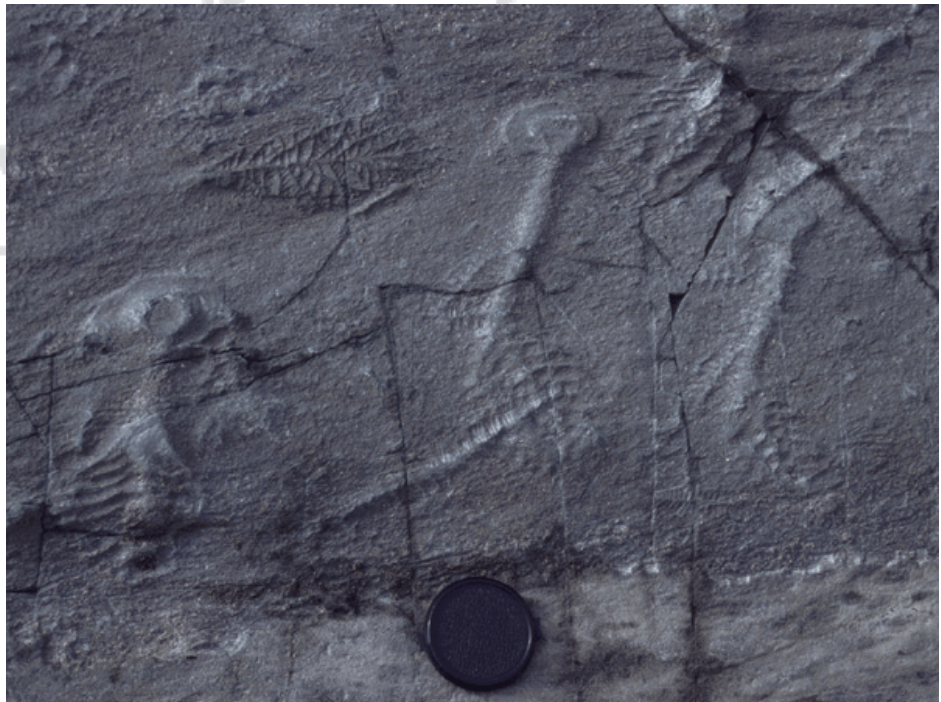


# Natural History of Newfoundland and Labrador: Geological Formation

## Just How Old is Newfoundland and Labrador?

(1) If you were to ask someone the age of Newfoundland and Labrador, they might think about John Cabot's naming this "new founde land" in 1497 and say "about 500 years." The correct answer, of course, goes back much, much further than that and lies not in its human history, but in the age of its rocks. That history is studied through **geology**, the **scientific** study of the earth and its **land-forms**.

(2) Newfoundland and Labrador has a fascinating geological history. It is a tale that has unfolded slowly over hundreds of millions of years. Rocks in parts of Labrador and fossils near Cape Race on the Avalon Peninsula are among the oldest on earth. The story of our geological history involves **unimaginable** forces acting deep within the earth and over much of the planet's outer surface. This passage is a brief **summary** of this tale.

