

Geology Merit Badge Requirements at Devils Lake

1. Define geology. Discuss how geologists learn about rock formations. In geology, explain why the study of the present is important to understanding the past.

Study of the earth and its history, or, more precisely, "The science, which studies the earth, the rocks of which it is composed, and the changes it has undergone, or is undergoing." The present is a product of earth history. The history is contained within the rocks that lie like tattered remnants of an ancient scroll. Geologists are historians who must know the "present" in order to restore these fragments, like a detective, and pierce through time to understand the past.

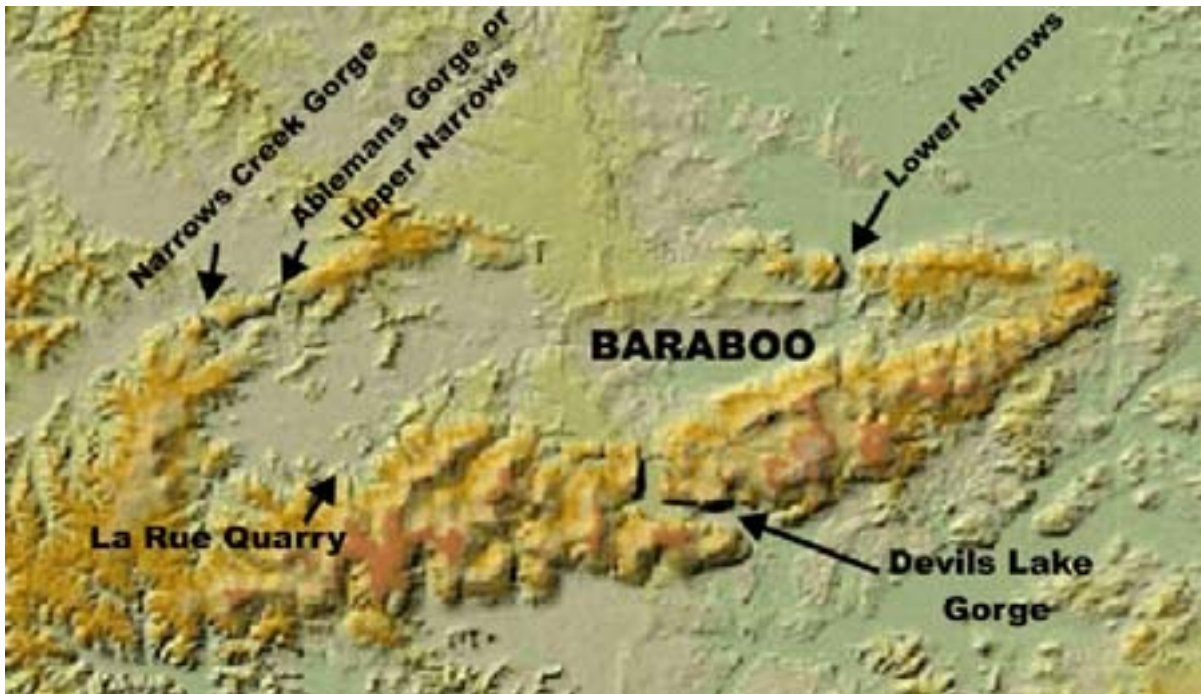
2. Pick three resources that can be extracted or mined from Earth for commercial use. Discuss with your counselor how each product is discovered and processed.

The first two resources are pre-selected as they relate directly to the geology of the Devils Lake area. Choose your own resource #3. Hint: Complete requirement #3 first to become more familiar with the Devils Lake/Baraboo geology.

Resource #1:	Baraboo Quartzite (see pages 2-9 of Baraboo Syncline Aerial Photos handout)
How mined/extracted:	
Discovered/Processed:	
Resource #2:	Glacial Till/Gravel (see page 24 of Baraboo Syncline Aerial Photos handout)
How mined/extracted:	
Discovered/Processed:	
Resource #3:	
How mined/extracted:	
Discovered/Processed:	

3. Review a geologic map of your area with your counselor and discuss the different rock types and estimated ages of rocks represented. Determine whether the rocks are horizontal, folded, or faulted, and explain how you arrived at your conclusion.

