Exploring Weathering and Sedimentary Processes with Google Street View

**Background**

If we had unlimited time and an unlimited budget for this course, we would take a trip across the country to see everything you are learning in real life. Unfortunately, this is an 8-week online class so we’re going to travel around virtually.

Google Street View merges 360o images with Google Maps so that you can get an immersive sense of a location you are exploring. Geology is always all around us, so we can use Google Street View to look at 360o images of the geologic features you’re learning about.

Learning Objectives:

* Identify sedimentary structures (e.g., cross-bedding and ripple marks) and explain what they tell us about past environments
* Identify examples of physical and chemical weathering

**Directions**

For each location below, be sure to explore the photo by: dragging your mouse around the 360o view around you, and using the scroll feature on your mouse to zoom in and out on specific parts of the image. Answer each question that accompanies the link.

Sedimentary Rocks and Structures

1. Visit [Palfrey’s Glen](https://www.google.com/maps/%4043.4188461%2C-89.6432419%2C3a%2C75y%2C307.78h%2C90t/data%3D%213m8%211e1%213m6%211sAF1QipNmTUEcGcDsfjxb7fAEI0LMVZ_um1M7ibs3g7rT%212e10%213e11%216shttps%3A//lh5.googleusercontent.com/p/AF1QipNmTUEcGcDsfjxb7fAEI0LMVZ_um1M7ibs3g7rT%3Dw203-h100-k-no-pi-0-ya323.86398-ro-0-fo100%217i8704%218i4352?hl=en) in Wisconsin. You should see layers of sedimentary rocks in a canyon. One of those sedimentary rocks is Sandstone. Based on the [Key to the Identification of Basic Sedimentary Rocks](https://csmgeo.csm.jmu.edu/geollab/Fichter/SedRx/basickey.html), what is the other type of sedimentary rock you can see in this location? (2pts)
2. The grain size of the sedimentary rock tells you about the energy of the environment. Water must move fast to carry pebbles and cobbles (see “grain size” column in the Scheme for Sedimentary Rock Identification). Therefore, a conglomerate must have been deposited (or dropped) quickly from fast moving water. Slower flowing water can deposit sand. Very slow moving or even still water can carry and deposit silt and clay.

So, the sedimentary rock we find tells us something about the environment at a particular location at a specific time when the rock formed. At this location we can see two types of sedimentary rock. It looks like there are multiple layers of each type, so the environment went back and forth.

Describe what environmental changes (e.g., changes in water flow) must have taken place for these two types of sedimentary rocks to form here in the past. (2pts)

1. Visit [Zion National Park](https://www.google.com/maps/%4037.3241667%2C-113.0591667%2C3a%2C81.6y%2C105.07h%2C65.37t/data%3D%213m8%211e1%213m6%211sAF1QipM-rDiNOuHkwlKRNG1kKcDYwNfrlUy8PDOv4sMk%212e10%213e11%216shttps%3A//lh5.googleusercontent.com/p/AF1QipM-rDiNOuHkwlKRNG1kKcDYwNfrlUy8PDOv4sMk%3Dw203-h100-k-no-pi-0-ya28.00001-ro-0-fo100%217i8192%218i4096?hl=en). In the light tan outcrop across from where the photo is being taken, you should notice a specific sedimentary structure that is discussed in the [Historical Geology: Sedimentary rocks and sedimentary structures video](https://www.youtube.com/watch?v=ZY8XNL4-mCE). Which structure can you see in the outcrop? (1pt)
	1. Ripple marks
	2. Mud cracks
	3. **Cross bedding**
2. Based on what you learned in the video and the Scheme for Sedimentary Rock Identification, what type of sedimentary rock to you think this is? (1pt)
	1. Conglomerate
	2. Breccia
	3. **Sandstone**
	4. Rock Gypsum
3. The rock that the photographer is standing on is very different from the light tan sedimentary rock across the way. It’s black with iron staining and contains tiny holes. Which of the following rock textures do you see? (1pt)
	1. Glassy
	2. **Vesicular**
	3. Crystalline
	4. Clastic
4. Based on the [Igneous Rock Classification Key](https://csmgeo.csm.jmu.edu/geollab/Fichter/IgnRx/IgnRx.html), which of the following igneous rocks is the photographer standing on? (1pt)
	1. **Basalt**
	2. Granite
	3. Gabbro
	4. Obsidian

Weathering

1. Visit [Apikuni Falls](https://www.google.com/maps/%4048.8142073%2C-113.6426379%2C3a%2C75y%2C286.09h%2C106.92t/data%3D%213m8%211e1%213m6%211sAF1QipNqEZumt7p5nGF-359uDH08edsiV2Pt1NEmRurQ%212e10%213e11%216shttps%3A//lh5.googleusercontent.com/p/AF1QipNqEZumt7p5nGF-359uDH08edsiV2Pt1NEmRurQ%3Dw203-h100-k-no-pi-30.000002-ya21.87502-ro-0-fo100%217i8704%218i4352?hl=en) in Glacier National Park. Some of these rocks has a white color, but they have an orange color where they are exposed to water from the waterfall. Which type of weathering is producing the orange colored rocks? (1pt)
	1. Hydrolysis
	2. **Oxidation**
	3. Exfoliation
	4. Frost wedging
2. Visit [Stone Foundation](https://www.google.com/maps/%4043.4197377%2C-89.6409395%2C3a%2C75y%2C239.08h%2C86.98t/data%3D%213m8%211e1%213m6%211sAF1QipMi1h4NuCG1pnoBIeSLEppDFGDSivdctpxRj6Il%212e10%213e11%216shttps%3A//lh5.googleusercontent.com/p/AF1QipMi1h4NuCG1pnoBIeSLEppDFGDSivdctpxRj6Il%3Dw203-h100-k-no-pi-0-ya234.04056-ro0-fo100%217i8704%218i4352?hl=en) in Wisconsin. There is evidence in this 360O photo for which type of weathering? (1pt)
	1. Hydrolysis
	2. Oxidation
	3. Exfoliation
	4. **Frost wedging**

