

### Overview

Every rock has a story to tell. Much like the life cycle of humans, rocks are created, transformed, they age and are weathered and can in some cases end up as dust before forming into another rock. This activity shares the traditional knowledge of the story of Grandfather Rock, and the scientific knowledge of the rock cycle. Students will discover that the rock cycle, has various phases and does not necessarily move linearly through those phases. In their journey through the rock cycle they will also come to know the relationship between volcanoes, igneous rocks, sweat lodges, saunas and Grandfather Rock.

**Source:** The original idea for this lesson comes from a lesson by DLESE Mountain Building Teaching Box. It has been adapted for Saskatchewan by the SMA.

**Duration:** one – two classes

### Materials:

- Rock Cycle Journey paper dice
- Rock Cycle Journey Station cards
- Student Data Table
- Student Rock Cycle Journey Summary Sheets
- Saskatchewan Rock Kit (optional): see Resources
- Keepers of the Earth: “Tunka-shila, Grandfather Rock”; “Old Man Coyote and the Rock”
- Saskatchewan Geological Survey Resource Map of Saskatchewan  
<http://www.economy.gov.sk.ca/resourcemap>

### Prior Knowledge:

Before attempting these activities students should have some understanding of the following:

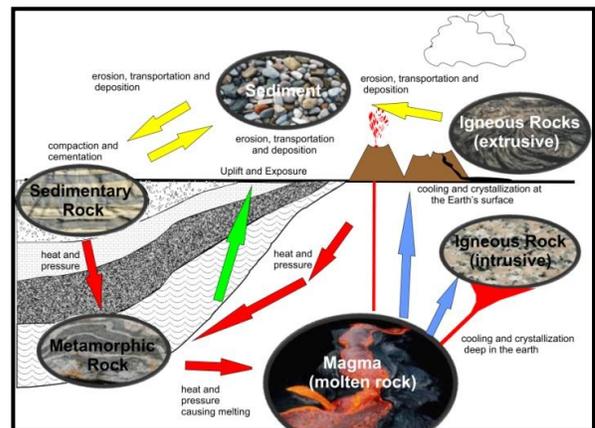
- Metamorphic, Sedimentary and Igneous rocks

### Note to Teachers:

In this activity, rock cycle phases (igneous, sedimentary and metamorphic), processes, such as melting, cooling (crystallization), weathering, erosion, burial, deformation, heating, and information about Saskatchewan mineral deposits are located at 11 different stations. Each station has a “die” – a box that is labeled on each of its six sides. The sides of the dice are marked to reflect the relative likelihood of materials actually moving through the phase.

### Instructional Methods:

- Simulation



### Learning Outcomes and Indicators

#### Grade 4: Rocks, Minerals and Erosion

**RM4.1 Investigate physical properties of rocks and minerals, including those found in their local environment.**

b) Document the locations and characteristics of rocks that exist in their local environment. (indirect)

**RM4.2 Assess personal, societal, and environmental impacts of human uses of rocks and minerals.**

- a) Discuss ways in which people of different cultures, value, respect, and use rocks and minerals, including First Nations and Métis connections to Mother Earth.
- f) Identify locations where minerals, including potash, sodium sulphate, salt, kaolin, uranium, copper, coal, diamond, and gold, are extracted in Saskatchewan.

**RM4.3 Analyze how weathering, erosion, and fossils provide evidence to support human understanding of**

### the formation of landforms on Earth.

c) Explain how rocks can be classified as igneous, sedimentary, or metamorphic based on the processes by which they form.

### Big Picture Questions

1. How did Saskatchewan's rocks form?
2. Which ones are associated with Saskatchewan's mineral deposits?

### Background Information

#### Traditional Knowledge:

Many indigenous cultures, are based strongly on a natural spirituality, one in which all things are connected, including rocks. There are many traditional stories to be shared that describe this interconnectedness. Two stories relating to the rock cycle are the Lakota story of Grandfather Rock and the Pawnee story of Old Man Coyote.

