$4.00

4-H Geology
Member Guide

OREGON STATE UNIVERSITY
EXTENSION SERVICE

4-H 340
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Contents

4-H Geology Project

Geology (Geo, Geos = the earth) is a science that deals with the history of the earth and its life as recorded in the rocks. Geology utilizes the principles of physics, chemistry, astronomy, zoology, botany, and others in its studies. There are many specialties or fields of study in geology, such as:

- Structural geology—the form, arrangement, and internal structure of rocks
- Physical geology—causes and processes of geological change
- Historical geology—time-arranged account of the events of the earth's past
- Mineralogy—study of the earth's chemical compounds
- Paleontology—study of life forms through fossils
- Economic geology—study of earth materials of commercial value
- and many others

Many geologists are involved in more than one of the specialties.

4-H Geologists go on hikes and field trips to study land forms and the rocks, minerals, and gem stones. They learn about the animals, plants, and weather. Using the *4-H Earth Science Leaders Guide for Grades 4–9*, learners will explore many aspects of geology.

To become a 4-H Geologist, you must be interested in the earth, its rocks and land forms, and the natural things in the outdoors. You must agree to attend 4-H meetings, cooperate with your club leader and the other members of your club, and do your best to complete your project.

Project Recommendations

1. Collect, identify, and label at least 10 rocks or minerals in your first year in this project. A minimum of five new specimens should be added each year.
2. Make at least two field trips to study land formations, rocks, minerals.
3. Describe a land form, such as a hill, canyon, cliff, valley, or lake, seen on each field trip. Explain how you think it was formed.
4. Describe rocks, minerals, soils, or other rock materials found on each field trip. Tell as much about them as you can—how they were formed and how they got where you found them.
5. Learn as much as you can about other natural resources seen on your field trip.
6. Visit a lapidary shop or museum to see a collection of rocks and minerals. Visit a mine or a cement, pumice, brick, or other mineral processing plant. Tell about what you saw.
7. Read an article, story, or chapter from a book on rocks, minerals, or geology and report to your club.
8. Advance as far as possible in the 4-H Geology Advancement Program.
9. Complete a 4-H Geology Record Sheet each year.

Books on Geology

Peterson's Field Guide to Rocks and Minerals, Frederick H. Pough, Houghton-Mifflin, 1997

Rocks and Minerals, Zim and Shaffer, 1989

Peterson's First Guide to Rocks and Minerals, Frederick H. Pough, Houghton Mifflin, 1991

National Audubon Society Field Guide to North American Rocks and Minerals, Charles Wesley Chesterman, 1979

National Audubon Society Field Guide to Fossils, Ida Thompson, Carol Nehring, 1982

Field Collecting Gemstones and Minerals, John Sinkankas, Geoscience Press, 1995

Hiking Oregon's Geology, Ellen Morris Bishop, John Eliot Allen, The Mountaineers, 1997

Roadside Geology of Oregon, David D. Alt, Donald W. Hyndman, Mountain Press, 1998

Geology of Oregon, Fourth Edition, Elizabeth Orr, William Orr, Ewart M. Baldwin, Kendall Hunt Publishing Co., 1992

Oregon State Parks, A Complete Recreation Guide, Jan Bannan, The Mountaineers, 1993

Trip Planning

Plan trips carefully to ensure safety. Always carry water and a first aid kit. Be informed on current road and weather conditions. Refer to 4-H Tours (4-H 0254L) and Guidelines for 4-H Nature Hikes (4-H 3000L) for assistance in planning trips.

Equipment Needed

- ☐ Alert eyes and an interested mind. Train yourself to pay attention to details, to see things and ask questions.
- ☐ Carrying bag (a cloth or canvas bag or knapsack) to carry rock specimens
- ☐ Cloth squares, newspapers, or small paper bags to protect specimens
- ☐ Hammer (a prospector's pick, geology pick, or mason's hammer with a flat face) for breaking rocks
- ☐ Gloves to protect your hands
- ☐ Pocket knife to test hardness of specimens
- ☐ Glasses or safety goggles to protect your eyes from flying fragments when breaking rocks. Do not allow your friends to stand too close if they do not have glasses.
- ☐ Hand lens with 6x to 12x power
- ☐ Labels. All specimens should be labeled as they are collected. Masking tape works very well.

- ☐ Waterproof pencil or felt-tip pen to write labels
- ☐ Notebook and pencil. As each specimen is collected, record its number and the place found, date, and other information about it in your notebook.
- ☐ Compass
- ☐ US Geological Survey's 7.5' quadrangle map for each area to be visited

Activities for 4-H Geologists

Presentations

A presentation is showing and explaining how to do or make something, by yourself or with one teammate. Preparing for a presentation is a good way to learn and develop your skills.

Some good topics for geology presentations include: how to label and store specimens, how to prepare a rock or mineral display, or how to use diagrams to illustrate geologic formations. A presentation could be developed with a slide show of one of your field trips. Refer to the additional options listed in the 4-H Geology Advancement Program in this booklet.

Exhibits and Educational Displays

4-H exhibits are an important part of the 4-H Geology project. You can learn a great deal while preparing an exhibit.

4-H Geology exhibits for 4-H fairs must meet the following qualifications. (Displays for store windows, school displays, meetings, and other uses need not be limited by these requirements.)

All 4-H exhibits should be labeled as follows:

Name	Grade
Class #	Year in 4-H Geology
Club	Box_____ of_____
Club Leader	County

If the exhibit is in a box to be opened for display, two labels will be needed—one on the outside and one on the inside. If the exhibit has more than one box, each should be labeled.

Educational displays about topics in earth science or geology should be attractive, interesting, and informative. For 4-H fairs, the maximum size is 24 inches deep (front to back), 30 inches wide, and 36 inches high.

