Rocks & Minerals

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Rocks & Minerals

Program of Study

I planned this as a six week unit but you can divide it up into a 4 week block and a 2 week follow-up if that suits your schedule better.

Week One
- What is a rock?

Week Two
- Igneous rocks

Week Three
- Sedimentary rocks

Week Four
- Metamorphic rocks

Week Five
- Gems

Week Six
- Fossils

There is no formal assessment piece, although a main lesson book, Nature table display, and Science notebook will have been compiled throughout the course of the unit.

Booklist:
Teacher Preparation

From Nature Stories to Natural Science		Donna Simmons
Path of Discovery: Volume 4, Grade 4		Eric Fairman
Science as Phenomena		Barbara Dewey
Teaching Geography		Roy Wilkinson
Mudworks		MaryAnn F. Kohl
The Hand-Sculpted House		Ianto Evans, et al.
Earth, Water, Fire and Air		Walter Kraul
The Forgotten Arts and Crafts		John Seymour
Educating the Will		Michael Howard
Rock and Gem		Ronald Bonewitz
Rocks and Minerals flash chart	ISBN 1-4114-016406	

Additional Resources:
Just for Fun

Hope Diamond: The Legendary History of a Cursed Gem — Richard Kurin
This book has a story about my grandfather, George Switzer, who was curator of Gems & Minerals at the Smithsonian Institution when they received the Hope.

The Great Clay Adventure	Ellen Kong
The Canterbury Tales	Geoffrey Chaucer
The Adventures of Tom Sawyer	Mark Twain
Whittle Your Ears	Barbara D. Betteridge

Additional Resources:
Picture Books and Poetry

Week One

Snowy Flowy Blowy: A Twelve Months Rhyme	Nancy Tafuri
Thank You, Santa	Margaret Wild
Chester the Worldly Pig	Bill Peet
Basho and the River Stones	Tim Myers
Everybody Needs a Rock	Byrd Baylor
On My Beach There Are Many Pebbles	Leo Lionni
If You Find a Rock	Peggy Christian

Week Two

Rocks and Minerals (The Question & Answer Book)	Elizabeth Marcus
How to Dig a Hole to the Other Side of the World	Faith McNulty
The Pebble in My Pocket: A History of Our Earth	Meredith Hooper
The Burning Mountain	Anico Surany
Volcanoes and Earthquakes	Robert Irving
A Journey through Time in Verse and Rhyme	Heather Thomas

Week Three

A Child's History of the World	V.M. Hillyer
Pome and Peel	Amy Ehrlich
The Story of a Nail	Irving & Ruth Adler

Week Four

Buried Sunlight: The Story of Coal	Raymond E. Janssen
The Agony and the Ecstasy	Irving Stone

Be sure that you have posters of natural features such as the Grand Canyon, sand dunes, waterfalls, and so on to decorate the classroom walls with.

MY BOOK NOTES:

Rocks & Minerals

Introduction

Notes on Earth Science from Science as Phenomena by Barbara Dewey:

"Earth science includes the study of mineralogy and geology. This study will require some fun field trips: caves and caverns, stream beds, mountains, oceans, and lakes, whatever is accessible to you. Discover what caused the various formations. Make a visit to your nearest Natural History Museum. It is worthwhile to buy a sample of the most common rocks and minerals; usually a set of these, all mounted in a neat little box, may be found in your science museum gift shop. This will help with identification of what you find on your rock hunting trips. Janice Van Cleave's Rocks and Minerals is helpful for this block as well.

"It may be worthwhile as well to focus on some minerals from a social and historic perspective, for instance gold or silver. See where it has appeared in previous studies, and in stories you have read together over the years. Do some library research on it together."

from page 13
Science as Phenomena

The book Rock and Gem is an excellent resource to have on hand to provide basic background as well as more in-depth information. It is well-organized and could be used as a guide for an order in which to present the information. The Table of Contents is arranged as follows:

- Origins
  - The formation of the universe
  - The formation of earth
  - Earth's crust
  - Collecting rocks and minerals
- Rocks
  - Rock formation
  - Types of rock
  - Igneous rocks
  - Sedimentary rocks
  - Metamorphic rocks
- Minerals
  - What is a mineral?

And so on.

UNIT PLAN:

Rocks & Minerals

Week One – What is a Rock?

Set A

"In the beginning,
God created the heaven and the earth."

Begin this unit with a fresh main lesson book and write this quote on the first page. Use beeswax crayons or some other art material to illustrate.

Parent Background: Read page 19-20 of Path of Discovery: Volume 4, Grade 4.

After the main lesson book page is done, begin a discussion of the greater whole, including the various regions of the world, as is described by Eric Fairman. Use Snowy Flowy Blowy to introduce this as this book describes each month of our calendar year with one word – however, in different parts of the world, what words might they use to describe their climate? In Australia the climate is temperate but seasons are the exact reverse of ours (if you can find it, read Thank You, Santa as a fun way to illustrate this).