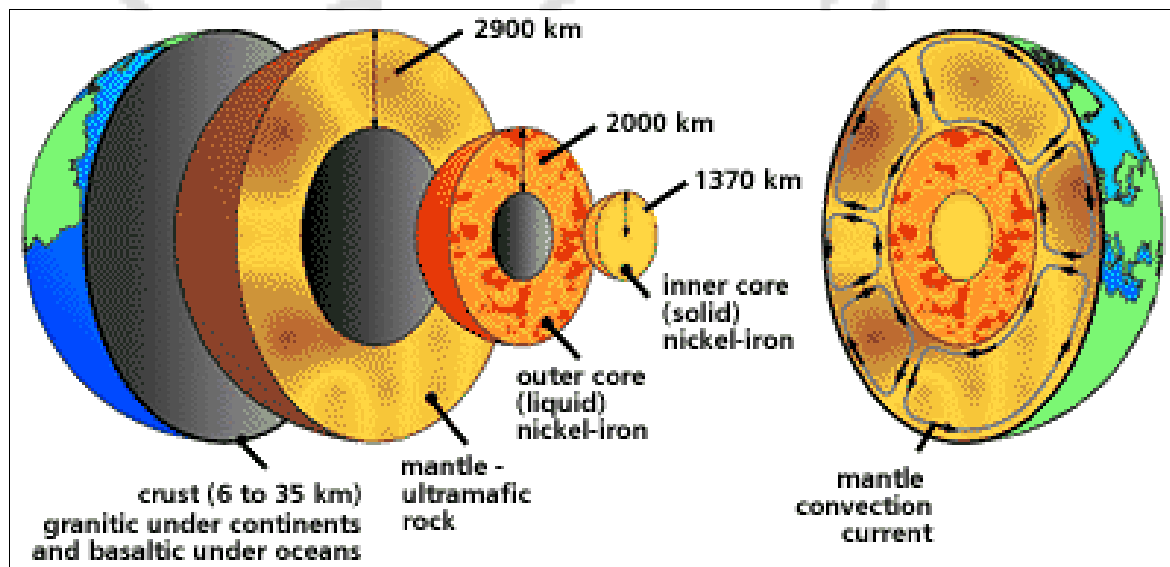


## The Theory of Continental Drift

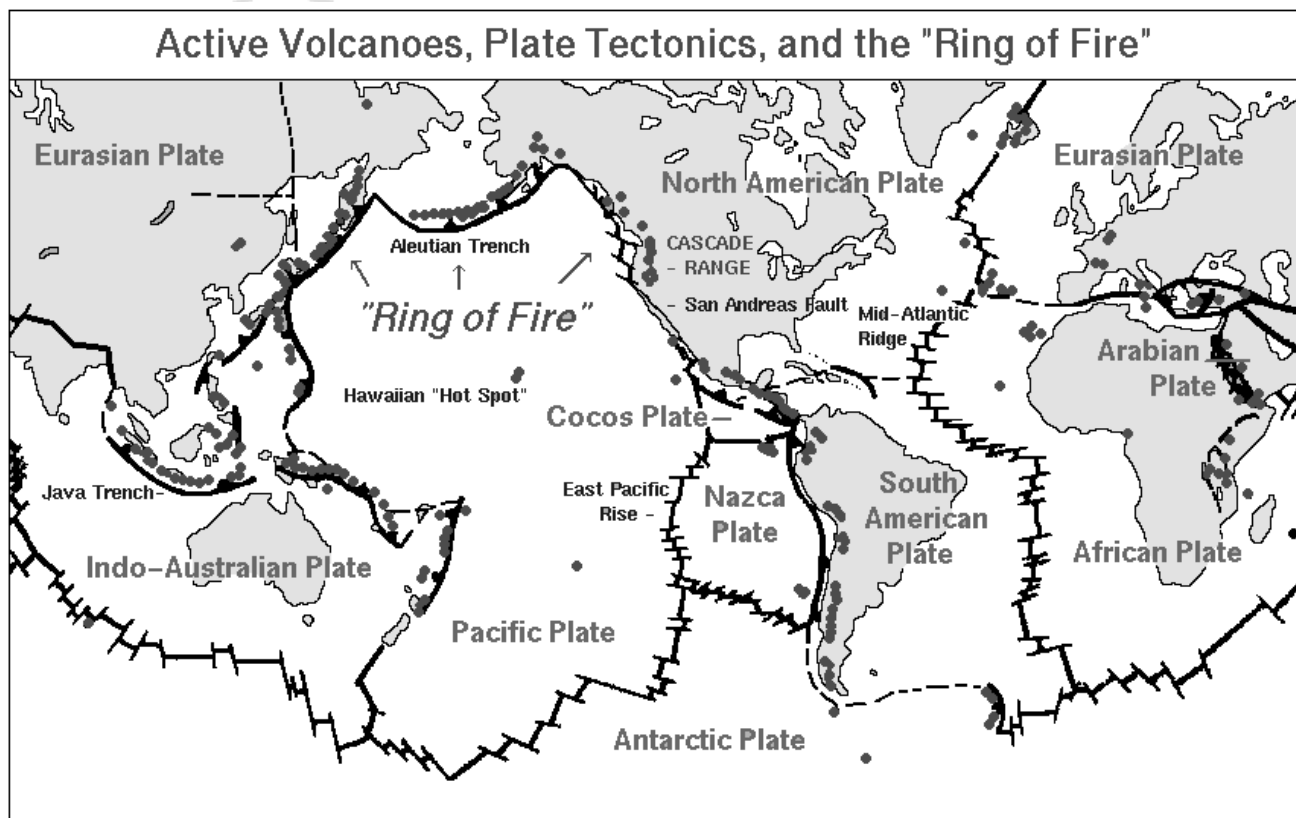
(3) To understand Newfoundland's geological history, you must first know a little about the **theory of continental drift** and **plate tectonics**. These theories suggest that the shape and position of each of the seven **continents** have changed a lot over the last billion years of earth history. To understand how continental drift works, you have to picture two things; a hard boiled egg with a cracked shell and **conveyor belts**!

