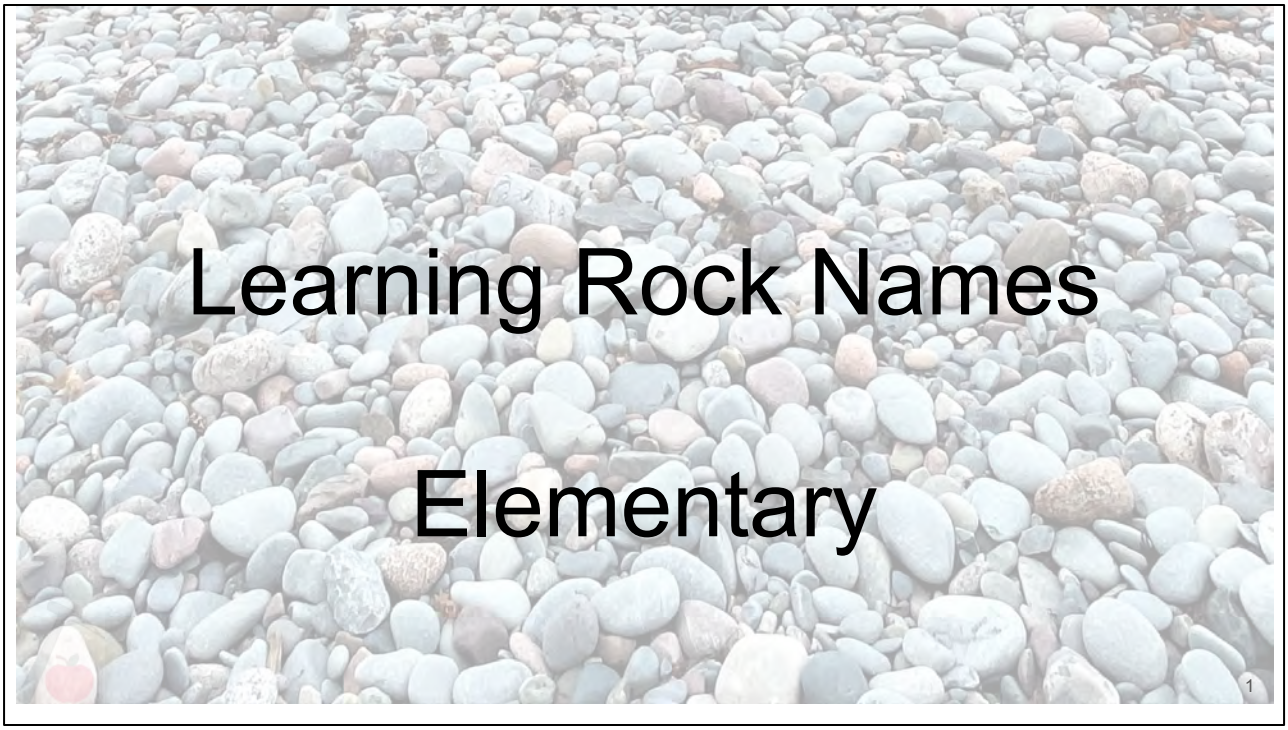


Notes for the Teacher

Instructions for the teacher are shown in italics.
This lesson plan is divided into 3 Rock modules which can be taught as separate modules or done on the same day over a period of 3 ½ to 4 hrs.
NOTE - The Mineral Module is 1½ to 2 hrs, so it is advisable to do this module on a day other than the Rock modules.

Rock Modules

Module 1 - How are Rocks Made?

- Duration - 40 to 45 mins
- Materials - How to Identify Rocks and Minerals booklet
- Classroom set up - individual or group

Module 2 - What's in a Rock?

- Duration - 1½ to 2 hrs
- Materials - PAIL #s 1, 2 and 3
- Classroom set up - group

Module 3 - What are the Rock Names?

- duration - 1 to 1½ hrs
- materials - PAIL #s 2 and 3
- Classroom set up - individual or group

The number of sets packed will be based on classroom size with 1 set per group of 4-6 students

PAIL 1

Bag #1 - large bag containing the following

- Small bag with two rocks (#37-granite and #18-red sandstone)
- Small bag with 4 minerals (quartz, feldspar, biotite, and hornblende) and small plastic container filled with sand
- Small bag with lego blocks and small pebbles
- Small rubbermaid containers - X 2

Large bag containing 4-6 hand lens based on group sizes

PAIL 2

Bag #2 - large bag with 7 rock samples in small bags (#25-schist, #29-gneiss, #40 -grey granite, #15-red granite, #7-amygdaloidal basalt, #14-conglomerate, and #4-grey sandstone)
Rock Mat with pencil case containing labels for the Rock Mat

PAIL 3

Bag #3 - large bag containing the following

- 5 rock samples in small bags (#2-slate, #39-vesicular basalt, #31-mudstone, #33-limestone, and #21-gypsum)
- Small bag with two streak plates, two pennies and a cloth

TEACHER PAIL

- Handouts #1 to #4 X # of students in the class
- How to Identify Rocks and Minerals booklet X # of students in the class
- How to Identify Rocks and Minerals- Student Workbook X # of students in the class
- Large bag with plastic water bottles (1/group) and plastic vinegar bottles (3/class to be filled just prior to instruction)

How are Rocks Made?

Module 1

Module 1 - How are Rocks Made?

This module introduces concepts of Earth's interior, plate tectonics, and the rock cycle. By the end of this module they will learn the names of the three rock types - Igneous, Sedimentary and Metamorphic and understand that the movement of plate tectonics creates a continuous cycle where rocks are formed and transformed - which is referred to as the Rock Cycle.

Classroom set-up
This module can be taught as either an individual or group activity. However, it is advisable to set up for group activity if Module 2 is being taught immediately after this one..

Duration *- 40 to 45 minutes*

Materials
How to Identify Rocks and Minerals booklet (one per student)
Video - THE GEOSPHERE - 4:52 mins

Geosphere

For us to live on Planet Earth we need these four things

Geologist study the **GEOSPHERE** which provides nutrients for food

3

Geosphere

Explain:
Scientists study the Geosphere to learn about Rock and Minerals.
All life on our planet Earth need these four things to live. The **Atmosphere** gives us air to breathe, the **Hydrosphere** provides us water, the **Biosphere** feeds us and the **Geosphere** provides the nutrients to make food

Play the video: Here is a short video to tells us about the Geosphere.

Duration - 10 - 15 minutes

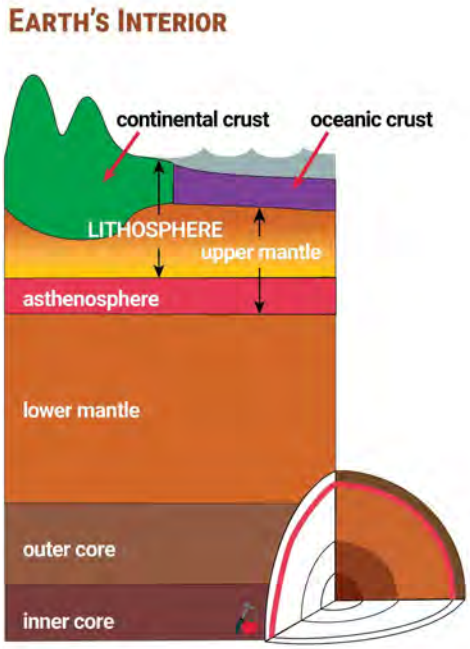
Materials - Video - THE GEOSPHERE - 5.42 minutes

Earth's Interior

The Earth is made up of three main layers **CRUST**, **MANTLE** and **CORE**

The **LITHOSPHERE** is made up of all the solid, rocky material of the Earth, includes

- dust in the air
- soil
- rock on and below the Earth's surface



Earth's Interior

Distribute *booklets*

Instruct: Open your booklet to page 1 to view this figure.

Explain:
In the Geosphere video we learned that the Earth is made up of three main layers - **Crust**, **Mantle** and **Core**. Another important layer is called the **Lithosphere** - it is made up of all the solid rocky material of the Earth. This includes the dust in the air, the soil, and rock on and below the surface of the Earth.

Duration - 2 - 3 minutes

Materials - How to Identify Rocks and Minerals booklet (one per student)

Plate Tectonic Map

Can you find where Canada is on this map?

What tectonic plate is under Canada?

What do the red arrows mean?

