

Tales of Earth and Space Sciences

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By Joan S. Wagner

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Emilia receives a telescope from her grandmother for her birthday. She has many questions about the universe and even builds a Moon Clock with the help of her grandmother, who is a science teacher.

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Students attending the Martin Luther King Middle School were being dropped off at their school at 6:00 AM for a field trip to the Adirondacks. They were divided into groups of four led by a parent or teacher.

As they hike the Adirondacks, they learn about Earth processes and geology.

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The students in Ms. Gomez's class were busy preparing their exhibits for Earth Day.

"I can't believe that Earth Day is almost here. It seems just like yesterday when Ms. Gomez told us about this project," said Griffin.

"That was in September," replied Nikko, "And now it is April. The year certainly has flown by."

Students develop projects that identify problems facing our planet and provide solutions.

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Earth Shapes Up

Students attending the Martin Luther King Jr. Middle School were being dropped off at their school at 6:00 AM for a field trip to the Adirondacks in upstate New York. They were divided into groups of four led by a parent or teacher.

The past few days in their science classes, they prepped for the trip. They were taught a lot about the processes that shape their planet, but this trip was to provide them with some first-hand experience.

The buses were lined up in front of the school. The students got onto their assigned buses. All of the students brought backpacks that included their lunch, extra water, some snacks, sunblock and insect spray.

"I have never been to the Adirondacks," Alba said to her friend Marva, who was sitting next to her on the bus.

"You have never been to the Adirondacks?" exclaimed Nelson, who was sitting behind the girls. "That is hard to believe."

"Well there are people who live in New York City that have never been to the Empire State Building," Alba countered.

"Just because you live near an area does not mean you have visited it," said Winston, who was sitting next to Nelson.

The buses soon left the school and headed to the New York State Northway. They were all going to hike Mt. Jo, a relatively simple hike, have lunch at the top and then head back down. In class, the week before, they were given some background about the geology of the Adirondacks.

"Use all of your senses while you hike," said their teacher, Mr. Anderson, "and the Adirondacks will unlock to you its amazing story."

After about 2 1/2 hours, the buses arrived at the Adirondack lodge. The students got off the buses and met up with their team leader. Marva, Alba, Winston and Nelson had signed up to be in the same group.

"How long is the trail?" asked Marva.

Their team leader, Mrs. Wilkins said, "It is about 2 1/2 miles round trip. When we get to the top, there is a beautiful view of the high peaks in the Adirondacks. We will have lunch there. After lunch, I will collect all your trash. During the hike, you must stay on the trail to avoid causing erosion around the trail."

Before Marva, Alba, Nelson and Winston's group began their climb, they walked over to Heart Lake.

"How do lakes form?" asked Winston.

"They form in different ways, but this one formed because of glaciers," replied Nelson.

"You are kidding!"

"No, I am not. I read a guide about this area and it said that many of the lakes in the Adirondacks formed from glaciers. I think Mr. Anderson may have forgotten to talk about that in class last week. They are called 'kettle lakes.'" According to the guide, when glaciers move, sometimes parts break off, get buried with soil and gravel and when they melt, leave depressions. When these depressions fill with water, kettle lakes form.

"Why are they called kettle lakes?" asked Marva.

“Well, I think you all have a handle on the water cycle,” said Mrs. Wilkins. Just then, she told the kids to wait a minute while she went into the woods.

“I think Mrs. Wilkins is contributing to the water cycle,” Winston joked.

When they began walking again, Marva yelled “Ouch!” as she tripped on a root and almost fell into a large boulder. “How did that get here? It doesn’t look like any of the other rocks on this trail.”

“Remember, the Adirondacks were eroded by glaciers. When glaciers move, they carry a lot of debris in the form of gravel and rocks. What you are looking at is what geologists call a glacial erratic. It was left behind by a glacier,” said Mrs. Wilkins. “It is not necessarily native to this region,” she continued.

“It’s hard to imagine anything could move that boulder!” said Marva.

The last part of the hike was the steepest, but soon all of the students were on the top of Mt. Jo. As they looked out, they could see a number of the high peaks of the Adirondacks. Mrs. Wilkins told the students that there are 46 high peaks in the Adirondacks. To be classified as a high peak they have to be at an elevation of over 4000 feet though technically, a few were not that high because of errors in early measurements. She pointed to Mt. Marcy, which is the highest peak in the Adirondacks and also in the state of New York.

The students were all admiring the view and how spectacular the mountains appeared as they ate their lunches. They all found a comfy spot to sit on Mt. Jo’s boulders.

In their science classes, the students had learned about the Theory of Plate Tectonics. As with all scientific theories, a tremendous amount of evidence supported this theory. The students were taught how Earth’s crust is divided into a number of plates that move on the layer called the mantle. As they move, they may collide. Denser plates sink under less dense plates, or can slide past one another, often rubbing. The motion of plates explains mountain building also known as orogeny, volcanic eruptions and earthquakes.