Rock and Mineral Collection Exhibits

A collection may include rocks, minerals, ores, gems, rock materials (sand, clay, soil), and fossils. At least 50 percent of the specimens must have been found by the exhibitor. The others may have been purchased or obtained by trading.

At least five of the specimens must have been acquired during the current year.

Specimens should be 1 to 2 inches long and 1/2 to 1 inch thick and reasonably uniform in size.

Granular or fragmental items, or items such as sand, silt, clay, volcanic ash, gems, etc., may be displayed in small vials or bottles.

The number of specimens must be within these limitations:

- Class 1—Juniors (grades 4, 5, 6)—10 to 20 specimens
- Class 2—Intermediates (grades 7, 8, 9)—15 to 35 specimens
- Class 3—Seniors (grades 10, 11, 12)—20 to 55 specimens

Exhibit cases shall be flat and not larger than necessary to display the specimens. Two or more smaller cases may be easier to handle and store than one large case. The case should not overshadow the collection. Polystyrene foam may be used to assist in positioning specimens. They need not be glued down. If glue is used, use a water soluble white glue so it will not show.

Each specimen shall be numbered, and the label will be numbered and include the minimum information as follows:

Number, name, or kind Where found Collected by*, Date	6. Basalt Rimrock near Gateway Jim Jones, 6/16/92

* name of person who found the specimen (or write in "traded for," "gift," or "purchased") and date obtained.

Intermediates and seniors will be expected to include additional information, such as the classification of rocks, composition of rocks and minerals, chemical formula of minerals, geologic formation (Astoria Sandstone or Columbia River Basalt), era, period or epoch (from Geologic Time Chart), and other interesting and useful information. Examples:

2. Basalt Igneous Columbia River Basalt Miocene Epoch Bluff at Oregon City Sally Smith, 4/14/92	7. Anadara (fossil shell) Astoria Formation Miocene Epoch Beverly Beach, Lincoln Co. Traded for, 8/2/91	12. Slate Metamorphic Jurassic period Rogue River west of Grants Pass Purchased, 8/2/91

Basis for Scoring a Rock and Mineral Collection Exhibit

It is the responsibility of the 4-H exhibitor to ensure that:

- The required number of specimens are presented for the class. Five acquired this year and at least 50 percent of these to be found by the exhibitor.
- The specimens are clean, bright, reasonably uniform in size, and show identifying characteristics typical of the rock or mineral.
- There is a good variety of specimens, including a good representation of those available in the local community.

- The specimens are correctly and completely identified. Identify all minerals in sample (except for rock types). Identify ores, classify rocks.
- The specimen labels are complete, accurate, neat, and legible, with correct spelling. Intermediate and senior members are expected to include more than the minimum information about specimens.
- The exhibit is neat and attractive, with specimens logically arranged.
- The display case is well done and properly sized.

Identification Contests

Geology identification contests are fun and will help you learn the common rocks and minerals of Oregon and important rocks and minerals from other areas. You should learn the class and name of rocks and the group and name for minerals. Spelling is important. Contests can be done in a variety of ways, between individuals, choose up sides in the club, or have contests with other clubs. A suggested scoring method is as follows:

Scoring	**Sample Score**			
5 points for correct name and class or group	Basalt	igneous		5
3 points for correct name only	Basalt			3
2 points for correct class or group only		igneous		2
1 point off for each misspelled word	Basolt	igenous	(-2)	3
0 points for incorrect names, illegible writing, or left blank				0

Identification of Rocks and Minerals

A mineral is a naturally occurring, non-organic substance that has a more or less definite chemical composition and a uniform structure or organization of the elements making up the mineral. A rock is a variable, random mixture of minerals. One mineral can be a rock. However, usually two or more minerals are mixed together by various natural processes to form a rock.

The following list includes rocks and minerals that are important to know. They have been divided into two suggested study categories: (1) junior, and (2) intermediate and senior.

Rocks (class)	**Junior**	**Intermediate and Senior**
Igneous	Basalt, Granite, Obsidian, Pumice	Andesite, Gabbro, Pegmatite, Scoria, Tuff
Sedimentary	Limestone, Sandstone, Siltstone	Breccia, Conglomerate Shale
Metamorphic	Marble, Serpentine, Schist	Gneiss, Slate, Quartzite

Continued on next page

Minerals (group)	Junior	Intermediate and Senior
Carbonates	Calcite	Dolomite
Feldspars	Orthoclase, Microcline	Albite, Labradorite
Ferro-Magnesian	Augite Silicates	Hornblende
Garnets	Almandite	Grossularite
Micas	Muscovite	Biotite
Oxides	Magnetite	Hematite, Limonite
Quartz	Agate, Petrified Wood, Quartz	Chalcedony, Chert, Jasper, Opal
Sulphates	Barite	
Sulphides	Galena, Pyrite	Chalcopyrite, Cinnabar, Sphalerite

The following list of physical properties of minerals provides information that will help you identify individual minerals. Information on these properties is listed in most rock and mineral books.

Physical Properties of Minerals

Cleavage is the tendency of certain minerals to split in definite directions, yielding smooth, plane surfaces known as a cleavage surface. In mica, for example, the cleavage is in a single plane; in quartz, cleavage is absent. A cleavage surface may be very small or it may be quite large. A cleavage surface may represent a crystal face.

Fracture refers to the character of a surface produced when a mineral is broken in any direction other than along a cleavage plane. Fracture may be described as even, uneven, rough, splintery, conchoidal (shell like), hackly, blocky, prismatic, fibrous, etc.

