Climate in the Rock Record!

Grade level	6-8
Standards	MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
Goals	- Students can explain how rocks and fossils can contain information about the Earth's past climatic conditions. - Students will describe rocks and fossils with different observation techniques and interpret the causes of relevant characteristics
Time	1 hour
# students	5-40
Materials	- Large rock samples brought for display - Smaller rock samples for the groups of students to handle - Hand lenses or magnifying glasses (optional) - Large printouts with terms/pictures/maps
Location	Possible in any outdoor location, i.e. park or playground
Logistics	Minimal, simply would want to be outside. Preferable for teacher to break students into groups beforehand for time efficiency
Caltech student needed?	Caltech student recommended to bring and be able to discuss the excellent rocks and fossils
Accessibility	No accessibility issues (as far as I know)

Lesson activities

Engage: (20 min)

- Begin by showing exciting, locally relevant samples with clear implications and expand from there. Ask students to describe what they see and what kind of place such a sample would come from (i.e. cold/warm climate)
- Start with a mammoth or similar ice age fossil that could be found at the La Brea tar pits. Then a warm/tropical plant fossil like palm leaves as can be

current found in LA, followed by a desert environment like salt and mudcracks that could be found in the SoCal deserts. May finish with coral/reef marine fossils as would be found in the Caribbean, noting that much of the rock record is from marine sediments.
- Point out the idea that understanding Earth's past climate and how it has changed will help us understand current climate change.

Explore: (30 min)
- split the students into groups and hand out a number of samples (three for each group) for them to describe and interpret themselves.
- Point out that not only can we use rocks to interpret past climatic conditions of temperature and precipitation, but we can also interpret relative sea level, which is *often* related to global climate with the development of ice sheets.
- Samples include a sedimentary conglomerate (an amalgamation of large pebbles and cobbles), a sandstone with ripples, and a shale with marine fossils.
- Say that one of these samples represents foothill sediments dumping out of mountains on land, one represents a beach, and one represents an open/deep ocean – bringing analogy of going from here near the San Gabriel Mountains, to Long Beach, to the ocean. Try to place each of the three samples and explain why you placed them as you did.
- Hover between the groups to support their discussions and nudge them in the right direction as appropriate

Wrap Up: (10 min)
- Bring everyone back together to talk through their observations and interpretations.
- Depending on time + interest, finish with adding the idea of a single place having a record showing a stack of conglomerate, sandstone, and shale – a single location showing relative sea level through time.
- Could also include a "challenge rock", such as ooids, for students to describe and interpret.

Optional extension activities
- Encourage walks/hikes with their family to local trails (e.g., Eaton Canyon, Arroyo Seco, or the beach) that would show modern sedimentary environments. Suggest that students notice that different locations have different types of rocks, plants, and animals, and how those might relate to climate and elevation
- Visit the La Brea tar pits!

Instructor support

Simply note that the details of this lesson rely partly on the rock samples available, but can be easily adapted to work with different rocks.