Set B

Parent Background: At this point we move to using Roy Wilkinson's book as our guide.

Tell your child that the word *Geography* means "description of the earth." Take a blank unlined journal (henceforth to be known as your Science notebook) and write this on the first page. Then take a Nature walk together and write down everything you can that helps you describe the earth. Don't lead him/her in this regard – stand back and see what he/she comes up with. Take plain pencils (so that you may sketch if you wish) but not colored pencils, which will make it obvious that you expect him/her to draw.

Set C

Landforms and Water Features

Having allowed your child to explore his/her own version of descriptions of the earth, you can now lead him/her into considering the surface of the physical earth in terms of landforms and water features. Every bit of the earth's surface is covered with both. Begin by reading "The Brook" by Alfred Lord Tennyson, as Wilkinson suggests:

THE BROOK

by: Alfred Tennyson (1809-1892)

ICOME from haunts of coot and hern,
I make a sudden sally,
And sparkle out among the fern,
To bicker down a valley.

By thirty hills I hurry down,
Or slip between the ridges,
By twenty thorps, a little town,
And half a hundred bridges.

Till last by Philip's farm I flow
To join the brimming river,
For men may come and men may go,
But I go on forever.

I chatter over stony ways,
In little sharps and trebles,
I bubble into eddying bays,
I babble on the pebbles.

With many a curve my banks I fret
by many a field and fallow,
And many a fairy foreland set
With willow-weed and mallow.

I chatter, chatter, as I flow
To join the brimming river,
For men may comeand men may go,
But I go on forever.

I wind about, and in and out,
with here a blossom sailing,
And here and there a lusty trout,
And here and there a grayling,
And here and there a foamy flake
Upon me, as I travel
With many a silver water-break
Above the golden gravel,

And draw them all along, and flow
To join the brimming river,
For men may come and men may go,
But I go on forever.

I steal by lawns and grassy plots,
I slide by hazel covers;
I move the sweet forget-me-nots
That grow for happy lovers.

I slip, I slide, I gloom, I glance,
Among my skimming swallows;
I make the netted sunbeam dance
Against my sandy shallows.

I murmur under moon and stars
In brambly wildernesses;
I linger by my shingly bars;
I loiter round my cresses;

And out again I curve and flow
To join the brimming river,
For men may come and men may go,
But I go on forever.

'The Brook' is reprinted from English Poems. Ed. Edward Chauncey Baldwin. New York: American Book Company, 1908.

After listening to this poem (without discussing it) take your child out to a place where he/she can watch a babbling brook – or look at a frozen one – and sketch it.

Set D

Continue to learn the name of and look of a variety of land and water features. Do field trips as often as you can (take your Science notebook!) and/or find stories to read to help you remember each. There's a series called Biomes of North America that you may be able find in your local library. Definitely visit the library to do additional research! Make sure you use all available reference materials (dictionary, encyclopedia, non-fiction section) and resist the temptation to just jump straight to the internet. Then use the recipes given in Mudworks to make models of the features you are learning about.

A comical way to review the appearance of our planet (have a globe handy) is Chester the Worldly Pig by Bill Peet.

Set E

While modeling the landforms and water features, your child may discover that many landforms and water features are the reverse of each other -- in fact, the Montessori method teaches them in this way; for example, lake, island, bay, peninsula, isthmus, and strait.

Lake	A body of water surrounded by land.
Island	A body of land surrounded by water.
Bay	A part of water that extends into the land.
Peninsula	A part of land that extends into the water.
Isthmus	A narrow strip of land which has water on both sides, and connects two larger bodies of land.
Strait	A narrow channel of water connecting two larger bodies of water.

For review, Enchanted Learning and other websites have worksheets and quizzes. Here are some examples (if you don't want your children working online you can copy and paste the text and create your own worksheets):
http://www.enchantedlearning.com/classroom/quiz/landforms.shtml

http://www.enchantedlearning.com/alphabet/wordforeachletter/geography.shtml

http://www.enchantedlearning.com/geography/landforms/label/

Landforms and water features are a good way to proceed "from the whole to the parts" when introducing a study of rocks. You can spend as much or as little time on this as you wish. It may be that a brief review of the surface features of your area (from a previous geography unit) is sufficient – or you may decide that your child needs to learn more about the earth as a whole and the processes which shape it before proceeding. Use your own judgment here.

In addition to modeling, add a painting of each landform or water feature that you have chosen to learn about, labeled with its name and a short definition, to your main lesson book. Your Science notebook should be full of drawings and notes from your field trips and research at the library.