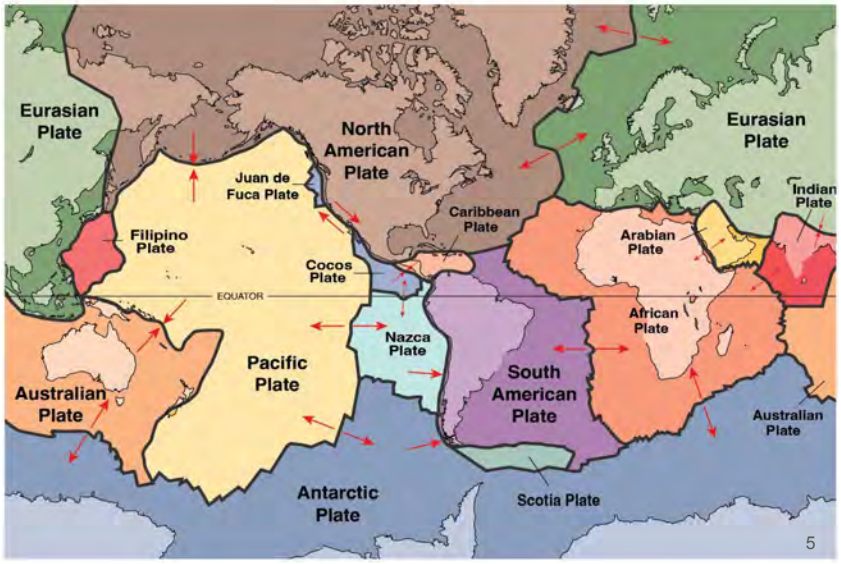


Plate Tectonic Map

Explain: From the videos we learned about the Earth's crust - which we can think of as the "skin" of the Earth. It is broken up into pieces called **tectonic plates**. This map illustrates all the different tectonic plates that cover the Earth.

Ask:
Can you find where Canada is on this map? What Tectonic Plate lies below Canada? Answer - North American Plate What do you think the red arrows mean? Answer - movement
Instruct: Find the red arrows. These show the direction that the plates are moving. The constant movement of tectonic plates is the reason why rocks are formed and always changing.

Explain: Go to page 2 of your booklet to see how different plates moves. As you can see they can either move towards each other and collide; move away from each other; or move past each other with their sides touching. The tectonic are always moving, but most move so slow that you can't notice it.

Duration - 2 - 3 minutes

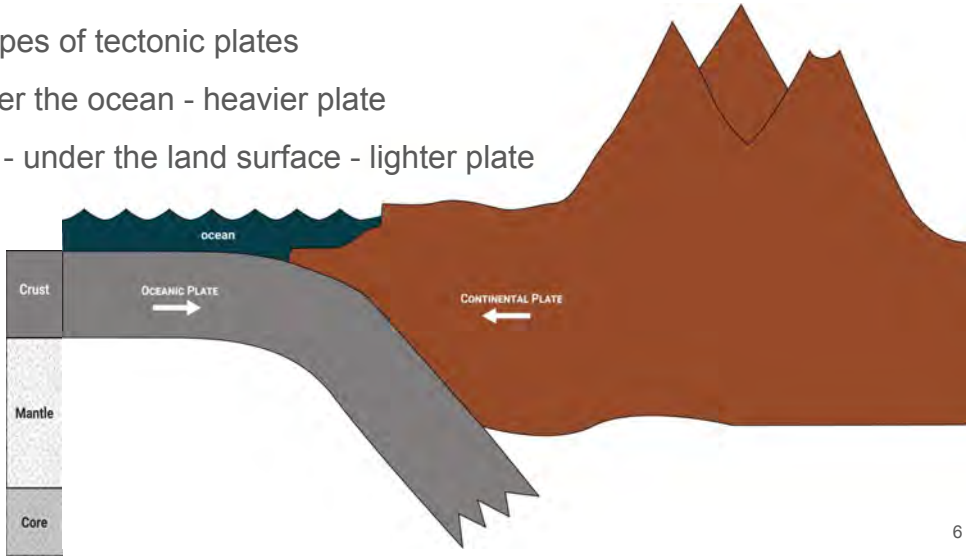
Materials - How to Identify Rocks and Minerals booklet (one per student)

Tectonic Plates

There are two types of tectonic plates

OCEANIC - under the ocean - heavier plate

CONTINENTAL - under the land surface - lighter plate



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Tectonic Plates

Instruct: Close your booklet now, as we learn about how the movement of the tectonic plates creates the three rock types of Igneous, Sedimentary and Metamorphic.

Explain:
There are two types of tectonic plates - **oceanic plates** (shown in grey) are found under the ocean and **continental plates** (shown in brown) make up our land surfaces.
In this example we have an oceanic plate moving towards a continental plate. When they collide, the oceanic plate gets pushed down into the mantle because it is heavier than the continental plate.

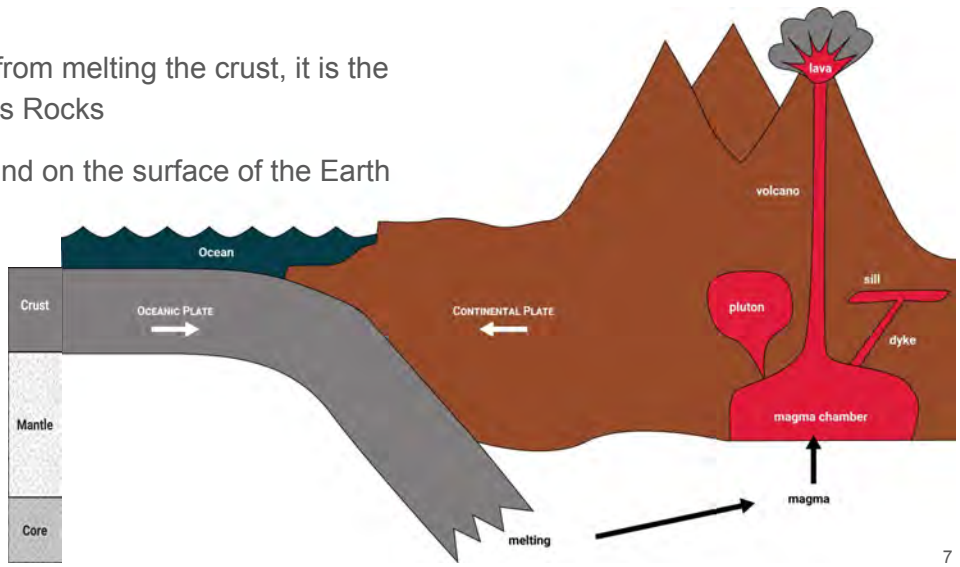
Duration - 2 - 3 minutes

Materials - none

Igneous Rocks

Magma is formed from melting the crust, it is the origin of all Igneous Rocks

They form below and on the surface of the Earth



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Igneous Rocks

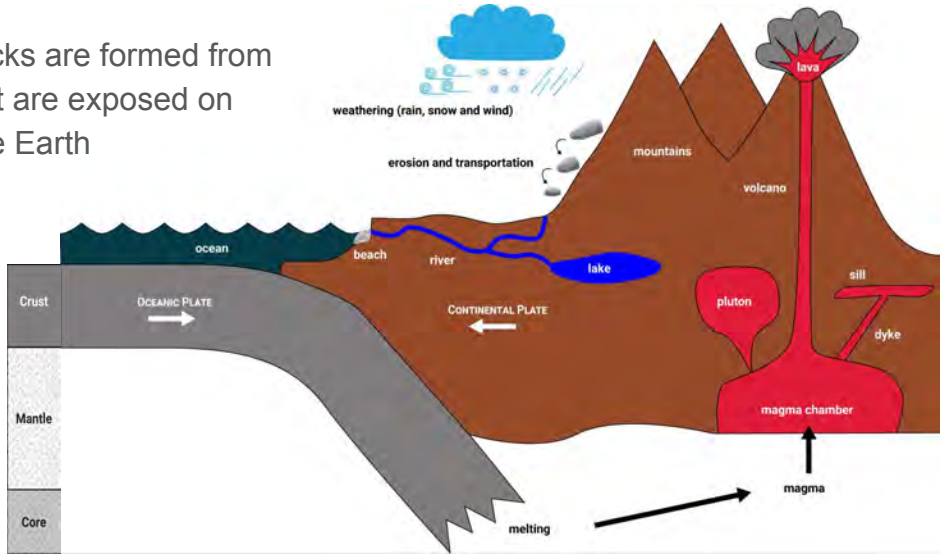
Explain:
The area on the right side of this diagram shows how **Igneous Rocks** are formed.
We learned in the video that the mantle is very hot - up to 3,000 degrees hot! That means that when the crust is pushed down into the mantle, the solid rock of the crust **melts** and creates **magma**. The magma collects in a magma chamber deep in the crust and then moves upwards towards the Earth's surface where it can can get trapped below the surface of the Earth in bodies such as a pluton, sill and dyke. Once they are trapped, the magma cools slowly to form solid rock inside the crust,. These rocks are called **Igneous Intrusive rocks** (to remember, think of "in" for rock forming **inside** the crust)
The magma can also be erupted from a volcano where it becomes a lava, which then cools rapidly into a solid rock on the surface of the Earth. These rocks are called **Igneous Extrusive rocks** (to remember, think of "ex" for rock forming when it **exits** the volcano).

