



# Outdoors

**\*Note:** sections of the lesson plan template marked with \* are optional, but may be useful for your planning.

<b>From Microbes to Mountains: Science in Our Neighborhood!</b> <b>Module: Mapping how rivers move mountains</b>	
<b>Short Description</b>	<p>This is one module that can be taught on its own or as part of a larger field trip exploring geoscience concepts at different scales in Pasadena. The field trip was designed in 2023 to be held at Hahamongna Watershed Park, but can be adapted to other locations. This module is appropriate for grades 6-10.</p> <p>This lesson can also be adapted to teach in a classroom.</p>
<b>Standards (NGSS)</b>	<p>MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.</p> <p>MS-ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.</p>
<b>Learning Objectives (Goals)</b>	<p>Students will identify local rock samples by type of rock.</p> <p>Students will match rock samples to rock types on a geologic map.</p> <p>Students will discuss how a watershed describes the flow of water and the erosion of rocks.</p>
<b>Time/duration</b>	25 minutes
<b># students</b>	8-35 students
<b>Location</b>	<p>This lesson was originally designed to be taught at Hahamongna Watershed Park, but it can be modified to be taught in a classroom.</p> <p>Hahamongna Watershed Park:  <a href="https://goo.gl/maps/NwSiQ8BgCTgfdBWd7">https://goo.gl/maps/NwSiQ8BgCTgfdBWd7</a> </p>

	<p>This park is within walking distance of La Cañada High School. For any other school, transportation will be needed or the module can be adapted to a different location.</p> <p>This lesson should be taught on an area of flat, open ground where up to 30 students can form a circle.</p>
<b>*Logistics</b>	<p>This activity is designed to take place outside, so scheduling during daylight hours and appropriate weather is recommended.</p> <p>Students will spend time sitting or kneeling on the ground, so they should wear comfortable shoes and clothing for outdoor activities.</p>
<b>Materials and Equipment</b>	<ul style="list-style-type: none"> <li>• Laminated, poster-sized printout of a simplified geologic map (attached). Suggested size: 3'x3'</li> <li>• Handout describing 3 rock types (attached), one per student.</li> <li>• Cobble samples that represent the 3 rock types: approximately 10-15 of each type. GO-Outdoors has a collection of cobble samples for this activity, or the instructor can collect their own. See more in the section "Instructor Support."</li> <li>• Optional, but helpful: trays or boxes with compartments that students can use to sort the rocks into three groups and keep them sorted. This will help when students are placing rocks on the map, and will be easier than having them carry piles of rocks with their hands.</li> </ul>
<b>Accessibility</b>	<p>This activity is designed for students to sit or kneel on the ground. However, a student using crutches, a leg cast, or a wheelchair can be included by modifying the activity to use flat area and/or a picnic table.</p>
<b>Safety Awareness</b>	<p>Hahamongna Watershed Park has areas of uneven ground. Poison oak is common off the trail, so students should be instructed to remain on the trail and grass lawn areas. In addition, this area is an active disc golf course. When choosing a location, remain aware of disc golfers to avoid students being injured.</p>
<b>GO-Outdoors Missions</b>	<p>At GO-Outdoors, we emphasize the following missions:</p> <ul style="list-style-type: none"> <li>• Instructor/Caltech volunteer will incorporate 10 Essentials of hiking and Leave No Trace etiquette into the trip and encourage students that they can do these things themselves, to make these concepts approachable.</li> <li>• We are looking forward to tailor our trips to student interests. At the start of each of our trips, we will ask each</li> </ul>

student to share what they hope to learn and we will try to incorporate them into the field trip.

### **Field trip activities**

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- **Brainstorm and introduction**

Display the rock samples in a pile, not sorted by rock type. Allow the students to see but not yet handle the rocks. Tell them the rocks were collected nearby in Pasadena (e.g., just up the river near JPL, in the case of GO-Outdoors' existing rock samples). The rocks were found in a riverbed, but where did they come from before they got there? Ask students to brainstorm.

The rocks came from the mountains! There are three different rock types we have collected. Each one has a different history, age, and formation process. We are going to sort the rocks into their three groups.

- **Rock identification**

Separate the students into groups of 3-5. Give each group a pile of roughly 10-15 rock samples. Students can now use their handouts to sort the rocks into three different groups.

Walk between groups and ask them what they notice about the rocks and how they sorted them. What is different between the rocks? Do they notice different colors, crystal properties, textures, shapes? Which one is their favorite?

- **Map exploration**

Once all the groups have sorted their rocks, bring them together to look at the laminated geologic map. Ask them what the different colors on the map represent. (Different rock types.) Ask students what the blue lines on the map represent. (Rivers.) Ask what the dotted blue line represents (a watershed).

