Everyday Minerals	Grade 4 - Understanding Earth and Space Systems Rocks and Minerals

Lesson Plan

Safety Notes: Be careful when using the steel nail to test hardness.

Description

Rocks and minerals are important resources which we use everyday, even if we don't realize it. Come and explore some of the ways minerals shape our everyday life.

These are the concepts that will be covered in this lesson:

- What are the differences between rocks and minerals?
- How to identify minerals using hardness.
- How to identify minerals using other characteristics such as colour, streak, and fluorescence.
- How minerals can be found throughout your house.

Materials

Mineral Testing Activity

- 3-4 minerals collected from outside
- steel nail
- copper penny or small piece of copper pipe
- black light (optional)
- unglazed ceramic tile (optional)

Everyday Minerals Activity

- 'Everyday Minerals' handout

Science Background

What is the difference between a **Mineral** and a **Rock**?

Minerals:

- occur naturally in nature (people did not make it)
- are inorganic (was not made by organisms)
- are solid (they can not be liquid or gas)
- have a definite chemical composition (there is a chemical formula to make them e.g. Halite which is table salt is NaCl, Na = sodium, Cl = chloride)
- have an internal structure (the atoms are arranged in a systematic pattern)

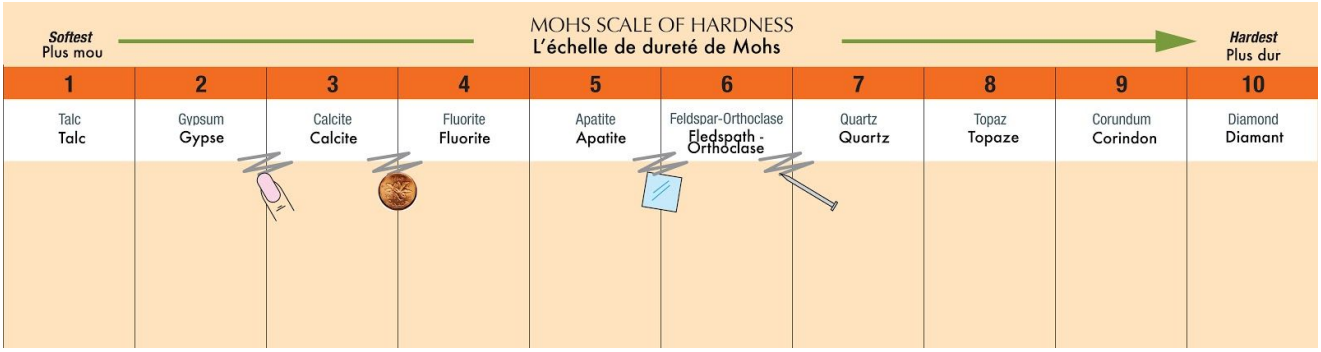
Rocks:

- occur naturally in nature (people did not make it)
- are made up of 2 or more minerals
- are either igneous, sedimentary or metamorphic

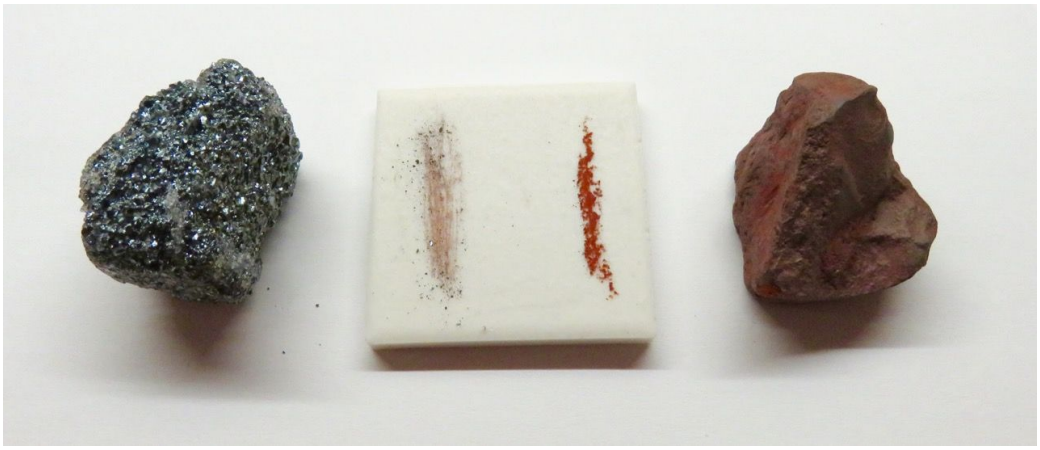
Think of rocks and minerals like baking a cake:
Imagine you are a chef required to bake a cake. In order to do this you will need to find ingredients such as flour, eggs, and sugar. Once the ingredients are mixed together and baked you get your cake. In terms of rocks and minerals, the ingredients in the cake represent the minerals and the cake itself is the rock. You need to add ingredients, the minerals, along with erosion, pressure, heat, etc., to make a rock.