Duration - 3 - 5 minutes

Materials - none

Sedimentary Rocks

Sedimentary Rocks are formed from broken rocks that are exposed on the surface of the Earth



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Sedimentary Rocks

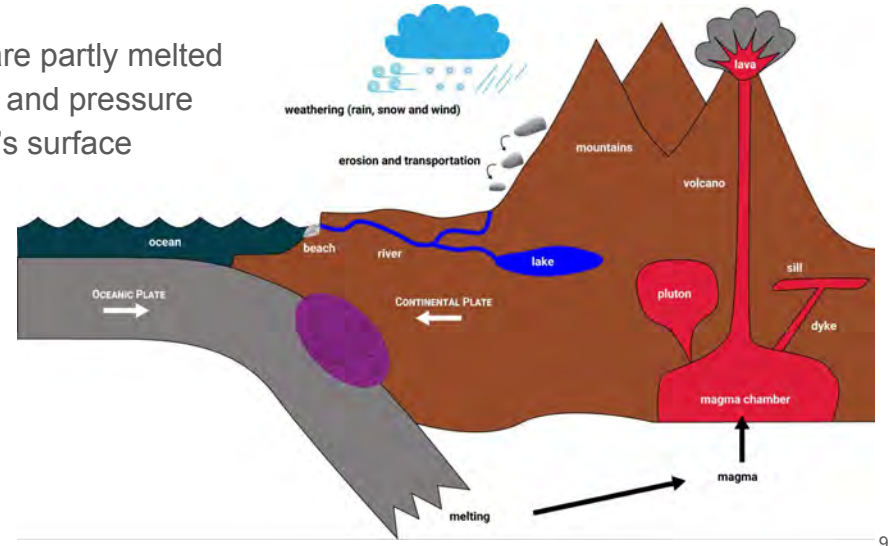
Explain:
The area on the left side of the mountains shows how **Sedimentary Rocks** are formed.
After the rock becomes exposed on the Earth's surface it starts to form sediments.
The first thing that happens is the rock gets broken up into pieces (called sediments) by the rain, snow, wind and also from the changing hot and cold temperatures - this is called **weathering**.
After the rock has been weathered, the broken pieces get moved and worn down into smaller pieces by processes called **erosion** and **transportation**. This happens when rock tumbles down a mountain slope or along the bottom of a river; and also when rocks get crushed and grinded down by moving glaciers.
Eventually, sediments stop moving and come to rest in lakes, rivers, beaches, and oceans - this is called **deposition**.

Duration - 3 - 5 minutes

Materials - none

Metamorphic Rocks

Metamorphic Rocks are partly melted and reformed by heat and pressure deep below the Earth's surface



Metamorphic Rocks

Explain:
The area in the purple circle shows **Metamorphic Rocks** are formed.
This is where the Oceanic and Continental Plate are colliding and pushing up against each other. This creates more pressure and higher temperatures and causes the rock to partly melt and change it into a different rock.

Duration - 2 - 3 minutes

Materials - none

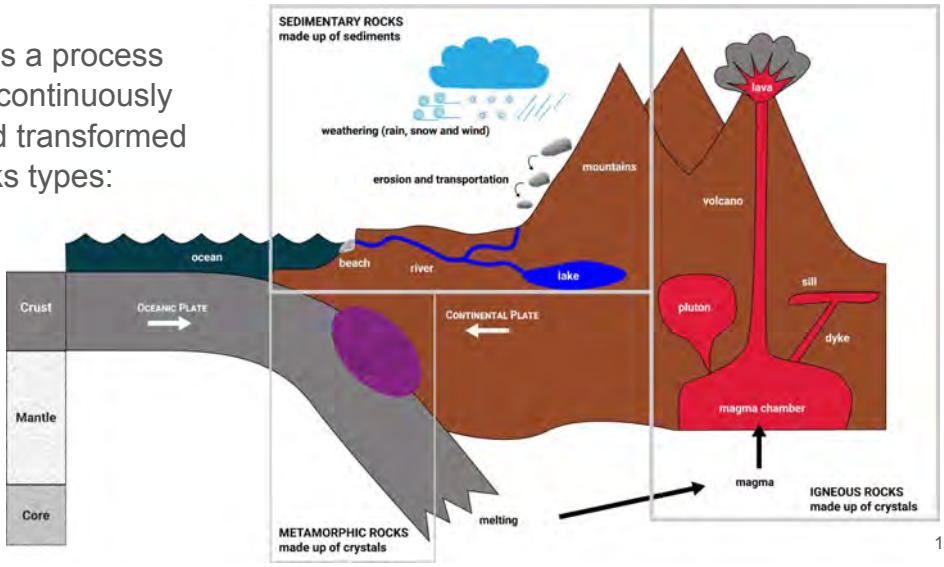
Rock Cycle & Rock Types

The Rock Cycle is a process where rocks are continuously being formed and transformed into different rocks types:

Igneous

Sedimentary

Metamorphic



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Rock Cycle & Rock Types

Explain *the continuous cycle motion*:
The formation of all the different rocks works as a cycle that is in continuous motion. If you think about the tectonic plates constantly moving, then what this means is that the rocks are also constantly moving and changing. This process is referred to as the **Rock Cycle**
The constant movement of the tectonic plates means that

- magma will keep forming, filling up magma chambers and creating **Igneous Intrusive rocks** below the Earth's surface
- volcanoes will keep erupting and creating **Igneous Extrusive rocks** on the Earth's surface
- rocks on the Earth's surface will keep weathering and creating **Sedimentary Rocks**, and
- rocks in the Earth's crust will keep changing into other rocks and creating **Metamorphic Rocks**.

Duration - 8 - 10 minutes

Materials - none

Teacher Note: *As this is the end of Module 1 - take a few minutes to briefly review the material learned up to this point - Earth's Interior, Plate Tectonics, Rock Types and Rock Cycle*

What's in a Rock?

Module 2

Module 2 - What's in a Rock?

This module is divided into three activities and includes hands-on activities which starts with the concept of crystals versus sediments and is followed with activities using rock samples and the Rock Mat. Students will sort 13 rock samples based on observations, with emphasis on texture (crystal vs sediment) and patterns. By the end of this module, students will have learned how to notice the different textures and patterns of rocks found in Igneous, Sedimentary and Metamorphic rock types.

Classroom set-up
This module is done in groups of 4 to 6 students. Each of the three activities are taught using materials from a different PAILS.

Duration - 1½ to 2 hrs

Materials

Activity 1 - Crystals and Sediments - learning what these are - use PAIL #1 which contains Bag 1 and bag containing Hand lenses (one per student)

Activity 2 - Sorting rock samples into Crystals and Sediments that are large enough to see - use PAIL #2 which contains Bag 2, Rock Mat and pencil case filled with labels for the Rock Mat

Activity 3 - Sorting rock samples into Crystals and Sediments that are too small to see and learning the rock types of all the rock samples - use PAIL #3 which contains Bag 3

Rock video

Rock video

Introduce the video: Let's take a closer look at the rock types that we have learned about.

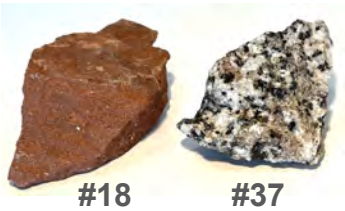
Play the video

Duration - 4 - 5 minutes

Materials - Video - Rocks and Minerals **-** (3.44 minutes)

Rock Observations

Describe these rock samples



#18 #37

How do they feel?

What colours do you see?

What other things do you notice?

Write as many words as you can to describe these rocks.

How does it feel?

What colours do you see?

Can you see any patterns?

What others things can you see?

Sample # ____

this rock is made up of _____

Sample # ____

this rock is made up of _____

13

Rock Observations - Activity 1

Explain: Now that you know the different rock types, we'll look at what they are made of.
Instruct: From PAIL #1, take a bag labelled number 1 and a second bag containing hand lenses. For now, only take out the hand lenses from the bag. Once you have your hand lens, choose a small object that you would like to examine closely, something like a pencil or an eraser.
***Demonstrate*:** Open your hand lens and hold it close to the eye that you want to look with. You can keep your other eye open or closed. Bring your object up close to the hand lens. Move it further away and closer until the object comes into focus.
Distribute *Handout #1*
Instruct*:* Take the two rock samples out from Bag 1. Describe each rock using the form. Write down as many descriptions as you can. Make sure everyone in your group gets an equal turn to look at each rock.
Explain: Because the rocks are not flat, you'll only see small parts of the rocks that are in focus, so keep moving the lens in and out and move the rocks around to look at more parts of the rocks.
When all the students are done, ***Ask****:* Can you give me what words you used to describe your rocks?
Write all the different words for each rock sample on the board and review the words used to describe the rocks. Add terms that might be missing.
Explain*:* sample #37 is made up of **Crystals** and it is an **Igneous** rock and #18 is made up of **Sediments** so it is a **Sedimentary** rock.
Duration - 12 - 15 minutes
Materials

PAIL #1 - Use the following material from Bag 1:

- Small bag with two rocks samples in it (**#37 - granite;** and **#18 - sandstone)**

Large bag containing Hand lenses (one per student)
TEACHER PAIL - Handout #1 - Crystal and Sediments (one per student)

Crystals & Sediments

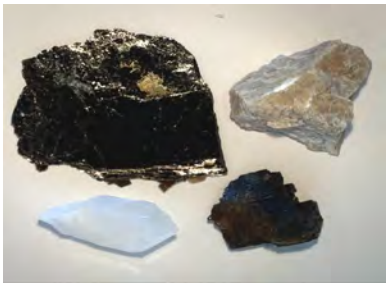
Most rocks are made up CRYSTAL or SEDIMENTS

How are they different?