Hardness. Some minerals are harder than others. This provides one means of identification. One method of comparing hardnesses of minerals is by a scratch test. A numbered series called Mohs scale of hardness has been worked out to test mineral hardness by resistance to scratching. Mohs scale is listed on the next page. Test the minerals you have collected with this hardness test. Make sure you have scratched and not just left a powder trace.

Specific gravity is the ratio of the weight of a substance to the weight of an equal volume of water. It is expressed by a number. Water has a specific gravity of 1. Most of the common rock-forming minerals have a specific gravity ranging from 2.5 to 4. With practice, you can make fairly good estimates of specific gravity by "hefting" mineral specimens of known specific gravity and comparing them with unknowns.

Luster refers to the appearance of a surface when viewed under reflected light. Varieties of luster are vitreous (glassy), pearly, greasy, metallic, earthy, resinous, adamantine (brilliant, like a diamond), etc. To obtain the proper luster of a mineral, the surface examined must be a relatively fresh one.

Color is an aid in the identification of some minerals. In many cases, however, color is not a distinguishing characteristic because many miner-

als exhibit many different colors. The color should always be noted, however.

Streak is the color of the mark made by some minerals when scratched on a hard, white surface such as unglazed earthenware (streak plate). Streak is the color of a mineral's powder left on the streak plate. Many minerals give no distinct streak. This is especially true of most minerals harder than the knife, and of light-colored minerals.

Special properties such as opacity, taste, magnetism, etc., sometimes aid in the determination of a mineral.

Reaction with acid is a chemical test that identifies a few minerals. Calcite, for example, effervesces freely when cold hydrochloric acid is applied, while dolomite effervesces freely only when hot acid is applied.

In the Table of Minerals, minerals are organized into their chemical groups (oxides, carbonates, etc.), and properties important in identification are noted. You might want to make charts containting similar information for the minerals you have that do not appear on the Table of Minerals.

Index	Mineral	Test
1	Talc	Easily scratched with fingernail. Soft, greasy.
2	Gypsum	Just scratched by the fingernail. Not greasy or soft. Fingernail = 2.5
3	Calcite	Very easily scratched by a knife. Just scratched by a sharp edge of copper, such as that of a new penny. Penny = 3.5
4	Fluorite	Easily scratched by a knife but not hard enough to scratch glass.
5	Apatite	Can be scratched with a knife but with some difficulty. (Most ordinary glass will have a hardness somewhere between 5 and 6.) Knife blade = 5.5
6	Feldspar	Not scratched by a knife. Scratches common window or bottle with difficulty.
6.5	Microcline	Not scratched by a knife. Scratches common window or bottle glass easily. Can be scratched with a file. Steel file = 6.5
7	Quartz	Scratches both a knife and glass easily. Harder than any other common substance.
8	Topaz	Scratches quartz easily. Much harder than any common material.
9	Corundum	Scratches topaz and compares with sapphire.
10	Diamond	Scratches topaz and corundum easily. Hardest substance known.

GENERALIZED GEOLOGIC TIME CHART FOR OREGON

ERA	PERIOD	EPOCH	PRINCIPAL GEOLOGIC EVENTS	AGE* (in millions of years)
CENOZOIC	QUATERNARY	HOLOCENE	Glaciers in mountains receding. Crater Lake and Newberry Crater formed by explosion and collapse of volcanic cones. Lava flows near Mt. Hood, at McKenzie Pass, and in central and southeastern Oregon.	.011
		PLEISTOCENE	Active glaciers in mountains. Growth of large volcanoes along crest of Cascades and in central Oregon. Pluvial lakes in south-central part of State. Mastodons and giant beavers in Willamette Valley; camels and horses in grasslands of central and eastern Oregon.	2-3
	TERTIARY	PLIOCENE	First eruptions of lava at crest of Cascade Range. Extensive outpouring of lava in south-central Oregon. Horses, rhinos, camels, antelope, bear, mastodons living in John Day country. Cascade Range high enough to form climate barrier. Drier climate east of High Cascade Range. Warm temperate climate west of Cascades initiates period of laterization.	12
		MIOCENE	Thick layers of lava extruded over much of State (middle and upper Miocene). Seas invade coastal areas; mollusks, fish, whales, sea lions. Oreodonts, rodents, 3-toed horses, giant pigs, rhinos, tiny camels, wolves, and saber-tooth cats living in John Day country. Mild, humid climate with extensive forests of Metasequoia. Last emplacement of granitic plutons in the State (Cascade Range) with accompanying mineralization. Coast Range begins uplift. Cascade Range growing in height.	26
		OLIGOCENE	Willamette Valley and parts of Coast Range covered by warm, shallow seas. Inhabited by abundant and varied mollusks. Warm temperate flora growing in both eastern and western Oregon, with Metasequoia, maple, sycamore, ginkgo, and katsura trees plentiful. Three-toed horses, camels, giant pigs, saber-toothed cats, oreodonts, tapirs in John Day country. Cascade Range too low to affect climate of eastern Oregon.	37-38
		EOCENE	A subtropical climate. Coal forming in coastal swamps. Palms, figs, avocados, pecans, and walnuts grow in central Oregon. Four-toed horses, rhinos, tapirs, crocodiles in Clarno area. Western Oregon covered by arm of ocean, locally many mollusks. Large volcanoes in area of Cascade Range.	53-54
		PALEOCENE	Not mapped separately in Oregon, but rocks of this age known in southern Coast Range.	65
MESOZOIC	CRETACEOUS		Most of State covered by warm seas. Ammonites, trigonia, and other mollusks, abundant in Medford and Mitchell areas. Tree ferns growing near Austin in Grant County. Formation of principal metalliferous deposits in State following batholithic intrusions.	136
	JURASSIC		Oregon largely covered by seas. Brachiopods, mollusks, and ammonites abundant. Some marine reptiles. Ferns, cycads, ginkgoes, and conifers growing on land areas. Period of serpentine intrusion with formation of chromite deposits followed by granitic intrusions in Klamath Mountains, Blue Mountains, and possibly Wallowa Mountains.	190-195
	TRIASSIC		Most of Oregon covered by warm seas. Sponges, corals, ammonites, gastropods, and nautiloids. Volcanoes active and widespread especially in northeastern and southwestern Oregon.	225
PALEOZOIC	PERMIAN		Warm seas cover much of State. Limestone reefs forming. Fusilinids common. Volcanism in northeastern part of State. Rocks now exposed in central and eastern Oregon.	280
	CARBONIFEROUS		Much of State covered by warm seas containing brachiopods and corals. Ferns and calamites growing on land areas. Rocks now exposed in Suplee area of central Oregon.	345
	DEVONIAN		Seas probably covered Oregon. Small limestone outcrops in central Oregon contain Middle Devonian corals (about 370 m.y.).	395
	PRE-DEVONIAN		"Pre-Devonian" includes the vast stretch of geologic time extending back to the oldest rocks found on the earth. Rocks of this age are not known in Oregon. Nearest "pre-Devonian" rocks (450 m.y. old gabbro) in Klamath Mountains, northern California.	