Let's take a closer look at minerals:
There are physical properties that can be used to help identify minerals. We will explore a few of these in this lesson. The first thing you'll want to do is have a look at the minerals colour. It's important to note that a single type of mineral can have many different colours but sometimes looking at its colour can help.

Hardness
The hardness of a mineral is an important identification feature. To help us determine the hardness we use a scale from 1 to 10 called Mohs hardness scale. Minerals that have a hardness of 1 are very soft and minerals with a hardness of 10 are very hard.



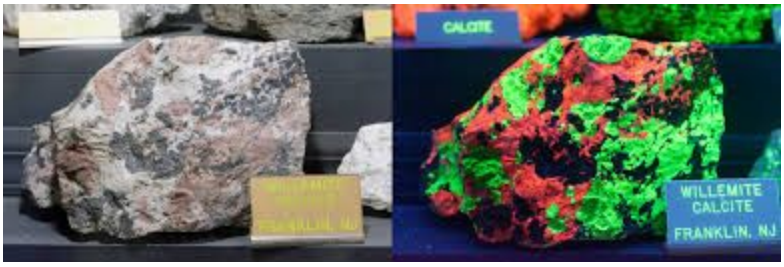
Streak.
Most minerals leave a mark, called streak, on an unglazed ceramic plate. The colour of this streak is used in identification, especially for those with a distinctive streak. For example the mineral hematite can have a black metallic colour but will leave a reddish brown streak. See the image below. Both these minerals are hematite. Though they look different they will still leave behind the reddish brown streak.



Fluorescence

Some minerals can "glow" different colours under ultraviolet light. Fluorescence is the ability of some minerals to absorb ultraviolet light and change it into visible light. Impurities within the crystal structures of a mineral are responsible for its fluorescence.

Below is a picture of a mineral called Willemite (pink coloured mineral) in Calcite (white colour mine. In the first image under natural light Willemite is a pink colour and calcite is a white colour. Under shortwave ultraviolet light Willemite is green and calcite is orange.



Now that we have an understanding of different characteristics used to identify minerals it's also important to understand where minerals are used in everyday life. Below you will find four everyday things that use minerals. The different mineral names have been underlined. How many can you count?

- Did you know that you eat minerals everyday? The mineral Halite is a common food preservative and flavour enhancer, which most people have in their pantry. Typically you would encounter it as a white granular powder, can you guess what it is? It's salt!

- Cosmetics contain a variety of minerals. Muscovite or other forms of mica are used to provide a shimmery or glitter like appearance. Talc and bismuth provide a shimmery or pearlescent appearance to the skin, bismuth is more effective than talc in this manner and adheres to the skin more than talc. Hematite and barite are used for colour, with barite being more gentle on your skin.

- Toilets and bathtubs use feldspar to make porcelain, pyrolusite as a colouriser (blue and green) or to remove other colours from glass and porcelain as part of a chemical reaction. Chromite is used in the fixtures and copper for the piping.

