

Geology Merit Badge Workbook



Please **PRINT** the information requested below:

Scout name: _____

Troop: _____

Town where troop is located: _____

Council: _____

Developed by Dr. Vince Cronin (Professor, Geology Department, Baylor University), incorporating the current requirements for the merit badge as of September, 2008

Vince_Cronin@baylor.edu
http://www.baylor.edu/Vince_Cronin/GeologyMB

For answers to some frequently asked questions about geology and science, go to
<http://www.baylor.edu/Geology/index.php?id=26719>

<http://www.scouting.org/BoyScouts/AdvancementandAwards/MeritBadges/mb-GEOL.aspx>

Geology MB Requirement Completion Record

	complete	incomplete
Requirement 1	_____	_____
Requirement 2	_____	_____
Requirement 3	_____	_____
Requirement 4b	_____	_____
Requirement 5C(1)	_____	_____
Requirement 5C(2)	_____	_____
Requirement 5C(3b)	_____	_____
Requirement 5C(4)	_____	_____
Requirement 5C(5b)	_____	_____

Counselor: Dr. Vince Cronin, Troop 308, Waco, Texas
Longhorn Council, BSA

Revised October 10, 2008

Requirement 1.

Write or print your response legibly.

Define *geology*.

Discuss how geologists learn about rock formations.

In geology, explain why the study of the *present* is important to understanding the *past*.

Requirement 2.

Write or print your response legibly.

Pick three resources that can be extracted or mined from Earth for commercial use. (We will discuss water, petroleum and copper.)
How is fresh water discovered and processed?

How is petroleum (oil and natural gas) discovered and processed?
<http://science.howstuffworks.com/oil-refining.htm>

How is copper discovered and processed?

Requirement 3.

Write or print your response legibly.

Review a geologic map of your area with your counselor and discuss the different rock types and estimated ages of rocks represented.

We will look at the Waco East and West geologic quadrangle maps by J.M. Burket (1963).

Formations	Period & Stage	Age (Myr)
Recent alluvium and river terraces	Quaternary	_____
Taylor Marl	Cretaceous, mid-Gulfian	_____
Austin Chalk	Cretaceous, mid-Gulfian	_____
South Bosque Formation	Cretaceous, early Gulfian	_____
Lake Waco Formation	Cretaceous, early Gulfian	_____
Pepper Shale/Woodbine	Cretaceous, earliest Gulfian	_____
Buda Limestone	Cretaceous, late Comanchean	_____
Del Rio Clay	Cretaceous, late Comanchean	_____

Determine whether the rocks [at or near the ground surface] are horizontal, folded, or faulted, and explain how you arrived at your conclusion.

Geologic Time Scale of Gradstein and others (2004)

Eon	Era	System	Age Range (Myr)
Phanerozoic	Cenozoic	(Quaternary	2.6 to today)
		Neogene	23.03 to today
	Paleogene	65.5 to 23.03	
Mesozoic	Cretaceous	Jurassic	145.5 to 65.5
		Triassic	199.6 to 145.5
		251.0 to 199.6	
Paleozoic	Permian	Carboniferous	299.0 to 251.0
		Devonian	359.2 to 299.0
		Silurian	416.0 to 359.2
		Ordovician	443.7 to 416.0
		Cambrian	488.3 to 443.7
542.0 to 488.3			
Proterozoic			2500 to 542.0
Archean			4000 to 2500
Hadean			~4650 to 4000

From the International Commission on Stratigraphy
<http://www.stratigraphy.org/>

Gradstein, F.M., Ogg, J.G., and Smith, A.G., Agterberg, F.P., Bleeker, W., Cooper, R.A., Davydov, V., Gibbard, P., Hinnov, L.A., House, M.R., Lourens, L., Luterbacher, H.P., McArthur, J., Melchin, M.J., Robb, L.J., Shergold, J., Villeneuve, M., Wardlaw, B.R., Ali, J., Brinkhuis, H., Hilgen, F.J., Hooker, J., Howarth, R.J., Knoll, A.H., Laskar, J., Monechi, S., Plumb, K.A., Powell, J., Raffi, I., Röhl, U., Sadler, P., Sanfilippo, A., Schmitz, B., Shackleton, N.J., Shields, G.A., Strauss, H., Van Dam, J., van Kolfschoten, T., Veizer, J., and Wilson, D., 2004. A Geologic Time Scale 2004. Cambridge University Press, 589 pages.