Watersheds are a special concept to describe where our water comes from and how water flows over the land. All of the water that falls within these dotted lines flows to the same place, into the Arroyo Seco river that flows alongside Hahamongna Watershed park. Does the river carry anything other than water?

Sand, dirt, leaves, animals, and rocks can flow with the river! The river carries pieces of the mountain with it down to the Arroyo Seco. Any rocks that flow with the river also came from the same watershed. Geologists who want to study rocks often need to go up into the mountains to see the rocks in place, but the river can do some of that work for us, collecting rocks from all over the watershed and bringing them to the same place.

- **Mapping how rivers move mountains**

Now ask students to bring their sorted rocks to the map. Students will match the rock types to areas on the map and place them on the area of the map where that rock type is represented!

Point out another rock type is also represented on the map. Can students find where on the map is anorthosite, the reddish-brown color? Why didn't we find any anorthosite in the Arroyo Seco? (It's because it's not inside the Arroyo Seco watershed!)

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**\*Optional extension activities**

This field trip module can be paired with other GO-Outdoors modules within the Microbes to Mountains field trip.

**Instructor support**

Instructors in Pasadena may wish to teach this lesson without the help of GO-Outdoors volunteers. In this case, instructors can contact GO-Outdoors to borrow rock samples from our collection, or collect their own rock samples to represent the three rock types in the handout. Representative rocks for the three rock types can easily be found in the riverbed near the entrance to JPL. See this pin on google maps: <https://goo.gl/maps/mKvRBNaBPmkNSRi3A>

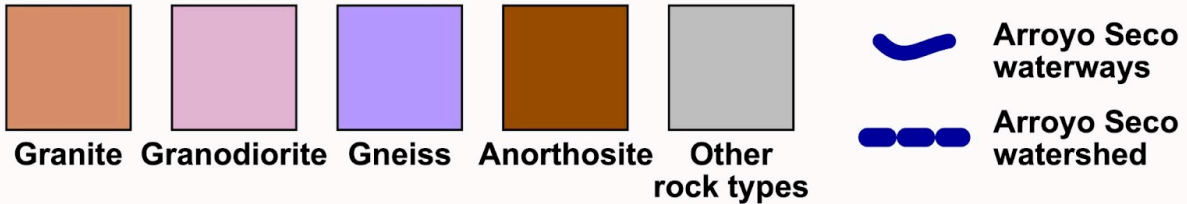
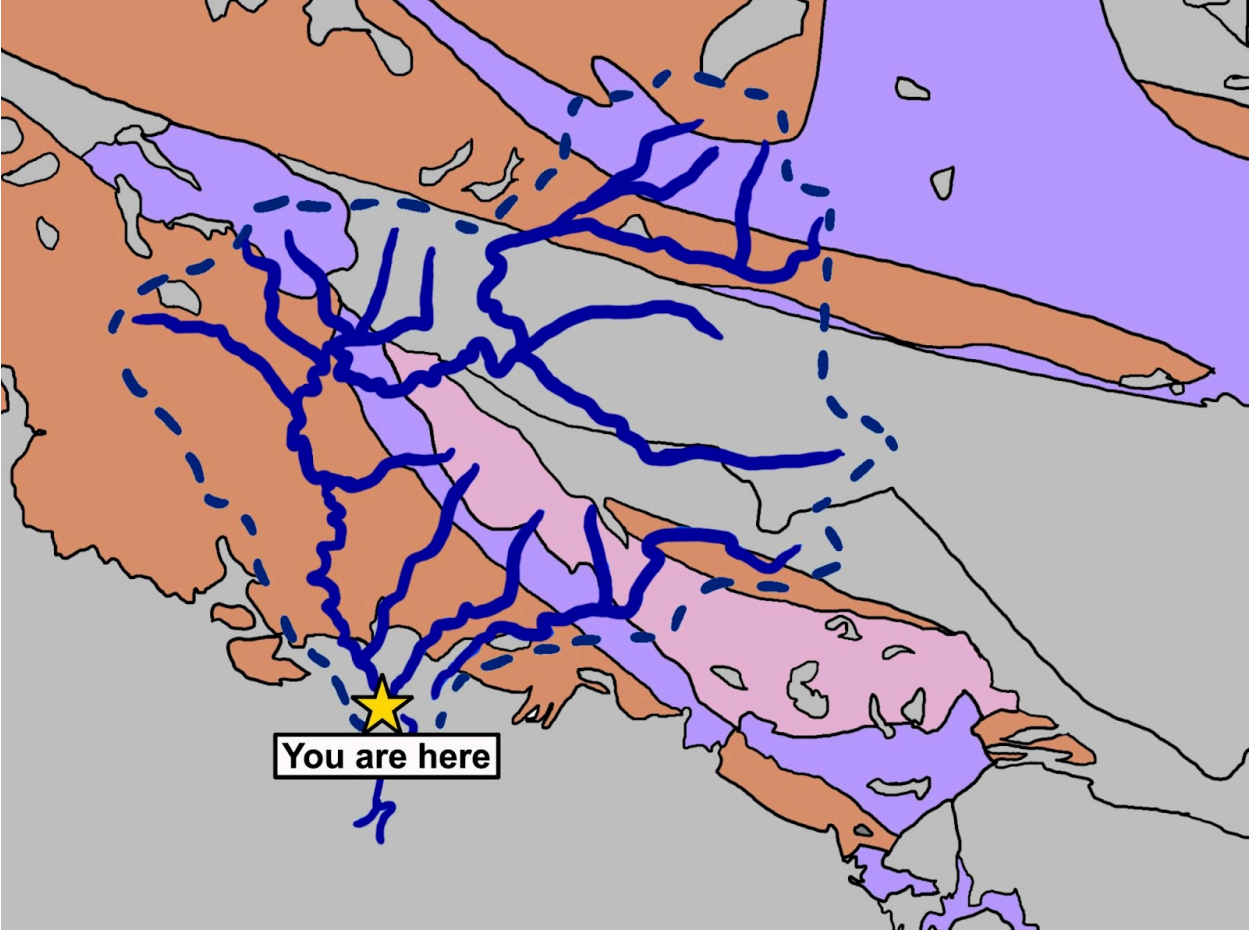
**Common misconceptions about the concepts**