- Our mobile devices use many different types of minerals. The device's glass screen is very durable because glassmakers combine its main ingredient, silica (silicon dioxide or quartz) sand, with ceramic materials and then add potassium. Layers of indium-tin-oxide are used to create transparent circuits in the display. Tin is also the ingredient in circuit board solder, cassiterite is a primary source of tin. Gallium provides light emitting diode (LED) backlighting. Bauxite is the primary source of this commodity. Sphalerite is the source of indium (used in the screen's conductive coating) and germanium (used in displays and LEDs). Let's not forget all the electronics and circuitry that are required! The content of copper in a mobile device far exceeds the amount of any other metal. Copper conducts electricity and heat and comes from the source mineral chalcopyrite. Tetrahedrite is a primary source of silver. Silver-based inks on composite boards create electrical pathways through a device. Silicon, very abundant in the Earth's crust, is produced from the source mineral quartz and is the basis of integrated circuits. Arsenopyrite is a source of arsenic, which is used in radio frequency and power amplifiers. Tantalum, from the source mineral tantalite, is added to capacitors to regulate voltage and improve the audio quality of a device. Wolframite is a source of tungsten, which acts as a heat sink and provides the mass for mobile phone vibration. The battery uses spodumene and subsurface brines as the sources of lithium used in cathodes of lithium-ion batteries. Graphite is used for the anodes of lithium-ion batteries because of its electrical and thermal conductivity. The speakers and vibration use bastnaesite, a source of rare-earth elements, that is used to produce magnets in the speakers, microphones, and vibration motors.

Pheww! Those are a lot of different minerals in only 4 items!

Activity Procedure

Mineral Testing

This activity will allow you to identify key properties of your mineral samples.

Hardness

To start, we will determine the hardness of your mineral based on Mohs Hardness Scale. Let's start with your first sample. Try to scratch the sample with your fingernail. If your fingernail scratches the mineral this is where you stop. This means that the sample is soft and has a hardness of 1 to 2.5. If you can't scratch the sample you will move on to the copper penny or the small piece of copper pipe. If you are able to scratch the sample this is where you will stop. Your sample has a hardness between 2.5 and 3.5. If it still doesn't scratch your sample you will move on to a steel nail. If you scratch your sample it has a hardness between 5.5 and 6.5. If your sample still did not scratch it is harder than 6.5 on Mohs hardness scale.

You will need to repeat this test for all your samples and record what you find using the hardness column of the Mineral Identification handout.

Streak
Using an unglazed ceramic tile, trace a line using your mineral. What colour do you see? Note this in under the streak column. Do the same with your remaining samples.

*Ask your parents to see if they have a spare tile if not, don't worry you can try and rub the mineral on a page or even your hand as softer minerals may still leave a trace.

The next test is not required for the handout, but is fun to try.

Fluorescence
Shine your black light on your minerals, do you see any changes in colour? Some minerals are fluorescent under ultraviolet light and this may help them with the identification.

Everyday Minerals Activity

The Everyday Mineral handout will require you to identify the minerals found in a stove and a bike. On each handout you will see a picture of the two items with a box of mineral names and how they can be used. Associate the mineral names found in the box to the blanks on the stove and the bike. It takes many different minerals to make some everyday items.

Debrief

By testing and observing some physical properties of minerals and gathering the information in a chart we can compare this with samples that we know and identify the minerals. Minerals are important to our everyday lives. We are surrounded by many items in our homes that need minerals in order to make them. If it's not grown it is mined!

Handout (Mineral Identification)

Fill out this chart for the samples you have collected.

Mineral Name	Colour	Hardness Test	Streak Test	Fluorescence
Sample 1				
Sample 2				
Sample 3				

This chart has examples of known samples. Compare your samples to the chart below. Do you think you have one of these minerals?