* Adapted from U.S. Geol. Survey

TABLE OF MINERALS

Oxides

Mineral	*Chem. Comp.*	*H.*	*G.*	*Cleavage*	*Color*	*Luster*	*Other Properties*	*Remarks*
QUARTZ	SiO_2	7	2.6	none	colorless	vitreous	sometimes in 6-sided crystals	One of the most important rock-forming minerals. Color due to impurities. Distinguished from feldspars by wet appearance.
MILKY QUARTZ	"	"	"	"	white	greasy		
CHALCEDONY	"	"	"	"	gray or milky	waxy	not crystalline; fracture conchoidal	Formed in cavities in rocks.
CHERT	"	"	"	"	white to black	earthy	not crystalline; fracture conchoidal	Found in limestones.
JASPER	"	"	"	"	red	waxy	not crystalline; fracture conchoidal	
HEMATITE	Fe_2O_3	5.5–6.5	5	"	steel-gray; red; black	metallic or earthy	dark red streak	Principal source of iron.
MAGNETITE	Fe_3O_4	5.5–6.5	"	"	black	metallic	black streak; magnetic	High-grade iron ore mineral.
LIMONITE	$2\ Fe_2O_3\ 3\ H_2O$	5–5.5	4	"	yellow-brown to black	earthy to metallic	yellowish-brown streak	Often called bog-iron ore. Earthly varieties quite soft.

Sulphides

PYRITE	FeS_2	6	5	none	brass-yellow	metallic	black streak	Called "fool's gold." Occurs in cubic crystals or in granular masses.
GALENA	PbS	2.5	7.5	perfect in 3 directions at right angles (cubic)	lead-gray	metallic	black streak; brittle	Principal source of lead. Often occurs in cubes.
SPHALERITE	ZnS	4	4	perfect in 6 directions (dodecahedral)	yellow; brown	resinous	streak white, yellow, brown—always lighter than mineral itself; brittle	Principal source of zinc.
CHALCOPYRITE	$CuFeS_2$	3.5–4	4.2	sometimes distinct in one direction	brass-yellow; often tarnished of iridescent	metallic	greenish-black	Important source of copper—fracture uneven.
CINNABAR	Hg S	2–2.5	8.1	1 perfect usually not distinct	cochineal red to lead-gray	adamantine	streak-scarlet; fracture uneven	Principal source of mercury.

Carbonates

CALCITE	$CaCO_3$	3	2.7	perfect in 3 directions (rhombohedral)	colorless; white; yellow; pink; blue	vitreous	effervesces freely in cold HCl	Principal constituent of limestone and marble.
DOLOMITE	(Ca, Mg) CO_3	3.5	2.8	like calcite	white	vitreous	effervesces very slowly in cold HCl	Present in dolomitic limestone.
MALACHITE	$CuCO_3$. $CuCO_3$. H_2O	3.5	4	none	green	silky to earthy	effervesces freely in cold HCl; pale green streak	Source of copper.
AZURITE	$2\ CuCO_3$. $Cu(OH)_2$	3.5–4	3.8	one perfect but interrupted one good	azure-blue	vitreous	effervesces in nitric acid	Source of copper.