Mrs. Wilkins thought it was a good time to talk about mountain formation since they were sitting on the top of one of the smaller peaks in the Adirondacks and had a nice view of some of the higher peaks.

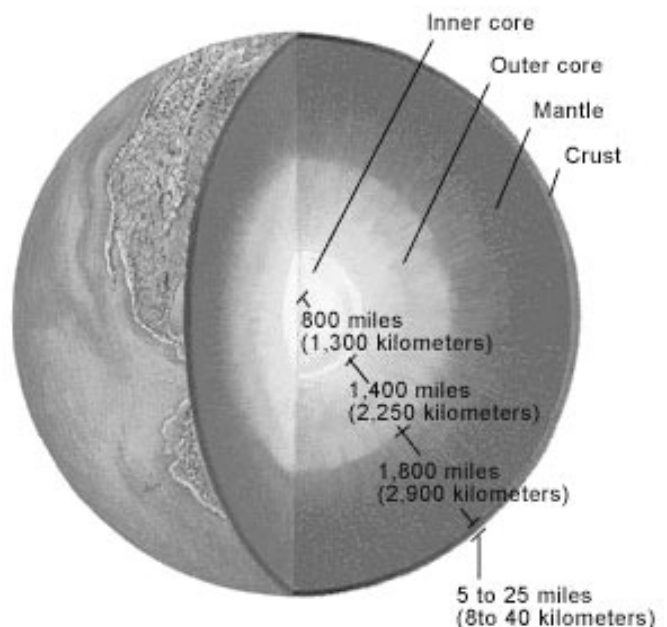
However, before Mrs. Wilkins could lead a discussion about plate tectonics, Marva said, “I bet the Adirondacks were formed by plate tectonics.”

“Glad you brought it up, Marva, because that is exactly what I wanted to discuss with all of you. There are different ways in which mountains can form due to the movement of tectonic plates. However, the bottom line for all mountain building is the crust of Earth must somehow get uplifted,” said Mrs. Wilkins.

“Except for volcanic mountains,” noted Winston.

“Yes, we should not forget the volcanic mountains we have in the world,” replied Mrs. Wilkins.

“Volcanic mountains form when molten rock or magma pushes through an opening in Earth’s crust.”



“Remember what Mrs. Wilkins said, ‘what we take in must go out’.” We do not want to pollute the Adirondacks with our trash,” Alba stated to her friends. Alba was also excited about the climb down because she wanted to collect some of the rocks. She loved to collect rocks and minerals and study them. However, she knew she was not to remove anything so she took pictures instead.

“Can we look for the very old rocks when we hike down?” asked Alba.

“Absolutely,” stated Mrs. Wilkins, pleased that the students had taken an interest in the geology of Mt. Jo.

“Always look down so you do not trip on rocks or roots,” Mrs. Wilkins reminded the students. She recalled a number of times she had slipped hiking the Adirondacks, which can be tricky because of the exposed roots and slippery rocks.

As they climbed down the steepest section of Mt. Jo, Alba found a rock with a number of bands in it. “Look, my rock is striped.”

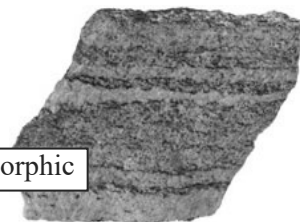
Nelson remembered looking at a rock like that in class. “That is a very nice gneiss rock,” he said with a smile. “No pun intended.” Mrs. Wilkins’ team stopped to look at the rock.

“Why is it striped?” Marva wondered.

“Isn’t that a metamorphic rock?” asked Nelson.

“Yes,” replied Mrs. Wilkins. “Most of the rocks in the Adirondacks are metamorphic.”

Gneiss, Metamorphic



“Metamorphic rocks are formed under extreme pressure,” stated Winston. “There must have been a lot of heat and pressure in the Adirondacks to have so many metamorphic rocks.”

“Very good, Winston. That’s what happens when tectonic plates move and mountains are formed,” said Mrs. Wilkins.

“Why are there bands in the rock?” asked Marva.

Mrs. Wilkins told them that gneiss rocks were placed under extraordinary heat and pressure causing them to behave like clay. This caused mineral grains to recrystallize and then segregate into bands due to differences in density, as can be seen in the gneiss rock. Marva was silent a moment and then said, “Just like the lab we did with liquid densities. The denser liquids sunk under the less dense ones.”

“Excellent, Marva, glad to know the labs we do in class are being applied in the field.”

Nelson picked up a rock near the creek. He noticed it was very weathered from being in the water.

“This looks like sandstone, which is a type of sedimentary rock.”