Which one is in which rock type?

- Igneous rock
- Sedimentary rock
- Metamorphic rock

Crystals



Sediments

14

Crystals & Sediments- Activity 1 continued

Explain*:* Most rocks are made up of either crystals or sediments. To help you understand what these are we'll look at some different materials.
Instruct: Place your four samples on the desk and pour out the material from the small plastic container into the larger container. Take a closer look at the samples with your hand lens and move around the material to feel it.
Ask: How are these different? Can you match the material in these two containers to the rocks you just described? *Answer*: The four samples are crystals representing the different minerals that make up sample #37 that you just described. Previously you learned (OR In another lesson you will learn) about minerals. The glassy mineral is quartz; the whitish one is feldspar; the thin black mineral is biotite and the other black mineral is hornblende. Notice that the minerals are shiny, some have flat surfaces with corners, and each mineral is mostly one colour. The material in the other container is sand that makes up sample #18. Sand is made up of small bits of broken rock.
Ask: Which is what rock type? *Answer -crystals are in Igneous and Metamorphic; and sediments are in Sedimentary Rocks.*
Duration - 8 - 10 minutes

Materials

PAIL #1 - Use the following additional material from Bag 1:

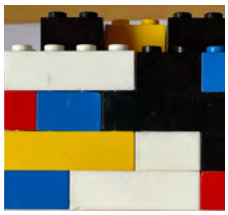
- rubbermaid container X 1
- small plastic container filled with sand (empty this into the rubbermaid container for students to feel the sand grains)
- small bag with mineral samples - **biotite** (black, thin sheets)**; feldspar** (whitish, blocky)**; quartz** (glassy prism)**; hornblende** (black, blocky)

Hand lens

Permeability

Permeability is a measure of how fast water flows through the rock

- Rocks made of crystals are **impermeable** because water can't get in between the **crystals**, like lego blocks



- Rocks made of **sediments** are **permeable** because water can flow through the spaces, like the Rice Krispie square or these pebbles

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Permeability - Activity 1 continued (OPTIONAL ACTIVITY)

Teacher Note - *Permeability is an important characteristic of a rock. This demonstration will also explain that crystals are interlocked much like lego blocks and sediments are held together by a "glue". You can use the analogy of a Rice Krispie square, where the rice is the sediment and the melted marshmallow is the glue that holds the sediments together.*

Instruct: Take a few lego blocks and stack them together. Now pour the pebbles into the container.

Explain: The lego blocks show how crystals are held together in a rock. The pebbles represent a rock made up of sediments.

Ask: What do you notice about the spaces between the blocks compared to the pebbles? Which one would allow water to run through it? *Answers*: There are no spaces between the lego blocks because the blocks snap together so no water would run through it - so they are **impermeable,** this is because the crystals are interlocked together. There are lots of open spaces between the pebbles which would allow water to flow through it - so they are **permeable,** this is because sediments are held together by a type of glue.

Instruct: Place your lego blocks and pebbles back into a small bag. Place your mineral samples back into their pouches. Pour the sand back into the small plastic container and place it and the minerals back in the back in a small bag. Place the two rock samples back into a small bag. Place all you small bags into Bag 1 and back into PAIL #1. KEEP YOUR HAND LENS FOR THE NEXT ACTIVITY.

Duration - 3 - 5 minutes

Materials

PAIL #1 - Use the remainder of the material from Bag 1:

- rubbermaid container X 1
- small sample bag containing lego blocks (empty onto desk and assemble) and pebbles (pour into rubbermaid container)

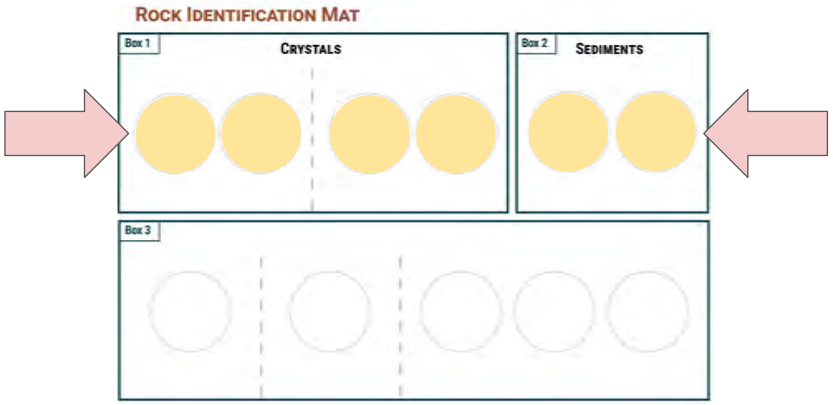
Rock Mat

Sort rocks from Bag 1 into

CRYSTALS

or

SEDIMENTS



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Sort rocks into Crystals and Sediments - Activity 2

Before starting this exercise, all the materials from the previous activity should be in PAIL #1.

Distribute: *Provide each group with a small plastic bottle filled with water. Use the plastic bottle labelled water.*

Instruct: From PAIL #2 - take out a large mat, a pencil case and Bag 2 from PAIL #2. Place the Rock Mat on your desk and take the rocks out of the small bags. From your pencil case, take out the two large labels that say **CRYSTALS** and **SEDIMENTS**. Place the **CRYSTALS** label on the left spot at the top of your Mat and **SEDIMENTS** on the right spot at the top of your Mat.

Sort all the rock samples by placing them in the space under **CRYSTALS** or the space under **SEDIMENTS**. Use your hand lens to look more closely at the rocks. You can also add a drop of water to the rock and rub it around to see more details

Confirm*: At the end of this activity the rock samples should be correctly sorted into* **CRYSTALS** and **SEDIMENTS**. CRYSTALS are samples - #25, #29, #40, #15 and #7. SEDIMENTS are samples - #14 and #4.

Duration - 12 -15 minutes

Materials

PAIL #1 - Hand lens

PAIL #2

- Bag 2 with rock samples numbered- **#25-schist; #29-gneiss; #15-red granite; #40-grey granite; #7-amygdaloidal basalt; #14-conglomerate; and #4-grey sandstone**
- Pencil case labels **CRYSTALS** and **SEDIMENTS** (if not already indicated on the mat)

TEACHER PAIL - plastic bottle filled with water (one per group) - handed out by the teacher/facilitator

Rock Mat

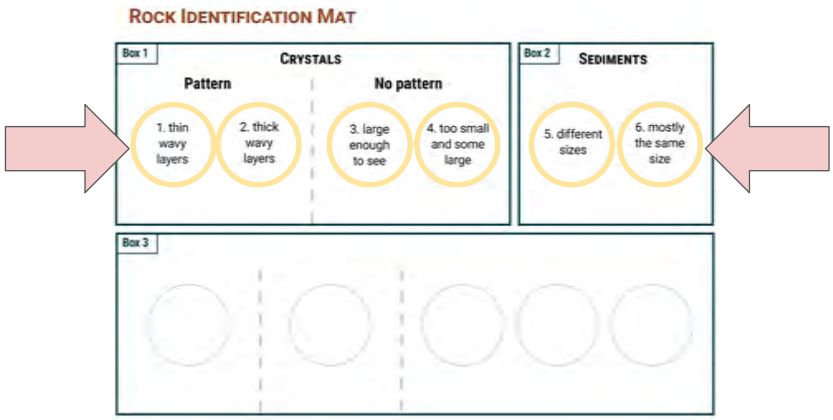
Match your rocks to the descriptions shown in the circles under

CRYSTALS

and

SEDIMENTS

Clue - two rocks match to one of the circles



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Match rocks to descriptions in the circles under CRYSTALS and SEDIMENTS - Activity 2 continued

Instruct:
Take out the rock description labels numbered 1. to 6. from the pencil case and also the large labels with the words **pattern** and **no pattern**.
Place the word **pattern** on the left hand side of the Mat above circles 1. and 2. Place the word **no pattern** above circles 3. and 4. Place the descriptions in the circles (1. to 6.) with the same numbers. Now, match the rocks to the descriptions. Use your hand lens to look more closely at the rock texture. Note that two of the rocks match to one of the circles.
Explain: Patterns will look different on the different surfaces. The pattern you are looking for is layers.
Confirm: *make sure the rock samples are correctly matched to the description* (1. - #25; 2. - #29; 3. - #15, and #40; 4. - #7; 5. - #14; 6. - #4)
Instruct: Keep your rock samples in their circles on the mat.