Mineral Name	Colour	Hardness Test	Streak Test	Fluorescence
Quartz	Many (colourless, white, pink, white, purple, black, grey,..)	6.5-7	white	some will
Muscovite (Mica)	Light Brown, silver or black	2.5-3	white, sheds tiny flakes	none
Calcite	White, Yellow, Red, Orange, Blue, Green, Brown, Gray etc.	3	white	some will
Feldspar (Orthoclase)	pink, white, gray, brown, blue,green)	6	white	some may
Halite	white (colourless, pink, yellow, red, purple or blue)	2.5	white	Red from Searles Lake, Ca or Orange from Poland

Handout (Everyday Objects: Bicycle)

From the list below, fill in the blank spots with the correct mineral(s) used to make the different parts of a bicycle. (Image Credit: Al2)

Bicycle diagram-en.svg: Al2, Borb, Richardprins, Keithonearth, Belamp, Hironiemusderivative work: Grandiose / CC BY (https://creativecommons.org/licenses/by/3.0)

List of minerals:

Titanium	Titanium	Aluminum	Stainless steel	Stainless steel
Rubber	Rubber	Steel	Graphite	

Common uses for these minerals:

Steel is an alloy of iron and carbon and usually other elements. Due to its hardness, high tensile strength and low cost, this material is commonly used in buildings, infrastructure, tools, ships, trains, cars, machines,bicycle frames and electrical appliances.

Aluminium is the most widely used non-ferrous metal, often used in cans, foils, kitchen utensils, window frames, aeroplane parts, or among other lightweight objects. Since steel is cheaper, aluminium is used when lightness, corrosion resistance, or engineering features are important.

Stainless steel is an iron-based alloy that contains chromium, which prevents the iron from rusting. Due to its excellent corrosion resistance, stainless steel is often used in architecture, from plumbing to construction material, as well as in cookware, kitchen sinks, cutlery, surgical instruments, major appliances, vehicles, aircrafts, and jewelry. Bicycle pull-brake cables consist of an inner cable of braided stainless steel wire.

Titanium is used to make alloys with other metals, like aluminium, molybdenum, manganese, iron, steel and stainless steel. It is used where lightweight, high strength and withstanding extreme temperatures are needed. For example, titanium is used for aeroplane parts, ships, cars, motorcycles, bicycle wheel spokes, jewelry, surgical implements, and implants.

Graphite's most familiar use is in pencil "lead", but it has many uses such as lubricants, in furnaces, batteries and brakes.

Rubber is very flexible, has a high elasticity, as well as a high resistance to water. It is commonly used in hoses, tires, shock absorbers, balloons, balls, diving gear, protective gloves, shoes, as well as insulating electrical instruments.