“That is the type of rock in which you can find fossils,” said Nelson.

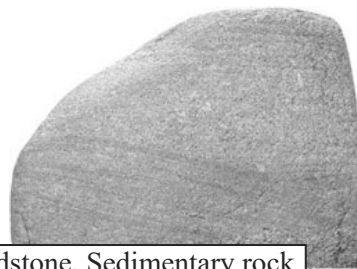
“Why can’t you find them in metamorphic rock?” asked Winston.

Alba and Marva listened in since they were interested in the answer.

“Isn’t sedimentary rock formed from weathered rock particles that get cemented together?” asked Alba.

Before Mrs. Wilkins could respond, Nelson replied, “Yes.”

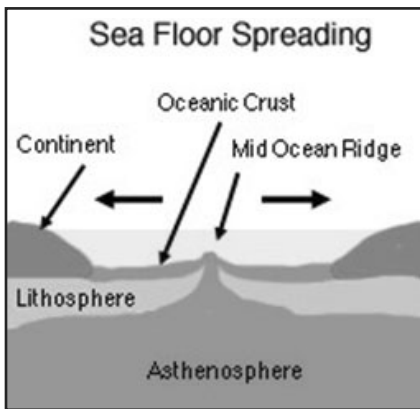
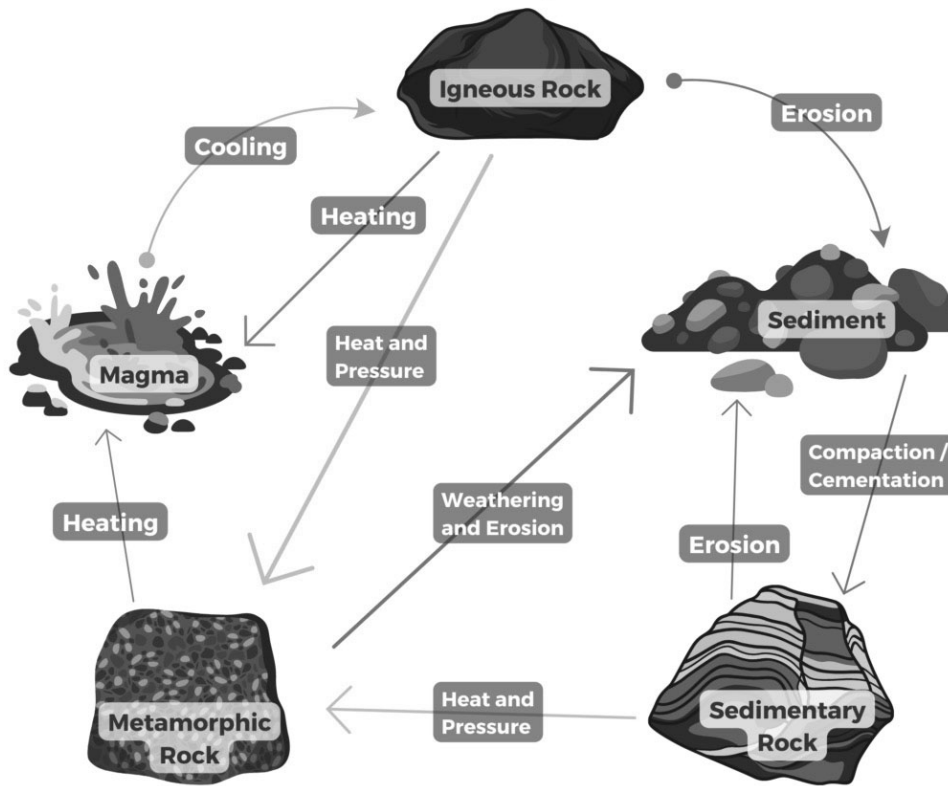
Sandstone, Sedimentary rock



Mrs. Wilkins was going to help out, but Nelson spoke before she could.

“Easy,” said Nelson, “Fossils would get destroyed under the Heat pressure that makes metamorphic rock. The fossil would distort in the hot rock.”

The Rock Cycle



“Yes,” replied Mrs. Wilkins, “One plate is moving under another plate in the Pacific Ocean. This activity is one of the reasons that area has a lot of volcanoes and earthquakes. In fact, the region is part of the ‘Ring of Fire’ because of this activity.”

“I can see the parking lot,” said Alba, a little sadly.