(4) Like the shell of the cracked hard-boiled egg, the outer layer of the earth, called the **crust**, is cracked too. These cracks, called **faults**, mark the boundaries of large pieces of crust call **plates**. Each plate contains a continent or a piece of the ocean floor or a **combination** of both. The sixteen largest of these **plates** are shown in the diagram on the next page. The thick black lines are the plate edges or **boundaries**. The black dots are locations of **active volcanoes**.

(5) The **theory of continental drift** also suggests that these **plates** are not at rest. They are moving, even if it is at a snail's pace. They have been moving this way since the earth formed a crust a few



**billion** years ago. **Geologists**, scientists that study the earth's history, know that underneath the crust, there is a thick layer of rock called the **mantle**. Rocks in the mantle are nearly **molten** and bend like plastic and flow like cold molasses. This flow acts like a conveyor belt and carries the continents and ocean floor along for the ride. In some places, like down through the middle of the Atlantic Ocean, the plates are moving apart to create new ocean floor, and in the case of Iceland, new land. In some places, the plates are **colliding**. Past **collisions** have created huge mountain ranges like the Coastal and Rocky Mountains of North America, the Andes Mountains of South America and the **Himalayas** in northern India. **Earthquakes** and **volcanoes**, which are used as evidence to support the theory of continental drift, occur more frequently along the plate boundaries than anywhere else.



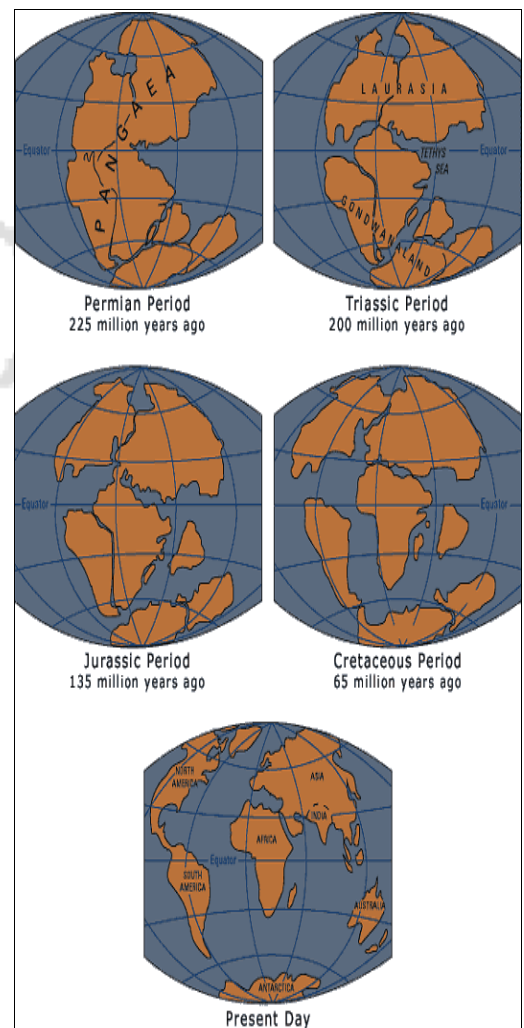
(6) Evidence for continental drift was first discovered by a German **meteorologist** named Alfred Wegener. He thought it was no **coincidence** that the shorelines of South America and Africa look like they could fit together or that the coastline of northwest Africa looked like it could fit up against the eastern **seaboard** of North America. At first, the theory and Wegener were **ridiculed**. Over the years some of the **evidence** that supports his theory has come from studies of the geology of Newfoundland itself. Today, the theory of continental drift, while not explaining everything about the formation of continents and mountains, is accepted almost without question.