Read-Alouds:
When learning about mountains, begin the read-aloud story for this unit… Mountains especially are the setting for many stories including Tolkien's The Hobbit or Tatsinda by Elizabeth Enright. You'll know best what stories your child would prefer and probably have many books on your shelf relating to different landforms and water features. Also consider any relevant poetry.

Roy Wilkinson's book is full of suggestions of literature which tie in with what you are learning, including quotes for mountain (page 8), wind erosion – relevant to Arches Natural Park in Utah (page 9), frost (page 10), the rain cycle (page 10), clouds (page 11), seeds (page 12), and so on. We don't have any study of weather in our lesson plans but as wind and/or water erosion comes up in your study of land forms, feel free to add in (in an "unschooling" manner) additional earth science content as is relevant to your child's interests. As Wilkinson says, Geography is a very holistic subject and can encompass much more than originally planned.

Here is the master list of landforms and water features for this age:

1. **archipelago**
2. **atoll**
3. **bay**
4. **butte**
5. **canyon**
6. **cape**
7. **cave**
8. **channel**
9. **cliff**
10. **continent**
11. **cove**
12. **delta**
13. **desert**
14. **dune**
15. **estuary**
16. **fjord**
17. **geyser**
18. **glacier**
19. **gulf**
20. **hill**
21. **island**
22. **isthmus**
23. **lagoon**
24. **lake**
25. **marsh**
26. **mesa**
27. **mountain**
28. **ocean**
29. **peninsula**
30. **plain**
31. **plateau**
32. **pond**
33. **prairie**
34. **river**
35. **sea**
36. **sound**
37. **source**
38. **strait**
39. **swamp**
40. **tributary**
41. **tundra**
42. **valley**
43. **volcano**
44. **waterfall**
45. **wetland**

See http://www.enchantedlearning.com/geography/landforms/glossaryprintable.shtml for definitions.

Set F

It is important that your child realizes that no landform or water feature is static – the entire surface of the earth is dynamic. Spend some extra time on the different types of erosion if you deem it necessary. Here are some notes from a homeschooler's website about their erosion experiments: http://www.bright.net/~double/erode.htm

There are more sophisticated erosion experiments, depending on how much experience your family already has with this subject. Donna Simmons suggests investing in a rock tumbler. Or, you could tell your child that you'd like to study erosion and have him/her come up with her own experiments. The Science notebook is the proper place to document these experiments – complete with the steps in the scientific process and photographs of your findings.

The Scientific Process

Scientists make progress by using the scientific method, a process of checking conclusions against nature. After observing something, a scientist tries to explain what has been seen.

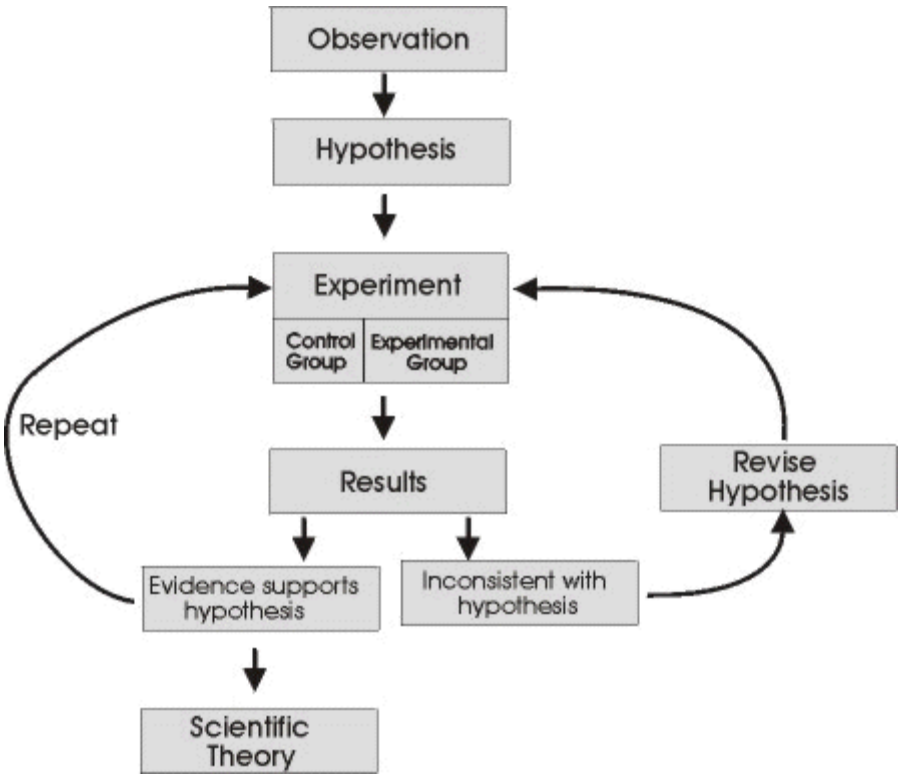
The explanation is called an hypothesis. There is always at least one alternative hypothesis.