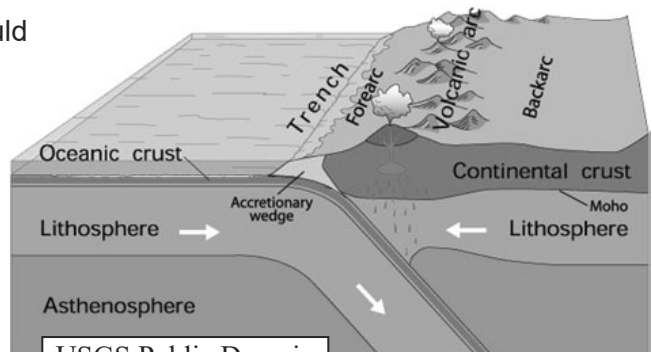
Mrs. Wilkins checked her watch. She instructed her group of students to board the bus and prepare for the ride back to school. “That was a lot of fun!” Alba said to Marva once they were on the bus. “We will have to try a few experiments with different rocks,” said Alba.

“We can see which type of rock weathers the fastest,” said Marva.

Winston and Nelson were figuring out how they could form a model of plate tectonics. They thought that could be a neat project for their science class.

“Suppose we took a large glass baking pan. We can place some water in it and cut up Styrofoam to represent the plates that make up Earth’s crust,” said Winston.

“How do we get them to move?” Nelson asked.



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Discussion Questions

1. How can a sedimentary rock change into an igneous or metamorphic rock?
2. Explain how the amount of water on Earth remains the same.
3. How are sedimentary, metamorphic and igneous rocks different from one another?
4. How do mountains form (orogeny)?
5. Why are very old rocks found in the Adirondacks?
6. What does plate tectonics have to do with mountain building?

Earth Shapes Up Science Vocabulary

1. **Bedrock:** The consolidated rock under weathered rock (soil).
2. **Condensation:** The process by which a gas changes into a liquid.
3. **Convection Currents:** Currents formed by differences in density in a liquid or gas & molten solids. It is one of the ways by which heat is transferred.
4. **Crust:** The outer solid layer of Earth.
5. **Crystals:** Matter with repeating, organized pattern to its structure.
6. **Debris:** In geology, fragments of rock left over from melting glaciers.
7. **Erosion:** The wearing down of solid earth by wind, water or other processes and its transport to other areas.
8. **Evaporate:** To turn from liquid into vapor.
9. **Fossils:** The remains of ancient living things such as bones, shells, casts or imprints in rock.
10. **Folded Mountain:** A mountain formed when two plates collide such as the Rocky Mountains.
11. **Geology:** The study of solid Earth and the processes by which it changes.
12. **Glacial Erratic:** A rock transported to another location by a glacier since it is not characteristic of the rock in that area.
13. **Glaciers:** A body of ice formed on land over centuries, originating from compressed, accumulated snow.
14. **Gneiss:** An example of a metamorphic rock characterized by mineral banding from heat/pressure.
15. **Granite:** An example of igneous rock often associated with mountain formation.
16. **Igneous Rock:** Rock formed from volcanic activity. It is melted rock that can cool quickly (obsidian or volcanic glass) or slowly (granite).
17. **Kettle Lakes:** Lakes formed as glaciers carve out a depression. When they fill with water, they are called kettle lakes.
18. **Magma:** Liquid or molten rock (semi-liquid).
19. **Mantle:** A semi-liquid layer of Earth under the Earth's crust.
20. **Metamorphic Rock:** Rock formed from heat and pressure without melting.
21. **Orogeny:** The process of mountain building.
22. **Plate Tectonics:** The theory that Earth is divided into a number of plates or sections that move over a semi-liquid layer of Earth.
23. **Plateau:** An uplifted relatively flat area of land. The Grand Canyon is a plateau carved out by the Colorado River, The Catskill Mountains in NYS is a plateau carved out by glaciers.
24. **Quartz:** a mineral composed of silicon and oxygen.
25. **Recycle:** The process by which something is converted to another use.
26. **Sandstone:** An example of sedimentary rock formed from small particles of sand.
27. **Sedimentary Rock:** Rock formed from sediments in water that stick together.
28. **Tectonic Dome Mountain:** A mountain formed by the uplifting movement of Earth's crust. It does not take place at a plate boundary, but results from the motion of the plates placing stress on the earth's crust.
29. **Water Cycle:** The movement of water on our planet through all of its natural phases: solid, liquid, and gas.
30. **Weathering:** The chemical or physical breakdown of solid Earth.

Next Generation Science Learning Standards Addressed in this Story

MS-ESS2: Earth's Systems

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

- Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches.

ESS2.A: Earth's Materials and Systems

- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and the matter that cycles produce chemical and physical changes in Earth's materials and living organisms.
- The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart.

ESS2.C: The Roles of Water in Earth's Surface Processes

- Water continually cycles among the land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.
- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.
- Global movements of water and its changes in form are propelled by sunlight and gravity.
- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.
- Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and creates underground formations.
- Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

Designing and Engineering Practices

- Developing and Using Models
- Planning and Carrying out investigations
- Analyzing and interpreting data
- Constructing explanations and designing solutions

Crosscutting Concepts

- Patterns
- Cause and Effect