1. Visit [Starved Rock State](https://www.google.com/maps/%4041.3141113%2C-88.9831187%2C3a%2C75y%2C176.52h%2C118.39t/data%3D%213m8%211e1%213m6%211sAF1QipO5vPT7dIHA8ZK6pJzyDEMud1HaULrHBWTdzwXX%212e10%213e11%216shttps%3A//lh5.googleusercontent.com/p/AF1QipO5vPT7dIHA8ZK6pJzyDEMud1HaULrHBWTdzwXX%3Dw203-h100-k-no-pi-0-ya4.6704226-ro-0-fo100%217i7168%218i3584?hl=en) Park in Illinois. What type of weathering you see in this 360O photo? (2pts)
2. Support your claim about the weathering in Starved Rock State Park with evidence you observe in the 360O photo. (2pts)
3. *Differential weathering* means that some rocks breakdown more easily than others. For example, in [this picture](https://upload.wikimedia.org/wikipedia/commons/1/18/Igneous_%28dolerite%29_compound_dyke_-_geograph.org.uk_-_44623.jpg) of a dolerite dike, you see a dark igneous rock forming a prominent low wall extending into the ocean. It sticks out above the beach sediment on either side of it (mostly sand) because the sand has formed from rocks that weathered away more easily. We consider the dolerite dike *more resistant* to weathering, because it resists weathering.

Differential weathering in an outcropping of rock can produce dramatic landscapes. If a rock weathers easily, it will break down easily making gentle slopes. If a rock resists weathering, it will make steep cliffs. Visit [Monument Valley](https://www.google.com/maps/%4037.0080155%2C-110.1880364%2C3a%2C90y%2C304.6h%2C85.92t/data%3D%213m8%211e1%213m6%211sAF1QipPAABHveLP_NZYyuXecNQ7yrcPXESv24W8ttQ_b%212e10%213e11%216shttps%3A//lh5.googleusercontent.com/p/AF1QipPAABHveLP_NZYyuXecNQ7yrcPXESv24W8ttQ_b%3Dw203-h100-k-no-pi0-ya298.5-ro-0-fo100%217i7168%218i3584?hl=en) in Arizona. Notice that the towers of rock are more resistant to weathering, while the gentle sided slopes at the bottom of the towers weather more easily.

Now visit [LaSalle Canyon](https://www.google.com/maps/%4041.3112419%2C-88.9713519%2C3a%2C75y%2C191.56h%2C124.57t/data%3D%213m8%211e1%213m6%211sAF1QipPkWMYHeekeU7rAeY_kkuOxuepbjf2KTu0hqYaT%212e10%213e11%216shttps%3A//lh5.googleusercontent.com/p/AF1QipPkWMYHeekeU7rAeY_kkuOxuepbjf2KTu0hqYaT%3Dw203-h100-k-no-pi-0-ya213.14394-ro-0-fo100%217i4000%218i2000?hl=en) at Starved Rock State Park in Illinois. The evidence of differential erosion less obvious. Describe where in the LaSalle Canyon you see resistant or easily weathered layers. What evidence can you observe of differential weathering? (2pts)

1. One type of physical weathering not covered in the videos is *abrasion*. A scratch on your skin or eye is called an abrasion and an “abrasive” person is someone that grates on your nerves. So, this form of weathering is just like it sounds. When sand or silt is picked up by water or wind and bumps into other rocks, it can round off the edges, making things smooth.

River rocks are rounded because they roll around in rivers, bumping into one another and chipping off their rough edges. Sand carried by river water acts like sandpaper, smoothing the surface of the rocks. For example, see this photograph of [rounded pebbles](https://upload.wikimedia.org/wikipedia/commons/b/bf/Round_pebble_pattern_%28Unsplash%29.jpg).

Abrasion also happens as a result of wind carrying sand. Visit [Devil’s Garden](https://www.google.com/maps/%4037.584938%2C-111.4150391%2C3a%2C31.9y%2C346.11h%2C103.01t/data%3D%213m8%211e1%213m6%211sAF1QipP2QvImI2OYMpjJKeF9cLj14MekeQBwr43U12cq%212e10%213e11%216shttps%3A//lh5.googleusercontent.com/p/AF1QipP2QvImI2OYMpjJKeF9cLj14MekeQBwr43U12cq%3Dw203-h100-k-no-pi-0-ya22.487963-ro-0-fo100%217i10240%218i5120?hl=en) in Grand Staircase – Escalante National Monument in Utah. The towers of rock are called *hoodoos.* How are Devil’s garden hoodoos an example of differential weathering? Provide evidence from your observations of the 360O photo. (2pts)

1. What evidence is there in the 360O photo of Devil’s Garden that the hoodoos and other rock outcrops were weathered by abrasion? (2pts)