### The Geological Formation of Newfoundland

(7) About five hundred million years ago, the area that now forms central North America was under a warm tropical sea called the **Iapetus Ocean**. It was surrounded by the land masses we now know as Europe, Africa and North America. For a hundred million years, forces within the earth's mantle slowly carried these **continents** on a **collision** course. As the continents drifted together, the ocean floor was squeezed and then pushed upward to form huge mountain ranges, one of which we now call the **Appalachians**. Central Newfoundland is actually the northernmost part of the Appalachians in North America. This range, although known by another name, continues through most of the British Isles and on to Norway. This is further proof, geologists believe, to support the theory of drifting continents.

(8) An area called the **Tablelands** in Gros Morne National Park has rocks that are so rare on the earth's surface, the region has been named a **UNESCO World Heritage Site**. The Tablelands



were once part of the earth's mantle but were pushed on top of the earth's crust during the **collision** of the continents many millions of years ago. These mantle rocks, normally dark green in colour, are now brown because they have been open to the **atmosphere** for such a long time. The soil on the Tablelands is so poor in **nutrients**, very little grows in this area. It has often been described as a **moonscape**.

(9) On the east coast of Newfoundland, rocks equally spectacular exist. They are not from the earth's mantle like the Tablelands but from Africa! This too is explained by continental drift. The story begins when the continental collisions finally ended some 400 million years ago. Instead of seven continents, all of the earth's landmass formed one **super-continent** called **Pangea**, meaning "all lands". Some 225 million years ago, the forces in the earth's mantle that brought the continents together now slowly began to pull them apart. The diagrams on the previous page show how this occurred over the past 225 million years. In the process a **remarkable** thing happened. A small bit of **Africa** got left behind!

When you stand on **Signal Hill** in St. John's, you are standing on rocks that are **identical** to ones in the country of Morocco in north Africa!

(10) As the continents drifted further and further apart, the gap that was created filled with water to form the Atlantic Ocean. Geologists believe continental drifting is still occurring. Europe and North America, for example, are moving apart about three centimetres every year!

### The Ice Ages

(11) While the forces of continental drift may have helped form Newfoundland, its present day shape, called its **topography**, is a result of **erosion** over the past 200 million years.



Erosion is **defined** as *the wearing down and washing away of the earth's surface by water, wind and ice*. Most of the erosion has been caused by the relentless pounding of the sea. But for the last three million years, **glaciers** of the last **ice age**, which ended just 18,000 years ago, has shaped most of the land around us.

(12) The Newfoundland **landscape** of flat-top mountains, **rounded** hills and large U-shaped valleys was shaped mainly by glaciers. Like giant pieces of sandpaper, these sheets of ice, sometimes a kilometre or two in thickness, smoothed and polished the tops of mountains, deepened lowlands to form lakes and cut deep into some river valleys connected to the sea to create **fjords**. The large bays on Newfoundland's west coast and in northern Labrador are really fjords, just like the ones in Norway.



(13) Other features caused by glacial ice but not created until the ice melted are also **visible** in Newfoundland, especially along the west coast of the island. Under the tremendous weight of the ice, the earth's **crust** was pushed down several hundred metres into the softer **mantle**. When the earth's climate warmed and the glaciers melted, areas along the coast were flooded by the sea. Wave action carved many features into the new shoreline. With the weight of the ice gone, the land slowly rose from the sea carrying these features with it. Today, there are many places along the coast of Newfoundland where beaches and **sea stacks**, like the one at Trout River in Gros Morne National Park pictured above, are 20 to 100 metres above present sea level.