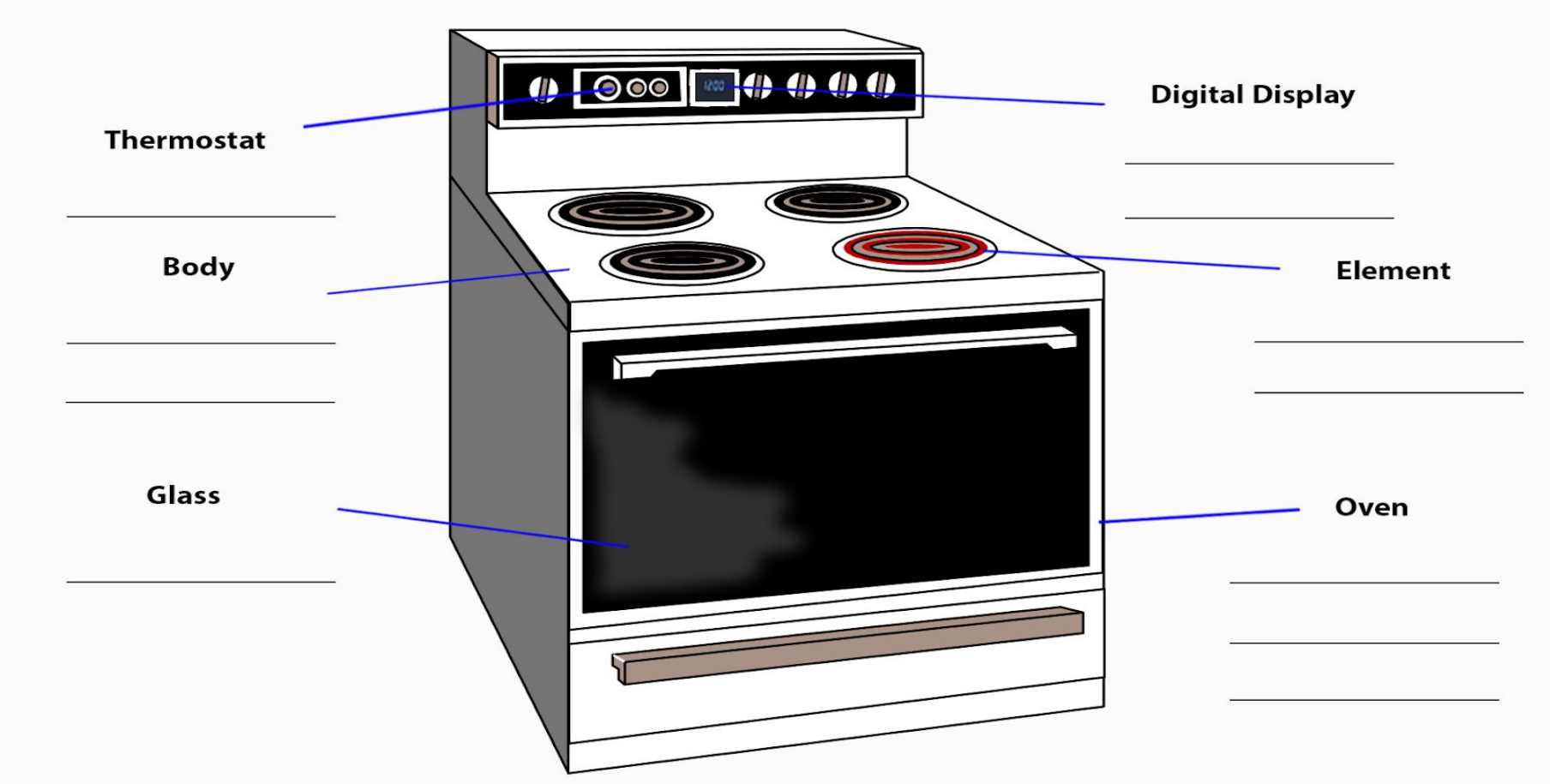
Handout (Everyday Objects: Bicycle) - ANSWERS

From the list below, fill in the blank spots with the correct mineral(s) used to make the different parts of a bicycle. (Image Credit: Al2)

Bicycle diagram-en.svg: Al2, Borb, Richardprins, Keithonearth, Belamp, Hironiemusderivative work: Grandiose / CC BY (https://creativecommons.org/licenses/by/3.0)

Handout (Everyday Objects: Stove)

From the list below, fill in the blank spots with the correct mineral used to make the different parts of a bicycle.



List of minerals:

Gallium	Pentlandite	Pentlandite	Cinnabar	Germanium	Chromite
Quartz/silica	Hematite	Hematite	Hematite	Galena	

Common uses for these minerals:

Cinnabar is an ore of mercury and is used in thermometers.

Gallium is a soft, silvery metal used mainly in electronic circuits, semiconductors and light-emitting diodes (LEDs). It is also useful in high-temperature thermometers, barometers, pharmaceuticals and nuclear medicine tests.

Germanium's largest use is in the semiconductor industry. When doped with small amounts of arsenic, gallium, indium, antimony or phosphorus, germanium is used to make transistors for use in electronic devices. Germanium is also used to create alloys and as a phosphor in fluorescent lamps.

Hematite is the most important ore of iron. It is used in steel components and in many products such as building materials, cars and mostly anything containing metal.

Pentlandite is an ore of nickel. It's most common use is in the production of stainless steel, like in sinks and cutlery, but is also an important alloy to make other metals stronger or more heat resistant..

Chromite is used on handles, buttons and other chrome plated components.

Galena, also called lead glance, is the ore of lead. It is used in weights for lifting and diving, in solder for electronic components, in components used to store energy, and most importantly in car batteries.

Quartz/silica is mainly used in glass, but it is also used in construction, ceramics as well as many other things.

Handout (Everyday Objects: Stove) - ANSWERS