#### Scientific knowledge:

James Hutton (1726—1797), the 18th-century founder of modern geology came up with the concept of the rock cycle. The main idea is that rocks are continually changing from one type to another and back again as they are weathered, eroded, and compacted at the earth's surface and subjected to heat and pressure and are melted at depth when forces on the earth cause them to sink back into the mantle. A continuous cycle.

The *Rock Cycle Diagram* shows the many ways that old rocks can be recycled as new rocks. Nearly all of the earth's crustal material originates from the flow of molten magma from deep within the Earth. Magma becomes igneous rock upon cooling. If it solidifies slowly deep within the Earth's crust, it forms plutonic rock such as granite. If it reaches the surface and erupts from a volcano, it solidifies quickly into volcanic rock such as basalt. The processes of weathering, erosion, transportation and deposition (in rivers, lakes and oceans) can convert any pre-existing rock into a sediment and finally a new sedimentary rock. Increased heat and pressure due to deep burial cause the growth of new minerals and possibly partial melting, converting any pre-existing rock into a metamorphic rock. Complete melting converts metamorphic rocks into magma, which may form a new igneous rock (Geological Highway Map).

Not all rocks go through each step in the cycle. For instance, a sandstone may be weathered breaking up into small fragments, the fragments are transported and

deposited eventually to be lithified as another sedimentary rock.

Mineral deposits are associated with particular rock types and processes.

In Southern Saskatchewan:

Potash was deposited as a sedimentary rock by crystallization of potassium-rich brines at the bottom of an ancient sea. Coal formed when vegetation rotting in a swamp was buried and subjected to pressure and increased temperature. Coal is also a sedimentary rock.

The elements, copper, zinc and gold occur in igneous rocks or in quartz veins in Saskatchewan.

### Vocabulary

extrusive	
igneous rock	intrusive
magma	mine
metamorphic rock	sedimentary rock

### The Activity

#### Teacher Preparation:

1. Cut out each die pattern and the signs for each station. Assemble dice by folding along lines and taping the edges together.
2. Set up the eleven stations in the classroom – one for each die and matching Station cards. Each card has the number of the station and the name of the phase or rock type printed on it. Each die also has the name and number of the station on it.
3. If you have rock samples you could place a corresponding sample at the appropriate station.

#### The Activity:

#### Rock Cycle Journey and Mineral Deposits

##### Activity 1.

1. Read the First Nation legends Tunka-shila, Grandfather Rock" and "Old Man Coyote and the Rock". These stories relate to the rock cycle with the creation of volcanic rocks and the transport of boulders.

2. Have the students relate the legends to what they know about rocks and the rock cycle, create a mind map or web.

3. Ask the questions:

### **Old Man Coyote and the Rock :**

- How did the big rock come to be sitting in the middle of the prairie?
- Are there any big rocks in your area?
- Are there any stories about the big rocks?
- What animals used these rocks in the past?
- The Night hawks pecks at Grandfather rock and breaks it into pieces before they fan it back together with their wings. What process does the breaking apart represent using Scientific knowledge?

### **Tunka-shila, Grandfather Rock:**

- What is the scientific name for Grandfather rock?
- What is the scientific explanation of how the rock formed?

**Activity 2.** (This activity can be done using the *Rock Cycle Journey Table* or by collecting beads and creating a lanyard. (See Extension 1.)

1. Explain to the students that they are going to do an activity to learn more about rocks and what happens to them.
2. Review with the students the rules in the instructions before starting the activity.
  - a. Orient the students to the activity by instructing them to think of themselves as a mineral grain, or a tiny piece of rock moving through a rock cycle. (From place to place in the earth).
  - b. Go through the sample table or the *Bead Colour Explanation Chart* as in Extension 1.
  - c. Hand out the *Rock Cycle Journey Table* (or lanyard and beads) for each student to complete on their journey.
3. Have the students choose a station to start at. Spread the students out so that each station has approximately the same number of students to begin with.
4. Students begin by taking turns rolling the die at their station and following the directions to either “go to” another station or “stay put”. If they stay put they go to the back of the line and wait their turn to roll again.