## Geology of Labrador

(14) The geological history of Labrador and parts of western Newfoundland are different from that of the island part of our province. Here the rocks are among some of the oldest on the **entire** planet. They are part of the **Canadian Shield**, an ancient land mass that formed when the earth's surface was cooling to form its first crust. For many millions of years, this ancient land was all that existed of North America. Today, the shield is a large mass of land around Hudson Bay. Its location in Canada is pictured to the right.



## Geology of Gander Area

(15) Gander Lake lies in a **fault** that stretches from Notre Dame Bay, across central Newfoundland to Hermitage Bay. This fault was once a **plate boundary**. There was a great deal of geological activity here 500 million years. Geologists have found rocks that are **remnants** of ancient volcanoes and **fossils** of shelled creatures that once lived on the bottom of the sub-tropical sea. Rocks that once laid flat to form the ocean floor are now **tilted** upward and form some of the landscape around Gander.

(16) The most interesting story **surrounds** Gander Lake itself. Before the ice ages, Gander Lake was not a lake but a fjord. It was connected to Freshwater Bay via Gambo Pond. During the ice ages, the lake was cut-off from the sea by a glacier that filled Gambo Pond and most of the surrounding area. When the glacier melted, it left behind enough sand and gravel to dam the lake and keep out the sea. As water **accumulated** the valley became what we now call Gander Lake. Eventually a major river from the lake did form. It flowed northward into Gander Bay. Today we call it the Gander River.

## Student Activities Geological Formation of Newfoundland

Directions: Answer the following questions on **loose leaf** in your **social studies duotang**. Write in complete sentences using your best handwriting.

### Vocabulary

1. Context Clues: Write definitions for each of the following words based on the information in the passage. The paragraph numbers are written in brackets.
- |                 |                  |                    |
|-----------------|------------------|--------------------|
| a. geology (1)  | c. geologist (5) | e. Pangea (9)      |
| b. erosion (11) | d. plates (5)    | f. topography (11) |

### Comprehension Questions: Writing Complete Answers

Directions: Highlight the key words in each of the following questions. Use these keywords to locate the topic that contains the information to answer the questions. Highlight the parts of the passage that provide the answer. Write the answer in your own words.

1. What does the theory of continental drift attempt to explain?
2. Why would you recommend a trip to Gros Morne National Park for someone interested in geology?
3. What evidence of an ice age has been left on the surfaces of Newfoundland and Labrador?
4. Why can you find sea stacks and ocean beaches over 100 metres above sea level in parts of Newfoundland?



## True or False:

Directions: Indicate whether each of the following is true or false.

- \_\_\_\_\_ Newfoundland was formed by the collision of continents.
- \_\_\_\_\_ The continents have stopped moving in present times.
- \_\_\_\_\_ The landscape of Newfoundland contains evidence of glaciation.
- \_\_\_\_\_ There are rocks in Newfoundland similar to rocks in Africa.
- \_\_\_\_\_ Gander Lake was always a fresh water lake.
- \_\_\_\_\_ Gros Morne National park is located in eastern Newfoundland.

## Thinking About Words

Directions: Answer the following questions on looseleaf.

A **theory** is an unproven idea. Theories are supported by evidence. Evidence is anything that helps to support the theory.