A part of nature is tested in a "controlled experiment" to see if the explanation matches reality. A controlled experiment is one in which all treatments are identical except that some are exposed to the hypothetical cause and some are not. Any differences in the way the treatments behave is attributed to the presence and lack of the cause.

If the results of the experiment are consistent with the hypothesis, there is evidence to support the hypothesis. If the two do not match, the scientist seeks an alternative explanation and redesigns the experiment.

When enough evidence accumulates, the understanding of this natural phenomenon is considered a scientific theory. A scientific theory persists until additional evidence causes it to be revised.

Nature's reality is always the final judge of a scientific theory.



from http://www2.nau.edu/~gaud/bio372/class/behavior/sciproc.htm

Set G

Moving from the Big Picture to the smaller details, begin to take Nature walks looking specifically at rocks. Pick up anything that your child thinks is a rock (and also some things that he/she thinks are definitely not rocks). When you get home, organize them into Rocks and Not Rocks. Make a nice big chart out of posterboard with these two category headings and have your child sketch what he/she is putting in each column. Name the items if he/she knows their names (such as seashell, bark) or describe things that he/she does not know the name of. Add this chart to the new Nature table display.

Some good books to introduce this are:

Basho and the River Stones by Tim Myers

Everybody Needs a Rock by Byrd Baylor

In addition to deciding what is a rock and what isn't, have your child classify the rocks you have gathered according to his/her own system of classifications (some whimsical examples of this are given in On My Beach There Are Many Pebbles by Leo Lionni and If You Find a Rock by Peggy Christian). Again, you can use a large piece of chart paper and have your child give titles to each category. Don't glue the rocks down, though, as you'll want to rearrange them next week when your child learns how rocks are categorized by scientists.

Rocks & Minerals

Week Two – Igneous Rocks

Set A

It is time for your child to learn that scientists categorize rocks primarily by how they are formed, not in any way by their appearance (which is probably how he/she decided to organize his/her collection). Read Rocks & Minerals by Elizabeth Marcus. Try the rock identification exercises using the rocks you have already gathered.

Main lesson book: Have your child include a diagram of the layers of the earth and explain each (this information is found on pages 7 and 8 of Rocks and Minerals).

Note: I am anticipating that the Science notebook will contain rough sketches, notes, and other general information gathering whereas the main lesson book will be the polished final result of your child's learning. However, if you find it easier to combine the two, feel free.

Set B

Follow up on yesterday's learning by reading How to Dig a Hole to the Other Side of the World. You might enjoy going outside and digging a hole as deep as you can. ☺ In fact, you may not be able to stop your child from trying this!

Parent Background: For this activity we are using The Hand-Sculpted House, chapter 8. After, or during the gigantic hole digging experiment, take a Nature walk and collect soil samples from several different areas around your house.

Place your soil samples in clear glass jars on your Nature table, as is shown on page 122. Follow the shake test procedure as described on pp.122-123 to determine your soil's composition. While you are waiting for the particles to settle out (this may take overnight) teach the information about soil composition on pp.120-121.

Add a page to your main lesson book with a description and pictures of

Topsoil

Stones and Gravel

Sand

Silt

Clay

Set C

Use the suggestions at the bottom of page 89 of From Nature Stories to Natural Science to continue the lesson today. "Go to a nearby river and look how it has carved a path through the earth and rock. Find a place where workers are excavating to build a house or a road, and see the layers of soil and rock. Climb a mountain or comb a pebbly beach for rocks and stones."

Examine your soil tests from yesterday. Do you have natural clay in your soil? Test the material you feel may be clay by giving it the tests on pages 124-126 of The Hand-Sculpted House:

Stickiness – palm test

Plasticity – crack test, squish test

Shininess – shine test

Hardness when dry – crush test

Observe what you have found in your own soil and write a passage in your main lesson book describing its makeup.

If your family is interested in building with cob, consider building a shelter or earth oven in your yard. It's a wonderful building material! You can also use the color photographs in this book to do a little mini-study of earth homes around the world. Geography and social studies are very much inter-related as the way in which people live is due in large part to their climate and the natural resources around them. This echoes your conversation from Day One of this unit.

Directions for Brickmaking are found on pages 156-158 of Forgotten Arts & Crafts.

Set D

Read The Pebble in My Pocket: A History of Our Earth to help get a sense of geologic time and how much the earth has changed throughout its history.

Parent Background: For Alan Whitehead's "Spiritual Science Insight on The Mineral Earth", see if you can borrow Sacred Places. He has some interesting articles in the front of the book but the majority is devoted to sacred places in Australia, so I don't think it's a must-buy. You may be interested in reading these chapters though:

Four Mineral Elementals – interviews with rock spirits (metamorphic, sedimentary, igneous, plutonic), discusses briefly how the various types of rocks are formed and gives characteristics and examples of each. Plutonic, by the way, he defines as rocks made of molten magma which do not break through the surface and are formed under the earth's crust (granite is an example).