General Notes about the Cretaceous in Texas

Middle Gulfian will be considered approximately the same as *Santonian* (83.5 to 85.8 Myr) or *Coniacian* (85.8 to 89.3 Myr) stages

Early Gulfian will be considered approximately the same as the *Turonian* stage (89.3 to 93.5 Myr)

Earliest Gulfian will be considered approximately the same as the *Cenomanian* stage (93.5 to 99.6 Myr)

Upper Comanchean will be considered approximately the same as the *Albian* stage (112 to 99.2 Myr)

Requirement 4.

Write or print your response legibly.

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 necessary for such a career

*For more information about careers in geology, go to
<http://www.agiweb.org/workforce/brochure.html>
http://www.baylor.edu/Geology/pdfs/geology_as_a_career.pdf
<http://www.earthscienceworld.org/careers/>
<http://www.agiweb.org/careers>

Requirement 5.

Write or print your response legibly.

C. Mineral Resources Option

1. What is *rock*?

Discuss the primary classes of rock, including their origin and characteristics.

a. **Sedimentary** rock forms (how) _____

Examples of clastic rock: _____

Examples of carbonate rock: _____

Examples of evaporite rock: _____

b. **Igneous** rock forms (how) _____

Intrusive igneous rock forms (where): _____

Extrusive igneous rock forms (where): _____

Examples of intrusive rock: _____

Examples of extrusive rock: _____

c. **Metamorphic** rock forms (how) _____

Examples of metamorphic rock: _____

2. What is a *mineral*?

How do minerals form? _____

What is the *chemical composition* of some important minerals:

quartz _____ calcite _____

K-feldspar _____ apatite _____

graphite _____ diamond _____

How do you measure the *hardness* of a mineral using the Mohs hardness scale? _____

What is a mineral's *specific gravity*, and how do you measure it?

Do all minerals have their own distinctive *color*?

What is a mineral's *streak*? _____

What is a mineral's *cleavage*? _____

What is a mineral's *luster*, and what are some of the terms used to describe a mineral's luster? A mineral's luster is _____

Some terms use to describe a mineral's luster include _____

3. 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 if it is a rock, give the name of its type (sedimentary, igneous, metamorphic, hydrothermal) or, if it is a mineral, list its identifying physical properties.

Spec #	Name	Rock/Mineral	Type or properties
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Minerals

Name	Color	Growth shape	Cleavage/fracture	Hardness	Other...
<i>biotite</i>	black	flat sheets	1 plane, forming thin flexible sheets	?	mica mineral
<i>calcite</i>	variable or colorless	pointy or pencil-shaped prisms	3 planes, squashed box	3	fizzes in acid
<i>gypsum</i>	clear to white	flat plates	1 dominant direction	2	soft
<i>halite</i>	clear to white	cubes	3 planes, at right angles	?	tastes salty
<i>feldspar</i>	salmon pink to white	boxy crystals	2 planes, at ~90°	?	very common
<i>muscovite</i>	clear to silvery	flat sheets	1 plane, forming thin flexible sheets	?	mica mineral
<i>quartz</i>	variable or colorless	pointy ended prisms	breaks like glass	7	very common

Sedimentary Rocks

Name	Grain size	Description
<i>conglomerate</i>	>2 mm diameter	This is gravel cemented and compressed together to form rock.
<i>sandstone</i>	feels gritty, <2 mm	This is sand cemented and compressed together to form rock.
<i>siltstone</i>	too fine to feel grit	This is silt cemented and compressed together to form rock.
<i>shale</i>	too fine to feel grit	This is mud cemented and compressed together to form a soft rock. The plate-like clay minerals are rotated to be nearly parallel to each other due to stress, so the rock has a layering called fissility.
<i>limestone</i>	variable	This is a carbonate sedimentary rock with grains composed mostly of calcite. It fizzes in acid, and may have fossils.
<i>chalk</i>	very fine	This is a carbonate sedimentary rock with grains composed mostly of calcite. It fizzes in acid, and is composed of tiny coccolith microfossils.