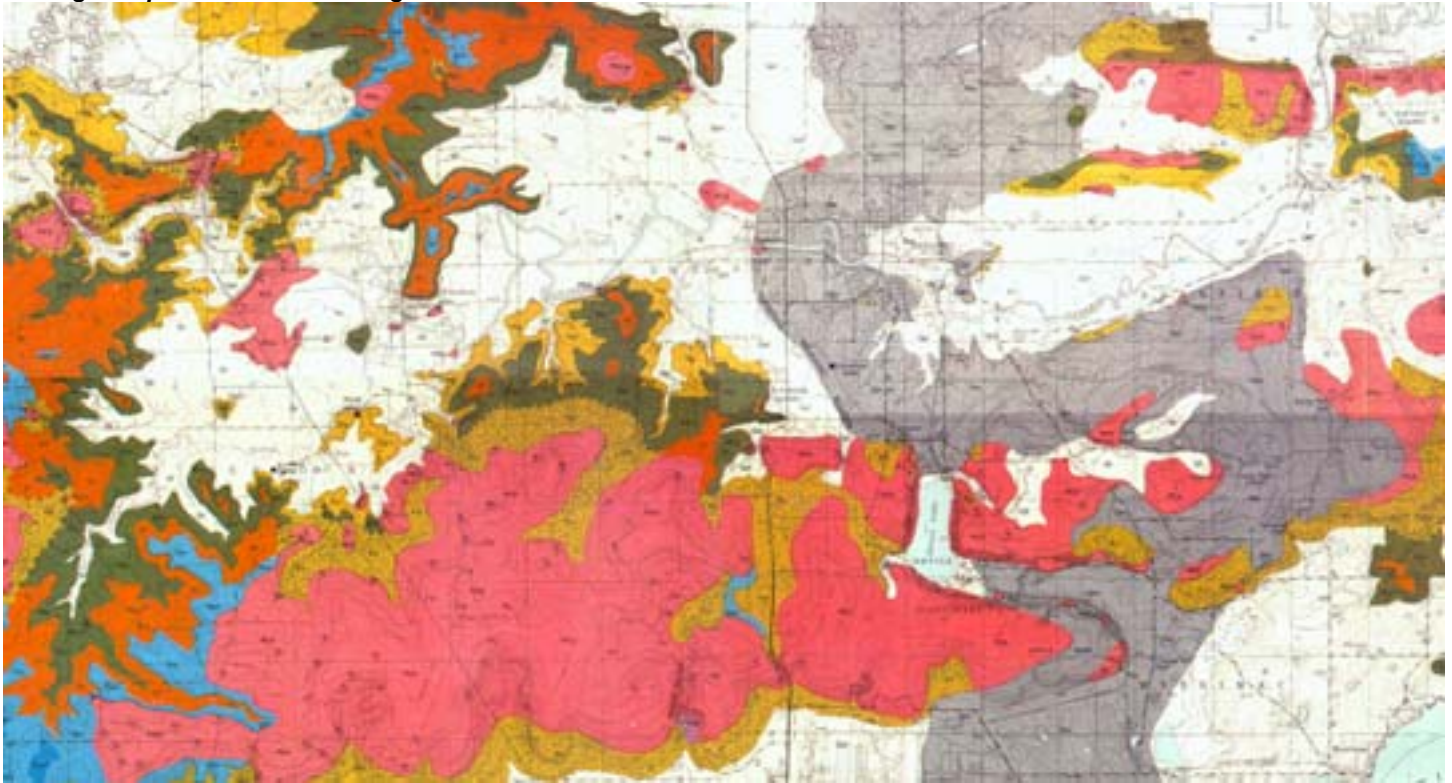
Start by looking at the digital terrain model of the Baraboo area below. Devils Lake is in the "L" shaped valley south of Baraboo. The origin of the Devils Lake landscape is threefold:



- The Baraboo Hills were created by differential erosion. The Baraboo Hills were once completely buried under a layer of soft sandstone. Over the past few million years, the soft sandstone has eroded away, but the tough quartzite has stood its ground. This is why the quartzite sticks out as an 800 foot high ridge.
- An ancient river cut a notch, or valley, into the quartzite ridge at least 520 million years ago. This "L" shaped valley clearly shows up on both the topographical and geological maps of Devils Lake.
- During the last ice age, the Wisconsin glacier stopped right at Devils Lake. One arm of the ice blocked one end of the "L" shaped valley and another arm of the ice blocked the other end of the valley. When the ice melted away, it dropped a large amount of sand, gravel and boulders to create natural earthen dams at both ends of the valley. These natural dams created Devils Lake.