For example, rock material may remain in a molten state inside the earth for long periods of time. To show this, the die at station # 10, “Magma,” has four sides that say “magma (stay as you are)” and only two sides that say “cooling and hardening.” If you roll the “magma (stay as you are)” side of the die, you will stay at station #10 and roll again when it is your turn. If you roll one of the sides that say “cooling and hardening” you would move to station #9, the “Cooling and Hardening (crystallization)” station.

Remind the students to be careful with the die.

5. While at each station students **must record** (station # and what happened to them) on the *Rock Cycle Journey Table* for each roll of the die and its outcome on their data table even if they end up rolling it multiple times. **See example Rock Cycle Journey Table.**

If using beads and lanyard, have student collect **ONE** bead for each time they roll the dice.

**If the student has stayed at the station for 3 rolls of the die, have them move to the station number indicated on the die.**

Each step in the rock cycle can take as little as 200,000 years or as much as several million years. For this activity, count each roll of the die as 200,000 years. Students multiply the number of tosses of the die by 200,000 years to get the number of years spent in the rock cycle.

After the activity is over they will have a record of what happened.

### **Summary Activities (1 class)**

6. Review the Questions asked in Activity one and revise or add to the mind map or web. Discuss the scientific evidence that Grandfather rock is a volcanic rock. Discuss how igneous rocks are used in sweat lodges and saunas because they can withstand great heat.

### **Old Man Coyote and the Rock :**

- How did the big rock come to be sitting in the middle of the prairie? (**Transported by glaciers/erosion**).
- Are there any big rocks in your area?
- Are there any stories about the big rocks?
- What animals used these rocks in the past? (**Buffalo rubbing rocks**).

- The Night hawks pecks at Grandfather rock and break him into pieces before they fan it back together with their wings. What process does the breaking apart represent using Scientific knowledge? (**erosion**)

### **Tunka-shila, Grandfather Rock:**

- What is the scientific name for Grandfather rock? (**igneous extrusive or lava rock – basalt**)
  - What is the scientific explanation of how it formed? (**once molten magma deep in the earth that reached the surface and flowed out of a volcano**)
7. Once the rock cycle journey has been completed have the students summarize their journey either as a story, essay, PowerPoint, poster, cartoon, animation or video. Students could use the **Rock Cycle Journey Summary Sheet to help them get started.**
- \* Leave the 11 stations posted for the students to revisit and gather information when they work on their summary.*
8. Have students complete the journal questions.

### **Assessment Method and Evidence**

#### ✓ Journal questions:

- Students will be able to explain the process of how a mineral could start out in an igneous rock, become part of a metamorphic rock and end up as a sedimentary rock.
- Students will be able to explain that Grandfather Rock is an igneous rock and that it was formed in great heat from the magma below the Earth's crust. It can withstand great heat and that is why igneous rocks are used in sweat lodges and saunas.
- Students will be able to list at least 3 Saskatchewan mineral deposits and the rocks they are hosted in.

#### ✓ Activity Data Summary Sheet (If using this method instead of beads)

- Students will hand in the record of their journey through the rock cycle on a **Data Summary Sheet**. The record of their journey is the basis of their summary story or cartoon.

#### ✓ Summary:

- Students will summarize their journey through the rock cycle as listed on their Data Sheet or through their beads either in story/cartoon/PowerPoint or other format. The summary will reflect their understanding of the cyclic nature of the rock cycle and the vast length of time for the geological process.

### **Extension Activities**

1. Students could collect a bead as they go to each station. These beads can be used to create a lanyard or bracelet and will help with the recounting of the student's journey in the rock cycle. (See Bead Colour Description Chart).
2. Follow up with the Keepers of the Earth **Activity Rock to Rock: a Fantasy Journey** on pg. 61.
3. When discussing "Grandfather Rock" have students find (or show) pictures or videos of new volcanic islands forming (Iceland, Japan, Solomon Islands), and discuss the rocks, and early earth forming processes (cloud and water formation, weathering, erosion and soil formation).
4. Using the Saskatchewan rock kit, have students determine which station the rocks represent. Locate the Saskatchewan rock samples on a geology map.
5. Have students research one of Saskatchewan's mineral deposits (potash, uranium, gold, coal, diamonds, rare earth elements, copper, nickel, lead, sodium sulphate) and determine what rock type the mineral occurs in (igneous, sedimentary or metamorphic).

