Activity: Investigating the Chemistry under Your School

FOR THE TEACHER

Summary
In this activity, students investigate the earth chemistry under their school by examining what rocks or other materials are found there use geological maps. Students determine how the rocks are affected by surface conditions, like the weather.

Grade Level
High School

NGSS Alignment
This activity will help prepare your students to meet the performance expectations in the following standards:

- **HS-ESS1-6:** Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth’s formation and early history.
- **Scientific and Engineering Practices:**
  - Analyzing and Interpreting Data
  - Engaging in Argument from Evidence

Objectives
By the end of this activity, students should be able to:

- Read a geological map, collect and analyze related data.
- Determine the composition of rocks in their local area.
- Identify the level of weathering resistance for a particular rock type and its impact on landforms.

Chemistry Topics
This activity supports students’ understanding of:

- Earth Chemistry
- Elements
- Compounds
- Minerals
- Composition

Time
**Teacher Preparation:** 10 minutes
**Lesson:** ~45 minutes

Materials

- Computer with internet access
- Student Handout

Safety
- No specific safety precautions need to be observed for this activity.

Teacher Notes
- For more information about teaching Earth Chemistry in your chemistry classroom, read the associated Chemistry Solutions articles:

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FOR THE STUDENT
Lesson

Investigating the Chemistry under Your School

Background
We can study chemistry in the laboratory, but we can also take our studies outside because the earth is a large sphere of chemicals! This activity investigates the earth chemistry under your school by investigating what rocks or other materials are found there, using geologic maps. We can then look at how these materials are affected by surface conditions, like the weather, and then change to give you the landscape you see as you travel your community.

Instructions

**Part A:** What chemicals (rocks) are under and around your school? *Using either or both of the sources (1 and/or 2) below,* investigate the bedrock underneath the soil:

1. Access the National Map at the USGS website: [https://viewer.nationalmap.gov/advanced-viewer/](https://viewer.nationalmap.gov/advanced-viewer/)
   a. Zoom and pan until you find the area around your school. You can use the search box to input your school’s address, though you might need to zoom out some from that result so the basemap will appear.

<table>
<thead>
<tr>
<th>Important Tool Buttons</th>
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<tbody>
<tr>
<td>Add Data</td>
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   b. Click on the **Add Data** tool icon. A new window will open. You will see **Featured Data** in the upper left corner of the window. Click the down-arrow that appears next to it and select **ArcGIS Online**. Now, in the adjacent **Search** box, type "sgmc" without the quotes and click the magnifying glass.
c. In the search results, find "State Geologic Map Compilation – Geology", and click ADD. Close the Add Data window.

d. Now you can use the **Layer List** tool icon to turn the geology layer on or off. Also, you can use the options available in the ellipsis (the three dots at far right for that layer) to vary the transparency of the layer. On the map, you can click on a color and then the arrow (>) for the name and information about that rock unit.

*If you used source 1, record any chemicals (rocks) that you have discovered to be located under and around your school:*

2. Access mapView (this requires Flash) [https://ngmdb.usgs.gov/mapview/](https://ngmdb.usgs.gov/mapview/)
   a. Use a mouse wheel or tools at left to zoom in on your state. Maps drawn at different scales will be shown depending on what maps exist for a particular location.

<table>
<thead>
<tr>
<th>Important Tool Buttons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opacity</td>
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</table>

   b. Use the Opacity button at the right to temporarily dim the geology so you can see the basemap. Once you have zoomed in on your school area, use the Opacity button again to make the geologic map visible.

c. Click near your school and you will get a pop-up window for the map in this location. Choose **Browse** to view this map; some are large files and so take a moment to appear. The **Download** choice may also be another way to look at the map, and that window may provide more availability information.

d. You'll need to read the map in your area, probably noting the abbreviation/symbol and color of any rock unit of interest, then look for that symbol and color in the legend for the map.

*If you used source 2, record any chemicals (rocks) that you have discovered to be located under and around your school:*

**Part B:** What is the chemistry of the rocks found in your area? Compare the type of rock that you know to be in your area with the information provided in Table 1 to determine the chemistry of the rocks. Record your findings below:

Table 1, shows the chemistry of the major rock types that are composed of silicate minerals. Since it's impossible to list all the possible rock types, **use internet or library research** to determine if a rock you need is similar to one in the table, or you can find separate information on the composition of the rock you need.
The major rocks that are not silicates are *limestone* (a sedimentary rock) and *marble* (a metamorphic rock). Both of these are mainly composed of the mineral calcite, which is CaCO₃.