The geologic maps of this same area on the following pages will help you see how geologists represent the bedrock formations and interpret the history that caused their shape and form.

Geologic Map of the Baraboo Range



The above map of the Baraboo Range, which includes Devils Lake (lower right), shows how geologic maps overlay bedrock structure onto a topographic map. The map displays three geologic attributes that help you understand and “read” the bedrock formations.

First, it uses colors to separate the different types of bedrock formations by geologic time. So sandstone from two different times in the earth’s history would be represented by two different colors on the map, even though both formations are the same material. The formations are separated by thin solid lines when the exact location between the formations is visible. And by dotted or dashed lines when it’s underground and can’t be seen, but is inferred. (Thick solid lines on geologic maps indicate faults or cracks in the bedrock. But there are no such faults around Devils Lake.)

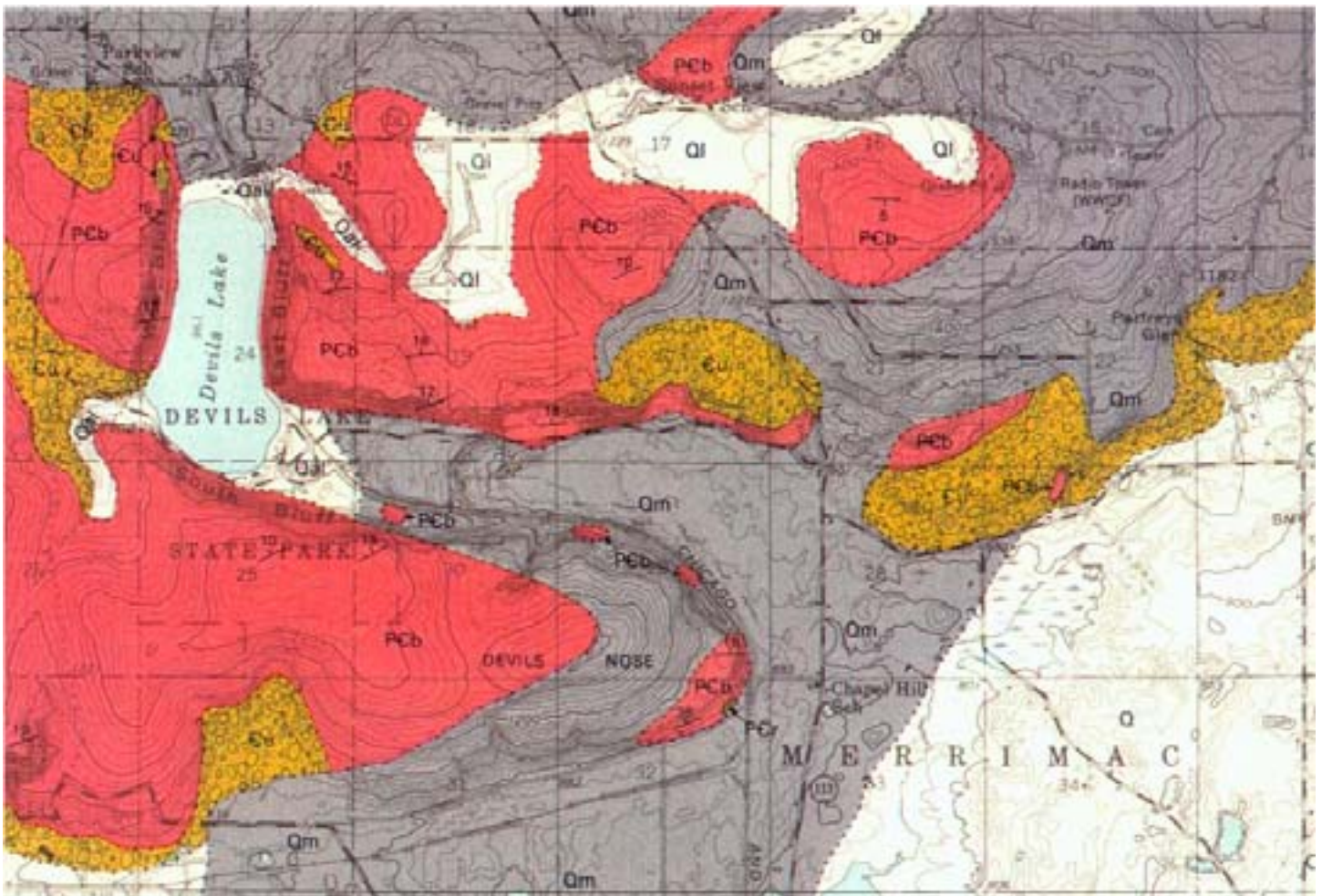
Second, the map also indicates when the bedrock was formed and what material it’s made from by letters. The capital letters indicate the time and the small case letters the type of material. For example, notice the pink formation labeled “PCb.” The “PC” indicates the formation was formed during the Precambrian Eon; and the “b” stands for Baraboo Quartzite. (see Geologic Time Scale at right or the larger Web Geological Time Machine handout.) Bedrock formations are often named after the location where they were first discovered and described, hence Baraboo Quartzite. Likewise, the yellow formation labeled “Cu” is Cambrian Sandstone. (Unfortunately, I do not have an entire key for the map. I will try to locate one or a better map later.)

