Sulfur dioxide (tonnes per day)		
Summit uplift (mm)		

2. The earthquakes are getting shallower each week. What does that suggest is happening to the magma? 2 pts
Explain why rising magma would cause small earthquakes.

3. The 2009 swarm did not end in an eruption. Name two ways the data from the last twelve weeks are different from 2009, and explain why those differences matter. 3 pts

Part B: Your argument

CLAIM

Claim: Is an eruption of Mount Corva becoming more likely? Which alert level should the observatory set at the end of week 12? Write your claim as a forecast.

EVIDENCE

Evidence: Give at least three pieces of evidence with numbers from the tables. Include at least one comparison with the 2009 swarm and at least one fact from the deposits.

REASONING

Reasoning: Explain what each signal tells you about magma beneath the volcano, why several signals rising together are stronger evidence than one, why the data cannot give an exact date, and why Corva's history matters for Pine Hollow.

Part C: From forecast to action

4. Name two mitigation steps Pine Hollow's leaders should take now, before any eruption begins. For each, say which piece of evidence makes it necessary. 3 pts

5. The mayor asks the observatory, 'On what day will it erupt?' Write a two- or three-sentence answer that is honest and still useful. 2 pts

Building the argument

Claim frame: 'The data show that an eruption of Mount Corva is becoming (more / less) likely, so the alert level should be ____.' Evidence frame: 'From week 4 to week 12, ____ rose from ____ to ____.' Reasoning frames: 'Rising earthquakes and shallower depths suggest ____.' 'Unlike in 2009, ____.' 'Because Corva's magma is thick and its past flows reached 15 km, ____.' 'The data cannot tell us the day because ____.'

When scientists got it right, and what it cost to wait

In 1991, scientists watching Mount Pinatubo in the Philippines used rising earthquakes, gas and ground swelling to forecast a large eruption, and tens of thousands of people were evacuated before it erupted on June 15. Read the USGS fact sheet about the eruption. Write a paragraph comparing their evidence with Corva's, and explain one problem officials face if they evacuate too early (people may go home before the eruption) or too late.