Here's an excerpt from the Four Mineral Elementals chapter which I found interesting:

> "...how do I tell one rock from another? They all look the same to me!" I thought he'd have an apoplexy over that one!
>
> "Look the *same*!!" but he pulled himself together and attempted to simplify the complex for this stupid human. "Even your geologists know – and they know precious little – of the relationship between the four *Keys of Identification* and the 4-fold, 4-elemental process of rock creation.
>
> They identify rocks with four orderly processes, based on the Four Elements. The first is COLOUR – the fire element. The colour of a rock is determined by the degree – as it were – of heat present in its forming. With black rock the heat was intense, white rock cool – and all shades of the spectrum in between. Metallurgists use colour as an indication of temperature all the time – white heat in iron being an example. Black, white and pink granite is evidence of three clear cooling stages on that particular rock's slow journey to the surface of the earth from its magma-hot home.
>
> The second identification is TEXTURE; this is determined by the rock's association with Air, the 2nd element. If a rock mineralizes quickly, the air has little impact, say on a smooth basalt lava flow. If slowly, the air textures the rock surface in various ways – again with lava, it might contain 'eye pockets', or scrimshawing even.
>
> Then we have the ACID test, the 3rd – that of the Liquid Element. Acid reacts with some rocks but not others. Pour sulpheric acid on a piece of marble (with its animal-alkaline origins), and it bubbles away merrily. Acid rain is eating away the surfaces of many of the statues and buildings in Europe I hear."
>
> "Gosh, you do know a lot – and living out here in the sticks..." the little Kobold's glare warned me off casting further aspersions against his sylvan home. He continued, his tone acidic!
>
> "The 4th, and most complex rock test is on its MINERAL CONTENT. Does it contain iron, or feldspar, or silica? This of course harnesses the mystery of the Mineral World itself for its interpretation. The 4-fold element in Petrology – fire-colour; air-texture; water-acid; mineral-mineral – is a reflection of the evolution of the earth itself. Earth is the 4th incarnation of our planet. The previous three were Ancients Saturn, Sun and Moon – though we gnms weren't there then. They created the elements fire, air and water respectively. Our activities only really began in Atlantis, when the earth mineralized. That's why there's so many references to us in Atlantean legends. But time flies (not that time worries us much); I have lots of young plants to push up tonight. Just follow the path till you find a large sandstone boulder in a creek."
>
> "But wait, what's your name? I need it for my article!" His reply was almost unintelligible, and certainly unprintable, but made reference to his being a creative principle rather than an individual – so why have a name?

Seven Soul Metals – these are Sun/gold, Moon/silver, Mercury/quicksilver, Venus/copper, Mars/iron, Jupiter/tin, Saturn/lead, also includes how each planet relates to an organ as well as a region of the body AND a stage of life

Excerpt:

"The Magnificent Seven were created on the third planetary condition, Ancient Moon, remember I told you about planetary evolution yesterday. This was a soul-substance creation; a kind of metaphysical liquid condition. The human soul, the Astral ("Soul") Body, was created on Old Moon also; that's why the seven metals influence – and indeed are part of – our 7-membered soul. In fact the higher aspect of these seven metals we see today *are* the planets.

In fact (Steiner's) the Greco-Roman "Age of Meteorology" – of the planets – is sometimes called the Age of *Metalurgy*."

He also includes a quote from Chaucer's Canterbury Tales:

The bodyes sevene eek, lo! hem here anoon:
Sol gold is, and Luna silver we threpe,
Mars iren, Mercurie quyksilver we clepe,
Saturnus leed, and Juppiter is tyn,
And Venus coper, by my fader kyn!

CHAUCER, "The Canon's Yoeman's Tale"

Twelve Zodiacal Gems – these are Cancer/ruby, Leo/peridot, Virgo/sapphire, Libra/opal, Scorpio/topaz, Sagittarius/turquoise, Capricorn/garnet, Aquarius/amethyst, Pisces/aquamarine, Aries/diamond, Taurus/emerald, Gemini/pearl

The Seven Oceans – these are North Pacific, South Pacific, North Atlantic, South Atlantic, Arctic, Southern, Indian. He also includes a poem (actually originally written as a song for his Seven Oceans main lesson block, there are seven verses and a chorus to "Song of the Seven Sea Sisters" – full musical notation is included in his book 33 Sun Songs). Each ocean also has a related planet and personality – he even goes so far as to remark that the Mars ocean was the site of the atomic bomb!

The Seven Continents – He names them the same as everyone else: North America, South America, Europe, Africa, Asia, Australia, Antarctica, but adds more thoughts including, "If the seven oceans express World Soul, with their softening influence, then the seven continents are World Body – the Seven Sea Sisters hand-in-hand with the Seven Terra Brothers."