Third, there are flat “T” symbols with a nearby number scattered throughout the formations. These symbols indicate “Strike,” “Dip” and “Angle.” This information allows you to interpret the direction or orientation of the bedrock formation if it’s no longer horizontal or level. The two major formation types are “Anticlines” and “Synclines.” The Baraboo Range is actually a huge syncline formation. The flat quartzite bent into a huge “U” or canoe shape 1.5 billion years ago when two ancient land masses collided and the center buckled downward. An anticline is shaped more like an “A” when the middle buckles up. I use the “A” shape, the first letter in the word anticline, as a way to remember which is which. The large pink area at the bottom of the map is the southern end on the syncline; the bedrock then dives down northward under the city of Baraboo and rises again north of the city.

GEOLOGIC TIME SCALE					
EON	ERA	PERIOD	EPOCH	Present	
Phanerozoic	Cenozoic	Quaternary	Holocene	0.01	
			Pleistocene	1.6	
		Tertiary	Neogene	Pliocene	5.3
				Miocene	23.7
				Oligocene	36.6
			Paleogene	Eocene	57.8
				Paleocene	66.4
				Cretaceous	144
	Mesozoic	Jurassic	208		
		Triassic	245		
		Paleozoic	Carboniferous	Permian	286
				Pennsylvanian	320
			Mississippian	360	
			Devonian	408	
Silurian	438				
Ordovician	505				
Precambrian	Proterozoic	Cambrian	570		
		Archean	2500		
		Hadean	3800		
				4550	