1. What evidence did Alfred Wegener use to support his theory of continental drift?

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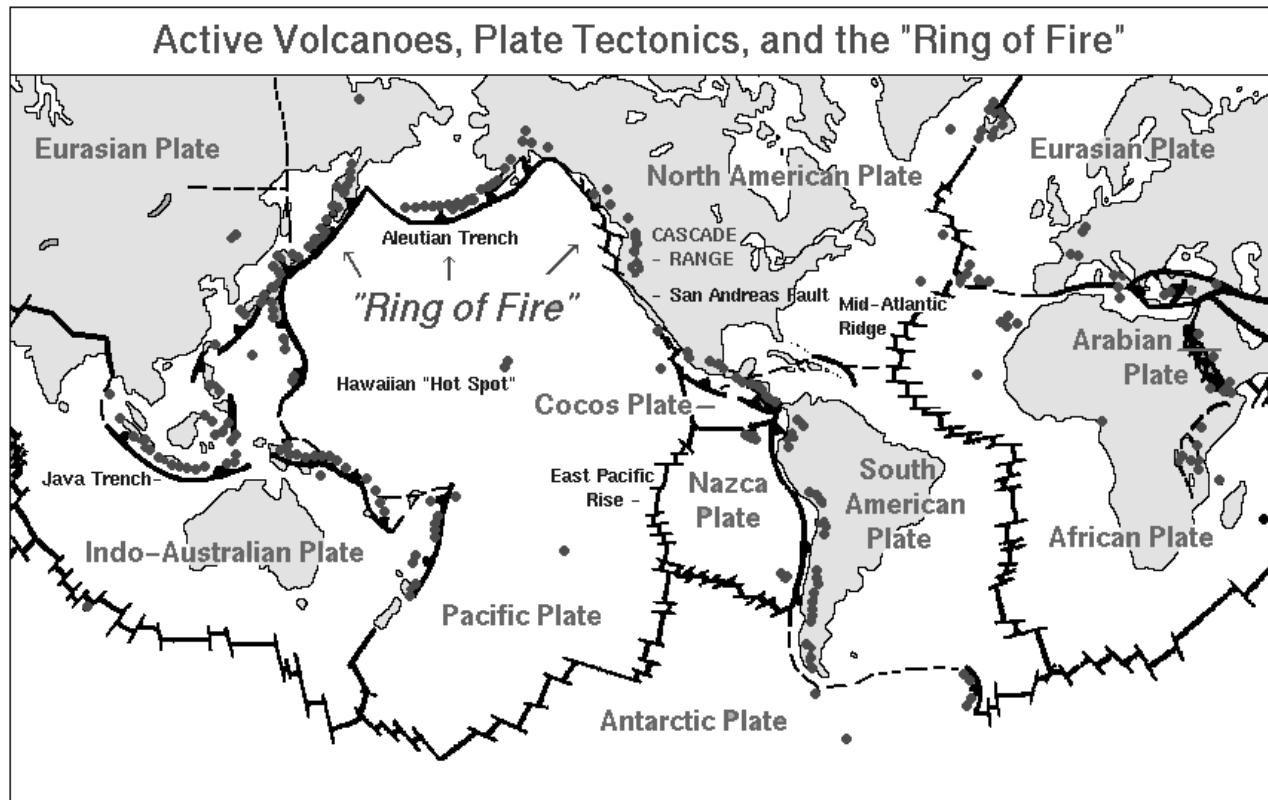
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2. Geologists have long used a **concept** or an idea to help them explain how the earth got to be the way it is today. It was first developed by James Hutton in 1785, and is still in use today. The concept says: "**the present is the key to the past.**" This means we can learn about the earth's past by observing what is happening on it today.

What can we study about the earth today that might help explain what happened on the planet millions of years ago?

## Visual Literacy: Interpreting a Diagram



Study the diagram above. Using the map and the passage, answer the following questions in your duo-tang. Write in complete sentences and in your best handwriting.