Duration - 12 - 15 minutes

Materials
PAIL #1 - Hand lens
PAIL #2

- Bag 2 with rock samples numbered- **#25-schist; #29-gneiss; #15-red granite; #40-grey granite; #7-amygdaloidal basalt; #14-conglomerate; and #4-grey sandstone**
- Pencil case labels - **pattern** and **no pattern** (if not already indicated on the mat) and rock descriptions 1. to 6.

TEACHER PAIL - plastic bottle filled with water (one per group)

Rock tests for some Sedimentary rocks

Vinegar Test

- Hold the streak plate firmly on your desk
- Make a powder with the rock
- Add a drop of vinegar on the powder
- Wait to see if bubbles form
  = LIMESTONE

Hardness Test

- Use the penny to try to scratch the rock
- The rock is softer than the penny if there are grooves in the rock
  = GYPSUM

Rock Test Demonstrations

Explain: In the next sample of rocks that you will receive, the crystals and sediments will be too small to see. Two of the rock samples will be Sedimentary rocks that can be identified by tests that you will perform. I will demonstrate how to do these two tests.
Demonstrate: **Vinegar Test -** The first test will determine if the rock contains a mineral called calcite which is found in a Sedimentary rock called a LIMESTONE. To do this test, start by placing the streak plate of the desk. Hold it securely so it stays in place and then scratch the rock on the streak plate so it makes a powder. Place a drop of vinegar on the powder and look for bubbles to appear. It might take a few seconds and the bubbles might be really small. Look inside the drop of vinegar for tiny bubbles.
Emphasize caution: Always handle the rock samples with care as they are used by other classes. After you have done the streak test, wipe the powder and vinegar off the streak plate with the cloth.
Demonstrate: **Hardness Test -** This is a test that will determine if the rock is a Sedimentary rock called gypsum. Gypsum is a rock that is very soft in comparison to most rocks. If the rock can be scratched by a penny then the rock is very soft. When you try to scratch the rock with the penny, look closely at the scratch mark on the rock. If it can be rubbed off and there are no grooves on it, then the penny didn't scratch the rock. You might notice scratches on the penny when the rock is harder than it.
If you notice grooves in the rock then the penny is harder than the rock and determine that the rock is gypsum.

Duration - 3 - 5 minutes

Materials for the demonstration
TEACHER PAIL

- Small bag containing - Limestone rock; streak plate; penny; and cloth
- Plastic bottle filled with vinegar

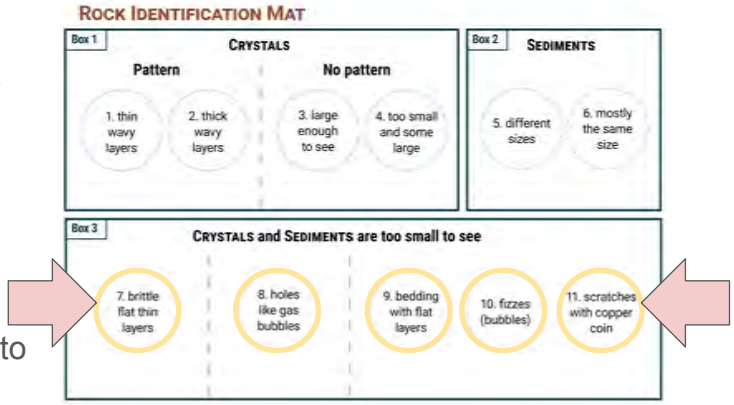
Rock Mat

Match your rocks to the descriptions in the circles under

CRYSTALS and SEDIMENTS are too small to see

Perform

- **Vinegar test** to match rock to circle 10. LIMESTONE
- **Hardness test** to match rock to circle 11. GYPSUM



Match to bottom row - Activity 3

Instruct: Leave your rocks on the Mat in the **CRYSTALS** and **SEDIMENTS** circles for this activity. From PAIL #3, take out Bag 3. From the pencil case, take out the labels numbered 7. to 11. and add them to the circles with the same numbers in the **CRYSTALS and SEDIMENTS are too small to see**. Now match the rocks to these descriptions. Find the two rocks that match circle #10 - by doing the vinegar test and then circle #11 - by doing the hardness test. For the remaining rocks you will have to notice the patterns which are usually seen as layers. Look over the entire rock as the pattern will not look the same on the different surfaces.

Confirm: students have correctly matched the rock samples to the descriptions. (7. - #2; 8. - #39; 9. - #31; 10. - #33; 11. - #21)

Duration - 12 - 15 minutes

Materials

PAIL #1 - Hand lens

PAIL # 2 - Pencil case labels

- label **CRYSTALS and SEDIMENTS are too small to see** (*cut into two pieces*)
- rock descriptions 7. to 11.

PAIL #3

- Bag 3 with rock samples numbered **#2-slate; #39-vesicular basalt; #31-mudstone; #33-limestone; and #21-gypsum**
- small bag with two pennies, two streak plates and one cloth

TEACHER PAIL

- plastic bottle filled with water - one per group
- plastic bottle filled with vinegar - held and distributed by teacher and facilitator

Rock Mat

Match the rock types

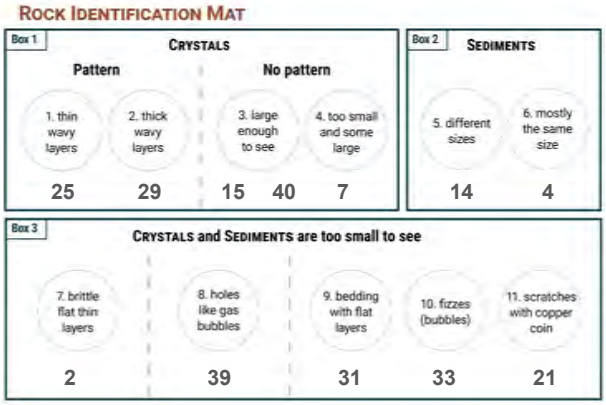
- place the rock type labels below each of the circles

Remember

Igneous has crystals

Sedimentary has sediments

Metamorphic has crystals



Match Rock Types to all the circles - Activity 3 continued

Instruct: Here are the rock samples numbers that match the circles. Fill in these numbers under each circle on your Rock Mat form. Make sure all your rock samples are placed correctly in the circles
Ask: What are the three rock types? Answer Igneous, Sedimentary and Metamorphic
Instruct: From the pencil case, remove the remaining contents, these should be the rock type labels.
Ask: What are the PLACES and PROCESSES for Igneous rocks? Are they made up of crystals or sediments? Find all the rocks that are **Igneous**
Ask: What are the PLACES and PROCESSES for Sedimentary rocks? Are they made up of crystals or sediments? Find all the rocks that are **Sedimentary**
Explain: Then, all the rocks that are left over, must then be **Metamorphic**!

Duration - 8 - 10 minutes

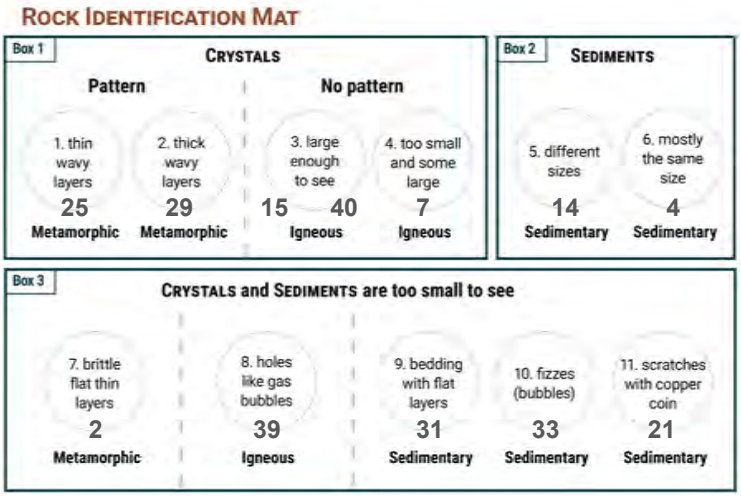
Materials
PAIL #1 - Hand lens
PAIL #2

- Bag 2 with rock samples numbered- **#25-schist; #29-gneiss; #15-red granite; #40-grey granite; #7-amygdaloidal basalt; #14-conglomerate; and #4-grey sandstone**
- Pencil case labels - **Igneous, Sedimentary** and **Metamorphic**.