<table>
<thead>
<tr>
<th>Rock classes</th>
<th>Felsic rocks (contain K and Na)</th>
<th>Mafic rocks (contain Ca, Fe, Mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Igneous rocks</td>
<td>Granite, Rhyolite</td>
<td>Basalt, Gabbro</td>
</tr>
<tr>
<td></td>
<td>Diorite and Andesite are mixtures of felsic and mafic</td>
<td></td>
</tr>
<tr>
<td>Metamorphic rocks</td>
<td>Gneiss, Schist, Phyllite, Quartzite</td>
<td>Amphibolite, Metabasalt, Serpentinite</td>
</tr>
<tr>
<td>Sedimentary rocks</td>
<td>Conglomerate &amp; breccia, Sandstone, Siltstone, Shale &amp; mudstone, All unconsolidated sediments (&gt; not lithified into solid rock)</td>
<td>(Mafic minerals have usually weathered out of sediments that would become sedimentary rocks)</td>
</tr>
</tbody>
</table>

Table 1. Rocks made of *silicate* minerals. All contain silicon and oxygen, and usually aluminum.

**Part C:** How resistant to weathering are the chemicals (rocks) in your area? Use the information in Table 2 to determine the resistance of the rocks identified in your area. Record your findings below:

Table 2 shows qualitatively how resistant major rock types usually are compared to each other. There will be exceptions depending on particular rock compositions. Also, Table 2 is for areas with rain; limestone and marble are relatively resistant in dry areas.

<table>
<thead>
<tr>
<th>Rock class</th>
<th>Non-resistant</th>
<th>Moderately resistant</th>
<th>Resistant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Igneous</td>
<td>Rhyolite</td>
<td>Gabbro</td>
<td>Granite</td>
</tr>
<tr>
<td>Metamorphic</td>
<td>Marble</td>
<td>Schist, Slate</td>
<td>Gneiss, Quartzite</td>
</tr>
<tr>
<td>Sedimentary</td>
<td>Shale, Siltstone, Limestone, Conglomerate</td>
<td>Sandstone</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Comparative resistance to weathering for common rock types. The farther to the right a rock is in this table, the more resistant it is. Note: This is an approximate ordering, and there will be exceptions.

**Part D:** Can you find places where the rock resistance has made landform differences? Record your findings below:

If a resistant rock is adjacent to a less resistant rock in an area's geology, often the less-resistant rock will wear away faster and make land that is lower in elevation than the adjacent resistant rock. So, the landforms may be a result of the different chemistries of these rocks. You may be able to think of hills or mountains near your school, and can look at the maps to see if they are underlain by more resistant rocks.
To compare rocks and landforms:
1. In the resource in Part A, #1 above, you already looked at topographic contours to see landforms. But, you can also use the Basemap Gallery button to select other basemaps to help you see the landforms. There are also other layers that show elevations in the Layer List window.
2. In the resource in Part A, #2 above, you can also choose the "USGS Topo" basemap to see high and low areas. Then vary the map Opacity to see how the landforms and geology match. The geologic map for your area may also have elevation contour lines on that map.

In reality, there are many factors that influence landforms and so you might or might not find rocks that match the landforms. The path of streams and rivers can be influenced by factors that applied in the past and so not be clearly related to the rocks we see today; stream paths can also be random in areas of uniform rocks. The structure of the rock units, for example, whether they are folded or faulted can also be important.

In any case the geology of your area is its chemistry in the elements, minerals (compounds), and rocks (mixtures of minerals) found in your neighborhood. The landforms you travel over are often in part controlled by how the chemistry has reacted to the weather in a natural outdoor "experiment" that has likely been going on for a long time. So the chemistry of the earth is all around you wherever you go.

If you finish examining the geology of your local area, you can use the same geologic map sources to investigate other areas of the United States with distinctive landforms from the underlying geology/chemistry. You can select areas you have visited or state and national parks for places of interest. Especially if you are using map resource from Part A, #1 (The National Map), there are many other layers that can tell you a variety of things about any area you choose in the U.S.