Age in millions of years before present

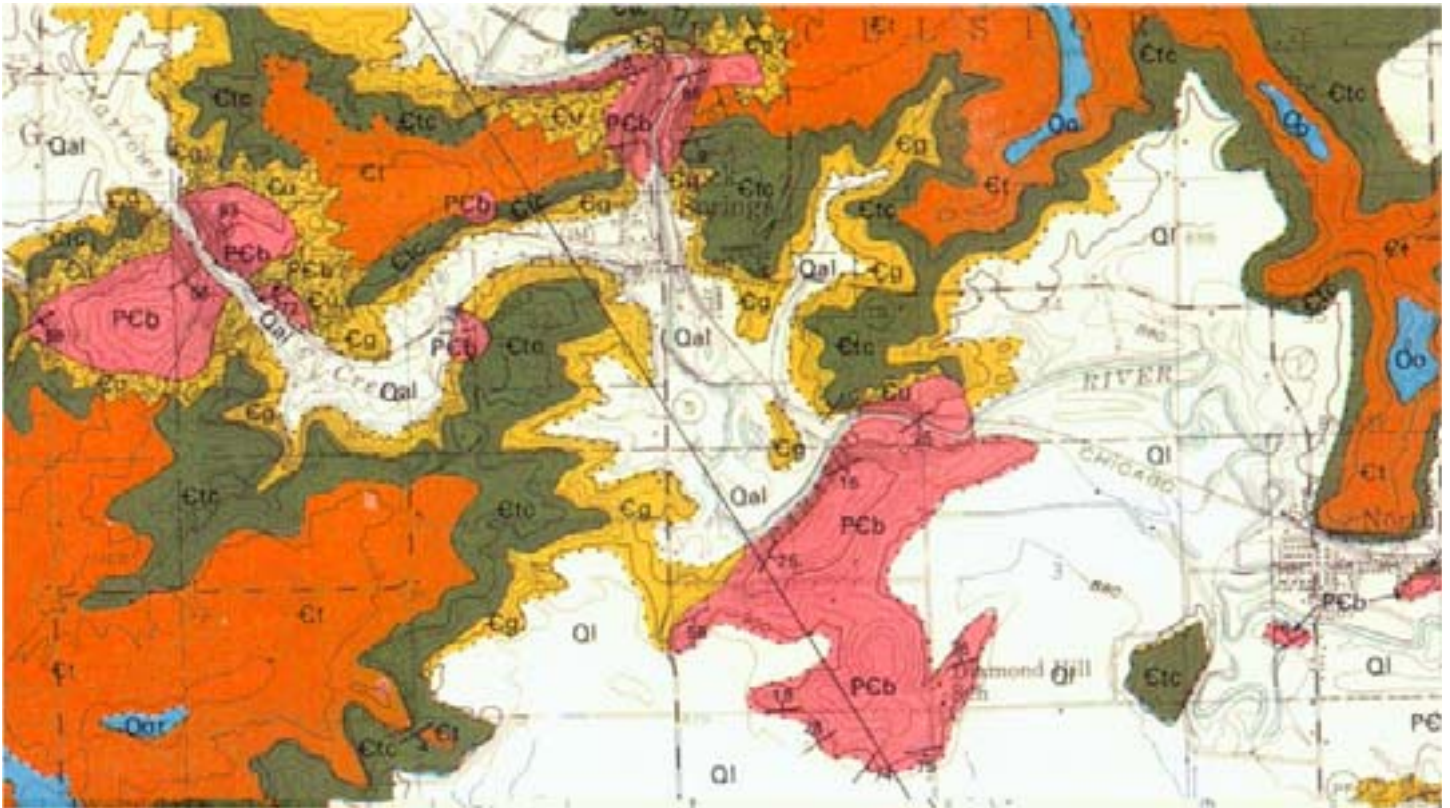
Geologic Map of Devils Lake, Baraboo Range, Baraboo, WI



Identify three bedrock formations on the above geologic map of Devils Lake. (This map and the two on the following page are close ups extracted from the larger map on the previous page.)

Pink labeled PCb	
Gold labeled Cu	
Grey labeled Qm	
Describe the orientation of the “Strike,” the direction of the “Dip,” and the “Angle” of the dip from the “T” shaped symbol just below the “South Bluff” on the above map (North is towards the top).	