Sulphates

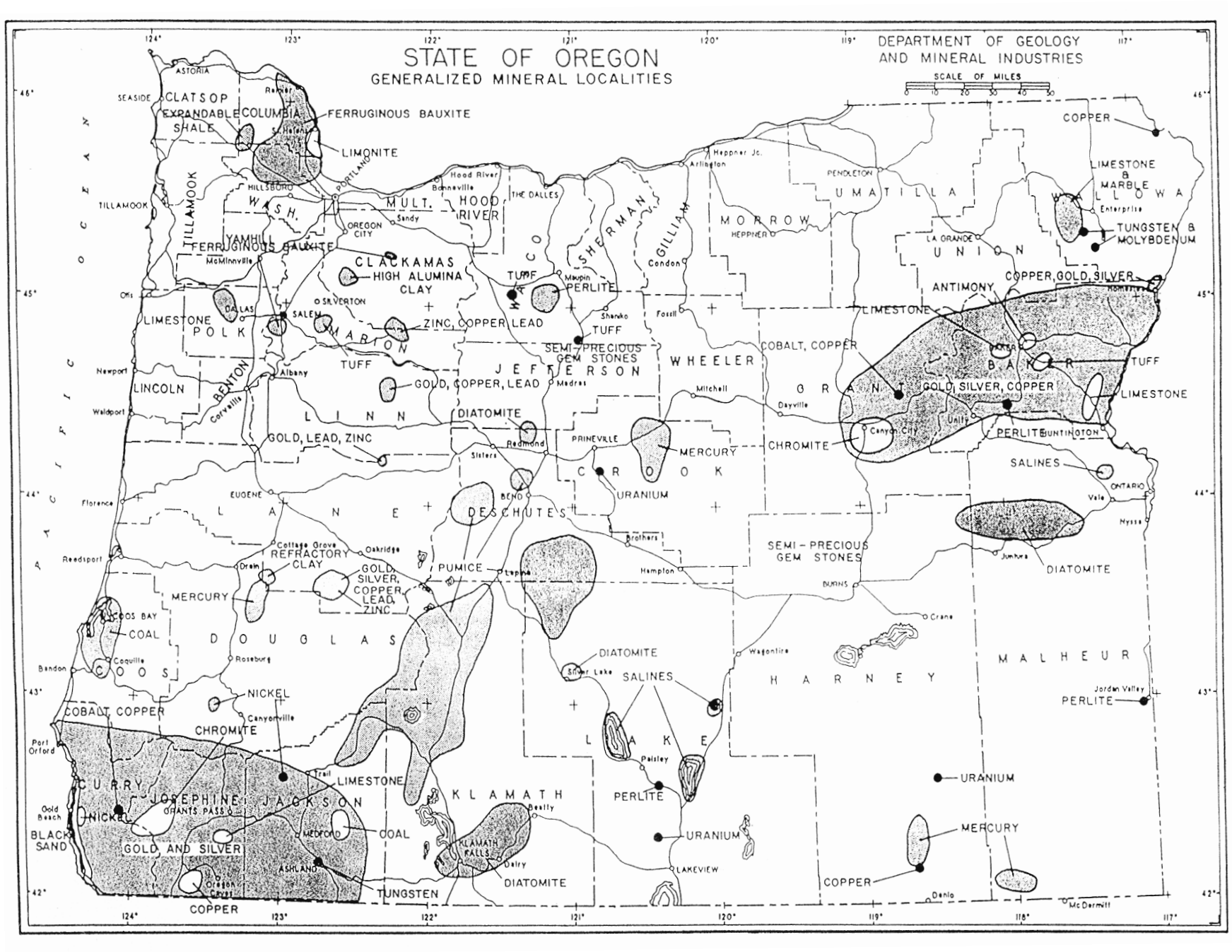
Mineral	*Chem. Comp.*	*H.*	*G.*	*Cleavage*	*Color*	*Luster*	*Other Properties*	*Remarks*
GYPSUM *var.* Selenite	$CaSO_4 : 2\ H_2O$	2	2.3	3 cleavages; one perfect	white or colorless	pearly	transparent; large crystals; flexible, but inelastic plates	Used in certain optical instruments.
var. Satin spar	"	"	"		white or gray	silky	translucent or apaque; very finely crystalline	Used for manufacture of plaster of Paris
BARITE	$BaSO_4$	3	4.5	perfect platy; good in 2 other directions	white; gray; blue	pearly	transparent to opaque	Distinguished by sp. gr.