### **Resources**

Caduto, M.J. and Bruchac, J. (1997). **Keepers of the Earth** Native American Stories and Environmental Activities for Children. Fulcrum Publishing, Golden Colorado. Pgs 57 – 63.

DLESE Mountain Building Teaching Box. **The Rock Cycle**. Available at: (<http://www.teachingboxes.org/mountainBuilding/index.jsp>)

**Geological Highway Map of Saskatchewan:**

Saskatchewan Geological Society Special Publication Number 15. Available to purchase at:  
[http://www.sgshome.ca/publication\\_list](http://www.sgshome.ca/publication_list)

Northern Saskatchewan's Rock Cycle:

**Northern Saskatchewan Geoscape poster: If Rocks**

**Could Talk.** Available to download at:  
[http://publications.gc.ca/collections/collection\\_2007/nrc-an-rncan/M41-8-91E.pdf](http://publications.gc.ca/collections/collection_2007/nrc-an-rncan/M41-8-91E.pdf)

Saskatchewan Geological Survey Resource Map of Saskatchewan Available to download at:  
<http://www.economy.gov.sk.ca/resourcemap>

**Saskatchewan Rock Kit:** Saskatchewan Geological Survey offers one set of 24 Saskatchewan rock samples to each school. To order a free rock kit, teachers should contact Geological Publications at 306-787-2528 or email [er.publications@gov.sk.ca](mailto:er.publications@gov.sk.ca) and provide the school name and mailing address.

**Volcano formation videos:**

Japan: <http://www.youtube.com/watch?v=6fIDbhnzCLY>

Solomon Islands:

<http://www.youtube.com/watch?v=CsKTzBZNjtE>

be formed and new structures in the rock.

**Mine:** An opening or excavation in the earth for the purpose of extracting minerals.

**Sedimentary Rock:** Rock formed by the accumulation of sediment in water or from air.

## Vocabulary

**Deposit:** A natural occurrence or accumulation of mineral material, as uranium, gold, coal, or potash ore.

**Extrusive:** Igneous rock that has been erupted in a molten state onto the surface of the Earth. Extrusive rocks include lava flows and pyroclastic material such as volcanic ash.

