SUCCESS ACADEMY EDUCATION INSTITUTE

# Earth and Space Science:
# Unit 2

# Catastrophic Events: Introduction

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## Purpose: The Why, What, and How of This Unit

**Essential Question:** Do New York City residents need to worry about earthquakes and volcanoes?

**Unit Storyline Synopsis:** With major catastrophic events receiving more media attention within the last ten years, some may wonder whether or not a natural disaster could personally affect them. In this unit, scholars will think about whether New York City should worry about the effects of earthquakes and volcanoes.

Seismology and volcanology have developed into the complex areas of study they are today through the extensive use of technology and data. Throughout the storyline, scholars flexibly analyze new sources of data as they encounter unfamiliar maps and graphs. At the end of the unit, scholars are able to confidently assess the likeliness of earthquakes and volcanoes affecting New York City.

**Why This Unit?** Catastrophic events have fascinated humans since the beginning of time. Earthquakes have brought complete devastation to Haiti and Japan, whereas volcanoes have brought the fall of Pompeii in Italy and Sainte-Pierre on the island of Martinique. Scientists use modern technology to keep our population as safe as possible, but these events are often unpredictable.

By studying seismology and volcanology, scholars will learn what natural disasters are, what causes them, and how we can attempt to predict them.

# What Is the Bottom Line?

**Big Idea 1:** Natural disasters are unavoidable because of Earth's structure and geologic forces.

- The ground may feel stable underneath our feet, but we rest on a gigantic (75,900,000 square kilometer) tectonic plate. When this plate collides with, brushes against, or pulls away from another plate, disaster strikes.
- When the motion energy of an object like a tectonic plate changes, there is inevitably some other change in energy at the same time. This change in energy can result in destruction.

**Big Idea 2:** Scientists study earthquakes and volcanoes to help us better prepare for the future.

- By using specialized tools and many methods of data collection, scientists have amassed an enormous amount of information about natural disasters that can help forecast the locations and likelihoods of events.
- Despite the inevitability of these events, we are not rendered helpless: Engineers and scientists work in tandem to develop new solutions that protect people and their surroundings from devastation.

**How do NGSS practices and crosscutting concepts support mastery of the Big Ideas? Science and Engineering Practices** highlighted in this unit:

- **Developing and Using Models**
    - Develop and/or use models to describe and/or predict phenomena.
    - Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.
- **Constructing Explanations and Designing Solutions**
    - Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or to design a solution to a problem.
    - Apply scientific ideas to solve design problems.

**Crosscutting Concepts** highlighted in this unit:

- **Patterns**
    - Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena and designed products.
- **Cause and Effect**
    - Cause-and-effect relationships are routinely identified, tested, and used to explain change.

# Safety

**Plan carefully for safety in all lessons. The top safety risks in this unit include:**

- In Lesson 4, scholars use food products in the lab. Be conscious of the allergies your scholars have whenever using food products in the classroom. If scholars have severe allergies to any of the ingredients in the “magma” samples, you will need to find an alternative.
- In Lesson 5, scholars observe seismograms under different conditions by creating “earthquakes” and shaking the lab tables. Be conscious of room space and noise to ensure safety of scholars and other classes when preparing for the lesson.

**Important Note:** These lesson plans highlight some of the safety risks you should be aware of while teaching these lessons. These safety suggestions are not meant to take the place of a formal science safety training. Please be sure to follow all safety rules from your district, as well as all local, state, and federal science safety guidelines.

# Unit Storyline

**A note on this storyline:** This unit focuses on the potential threat of earthquakes and volcanic eruptions to New York City residents, as the schools it was originally designed for are located there. If you are not based in New York, consider adapting the materials to replace New York with your own city or town!
**Engage: Get scholars excited to learn about some of the most powerful, devastating natural events on Earthâ€” volcanic eruptions and earthquakes. By the end of the Engage section, scholars should be invested in the Essential Question: Do New York City residents need to worry about earthquakes and volcanoes?**

- **Lesson 1: What Are Natural Disasters?** In this introductory investigation, scholars share what they already know about natural disasters. They assess New York City’s risk of experiencing natural disasters by digging into several online resources.
- **Lesson 2: Mapping Natural Disasters** Scholars study the connection between plate tectonics and natural disasters. They discover that proximity to a plate boundary greatly increases your chances of experiencing a natural disaster!

**Explore: Prepare for an earthquake to rock the science lab! In these investigations, scholars discover the connection between tectonic plate activity and the formation of earthquakes and volcanoes. Through modeling, reading, studying footage, and re-creating earthquakes, scholars learn about their devastating effects.**

- **Lesson 3: Shaky Ground** Now that they know where earthquake waves come from, scholars learn how earthquake waves travel through the Earth to the surface. They study the three major waves that occur during every earthquake and explore their effects on Earth’s surface.
- **Lesson 4: Volcano Formation** It’s time for an explosion! Scholars model volcanic eruption and formation to learn how the composition of magma affects volcanic activity.
- **Lesson 5: Measuring Earthquakes** In this investigation, scholars read eyewitness statements to explore the ways in which we measure earthquakes. By using seismographs to re-create earthquakes in the classroom, they learn how the energy/magnitude of an earthquake relates to the damage it causes in a given area.

- **Lesson 6: The Aftermath** Believe it or not, volcanic eruptions aren't all bad. Scholars read about the impacts of volcanic activity on Earth and compare their findings to the effects of earthquakes.

**Explain: Scholars learn why tracking natural disasters and collecting data on these monumental events is so important to scientists. Through the exploration of topographic maps, scholars also learn what makes some areas more vulnerable to crippling damage.**

- **Lesson 7: Finding the Epicenter** It's time for some triangulation! Scholars use S–P graphs to find the distance from a given location to the epicenter of an earthquake. Then they synthesize data from multiple locations to pinpoint the epicenter of an earthquake.
- **Lesson 8: Topographic Maps** Scholars construct topographic maps to determine areas most affected by volcanic activity. Scholars consider how topographic maps allow us to better assess risk and mitigate damage before disasters occur.

**Elaborate: Scholars apply their newfound understanding to engineer a model building that can withstand a simulated earthquake. Working in teams, they collaborate to design and construct a building, run trials, and revise their work.**

- **Lesson 9: Earthquake Design Challenge** We know that earthquakes are inevitable in many areas. If we don't want to politely request that everyone move out of California or rebuild the same skyscraper every year when it falls over again, we must design structures that are earthquake-safe! Scholars work in teams to design earthquake-resistant structures.

**Evaluate: Earthquake or volcano? Which is the most threatening catastrophic event faced by the people of New York City? Scholars synthesize their takeaways from each investigation as they construct arguments for a culminating debate.**

- **Lesson 10: Using Historical Data** In this culminating investigation, scholars compare the causes and impacts of earthquakes and volcanoes. Scholars debate: Are earthquakes or volcanoes ultimately a greater threat to New York City? How worried should we be about the safety of our own homes?

Note: This unit overview is flexible. When teaching the Explore and Explain lessons, the content toggles between earthquakes and volcanoes. An alternative approach would be to teach the earthquake lessons in succession and the volcano lessons in succession as mini Explore–Explain cycles (in the order listed below).

- Earthquake Content Lessons:
    - Lesson 3
    - Lesson 5
    - Lesson 7
- Volcano Content Lessons:
    - Lesson 4
    - Lesson 6
    - Lesson 8

# Extra Resources

In addition to the resources linked throughout the guide, use the following materials to help you prepare to launch this unit with scholars:

- **Printable Exit Tickets**
- **Printable Lab Notebook**