PAIL #3
Bag 3 with rock samples numbered **#2-slate; #39-vesicular basalt; #31-mudstone; #33-limestone; and #21-gypsum**

Rock Mat

Here are the rock types for each of the circles



Answers for the Rock Types for all the circles - Activity 3 continued

Instruct: Here are the answers to the rock types for your rock samples

Duration - 2 - 3 minutes

Materials

PAIL #1 - hand lens

PAIL #2

- Bag 2 with rock samples numbered- **#25-Metamorphic ; #29-Metamorphic; #40-Igneous; #15-Igneous; #7-Igneous; #14-Sedimentary; and #4-Sedimentary**
- Pencil case labels - **Igneous; Sedimentary**; and **Metamorphic**

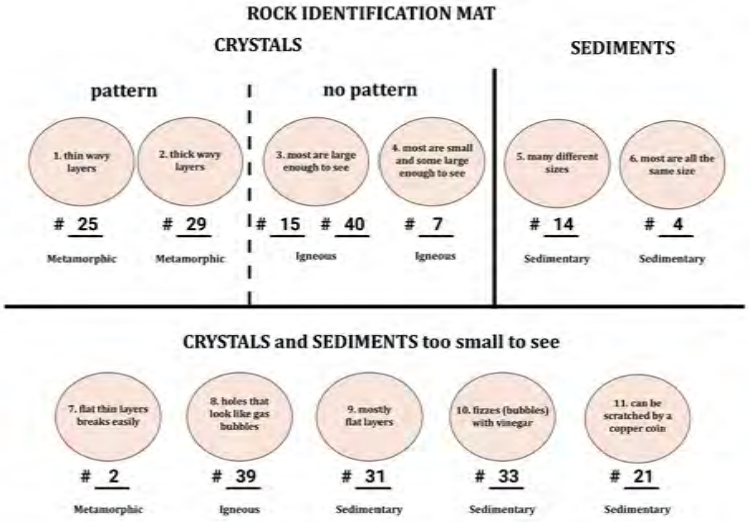
PAIL #3

Bag 3 with rock samples numbered **#2-Metamorphic; #39-Igneous; #31-Sedimentary; #33-Sedimentary; and #21-Sedimentary**

Rock Mat

Add the samples numbers under the circles

Use the answers to help you identify the rock name in the next module



Rock Mat Types and numbers - Activity 3 continued

Distribute: *Handout #2 - Rock Mat*
Instruct: Fill in the following form with the answers to the rock samples for the Rock Mat. You will use these to help you with the next module about learning rock names.

Duration - 3-5 minutes

Materials
TEACHER PAIL - Handout # 2 - Rock Mat

Teacher Note: *As this is the end of Rock Type - Module 2 - take a few minutes to briefly review students understanding of noticing crystals, sediments, and patterns in the rock.*
****** If you are continuing on to Module 3 on the same day as this Module - Place the Rock Mat and rock samples #33 and #21 back into the group's pail. Each of these rock sample should be placed inside a small sample bag and back into the Large Sample Bag #2. All remaining rock samples can stay of the group's desks.******

What are the Rock Names?

Module 3

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Module 3 - What are the rock names?

This module begins with a review of the rock types by referring to the How to Identify Rocks and Minerals booklet. Some of the slides are repeated from Module 1. Students will gain an understanding of the places and processes of each rock type - using the 3Ps Make a Rock (PLACE + PROCESS = PRODUCT). The review is followed by students choosing from one of the 10 rock samples to identify. They will complete the Rock Form, which includes sketching the rock, and use a Rock Key to help determine the rock name.

Classroom set-up
This module can be taught as an individual or group activity.

Duration - 1 to 1½ hrs

Materials
PAIL #1 - Hand lens
PAIL #2 - Bag 2 with rock samples numbered- **#25-schist; #29-gneiss; #15-red granite; #40-grey granite; #7-amygdaloidal basalt; #14-conglomerate; and #4-grey sandstone**
PAIL #3 - Bag 3 with rock samples numbered **#2-slate; #39-vesicular basalt; #31-mudstone; NOTE -** rock samples numbered **#33-limestone and #21-gypsum** should **NOT** be used for this Module
TEACHER PAIL
How to Identify Rocks and Minerals booklet
Handout #2 - Rock Mat
Handout #3 - Rock Form
Handout #4 - Rock Key

Note: The Rock Mat from PAIL #2 is not required for this module.

Igneous Rocks

PLACE

On Earth's surface

PROCESS

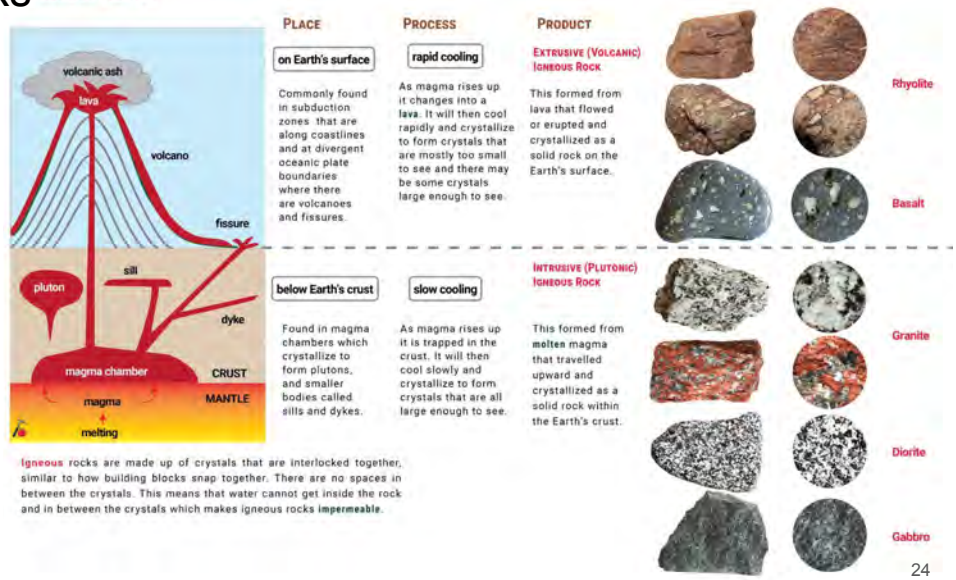
Rapid cooling

PLACE

Below Earth's surface

PROCESS

Slow cooling



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Igneous Rocks (OPTIONAL IF THIS MODULE IS NOT DONE ON SAME DAY AS MODULE 2)

Instruct: Open your booklets to page 5. to follow along

Explain: We will now review the PLACE and PROCESS for each of the rock types, starting with Igneous rocks to understand how they are formed and also why the rock types look different.

We learned in the video that the mantle is very hot - up to 3,000 degrees hot! That means that when the crust is pushed down into the mantle, the solid rock of the crust **melts** and creates **magma**. This magma collects in a magma chamber deep in the Earth's crust.

PLACE - On the Earth's surface - The magma from the magma chamber moves upwards and is erupted from a volcano where it becomes a lava.

PROCESS - Once the lava is erupted from the volcano it cools rapidly into a solid rock on the surface of the Earth.

PRODUCT - Igneous Extrusive rock - To remember the name, think of "**ex**" for rock forming when it **exits** the volcano. Some of the common rock names are rhyolite and basalt.

PLACE - Below Earth's surface - The magma from the magma chamber moves upwards towards the Earth's surface where it can can get trapped in bodies such as a pluton, sill and dyke.

PROCESS - Once they are trapped the magma cools slowly to form solid rock inside the crust.

PRODUCT - Igneous Intrusive rock -To remember the name, think of "**in**" for rock forming **inside** the crust). Some of the common rock names are granite, diorite and gabbro.

Duration - 3 - 5 minutes

Materials - TEACHER PAIL - How to Identify Rocks and Mineral booklet (one per student)

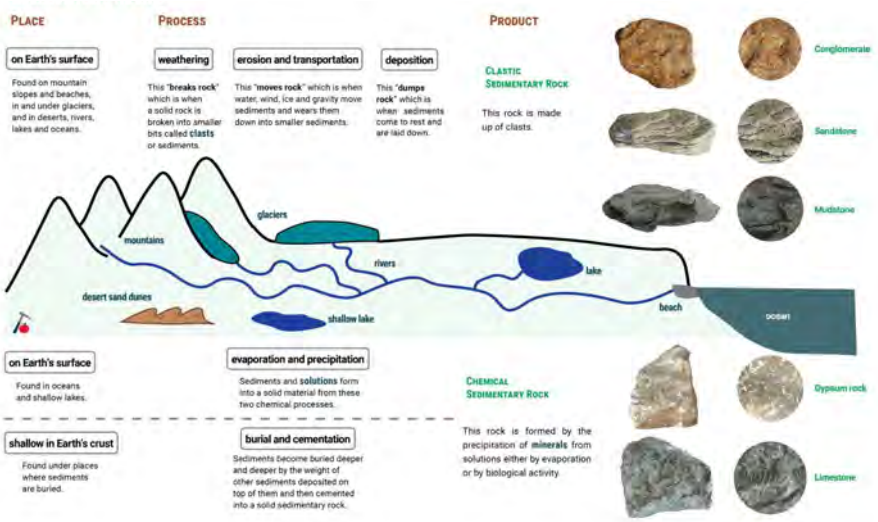
Sedimentary Rocks

PLACE

On Earth's surface

PROCESS

- Weathering, erosion and transportation, and deposition
- Evaporation and precipitation



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Sedimentary Rocks (OPTIONAL IF THIS MODULE IS NOT DONE ON SAME DAY AS MODULE 2)

Instruct: Open your booklets to page 7. to follow along
Explain: **PLACE -** all sedimentary rocks are formed **on the Earth's surface** where it is exposed and starts to form sediments by two processes.

