

# Volcanic Eruptions and Earthquakes: Mastery Check

**Learning target:** I can show what I know about where and why eruptions and earthquakes happen, how magnitude and frequency data are used to forecast them, and how people reduce their harm.

Retrieval and mastery check

About 40 min

Individual

MS-ESS3-2 · assesses

MS-ESS2-3 · supports

independent practice

writing

Name \_\_\_\_\_

Date \_\_\_\_\_

Period \_\_\_\_\_

## Directions

Work on your own. Part A has eleven items; Part B is one written response. Show your work on every calculation. For multiple-choice items, circle one letter. Remember: each whole-number step in magnitude means about 32 times more energy.

**You will need:** This worksheet, Pencil, Calculator

## Part A: Retrieval (items 1-11)

1. Which statement best explains why Mount Shasta and Lassen Peak exist in northern California? 2 pts  
☐ A. The Pacific Plate slides sideways past the North American Plate there.  
☐ B. A plate sinking beneath North America releases water, which lets the hot mantle rock above it melt at a lower temperature.  
☐ C. The mantle beneath California is a layer of liquid magma that leaks upward.  
☐ D. Heat from earthquakes melts the rock along faults.
2. Over two months, a volcano observatory records the changes below. Which combination most strongly suggests that an eruption is becoming more likely? 2 pts  
☐ A. Fewer earthquakes, less gas, and the ground sinking slightly  
☐ B. More earthquakes at the same depth, but no change in gas or ground height  
☐ C. More and shallower earthquakes, more sulfur dioxide, and the ground rising  
☐ D. A single magnitude 4 earthquake 50 km from the volcano
3. The 1700 Cascadia earthquake was about magnitude 9. (a) About how many times more energy does a magnitude 9 release than a magnitude 7? (b) Than a magnitude 6? Show the multiplication for both. 3 pts

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4. True or false: 'The USGS gives the Bay Area a 72 percent chance of a magnitude 6.7 or larger earthquake between 2014 and 2043, so scientists know it will happen before 2030.' Circle your answer and explain. 3 pts
- ☐ True   ☐ False   Explain your thinking:

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5. Explain the difference between an earthquake's focus and its epicenter. Then name the kind of seismic wave that reaches a distant seismometer first, and the kind that travels along Earth's surface. 3 pts

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6. Which of these is an example of **mitigation** rather than forecasting? 2 pts
- ☐ A. Counting how many magnitude 5 quakes a fault had in 50 years
- ☐ B. Measuring the gas coming from a volcano's vent
- ☐ C. Setting a new hospital on base isolators
- ☐ D. Calculating the chance of a strong quake in the next 30 years

7. A region recorded 18 earthquakes of magnitude 5 or larger in 60 years. (a) What is their frequency per year? (b) If the rate stays the same, about how many should the region expect in the next 30 years? (c) Can you say which years they will happen in? Explain in one sentence. 3 pts

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8. Draw a side view of the ground during an earthquake. Show and label: the fault, the focus, the epicenter, arrows for body waves spreading through the ground in all directions, and an arrow for surface waves traveling along the surface. 4 pts



9. Why does thick, gas-rich magma tend to erupt explosively, while runny magma usually pours out as lava flows? 3 pts

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10. What does an earthquake hazard map show? 2 pts

- ☐ A. The exact dates of future earthquakes in each area
- ☐ B. How likely each area is to have strong shaking, based on known faults and the locations, frequencies and magnitudes of past quakes
- ☐ C. Only the places where earthquakes have already caused deaths
- ☐ D. The epicenter of the next large earthquake

11. Earthquakes on the San Andreas Fault are shallow, but earthquakes in a subduction zone such as Cascadia can be both shallow and deep. Explain why. 3 pts

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## Part B: Synthesis

12. A friend says: 'Scientists warned people before Mount St. Helens erupted, so they should be able to warn us before the next big California earthquake too.' Write a response that (1) explains why eruptions can often be forecast from precursor events, (2) explains why earthquakes cannot be predicted, (3) describes what an earthquake forecast **can** tell people, and (4) gives two specific ways California reduces earthquake harm. 6 pts

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### Retrieval cues

Read only if you are stuck. Magnitude: one step = about 32 times the energy; two steps = about 1,000. Frequency = number of events ÷ number of years. Magma forms where water from a sinking plate lowers the melting temperature, where pressure drops as plates pull apart, or above a hot spot. For q12, plan four sentences first: one per numbered part.

### Design one more question

Write one new multiple-choice question about this chapter that would catch a student who thinks 'a magnitude 6 is only a little stronger than a magnitude 5'. Give four options, make every wrong option a mistake a real student might make, and write a key that explains why each wrong option is wrong.