Set E

Igneous rocks – granite, pumice, obsidian

Follow up on all this information with a rock and mineral test kit, where you can work more on identification. These are found all over the place, search online or check your local Natural History Museum. You can even join a "Mineral of the Month Club" http://www.mineralofthemonthclub.org/join.htm. Field trips at this point can move from solely consisting of Nature walks to including museum visits.

To focus especially on igneous rocks, see if you can find some photographs or camera footage of volcanic eruptions, get samples of igneous rocks (pumice is usually available in the grocery store near the cleaning supplies), and – if you want to – delve further into what it is like to experience a volcanic eruption. You may not want to do Vesuvius if you think it will be too disturbing, although there are lots of good programs for this – the Discovery Channel did an excellent reenactment program called Pompeii: The Last Day, which includes a close look at the lives of several people in Pompeii, actual footage from eruptions, text from the actual eyewitness description of Vesuvius eruption by Pliny the Younger, a lot of science about how the hot ash reacted with the atmosphere to create the different types of materials that fell from the sky, and so on. You can find it here: http://dsc.discovery.com/convergence/pompeii/pompeii.html

For picture book follow-up, The Burning Mountain is excellent. For nonfiction books, I like Volcanoes and Earthquakes. This might also be a good time to enjoy some experiments in all the four elements, such as those found in Earth, Water, Fire and Air. Experiments with hot air rising, especially, will help your child understand part of what happens in volcanic eruptions. Evenings might be warm enough to launch hot air balloons around a campfire (use a camping stove and not the direct fire)! There is a nice poem called "The Four Elements" on page 130 of A Journey in Time Through Verse and Rhyme which you might want to add to your main lesson book.

Check any kitchen supply store for granite samples. What are the qualities of granite that make it so desirable for countertops? Are there any disadvantages? There's a Canadian show called How It's Made which did a piece on granite countertops (series 2, program 1) and shows the entire process of quarrying, cutting, and polishing; this show is usually aired on The Discovery Channel. http://dsc.discovery.com/

Set F

Food for thought: Charcoal comes from fire. Is it a rock? Why or why not?

Another campfire opportunity!

Do some charcoal drawing if you wish.

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Week Three – Sedimentary Rocks

Set A

Begin this week by really sinking your hands into some sediment and enjoying it. Purchase some clay from a craft store and do a few art exercises with it. Compare the clay you may have found locally with the pre-purchased clay. What can account for the differences between them? Looking online you can find clays from all over the world. Consider buying several for purposes of comparison – color, texture, etc.

Use Learning About the World through Modeling for art exercises. If you want to extend into some ceramics, The Great Clay Adventure is a very teacher-friendly resource and has tons of great projects as well as lists of learning connections.

Set B

It would be wonderful if you could do a spelunking field trip or visit any caves or caverns. Stalactites and stalagmites are beautiful stone formations found in limestone caves. Stalactites grow from the ceiling and stalagmites from the ground (I still remember going to Luray Caverns as a girl and having them tell us that the stalactites have to hold "tight" to the ceiling so they don't fall and stalagmites are growing as much as they can in hopes of reaching the ceiling and someday they "might" get there). These giant icicles form when ground water seeps into tiny cracks in the walls. Unbelievably, a stalactite and stalagmite grows just 2 or 3 inches in a thousand years.

Set C

There are many many examples of sedimentary rocks; in fact, almost every rock you can think of is made this way.

Ask your child what kind of rock he/she thinks the one in A Pebble in My Pocket is. It is sedimentary – although it originally began as hot lava erupting and forming the new skin of the earth, it then became part of a mountain shifting and forming as the crust buckled up. Then a large chunk of the mountain broke off and pieces of it eroded over time and from wind and water. It ends up at the bottom of the ocean floor ("As each layer presses down, the layers beneath slowly harden and the particles cement together to form more rock, layers of sedimentary rock under the sea") and then rises again to the sunlight, breaks into smaller pieces again, and finally comes to rest as a small pebble.

It is important to understand that sedimentary rock is *formed from* igneous rock – all of our land surface came from the center of the earth – but that it is given a different name because it has undergone a profound change. The Rocks and Minerals Flash Chart explains this very well: "As igneous rock changes into sedimentary rock, a chemical reaction occurs among the various rock particles. This reaction 'glues' the particles together."