The rock type "gneiss" is pronounced like the word "nice."  
Rocks and minerals are two different things that have specific definitions in geology. A mineral is a solid substance with a consistent and unique chemical makeup: for example, table salt (NaCl) is a mineral, as well as diamonds (pure carbon, C) and quartz (SiO<sub>2</sub>). A rock can be made up of one or typically many different minerals in a mixture. Rocks can be sedimentary, metamorphic, or igneous, and often in igneous rocks you can see individual crystals that are each made up of different minerals.

**\*Handouts**

Attached to this lesson plan are the geologic map and rock type handout used for this lesson.

**Geologic map of Pasadena, the Arroyo Seco watershed, and the San Gabriel mountains**



# Geology of the Arroyo Seco

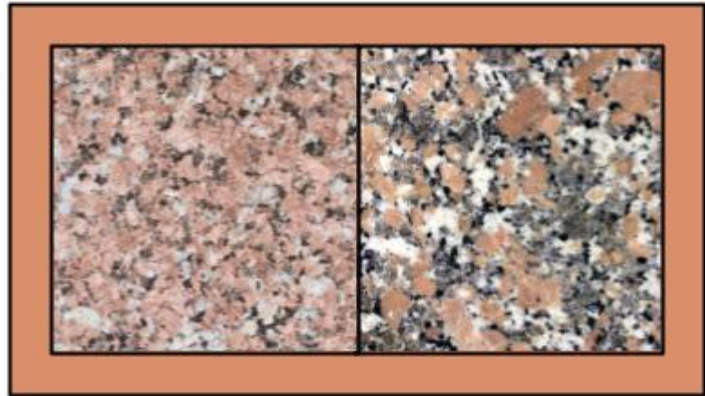
Today we will identify some of the different rocks found in the Arroyo Seco and figure out where in the mountains they were transported from.

- 1) Working in small groups, sort your pile of rocks into the three categories below (granite, granodiorite, gneiss).
- 2) Once all the groups have sorted their rocks, each group will place their rocks on the corresponding unit they eroded from on the large geologic map!

## Granite

**Pink, clear, and white minerals with small dark spots**

- Light colored rock
- Quartz (clear glassy mineral) and K-feldspar (pink mineral)
- Small flecks of biotite (dark flaky mineral) or muscovite (light flaky mineral)



## Granodiorite

**Mostly white with spots of black minerals**

- In the Arroyo Seco area, looks like a “dalmatian rock”
- Background of white-colored feldspar
- Large crystals of hornblende (black mineral)
- Little or no quartz (clear glassy mineral)



## Gneiss

**Layers of dark and light minerals**

- Alternating dark and light layers
- Dark layers have biotite (dark flaky mineral)
- Light layers have quartz (clear glassy mineral) and feldspar (light-colored mineral)
- Sometimes the layers are folded