Geologic Map of the Upper Narrows, Baraboo Range, Baraboo, WI

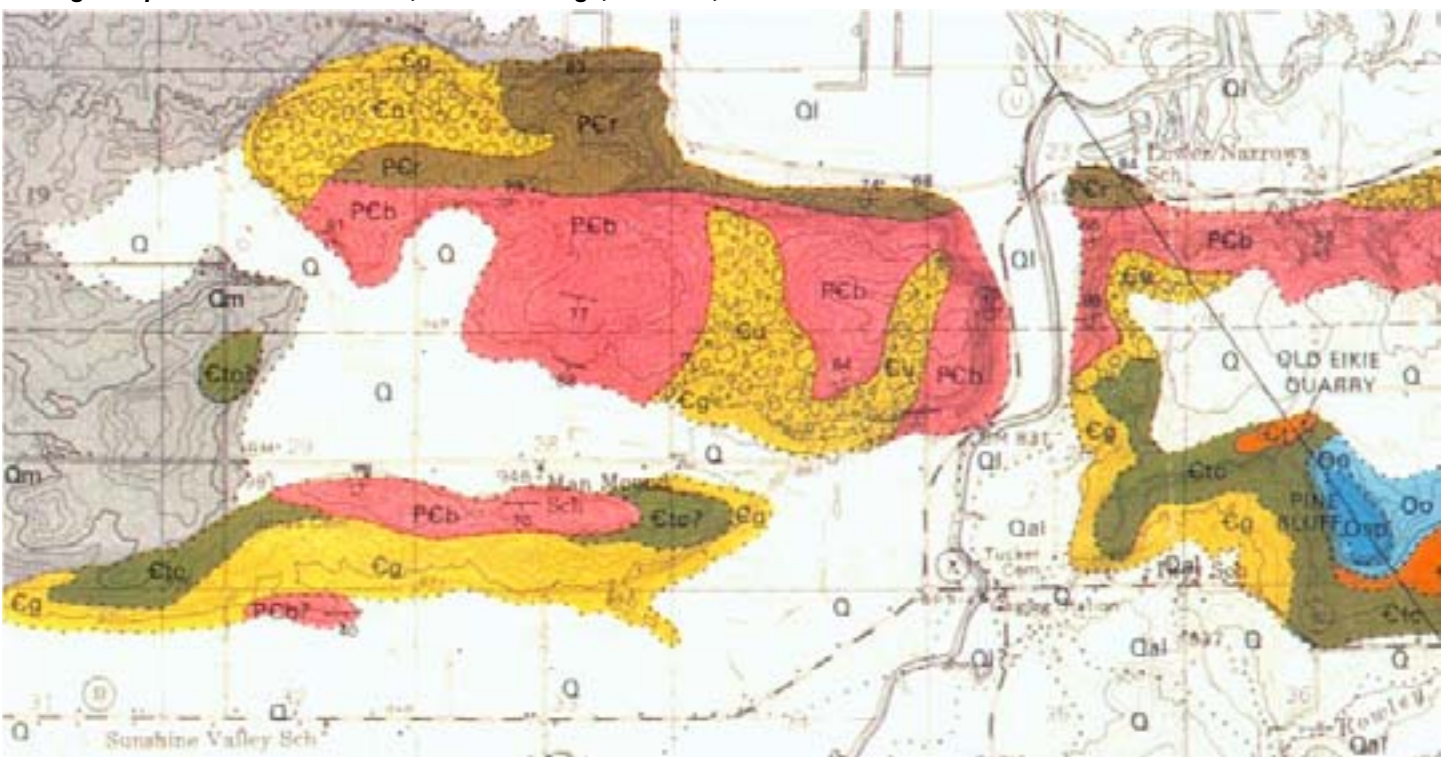


Describe the same properties from one of the symbols in the pink bedrock by Narrows Creek (upper left) on the above map and again for the Lower Narrows from the map below.

Narrows Creek:

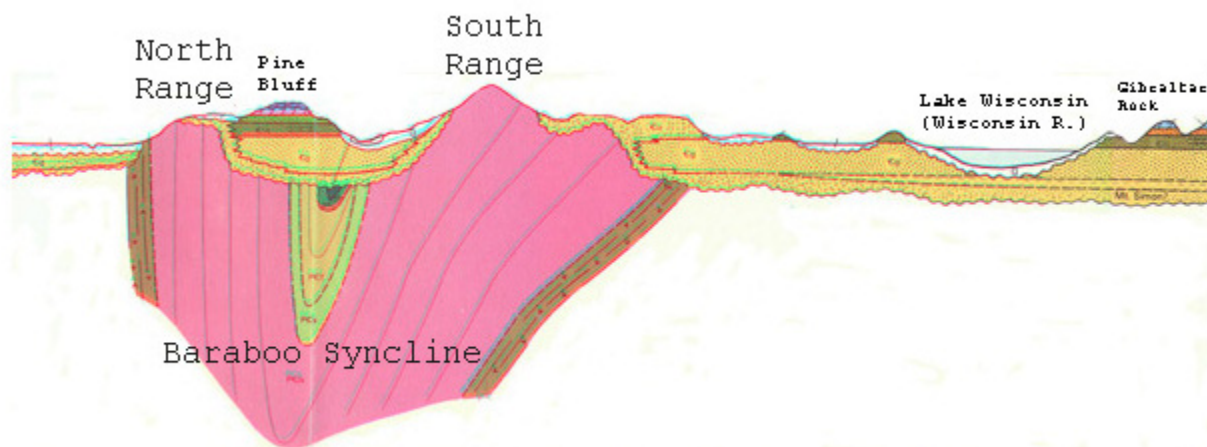
Upper Narrows:

Geologic Map of the Lower Narrows, Baraboo Range, Baraboo, WI



Find these areas on the full map on page 5 and explain how the geologic map symbols help you see the Baraboo Syncline. The cross section diagram below may help you visualize the syncline. How would they be different if the quartzite had buckled upwards in the middle instead, forming an anticline?

Cross Section of the Baraboo Syncline, Baraboo Range, Baraboo, WI



We will see evidence of the Baraboo syncline. I will show the scouts an example of tilted bedding planes in the quartzite. We can mention strike and dip at this point. We will see what happened to the quartzite bedrock when Illinois slammed into Wisconsin 1.5 billion years ago and how this collision folded the quartzite.

4. Do ONE of the following:

b. Learn about the career opportunities available in geology. Pick one that interests you and explain how to prepare for such a career. Discuss what courses might be useful for such a career. You may use resources found on the Internet (with your parent's permission), at the library, in books and articles from periodicals, from television programs, and at school.

5. Complete ONE of the options listed below A, B, C, or D.

We are working on option C as it best fits the use of Devils Lake to complete the requirements.

C. Mineral Resources Option

1. Define rock. Discuss the three classes of rocks including their origin and characteristics.

A naturally formed aggregate or mass of mineral matter constituting an appreciable and essential part of the earth's crust.

- **IGNEOUS:** a hard aggregate of interlocking mineral crystals formed from the cooling and solidification of a hot liquid material called magma. The crystals composing the igneous rock can be either large (slow cooling) or small (rapid cooling). Typical minerals in igneous rocks are feldspar, quartz, pyroxene, olivine and amphibole.
- **SEDIMENTARY:** Rocks formed by the accumulation of sediment in water (aqueous deposits) or from air (eolian deposits). The sediment may consist of rock fragments or particles of various sizes (conglomerate, sandstone and shale); of the remains or products of animals or plants (certain limestones and coal); or the product of chemical action or evaporation (salt, gypsum), or of mixtures of these materials. Some sedimentary rocks are composed of fragments blown in from volcanoes and deposited on land or in water. A characteristic of sedimentary rocks is a layered structure known as bedding or stratification. Sedimentary rocks are deposited flat or nearly flat.
- **METAMORPHIC:** Metamorphism (from the Greek for "changed form") is the process by which metamorphic rocks are generated. It involves the mineralogical and textural reordering of preexisting rocks within the earth's crust. These changes are caused by increases in temperature, pressure or chemical environment that occur at depths greater than roughly one kilometer. Most low temperature metamorphic rocks break along flat surfaces called schistosity planes. Slate is metamorphosed shale. Slates will split along flat, closely spaced surfaces. As the level of heating and pressure increases, minerals begin to segregate into distinct bands (phyllites, schists and gneises). This is called a foliated texture. The minerals in metamorphic rocks change with increasing temperatures and pressures.

Examples will be pointed out and discussed on the tour.

2. Define mineral. Discuss the origin of minerals and their chemical composition and identification properties, including hardness, specific gravity, color, streak, cleavage, luster, and crystal form.