Igneous Rocks

Name	Grain size	Description
<i>basalt</i>	mostly very small grains	Dark gray to black, commonly with gas-formed bubbles and sometimes with larger green (olivine) crystals; volcanic.
<i>rhyolite</i>	mostly very small grains	White to pink to purple, often with larger white or black crystals embedded in the fine-grained matrix; volcanic.
<i>granite</i>	most grains >3 mm	“Salt-and-pepper” rock with white and black minerals, commonly with pink potassium feldspar (K-feldspar); intrusive.

Is it a mineral?

Yes. What is its color?

- White to clear (translucent or transparent)
It may be *quartz*, *calcite*, *gypsum*, *halite* or *muscovite*
- Dark to black
It may be *biotite*, which splits into very thin, flexible sheets
- Pinkish
It may be potassium *feldspar* (K-feldspar)

What is its shape?

- Flat sheets
It may be a mica mineral (black *biotite* or clear *muscovite*) or it may be *gypsum*, which is softer than your fingernail
- Cube or rectangular solid
It may be *halite*, which tastes salty, or it may be *galena*, which is silver-metallic and heavy
- A squashed box (rhombohedron)
It is probably *calcite*, which fizzes in acid
- Pencil-shaped prism with a pointy end
It may be *quartz*, which breaks like glass and is quite hard, or it may be *calcite*, which fizzes in acid

No. Is it a sedimentary rock?

Yes. Does it fizz in acid?

Yes. It may be a *limestone* (a harder rock) or *chalk* (a softer rock)

No. What is the dominant grain size in the specimen?

Gravel-size (>2 mm). It is a *conglomerate*.

Sand-size (gritty feel but <2 mm). It is a *sandstone*.

Mud-size (too small to feel gritty). It may be a *shale* if it parts in roughly parallel surfaces (if it displays fissility), or it may be a *siltstone*, claystone or mudstone if it is more massive.

No. Is it an igneous rock?

Yes. Are most of its grains relatively large (>3 mm)?

Yes. It may be an intrusive igneous rock like a *granite*, which has grains that are white, black, gray and commonly pink.

No. It may be an extrusive (volcanic) igneous rock like a *rhyolite* (light pinkish, purple, cream color) or *basalt* (dark, often with gas bubbles)

No. It is probably a metamorphic rock.

Metamorphic Rocks

Name	Grain size	Description
<i>marble</i>	variable	usually white and fizzes in acid
<i>slate</i>	very small	black, dark gray, green, red; breaks in parallel planes
<i>schist</i>	medium to coarse	layered (foliated) rock that is shiny because of minerals like muscovite or biotite that reflect light.
<i>gneiss</i>	>2 mm	Looks like a layered granite; layers generally form alternating light and dark bands that may be folded.

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.

a. sand

b. gravel

c. asphalt

5. Choose two examples of rocks and two examples of minerals. Discuss the mining of these materials and describe how each is used by society.

a. magnetite

b. galena

c. coal

d. granite

Online Resources, from MeritBadge.org

Use any Internet resource with caution and only with your parent's or guardian's permission.

Boy Scouts of America: scouting.org

Boy Scout Merit Badge Workbooks: usscouts.org -or- meritbadge.org

Merit Badge Books: www.scoutstuff.org

American Association of Petroleum Geologists: <http://www.aapg.org>

American Geological Institute: <http://www.agiweb.org>

American Petroleum Institute: <http://www.api.org>

The Geological Society of America: <http://www.geosociety.org>

Paleontological Research Institute: <http://www.priweb.org>

Society of Exploration Geophysicists: <http://www.seg.org>

U.S. Geological Survey: <http://www.usgs.gov>

Iron refining <http://www.wisegeek.com/how-is-iron-refined-from-ore.htm>

Minerals <http://www.minerals.net/index.html>

<http://www.webmineral.com/>