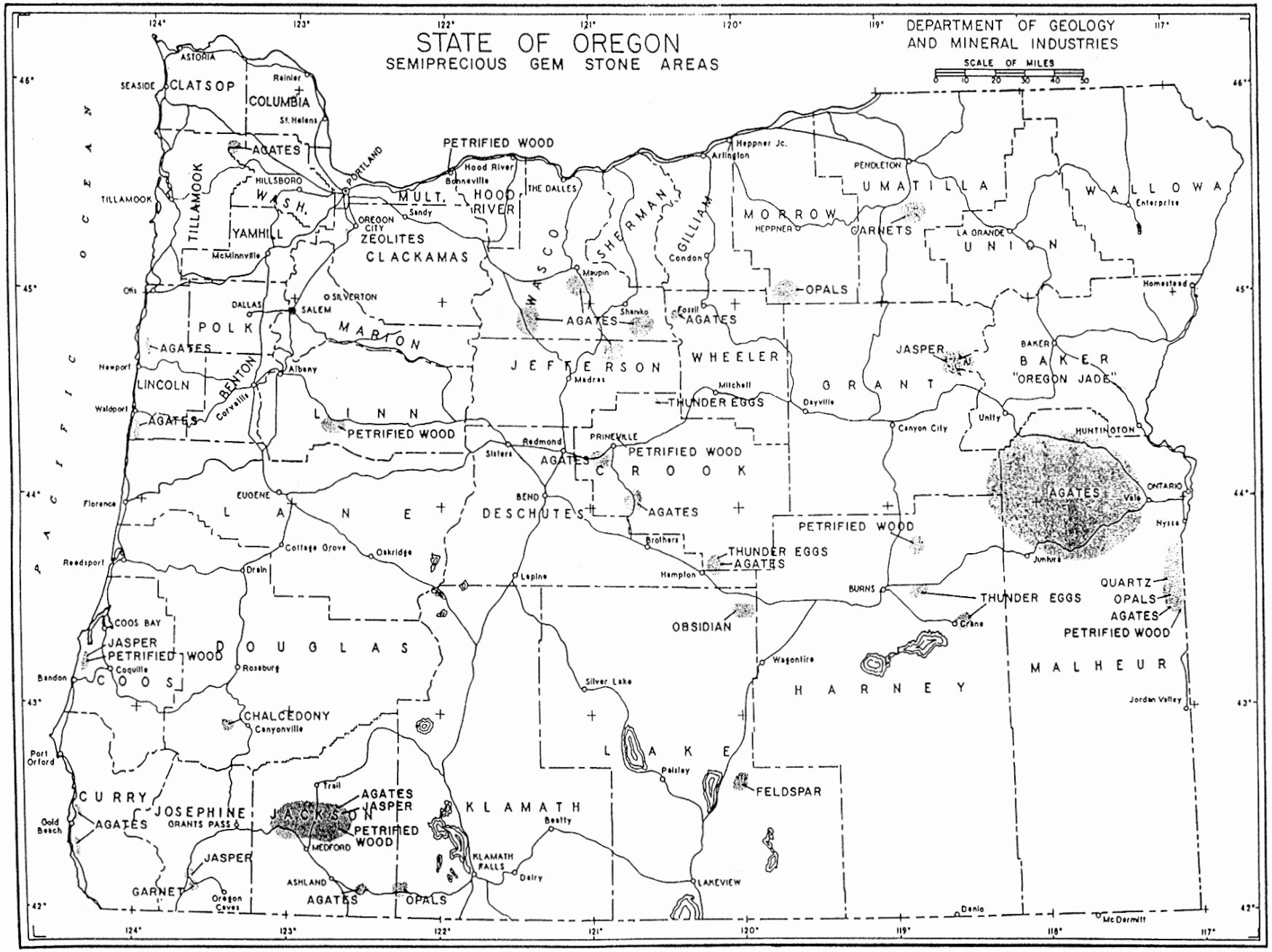
Anhydrous Silicates

ORTHOCLASE	$KAlSi_3O_8$	6	2.6	good in 2 directions at right angles	white; pink	pearly		Feldspar group; present in nearly all igneous rocks; recognized by light color and cleavage.
PLAGIOCLASE	NaCaAl Silicate	"	"	good in 2 directions near right angle	white to gray	pearly	platy aggregates quite common; specimens may show bluish-green iridescence	
HORNBLENDE	silicate of Fe, Al, Ca, Mg	5–6	3	good in 2 directions at app. 60°	black	vitreous	splintery surfaces common	A common mineral in igneous rocks.
OLIVINE	$(Mg, Fe)_2\ SiO_4$	6.5	3	none	olive-green	vitreous	usually in granular masses; individual grains are hard	Commonly found in dark igneous rocks.
GARNET	complex Fe, Al, Mg, silicate	7	4	none	red to brown	vitreous to resinous	often in 12-sided crystals with diamond-shaped faces; brittle	Commonly found in metamorphic rocks.

Hydrous Silicates

MUSCOVITE	hydrous KAl silicate	2–2.5	3	perfect in 1 direction	nearly colorless	vitreous	splits into thin flexible plates	Members of mica group; common in coarse-grained igneous rocks and in metamorphic rocks like schist and gneiss.
PHLOGOPITE	hydrous K, Mg, Al silicate	2.5–3	2.8	perfect in 1 direction	yellowish brown to brownish red	pearly	splits into thin flexible plates	
SERPENTINE	hydrous Mg, Fe silicate	2–5	2.6	none	yellowish-green to blackish green	earthly or greasy	greasy feel	Usually formed by alteration of olivine.
TALC	hydrous Mg silicate	1	"	sometimes perfect in 1 direction	white to pale green	pearly	soapy or greasy feel; may be massive or foliated; folia flexible but not elastic	Commonly found in metamorphic rocks, such as talc schist.
CHLORITE	hydrous Fe, Al silicate	1–2.5	2.6–2.9	sometimes perfect in 1 direction	grass green to blackish green	feebly pearly on cleavage surface	laminae flexible but not elastic streak, uncolored or greenish	


STATE OF OREGON
GENERALIZED MINERAL LOCALITIES
DEPARTMENT OF GEOLOGY
AND MINERAL INDUSTRIES
SCALE OF MILES
PACIFIC OCEAN
CLATSOP
EXPANDABLE SHALE
COLUMBIA
FERRUGINOUS BAUXITE
LIMONITE
TILLAMOOK
WASH.
MULT.
HOOD RIVER
SHERMAN
GILLIAM
MORROW
UMATILLA
UNION
WALLOWA
COPPER
LIMESTONE & MARBLE
TUNGSTEN & MOLYBDENUM
YAMHILL
FERRUGINOUS BAUXITE
CLACKAMAS
HIGH ALUMINA CLAY
TUFF
PERLITE
COPPER, GOLD, SILVER
ANTIMONY
LIMESTONE
POLK
MARION
ZINC, COPPER, LEAD
TUFF
SEMI-PRECIOUS GEM STONES
WHEELER
COBALT, COPPER
BAKER
TUFF
LINCOLN
BENTON
JEFFERSON
GOLD, COPPER, LEAD
GRANT
GOLD, SILVER, COPPER
LIMESTONE
LINN
DIATOMITE
GOLD, LEAD, ZINC
CROOK
MERCURY
CHROMITE
PERLITE
SALINES
LANE
DESCHUTES
URANIUM
SEMI-PRECIOUS GEM STONES
DIATOMITE
REFRACTORY CLAY
GOLD, SILVER, COPPER, LEAD, ZINC
PUMICE
MERCURY
COAL
DOUGLAS
COOS
DIATOMITE
SALINES
HARNEY
MALHEUR
PERLITE
NICKEL
COBALT, COPPER
CHROMITE
LIMESTONE
CURRY
JOSEPHINE
JACKSON
KLAMATH
LAKE
URANIUM
BLACK SAND
GOLD AND SILVER
COAL
MERCURY
COPPER
TUNGSTEN
DIATOMITE
COPPER


