American Museum *of* Natural History

# Mignone Halls of Gems and Minerals

## GRADES 9–12 • Earth Science Activity Sequence

### Natural Phenomenon

**Minerals can have different properties, including colors, shapes, and sizes.**

### Investigation Question

**What do minerals tell us about the role of water in their formation?**

**Overview:** Students will make connections between the properties of water and mineral formation by investigating the seemingly endless colors, shapes, and sizes of mineral crystals.

1. **Before the Visit:** Through a photo slideshow, students observe four specimens and then generate questions about the minerals and the role water might have played in their formation; they will revisit these questions after the trip.
2. **At the Museum:** At eight highlighted stops in the hall, students use worksheets to first examine basic information about the periodic table, and then—through a series of observations—explore the role of water in mineral formation.
3. **Back in the Classroom:** Students share and process what they've learned at the Museum, and then revisit the pre-visit photo slideshow and questions.

# Correlation to Standards

This activity supports the following Next Generation Science Standards:

### Performance Expectations

- **HS-ESS2-5 Earth's Systems**
  Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

### Disciplinary Core Ideas

- **ESS2.C: The Roles of Water in Earth's Surface Processes**
  The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks.

### Crosscutting Concepts

- **Structure and Function**
  The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

### Science & Engineering Practices

- **Planning and Carrying Out Investigations**
  Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

# Before the Visit

Through a photo slideshow, students observe four specimens and then generate questions about the minerals and the role water might have played in their formation; they will revisit these questions after the trip.

**TIME**

One class period

**PRIOR KNOWLEDGE**

Students should be familiar with (1) the hydrologic cycle, (2) the rock cycle, and (3) the properties of water.

**PREPARATION**

Teacher:

- Review the Educator's Guide to get an advance look at the major themes of the hall and what students will encounter (download at amnh.org/gems-minerals-educators).
- Review this three-part activity sequence and decide how students will engage with the content before, during, and after the visit.

Note:

- This sequence uses a jigsaw strategy, in which students are divided into home groups of four students per group (see next page).
- Stop 2 of the worksheets asks students to observe one of four large specimens. You may wish to pre-assign one specimen per student in each home group.

**PROCEDURE**

1. **Students are introduced to the featured phenomenon**—that minerals can have different properties, including colors, shapes, and sizes—by exploring Part 1 of a two-part photo slideshow (download at amnh.org/gems-minerals-educators):
   - **Part 1: Before the Museum Visit** features four specimens from the hall. This engagement activity uses the Visual Thinking Strategy (VTS) to help students practice observation, thinking, listening, and communication skills.
2. **Students generate questions about the minerals and the role of water in their formation.** Questions can be recorded on a class or group chart so that students can revisit the questions after their trip to the Museum. Tell students that at the Museum, they will investigate the role of water in mineral formation.
3. **Teacher prepares students for the Museum visit.** (See next page.)

# At the Museum

At eight highlighted stops in the hall, students use worksheets to first examine basic information about the periodic table, and then—through a series of observations—explore the role of water in mineral formation.

**TIME** 45 to 60 minutes

**PREPARATION** Teacher:

- Become familiarized with the student worksheet, the answer key, the notes to educator, and the hall map (download at amnh.org/gems-minerals-educators).
- Organize home groups of four students per group.
- Pre-assign one large specimen (from Stop 2) per student in each home group.
- Distribute and review worksheets with students.

**PROCEDURE**

1. **Students explore basics about the atomic structure of minerals** using the periodic table interactive (Stop 1).

2. **Students investigate the role of water in mineral formation** (Stops 2–8):
    - Observe a large specimen to identify traits such as color, size, and shape.
    - Watch videos about the role of water in mineral formation above and below ground.
    - Observe additional specimens and their traits.
    - Make hypotheses about the role of water in the formation of minerals.
    - Revisit the initial large specimen to apply their understanding of mineral formation.

# Back in the Classroom

Students share and process what they've learned at the Museum, and then revisit the pre-visit photo slideshow and questions.

**TIME**

One class period

**PREPARATION**

Teacher:

- Review the answer key to worksheets.
- Plan how students will surface, analyze and interpret, and share information gathered at the Museum.

**PROCEDURE**

1. **Students first gather with other students who investigated the same large specimen in Stops 2 and 8 of the worksheet.** They share the information they collected on their worksheets to compare and discuss findings about the role water might have played in the formation of that specimen.

   Suggested prompts:

   - What are this specimen's observable traits?
   - Based on these observable traits and other information gathered in your worksheets, what role do you think water played in the formation of this specimen?
   - What properties of water were important in the formation of this specimen?

2. **Each student consolidates findings on a chart** (see sample headers in step 3) to bring back to their home group.

3. **Students go back to their home group to share findings about all four large specimens.** Students synthesize information on a chart. Sample chart:

| **Large Specimen** | **Observable Traits** | **Role of Water in Mineral Formation** (discuss specific water properties, e.g. solubility, polarity) |
|---|---|---|
| Fluorite | | |
| Stibnite | | |
| Singing Stone | | |
| Giant Geode | | |

4. **Students analyze and discuss the chart.** Suggested prompts:
    - Compare the specimens. What is similar or different about the role water might have played in their formation?

5. **Students revisit the specimens** from the pre-visit photo slideshow (downloadable at amnh.org/gems-minerals-educators) by exploring:
    - **Part 2: After the Museum Visit.** Students use their observations and what they've learned at the Museum and in the group discussions to figure out the role(s) water might have played in the formation of each specimen (e.g. how water might have interacted with rock to form minerals).

6. **Students revisit the list of questions** they generated before their Museum trip to see which ones they can explain and which ones need further investigation.

**EXTENSION IDEAS**

Teacher model (or students do) experiments investigating the properties of water. Sample investigation questions:

- How many drops of water can fit on a penny? (Properties: polarity, surface tension, adhesion, cohesion)
- Can you cut water? (Properties: polarity, adhesion, cohesion)
- What happens when a substance (e.g. salt, sugar) is dissolved in water and then the water evaporates? (States of matter: liquid, gas)
- Do some substances (e.g. salt, sugar) dissolve better than others? (Property: solubility)

**MAKING REAL WORLD CONNECTIONS**

*HS-ESS2-5 Earth's Systems:* Students plan and conduct experiments to investigate the properties of water and its effects on Earth materials and surface processes. Examples of phenomena to investigate:

- Stream transportation and deposition using a stream table
- Erosion using variations in soil moisture content
- Frost wedging by the expansion of water as it freezes
- Chemical weathering and recrystallization by testing the solubility of different materials
- Melt generation by examining how water lowers the melting temperature of most solids

**ADDITIONAL RESOURCES**

- What Is Water (amnh.org/explore/ology/water/what-is-water)
  Students explore why and how water is important to our world.
- If Rocks Could Talk (amnh.org/explore/ology/earth/if-rocks-could-talk2)
  Every rock has a story to tell. Students can "meet" six rocks to find out the clues they provide about the history of Earth.
- Being a Geologist: Ed Mathez
  (amnh.org/explore/ology/earth/being-a-geologist-ed-mathez)
  Students can read this interview about what we can learn from studying rocks.