PROCESSES that form Clastic Sedimentary Rocks:
Weathering - The first thing that happens is the rock gets broken up into pieces (called sediments) by the rain, snow, wind and also from the changing hot and cold temperatures..
Erosion and transportation - After the rock has been weathered, the broken pieces get moved and worn down into smaller pieces. This happens when rock tumbles down a mountain slope, by the water flowing in the rivers and by moving glaciers.
Deposition - This is when sediments stop moving and come to rest in lakes, rivers, beaches, and oceans.
PRODUCT - Clastic Sedimentary Rocks - Some of the common rock names are conglomerate, sandstone, and mudstone

PROCESSES that form Chemical Sedimentary Rocks:
Precipitation - These are rocks formed from precipitation of a solution that forms from the shells and parts of sea animals and collect at the bottom of the ocean. This rock fizzes with acid - which is the same as the Vinegar test.
Evaporation - These are rocks formed from evaporation of a solution that forms in shallow lakes. They are usually very soft compared to other rocks, some softer than a penny (this is the hardness test).
PRODUCT - Chemical Sedimentary Rocks - Some of the common rock names are limestone and gypsum
Duration - 3 - 5 minutes
Materials - TEACHER PAIL - How to Identify Rocks and Mineral booklet (one per student)

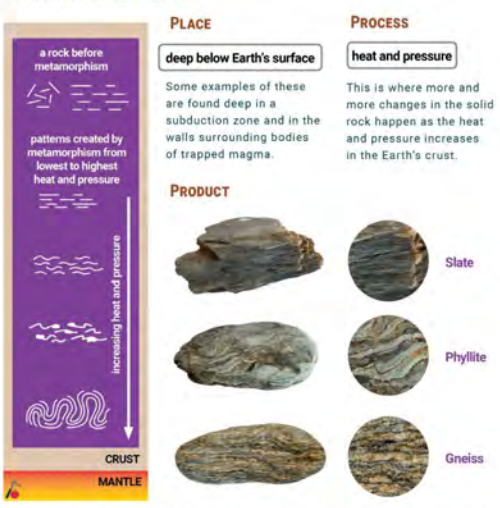
Metamorphic Rocks

PLACE

Below Earth's surface

PROCESS

Heat and pressure



Metamorphic Rocks (OPTIONAL IF THIS MODULE IS NOT DONE ON SAME DAY AS MODULE 2)

Instruct: Open your booklets to page 9. to follow along
Explain: This next slide shows how **Metamorphic Rocks** are formed.

PLACE - All metamorphic rocks are formed **below the Earth's surface**.
PROCESS - Heat and Pressure - These process work together to partly melt a rock and change it into another rock. The more heat and pressure creates rocks with more changes. Small change is when the layers are squeezed together into thin flat layers. The thin layers become wavy, and then thicker flat and wavy layers with greater heat and pressure.
PRODUCT - Some of the common rock names are slate, phyllite and gneiss

Duration - 2 - 3 minutes

Materials - TEACHER PAIL - How to Identify Rocks and Mineral booklet (one per student)

3Ps Make a Rock

PLACE

+

PROCESS

=

PRODUCT

PLACE	PROCESS	PRODUCT
on the Earth's surface where there are volcanoes and fissures	rapid cooling and crystallization	Extrusive Igneous Rock
shallow in the Earth's crust in magma chambers, plutons, sills and dykes	slow cooling and crystallization	Intrusive Igneous Rock
on the Earth's surface on mountain slopes and beaches, in and under glaciers, and in deserts, rivers, lakes and oceans	weathering erosion and transportation deposition	Clastic Sedimentary Rock
	evaporation and precipitation	Chemical Sedimentary Rock
shallow in the Earth's crust	burial and cementation	Sedimentary Rock
deep in the Earth's crust	heat and pressure	Metamorphic Rock
very deep in the Earth's crust	melting to form magma	origin of Igneous Rock

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3Ps Make a Rock (OPTIONAL SLIDE - DO IF TIME PERMITS)

This table is meant to review the PLACES and PROCESSES that were just discussed. You can choose to skip this slide.
Explain: This is a table that explains the PLACE and PROCESS for the three rock types.

Duration - 3 - 5 minutes

Materials - TEACHER PAIL - How to Identify Rocks and Mineral booklet (one per student)

Rock Form

Start at the top of the form

Collector - this is your name!

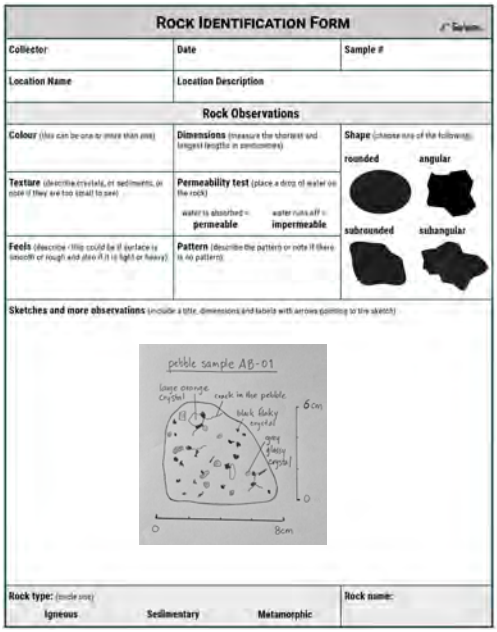
(don't worry about Location Name and Description)

Record observations in the boxes

Measure dimensions with your ruler

Sketch the rock sample (example shown)

Identify the rock type and rock name



ROCK IDENTIFICATION FORM

Collector:	Date	Sample #
Location Name	Location Description	

Rock Observations

Colour (this can be one or more than one)	Dimensions (measure the shortest and longest lengths in centimetres)	Shape (choose one of the following)
Texture (describe crystals, or sediments, or note if they are too small to see)	Permeability test (place a drop of water on the rock) water is absorbed = permeable; water runs off = impermeable	rounded, angular, subrounded, subangular
Feels (describe - this could be if surface is smooth or rough and also if it is light or heavy)	Pattern (describe the pattern or note if there is no pattern)	

Sketches and more observations (include a title, dimensions and labels with arrows pointing to the sketch)

Rock type: (circle one) Igneous	Sedimentary	Metamorphic	Rock name:

Rock Form

Distribute: Handout # 3 - Rock Form
Instruct: This is a form that is used to gather important information about a rock which is used to help determine its name. Let's go through the form
Record - Start by filling out the upper part of the form. Write your name in the Collector box and add today's date. Write down the sample number of the rock if there is one shown on the rock. You can leave the location and its description blank if this is not a rock you collected. Take care to write neatly and use your best grammar so others will understand what you have written.
Measure - Fill in the boxes under the Rock Observations section. Use your observation skills to measure some of the different characteristics of your rock. This includes colour, dimensions, shape, texture**,** permeability, how it feels and the pattern. In the large box you can add more details about your observations if needed.
To determine the **PERMEABILITY** - you will add a drop of water on the rock. If the water is absorbed - or goes into the rock - then it is permeable. If the water slides off the rock - then it is impermeable. **Sketch -** Use the space in the Sketches box to draw what you see and use your hand lens to take a closer look to describe your observations. A helpful tip is to make a trace of the rock outline and then add the details. Each sketch should include a title, the rock's dimensions and labels for the features that are described. An example of a sketch is shown.
Identify - Complete the form by choosing the rock type and identifying the rock name.

Duration - 5 - 7 minutes

Materials - TEACHER PAIL - Handout #3 - Rock Form (one per student)

Rock Key

Use this Key to determine the rock name

ROCK IDENTIFICATION KEY

TEXTURE	PERMEABLE	COLOUR	PATTERN	OTHER CHARACTERISTICS	ROCK NAME	ROCK TYPE
all or some sediments are visible	has high permeability	has light and dark colours	has no pattern	has mix of rounded pebbles and smaller sediments of different types	conglomerate	clastic sedimentary
	has medium permeability		• has no pattern • has an organized pattern with flat layers (bedding) • has an organized pattern with flat and wavy layers (bedding)	• has layers that are slanted in one or more directions • has black marks or animal tracks • has fossils of plant material • has ripples or mud cracks (has mostly sand-size sediments) • surface feels smooth like a powder • surface feels greasy	sandstone	
	has low permeability				siltstone, mudstone or shale	
all sediments and crystals are too small to see	is impermeable			• surface of the rock fizzes (bubbles) with a drop of vinegar • has fossil shells or fragments of dead sea animals	limestone	chemical sedimentary
				rock can be scratched with a penny (copper coin)	gypsum	
				powder of the rock fizzes (bubbles) with drop of vinegar	marble	metamorphic
				• fresh surface has sugary texture • crystals look like they are glued or melted together	quartzite	
		has dark colours	has an organized pattern with thin and slightly wavy layers (foliations)	has greenish colour and feels smooth	phyllite	
				breaks easily between layers and is brittle	slate	
		has dark to medium colours	has no pattern	has black to greyish colour with holes shaped like gas bubbles	basalt	igneous extrusive (volcanic)
			has an organized pattern with flat to wavy layers	• has reddish-purple or greenish colour • has holes with some filled in with light coloured crystals • has wavy layers and may have larger-size fragments or crystals	rhyolite	
all or some crystals are visible		has light and dark colours	has no pattern	has black to greyish colour with some holes filled in with light coloured crystals	basalt	
				has crystals of grey (quartz), white or pinkish-orange (feldspar) and black (biotite) colours	granite	igneous intrusive (plutonic)
		has dark colours		has specks of white (feldspar crystals) and black (hornblende crystals)	diorite	
				has mostly black crystals with dark-coloured feldspar crystals	gabbro	
		has light and dark colours	has an organized pattern with thin and slightly wavy layers (foliations)	has glittery flakes of mica and may have some larger crystals of different colours	phyllite or schist	metamorphic
			has an organized pattern with thin to thick and flat to wavy layers (foliations)	has layers (foliations) with different thicknesses that have dark and light coloured crystals	gneiss	

Rock Key

***Distribute*:** Handout #4 - Rock Key

Instruct:

After you have completed your Rock Identification Form, you will then determine the rock name by using this Rock Identification Key.