STATE OF OREGON
SEMIPRECIOUS GEM STONE AREAS
DEPARTMENT OF GEOLOGY
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SCALE OF MILES
PACIFIC OCEAN
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WASH.
MULT.
HOOD RIVER
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"OREGON JADE"
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LINN
CROOK
LANE
DESCHUTES
DOUGLAS
COOS
CURRY
JOSEPHINE
JACKSON
KLAMATH
LAKE
HARNEY
MALHEUR
PETRIFIED WOOD
AGATES
THUNDER EGGS
OPALS
GARNETS
OBSIDIAN
FELDSPAR
QUARTZ
JASPER
ASTORIA
SEASIDE
Rainier
St. Helens
PORTLAND
Hood River
Bonneville
THE DALLES
Heppner Jc.
Arlington
PENDLETON
Enterprise
LA GRANDE
HEPPNER
Condon
Homestead
TILLAMOOK
HILLSBORO
Sandy
OREGON CITY
McMinnville
Otis
SILVERTON
DALLAS
SALEM
Maupin
Shanko
Fossil
Newport
Albany
Madras
Mitchell
Waldport
Corvallis
Prineville
Redmond
Sisters
Deyville
Canyon City
Unity
BAKER
HUNTINGTON
Florence
EUGENE
BEND
Brothers
Vale
ONTARIO
Nyssa
Reedsport
Cottage Grove
Oakridge
Drain
Lapine
Hampton
Burns
Crane
Junction
COOS BAY
Coquille
Roseburg
Bandon
Wagontire
Silver Lake
Jordan Valley
CHALCEDONY
Canyonville
Port Orford
Trail
MEDFORD
Gold Beach
GRANTS PASS
Beatty
Paisley
KLAMATH FALLS
Dairy
ASHLAND
Oregon Caves
LAKEVIEW
Denio
McDermitt
124°
123°
122°
121°
120°
119°
118°
117°
46°
45°
44°
43°
42°

4-H Geology Advancement Program

This program will help you learn more about geology and the natural resources of Oregon. Learners select the options. For each step up the advancement trail, you must do 5 to 11 Geology options for each step and two options from the Supplementary groups: Outdoorsmanship, Personal Development, and Natural Resources. With your leader's approval you may develop one of your own options at each step.

Have your leader or parent initial each option when you complete it. When you have completed the required options for each step, your leader will order a 4-H Advancement Certificate for you.

Name:_____

Step 4: 4-H Geologist

Grade _____ Date Achieved _____ Leader Initials _____

Step 3: 4-H Mineral Master

Grade _____ Date Achieved _____ Leader Initials _____

Step 2: 4-H Rock Hound

Grade _____ Date Achieved _____ Leader Initials _____

Step 1: 4-H Pebble Pup

Grade _____ Date Achieved _____ Leader Initials _____

Geology Advancement Options

Step 1: 4-H Pebble Pup

(Complete at least five of these)

	Date Completed	Approved by
1. Spell and define the following geology terms: canyon, clay, compound, element, lava, mineral, rock, sand, soil, valley.	_____	_____
2. Collect, identify, and properly label 10–20 rock and mineral specimens.	_____	_____
3. Explain the difference between a rock and a mineral.	_____	_____
4. Explain the difference between igneous, sedimentary, and metamorphic rocks. Collect at least two of each class.	_____	_____
5. Explain why fossils are often found in sedimentary rock but seldom in other rocks.	_____	_____
6. Explain how a geologic feature (land form) in Oregon was formed. Name of feature: _____	_____	_____
7. Explain how river stones become rounded.	_____	_____
8. Explain how freezing and thawing can break large rocks.	_____	_____
9. Create paper or cardboard models of at least six crystal shapes. Name two or more minerals found in each shape. Explain how crystal shape is used to distinguish between minerals.	_____	_____
10. _____		
_____	_____	_____

Step 2: 4-H Rock Hound

(Complete at least seven of these)

	Date Completed	Approved by
1. Spell and define: cleavage, hardness, luster, ductile, magma, organic, dike, inorganic, weathering, topsoil, subsoil, and natural resource.	_____	_____
2. Collect, identify, and properly label 15–30 rock and mineral specimens.	_____	_____
3. Name three natural forces (agents of transportation) that move rock materials.	_____	_____
4. Explain how plants help prevent soil erosion.	_____	_____
5. Find a fossil. Learn as much about it as you can and report to your club or class.	_____	_____
6. Draw a diagram of a cinder cone and explain how it is formed.	_____	_____
7. Explain why river stones have different shapes such as flat, oblong, round, and egg-shaped.	_____	_____
8. Collect and polish a quantity of agates in a tumbler.	_____	_____
9. Research and create a presentation on Edward Cope and Charles Marsh and the Bone Wars.	_____	_____
10. Create a mineral hardness test kit and demonstrate to your club or class how to use it.	_____	_____
11. Plan a day trip for your family or group to a rock or fossil collection site.	_____	_____
12. _____		
_____	_____	_____

Step 3: Mineral Master

(Complete at least nine of these)

	Date Completed	Approved by
1. Spell and define: anhydrous, anticline, conglomerate, estuary, extrusive, hydrous, intrusive, loess, magnetism, moraine, Pleistocene, specific gravity, syncline, and Tertiary.	_____	_____
2. Collect, identify, and properly label 20–40 rocks and mineral specimens.	_____	_____
3. Describe and explain how a lava tube is formed.	_____	_____
4. Describe and explain how a dike is formed. Use pictures or diagrams.	_____	_____
5. Draw cross section diagrams of a glacial canyon and a water-formed canyon and explain the difference.	_____	_____
6. Know the common name and explain how each of the following is used: NaCl, H_2O, $CaSO_4$, Pb.	_____	_____
7. Explain how an artesian well works, or study a spring and explain where the water comes from.	_____	_____
8. Describe and explain three ways lakes are formed, and what causes river meanders and oxbow lakes.	_____	_____
9. Demonstrate gold panning techniques. Research locations where the public can go to pan for gold.	_____	_____
10. What causes earthquakes? Create a presentation with illustrations to describe a cause of earthquakes and ground movement.	_____	_____
11. Explain how the speed at which igneous rocks cool affects the size of their crystals. Use actual rock samples to demonstrate your presentation.	_____	_____
12. Research animals that lived in Oregon's John Day Basin between 54 million and 6 million years ago. Select one animal that is found in the fossil record through at least half of this time period and report on how the animal's physical structure changed with the changing climate.	_____	_____
13. Create a presentation with illustrations to describe how the theory of plate tectonics is related to fault block mountains, fold mountains, and volcanoes.	_____	_____
14. Research the Mount Angel Fault zone, the Portland Basin Fault zone, and/or the Baker Fault zone. What do people living in these areas need to know about faults and earthquakes?	_____	_____
15. _____		
_____	_____	_____