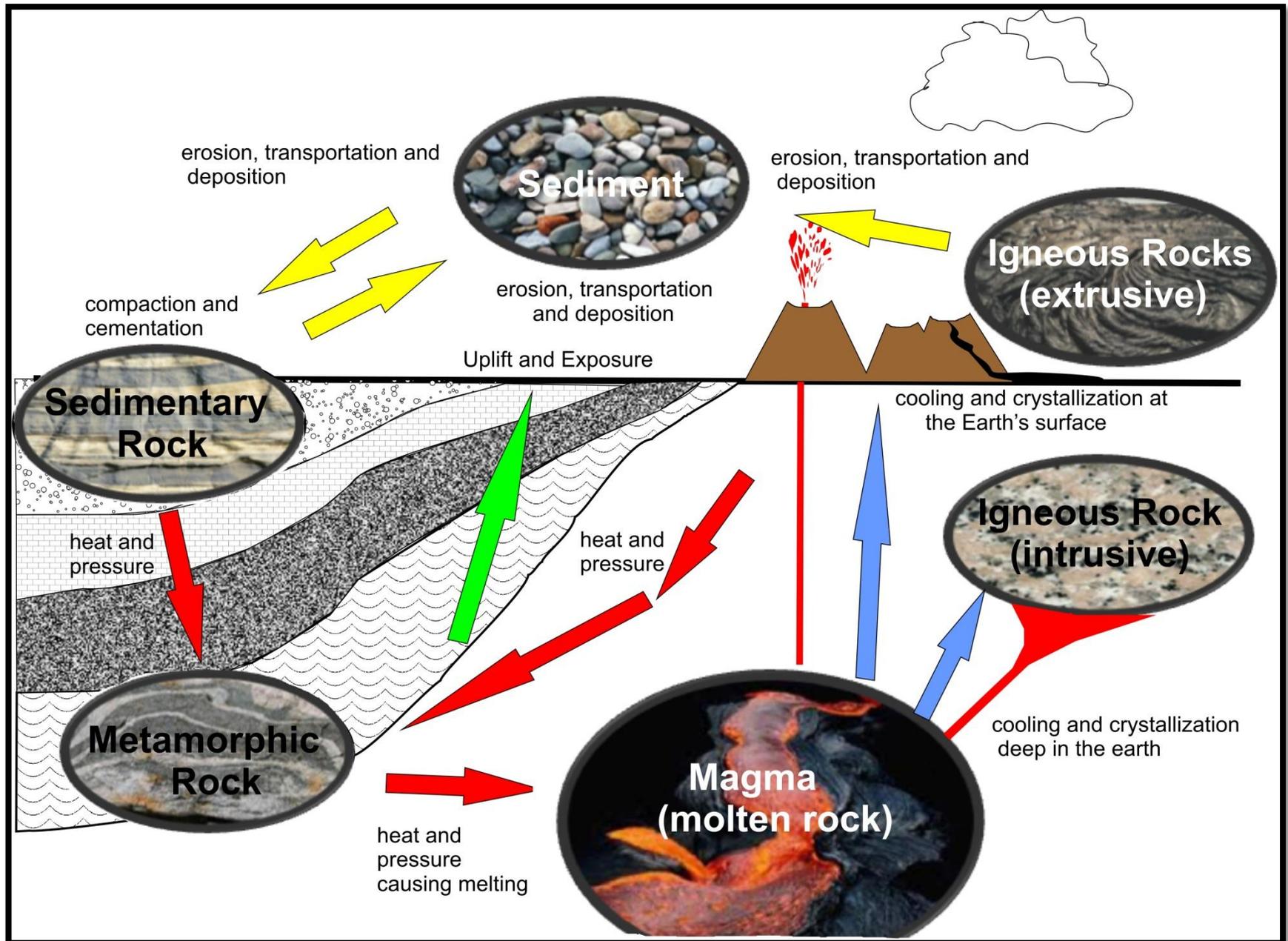
**Igneous:** Rock or mineral that solidified from molten or partly molten material, i.e., from a magma;

**Intrusive Rock:** Rock formed from magma that solidified without reaching the earth's surface.

**Magma:** Naturally occurring molten rock within the earth from which igneous rocks are formed.

**Metamorphic Rock:** Any rock, which has been altered by heat or intense pressure, causing new minerals to

# THE ROCK CYCLE





### SAMPLE ROCK CYCLE JOURNEY TABLE

ROLL #	STATION #	STATION NAME	WHAT HAPPENED (Stay as _____ or change into _____?)
1	10	Magma	Stay as magma
2	10	Magma	Stay as magma
3	10	Magma	Go to Cooling and Hardening (Crystallization)
4	9	Cooling and Hardening (Crystallization)	Cool and harden stay Crystalline
5	9	Cooling and Hardening (Crystallization)	Change to Igneous Rock

6	4	Igneous Rock	Change! Weathering and Erosion
7	11	Weathering and Erosion	Weathering and Erosion Stay here
8	11	Weathering and Erosion	Stay as Weathering and Erosion
9	11	Weathering and Erosion	Stay a Weathering and Erosion
10	11	Weathering and erosion	Change to Sediments

11	3	Sediments	Stay as Sediments
12	3	Sediments	Go to Compaction and Cementation
13	1	Compaction and Cementation	Go to Sedimentary Rock
14	7	Sedimentary Rock	Go to Weathering and Erosion
15	11	Weathering and Erosion	Go to Sediments

## Student Instructions

In this activity you will model what can happen to a bit of rock or a mineral as it travels through the rock cycle.