Set D

Sedimentary rocks – sandstone, chalk, shale

Look at some pictures of the Grand Canyon (carved out of sedimentary rock). See how the layers are different colors? These are different colors of sediment which slowly came together to form rock layers. Take some more walks and look for cliffs or other outcrops where you can see layers like these. By the way, it is actually possible to turn sand into sandstone (see this article: http://www.scienceagogo.com/news/20070121171915data_trunc_sys.shtml) but you won't be able to achieve it at home! However, see if you and your child can come up with some kind of experiment where you add a great deal of pressure to a pile of sand, wait for the remainder of the unit, and then check to see the results. This will help give your child an idea of just how long it takes rock to form…

Add a page to your main lesson book about how sedimentary rock is formed. Here is an example of a simple explanation: "Every minute of every day, rocks are being worn down by wind and rain. Tiny grains of dirt, sand, mud and clay are worn off and washed into streams, rivers, lakes and oceans. When these tiny bits of sand and dirt settle to the bottom of the water, they are called sediment. Minerals in the water and microscopic, or very tiny sea animals also get mixed in with the dirt and sand to form the sediment. Every day more sediment piles on top of what is already there. After thousands and millions of years we end up with a really deep pile of sediment. The weight and pressure from all the stuff on top turns the sediment on the bottom into sedimentary rock!"

Limestone is an example of a very common sedimentary rock (which forms in a marine environment) and is used to make cement, plaster, and chalk… even glass! Glass is made by heating a mixture of limestone, sand and soda (sodium carbonate). Go around your house and look for items which you think were made with rocks or minerals. Visit a glassblower if you can.

More things to think about: People buy powdered lime and add it to their flowerbeds – research why this is so and what happens. Read about "Lime Burning" in Forgotten Arts & Crafts if you have it. Or try making whitewash and read Chapter II of Tom Sawyer!

Set E

Two other sedimentary rocks you may want to spend some time on are flint and slate: http://en.wikipedia.org/wiki/Flint; http://en.wikipedia.org/wiki/Slate.

Begin with the "Precious Stones" poem by Christina Rossetti (found on page 158 of A Journey Through Time in Verse and Rhyme). Ask your child if he/she knows what the phrase "a flint holds fire" means. Then show your child how to light a fire with one (another good outdoor camping activity). If you've ever watched this TV show, ask your child if the phrase "The Flintstones" now has different meaning!

According to Wikipedia, flint was one of the rocks commonly used in the Stone Age to make stone tools. This is because it breaks in a predictable way, in thin splinters, thereby allowing it to be shaped easily with a "hammerstone." This process is referred to as "knapping." Get some samples of flint and try it! Read chapter 3 "Fire! Fire!" from A Child's History of the World for an overview of the Ages and their technological discoveries: Stone Age, Bronze Age, Iron Age. According to my edition of the book, we are still in the Iron Age – but some people now call this the Information Age. What do you think?

A nice follow-up to the Bronze Age is the book Pome & Peel. See if you can find a bronze statue at an art museum, or some other piece of bronze, to examine up close.

For slate, some possible explorations could be "Slate Cutting" on page 59 of Forgotten Arts & Crafts or writing on a slate with a slate pencil (this can be found at Rosie Hippos) if your child has never tried this before http://www.rosiehippo.com/productdetail.asp?groupnumber=S233. Also, see if you can find a building with a slate roof. What might be some advantages of a slate roof? Disadvantages?

Set F

Talk with your child about the relationship between rocks and minerals (again, explained quite well on the Flash Chart). Rocks are made up of minerals. Minerals are made up of elements. There are many many minerals; there is actually a mineral named after my grandfather, George Switzer! http://www.mindat.org/min-3848.html. It has a hardness of 2. Ask your child what that means…

Choose one item made in part from a mineral and study its life cycle from origins to final product. I suggest the nail. The Story of a Nail by Irving and Ruth Adler is an older book but an excellent resource which covers not only the history of the nail (and life before nails) but all of the different materials needed to make iron: iron ore, coal, and limestone. There are lots of diagrams and a glossary in the back. It is part of an old series, now out of print, called The Reason Why series.

Studying coal is also a good transition to the next week's lessons on metamorphic rocks.

Rocks & Minerals

Week Four – Metamorphic Rocks

Set A

Roy Wilkinson's book states on page 13:

> "Perhaps there are some factories near so that manufacturing industries can be included in an elementary way, possibly coal mines. There will certainly be a bus route or railway line not far away, and luckily or unluckily, according to viewpoint, some air transport overhead."

See if there is a mine or quarry near you and what is being excavated. There are also coal trains which may go by even if there is no mine near you.

In the area where I live, a great deal of gravel is mined. Who knew that people mine gravel? What do you think it's for?

At the end of last week, you learned briefly about the story of coal as part of The Story of a Nail. Use the lesson plans from The American Coal Foundation to follow up on this: http://www.teachcoal.org/lessonplans/rocks_minerals.html. It is especially helpful that they offer free samples of different types of coal!

The lessons suggest that you begin by showing your child a sample of anthracite coal, one type of coal which is metamorphic (most others are sedimentary, as was indicated in Irving and Ruth Adler's book). Use this opportunity to explain what a metamorphic rock is (use the Rocks and Minerals Flash Chart as a quick review).