Start with the **TEXTURE** column. Choose only one of the boxes in TEXTURE column by marking it with a check mark or circling it. Then move to the right. Find all the boxes that touches the one you chose - there could be more than one box. Mark all the boxes that it connects to and continue moving to the right choosing boxes that match the observations from your Rock Identification Form.

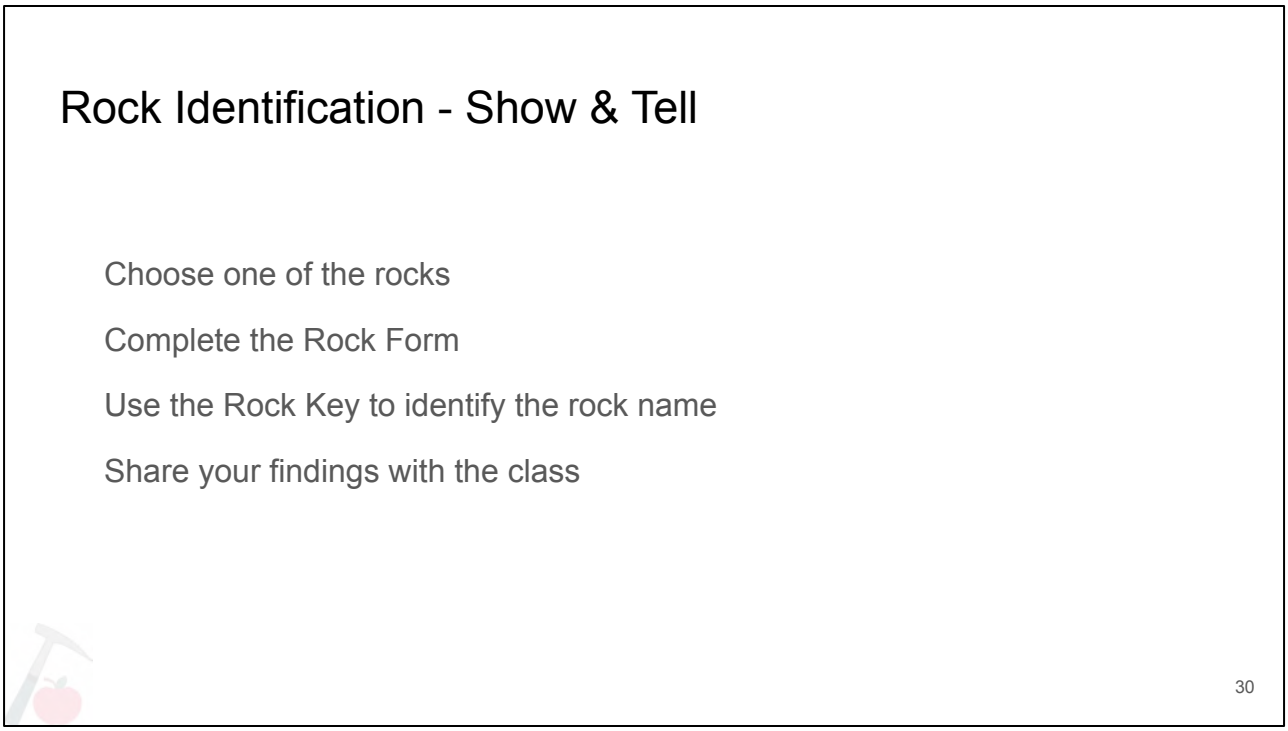
There could be one or more than one box that connects to the PERMEABLE, COLOUR and PATTERN that matches your rock.

When you get to the column **OTHER CHARACTERISTICS**, there should only be one box that matches your rock. From here the next box will be the rock name!

Remember to refer to your Rock Mat Form to remind you of the rock types and observations about the textures.

Duration - 5 - 7 minutes

Materials - TEACHER PAIL - Handout #4 - Rock Key (one per student)



Rock Identification - Show and Tell

Instruct: Now it's time to take a closer look at the details. Select one rock that you want to identify and complete the Rock Identification Form. One form is completed for each rock sample. After you have finished filling in the Rock Form, use the Rock Key to identify the rock name.

SHOW & TELL *- start this after most have completed at least one rock identification*
Ask*:* Who would like to be our first volunteer to tell the class about the rock you identified?
Go around the class to each group asking for a volunteer.
Draw a table on the whiteboard with the following column headings: Name; Rock Number; Rock type; Rock Name. Add information into the columns for each of the presenters. Once each student finishes their presentation, provide some brief feedback on their observations, sketch, etc, but don't say if they got the rock type and name correct.

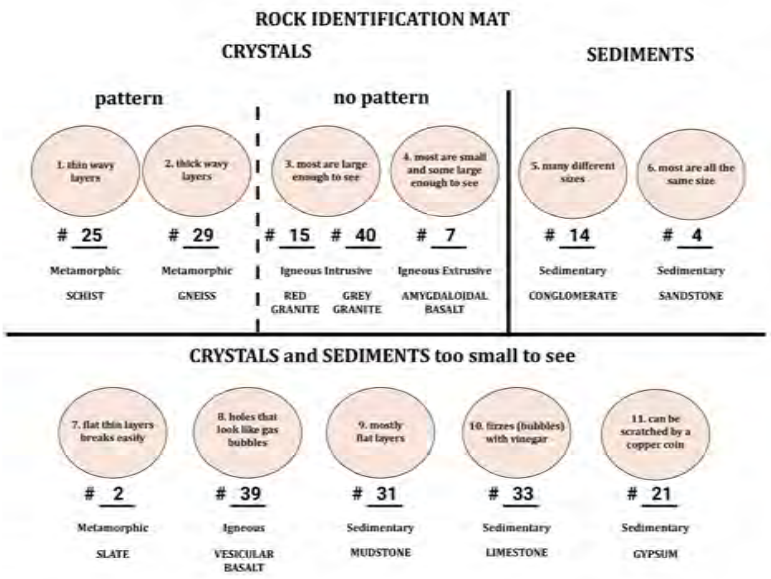
Duration - 40 - 45 minutes (or as time permits)

Materials -
PAIL #1 - Hand lens
PAIL #2 - Bag 2 with rock samples numbered- **#25-schist; #29-gneiss; #15-red granite; #40-grey granite; #7-amygdaloidal basalt; #14-conglomerate; and #4-grey sandstone**
PAIL #3 - Bag 3 with rock samples numbered **#2-slate; #39-vesicular basalt; #31-mudstone; NOTE -** rock samples numbered **#33-limestone and #21-gypsum** should **NOT** be used for this Module
TEACHER PAIL
Handout #2 - Rock Mat
Handout #3 - Rock Form
Handout #4 - Rock Key

Rock Names

Answers for

- rock type
- rock name



Rock Names

***Explain**:*
Take each of the samples, show it to the class, describe it and then state the rock type and the rock name. You can also go back to the table on the whiteboard and congratulate those who got their rock names correct - but also acknowledge those who didn't by mentioning that this was difficult and everyone did a great effort.
***Distribute**:* How to Identify Rocks and Minerals - Student Workbook.
Explain:
Once the workbooks are handed out, explain that these are for the students to keep to use as a review of the material. The answers can be found in the text following the diagrams.

Duration - 3 - 5 minutes

Materials
PAIL #2 - Bag 2 with rock samples numbered- **#25 ; #29; #15; #40; #7; #14; and #4**
PAIL #3 - Bag 3 with rock samples numbered **#2-slate; #39-vesicular basalt; #31-mudstone; NOTE -** rock samples numbered **#33-limestone and #21-gypsum** should **NOT** be used for this Module

TEACHER PAIL - How to Identify Rocks and Minerals - Student Workbook (one per student)

This is the end of the Rock lesson. If time permits, take time to ask if there are any questions. Was there something they wanted to learn but didn't?