Step 4: 4-H Geologist

(Complete at least eleven of these)

	Date Completed	Approved by
1. Define and spell: batholith, Cenozoic, Eocene, horst, graben, Mesozoic, Miocene, Oligocene, Paleozoic, Pliocene.	_____	_____
2. Collect, identify, and properly label 30–55 rock and mineral samples.	_____	_____
3. Name and describe three geologic formations you have observed in Oregon.	_____	_____
4. Draw diagrams of the calderas of Crater Lake and Newberry Crater. Explain the similarities and differences of how each was formed.	_____	_____
5. List the names of the metals obtained from the following and explain how each is used: bauxite, chromite, cinnabar, galena, garnierite, hematite, sphalerite, and zircon.	_____	_____
6. Find and identify a fossil. Learn as much as you can about the plant or animal—when and how it lived, the climate at the time, and how the fossil was formed. Report to your club or some other group.	_____	_____
7. Study a lake or pond. Explain how you think it was formed, what is happening to it now, and estimate how long it will remain a lake or pond.	_____	_____
8. Describe two methods by which caves are formed. Give two Oregon examples.	_____	_____
9. Look through your house and see how many things are related to something mined from the earth.	_____	_____
10. Study one or more geological maps of your area and show one other person how to read them.	_____	_____
11. Research and create a presentation describing two or more possible careers in a specialty of earth science.	_____	_____
12. Research and create a presentation describing recent seismic events on Mt. Hood.	_____	_____
13. Research and create a presentation describing geothermal activity on Mt. Hood.	_____	_____
14. Research and create a presentation describing the use of geothermal energy for the benefit of people.	_____	_____
15. How is soil formed? Create a presentation using two or more actual soil samples to describe soil formation and the development of soil horizons.	_____	_____
16. _____		
_____	_____	_____

Supplemental Advancement Options

Outdoors

	Date Completed	Approved by
1. Participate in a community, roadside, campground, or streambank cleanup. (This elective may be repeated for each step.)	_____	_____
2. Make a map that will show someone else how to get to one of your favorite places.	_____	_____
3. Demonstrate how to determine directions without a compass.	_____	_____
4. Build a safe campfire and put it completely out.	_____	_____
5. Make an overnight hike and camp where you must carry everything you need for at least 1 mile. Leave a clean camp.	_____	_____
6. Cook a complete meal for yourself and one other person over a campfire.	_____	_____
7. Demonstrate how to read and use a geological series quadrangle ("quad") map.	_____	_____
8. Know what to do in case you get lost.	_____	_____
9. Make a survival kit.	_____	_____
10. Define hypothermia and know how to prevent and treat it.	_____	_____

Personal Development

1. Lead the Pledge of Allegiance and 4-H Pledge at a 4-H meeting.	_____	_____
2. Lead a song or a game at a 4-H meeting.	_____	_____
3. Preside at a meeting larger than your 4-H club.	_____	_____
4. Write a news story for a local paper.	_____	_____
5. Participate in a radio or television program.	_____	_____
6. Give a presentation to a group larger than your 4-H club.	_____	_____
7. Serve as host for a 4-H meeting at your home. See that everyone is welcomed and made comfortable.	_____	_____
8. Serve as a youth leader.	_____	_____
9. Serve as a camp counselor.	_____	_____
10. Visit a senior citizens home and show them your geology collection. Tell them about a trip you took to collect specimens.	_____	_____

Natural Resources and Conservation

	Date Completed	Approved by
1. Observe and/or read about and report on a wild animal or plant. Birds, fish and insects are animals, too. (This elective may be repeated for each step.)	_____	_____
2. Find and identify the tracks of five wild animals. Make casts of the tracks with plaster of Paris.	_____	_____
3. Observe and identify 10 birds. Describe their preferred habitat, food, and nest types.	_____	_____
4. Find and identify 10 native trees or shrubs.	_____	_____
5. Find and identity 10 wild flowers or other non-woody plants, not trees or shrubs. Do not collect protected species.	_____	_____
6. Find and identify 10 kinds of aquatic animals such as crayfish, mussels, starfish, salamanders, etc. Do not collect or disturb them. Describe their habitats.	_____	_____
7. Collect, identify, and label 10 insects.	_____	_____
8. Name three beneficial insects and tell how they benefit humans.	_____	_____
9. Name five harmful insects and tell what damage they do.	_____	_____
10. Explain three ways that insects differ from other animals.	_____	_____
11. Explain how the life history of an insect with complete metamorphosis differs from an insect with incomplete metamorphosis.	_____	_____
12. List five habits of birds that are beneficial to humans.	_____	_____
13. List five wild animals that are protected by law. Explain why each is protected.	_____	_____
14. Explain why plants are essential to animal life and why sunlight is essential to plant and animal life. Create an Energy Web to illustrate your explanation.	_____	_____
15. Explain how oxygen, sediment, and temperature of water affects fish life.	_____	_____

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