Complete the lesson plans from The American Coal Foundation.

Set B

Metamorphic rocks – gneiss, schist, marble

Happily, coal is not the only example we find of metamorphic rock. Now is our chance to play with marble! A reference to marble sculpting was made in Pome & Peel and this week is an excellent chance to follow up on it. In Educating the Will, Michael Howard gives a lively description of how wonderful marble carving is for children. You can introduce this by reading excerpts from The Agony and the Ecstasy (about the life of Michelangelo) and the process of choosing marble and "seeing" a statue inside it. The carving is simply a process of freeing the form inside – it is not about destruction. Check the chapters for excerpts about his work in bronze too, if your child is interested. For visuals, there are many beautiful picture books of Michelangelo's sculptures and other work.

Rocks & Minerals

Week Five – Gems

Some ideas:

The book Rock and Gem will be especially valuable here, for its lovely pictures and for the informative text (be sure to check out the section on organic gems including pearls and amber). Visit jewelry stores to see samples of different gems. Learn about the 4 C's of buying diamonds. Ask your child to research her birthstone. Some national parks have places where you can dig or pan for gemstones – see if there is one near you. If you want to, you can also get into gold, silver, and other precious metals.

Rocks & Minerals

Week Six – Fossils

Some ideas:

Donna Simmons gives a long list of suggested books for this block, including several on paleontology. Rock and Gem also includes a fossil section. See if there is any evidence of dinosaurs living in your area. When I was in college, my Geology class took a field trip to Dinosaur State Park and we got to walk along a river bank and see fossilized dinosaur footprints. Realizing that, millions of years ago, dinosaurs walked in the mud at that exact same place sent chills down my spine – even now when I remember it. Fill your house with dinosaur books (find more resources on paleontology on page 91 and 92 of Donna's book)! There are so many excellent books because most kids go on a dinosaur "craze" at some point. If that's happening with your child, nourish it. You can purchase all kinds of dinosaur archaeology kits, 3 dimensional puzzles, etc.

There are other types of fossils besides dinosaur bones – there are "living fossils" such as cockroaches, which have changed very little in millions of years. There are also kits you can buy which let you watch ancient animals grow, such as Aquasaurs: http://www.mindwareonline.com/MWEstore/ProductDetails/ProductDetails.aspx?pid={58C664FF-1702-41AC-8227-22B5E07CF71A}&price=$19.95&Referer=QUICK_SEARCH&Alias=aquasaur&_COUNTRY_ID={83F02198-6C32-11D3-811F-0000F80627E2}&_SESSION_ID={73454CE4-F2DC-4E2C-863B-3EF669312F2A}&_LKA=633137247811938750

Ancient plants such as ferns and ginkgos have stood the test of time. And there are other things which fossilize besides footprints, leafprints, and bones... at a museum near us, they have coprolites (fossilized crocodile feces). That was one of the favorite items with school groups! Also, you can find fossilized sharks teeth at our beaches, as well as fossilized coral. It's hard for me to know what you might find in your area, so explore and have fun!

Rocks & Minerals

Cumulative Project

Whittle Your Ears contains a play called "The Castle of the Kingdom of the Stones" which you may or may not be able to use in this unit (depending on the size of your family and/or whether you are part of a homeschool group). You could read the play aloud, illustrate a scene from it, try claymation (using polymer clay for the different characters) and make a movie... whatever seems to work. Or, you can skip it!

But here is the cast of characters in case you are interested:

King of the Stones
Queen, his wife
Prince, his son

Rocks:

Gravel	Sandstone
Marble	Limestone
Lava	Granite

Minerals:

Quartz	Sulphur
Salt	Mica
Pyrites	Feldspar

Seven Metals:

Quicksilver	Lead
Copper	Silver
Iron	Gold
Tin	

Twelve Precious Stones:

Opal	Topaz
Amethyst	Zirkon
Turquoise	Emerald
Agate	Sapphire
Malachite	Ruby
Garnet	Corundum

Spirit of Carbon (later as disenchanted Diamond)
First Gnome
Second Gnome
Host of the Gnomes

Another possible cumulative project is clay dyeing or cave painting, both ancient arts. Clay is one of the oldest dyes known to man and cave paintings were often made using ochre. See if you find ochre in your soil (ochre is basically rusted dirt which means it contains iron). Prairie Fibers (http://www.prairiefibers.com) offers online classes, including one on rust dyeing and clay dyeing. The course is $65 and includes downloadable written instructions and videos, as well as access to a virtual classroom where you can meet other students:
http://www.prairiefibers.com/mm5/merchant.mvc?Screen=PROD&Store_Code=TPFC&Product_Code=CLASS04&Category_Code=PRINT

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Journaling Page

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