### Background:

This activity has 11 different stations. Each station has a “die” – a box that is labeled on each of its six sides. For example, at station #10, the materials that make up a rock may stay as liquid rock or Magma, inside the earth for long periods of time. To show this, the die at station # 10, has four sides that say “Magma (stay as you are)” and just two sides that say “cooling and hardening.” If you roll the “magma (stay as you are)” side of the die, you will stay at station #10 and roll again when it is your turn. If you roll one of the sides that say “cooling and hardening” you would move to station #9, the “Cooling and Hardening ( where the minerals form crystals)” station.

1. Begin by choosing one station to start at. There are 11 stations so there should be two or three students at each station at the beginning of the game. It does not matter where you start; you probably will have a chance to visit other stations during the game.
2. Using the **Rock Cycle Journey Table** record the # of the station you begin at as well as the name of the station. If using a bead, add a bead for the first station.
3. Now roll the die and record what the die instructed you to do in the “what happened” column of the table and either stay at that station if it says STAY or move to the station number shown.
4. In reality there is no set time for how long rocky material spends at each phase of the rock cycle. It may speed through in just 200,000 years or so, or it may stay at the same point in the cycle for millions of years. For the purposes of this game, **each roll of the die represents 200,000 years**. Even if you end up staying at the same place for multiple turns, every time you roll the die you add another 200,000 years to the age of your rock.
5. It is important to keep careful records, as you will need the information to complete a story of your journey through the rock cycle.

**ROCK CYCLE JOURNEY TABLE**

ROLL #	STATION #	STATION NAME	WHAT HAPPENED (Stay as _____ or change into _____?)
1			
2			
3			
4			
5			

Grade 4 Rocks, Minerals and Erosion: The Rock Cycle Journey and Mineral Deposits continued

ROLL #	STATION #	STATION NAME	WHAT HAPPENED (Stay as _____ or change into ____?)
6			
7			
8			
9			
10			

Grade 4 Rocks, Minerals and Erosion: The Rock Cycle Journey and Mineral Deposits continued

ROLL #	STATION #	STATION NAME	WHAT HAPPENED (Stay as _____ or change into _____?)
11			
12			
13			
14			
15			



If you collected beads draw your beads. Then below draw the beads of a friend. Remember to always put the starting beads below each other.

My beads: 

My friends: 

Circle where your journey was the same, at the same time.

BEAD COLOURS	STATION - ROCK - PROCESS
Purple	1. Pressing and Cementing
Black	2. High Temperature and Pressure
Light blue	3. Sediments
Orange	4. Igneous Rock
Green	5. To the Surface
Dark blue	6. Metamorphic Rock
Yellow	7. Sedimentary Rock
Pink	8. Melting
White	9. Cooling and Hardening (Crystallizing)
Red	10. Magma
Clear	11. Weathering and Erosion

4. In the legend Tunka-shila, Grandfather Rock a great burning rock rose up out of the water creating steam which formed the clouds.

a). In scientific terms what is the burning rock rising up out of the water called?

\_\_\_\_\_

b). What type of rock was formed? \_\_\_\_\_

c). What would be the best type of rocks to use in a sweat lodge or sauna and why?

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

# MY JOURNEY THROUGH THE ROCK CYCLE

Name: \_\_\_\_\_

Draw pictures of what happened to you during your journey through the rock cycle.

1.	2.	3.	4.
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# MY JOURNEY THROUGH THE ROCK CYCLE (pg.2)

5.	6.	7.	8.
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# MY JOURNEY THROUGH THE ROCK CYCLE (pg.3)

9.	10.	11.	12.
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# MY JOURNEY THROUGH THE ROCK CYCLE (pg.4)

13.	14.	15.	16.
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## **Saskatchewan Rock Kit links with the Stations**

Station 3 Sediments: ***Saskatchewan Rock Kit # 24***

Station 4 Igneous Rocks: Intrusive –Plutonic ***Saskatchewan Rock Kit #'s 7, 9, 13***  
Extrusive – Volcanic ***Saskatchewan Rock Kit #'s 8, 17 & 18***

Station 6 Metamorphic Rocks: Schist – *Saskatchewan Rock Kit #21*  
Gneiss - ***Saskatchewan Rock Kit #22***

Station 7: Sedimentary Rocks: ***Saskatchewan Rock Kit #'s 1,3,10, 11, 14, 24***