A naturally occurring crystalline solid having a definite chemical composition and usually a characteristic crystal form. Minerals consist of highly ordered geometric arrangements of atoms. The outward crystal shape is a reflection of the ordered arrangement of the atoms inside the crystal. Glass differs from minerals in that the atoms in glass are not ordered. The most common rock-forming minerals are quartz, feldspar, mica, amphibole, olivine, calcite and pyroxene. Minerals can be identified by their crystal shape, chemical composition, optical properties, or physical properties. Common physical properties used to identify minerals are hardness, specific gravity, color, streak, cleavage, luster and crystal form.

- **HARDNESS:** Mineral hardness is classified on a scale of 1 to 10, where 1 is the mineral talc and 10 is diamond. A process of elimination is used to zero in on the hardness of an unknown mineral by attempting to scratch minerals of known hardness. If a mineral can be scratched by diamond, it has a hardness less than 10. If the same mineral can scratch quartz, it has a hardness greater than 7. You need a fairly large mineral sample in order to determine hardness.
- **SPECIFIC GRAVITY:** Specific gravity is the ratio of the mass of a mineral to the mass of an equal volume of water. Specific gravity is a measure of the density of a mineral. If you have four mineral samples of equal size, the heaviest sample is the one with the highest specific gravity. Specific gravity is related to the atomic weight of the atoms inside the mineral and how tightly packed those atoms are inside the mineral. Some minerals have only one characteristic specific gravity. Others exhibit a range of specific gravities.
- **COLOR:** Color is not the best way to identify a mineral since many minerals exhibit a wide range of colors depending upon their precise composition, and impurities within the mineral. Also, many minerals can have the same, nondescript color. Use this characteristic with caution.
- **STREAK:** Streak is the color left behind after rubbing a mineral sample across a porcelain plate. The color of the powdered mineral left behind is called the streak color. This color can be used to help classify some minerals. For example, the mineral sphalerite has a reddish-brown streak.
- **CLEAVAGE:** Cleavage is the characteristic way a mineral specimen breaks when struck with a hard object. Cleavage occurs because many minerals break along certain planes of atoms within the crystal structure. Some minerals do not have cleavage planes and tend to break along an irregular surface. Quartz is an example of a mineral with no cleavage planes. Other minerals can have one, or more, cleavage planes. Table salt is a common mineral that has three perpendicular cleavage surfaces that cause it to break into block-like fragments. Cleavage is one of the most important properties for identifying common minerals.
- **LUSTER:** Luster is the character of light reflected from the surface of a mineral. Examples are greasy, metallic, shiny, glassy, dull, waxy, etc. Luster is a useful characteristic for identifying minerals.
- **CRYSTAL FORM:** Crystal form is the physical shape of a mineral specimen. Many minerals exhibit complex geometric shapes that are directly related to their orderly internal arrangement of atoms. Most minerals grow in a crowded environment where they compete with other minerals for space. For this reason, the crystal form is distorted or destroyed. Crystal form is generally not helpful in identifying minerals in the field.

Note: many mineral samples cannot be identified without the help of special microscopes or laboratory tests. The five most common minerals can be identified in the field with a little practice. Will be discussed briefly on the tour

3. Do ONE of the following:

- a. Collect 10 different rocks or minerals. Record in a notebook where you obtained (found, bought, traded) each one. Label each specimen, identify its class and origin, determine its chemical composition, and list its physical properties. Share your collection with your counselor.
- b. With your counselor's assistance, identify 15 different rocks and minerals. List the name of each specimen, tell whether it is a rock or mineral, and give the name of its class (if it is a rock) or list its identifying physical properties (if it is a mineral).

Collection may include specimens from the Devils Lake area but not from within the park itself as law prohibits that.

4. List three of the most common road building materials used in your area. Explain how each material is produced and how each is used in road building.

Material #1:	
Produced:	
Used:	
Material #2:	
Produced:	
Used:	
Material #3:	
Produced:	
Used:	

5. Do ONE of the following activities:

b. With your counselor, choose two examples of rocks and two examples of minerals. Discuss the mining of these materials and describe how each is used by society.

Use the Industrial Minerals Uses handout to pick two minerals. Chose new materials not used to meet an earlier requirement.

Rock #1:	
Mined:	
Use:	
Rock #2:	
Mined:	
Use:	
Mineral #1:	
Mined:	
Use:	
Mineral #2:	
Mined:	
Use:	