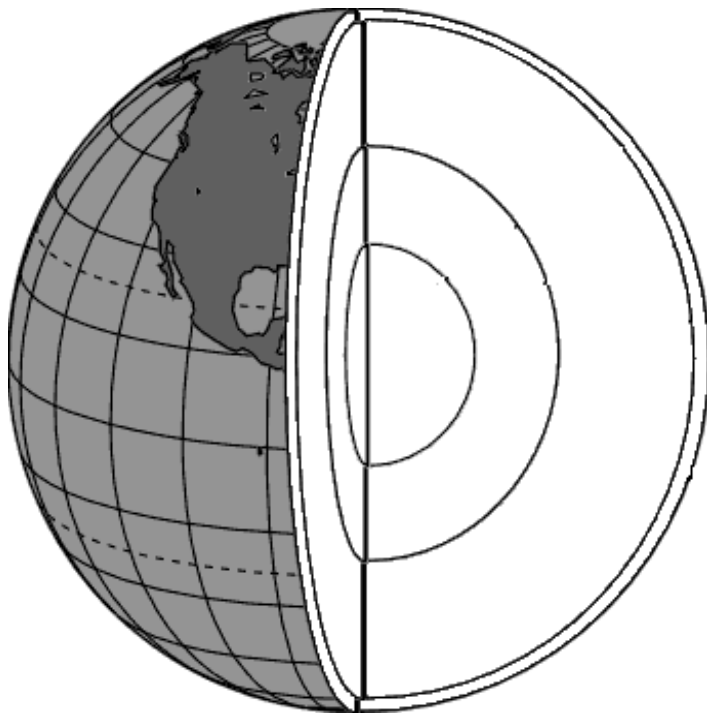
- What does this diagram show?
- What do the thick black lines represent?
- What do the black dots represent?
- What observation can you make about the volcanoes and the location of the edges of the tectonic plates?
- What do you notice about the names of six of the tectonic plates?
- If you wanted to see an active volcano in North America, where would you have to go?
- How do you think the "Ring of Fire" got its name?

## Visual Literacy: Labeling a Diagram

When working with diagrams, there are a couple of ways of presenting information. One way is to label the diagram by drawing lines to each part and then writing a label at the end of each line. Label the diagram of the layers in our planet following each of these rules for labeling

1. Labeling lines must be well spaced and clearly end on the part being labeled.
2. Labeling lines must not end too near or too far from the diagram.
2. Labels must be written horizontally starting at the ends of the lines.

terms for labeling: mantle, crust, outer core, inner core.



# Visual Literacy: Labeling a Diagram

Information on what this illustration shows can also be done using colours. Think about what the diagram is showing to complete the following.

a. Would you use the **same** of **different** colours? Why?

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b. If you choose more than one colour, how many colours would you choose?

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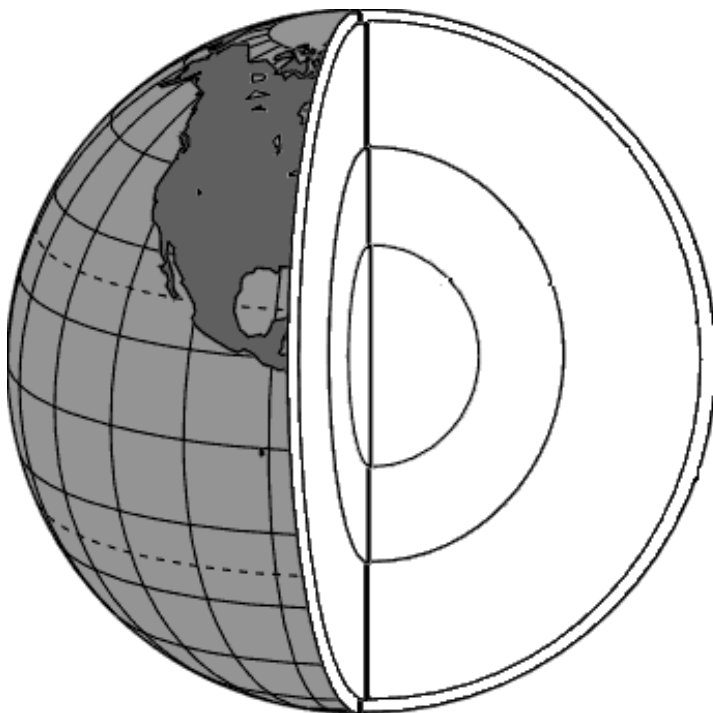
c. What colour choices would you make?

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d. Why would you choose these colours?

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e. Colour the diagram and the key to show the layers of the earth's surface.



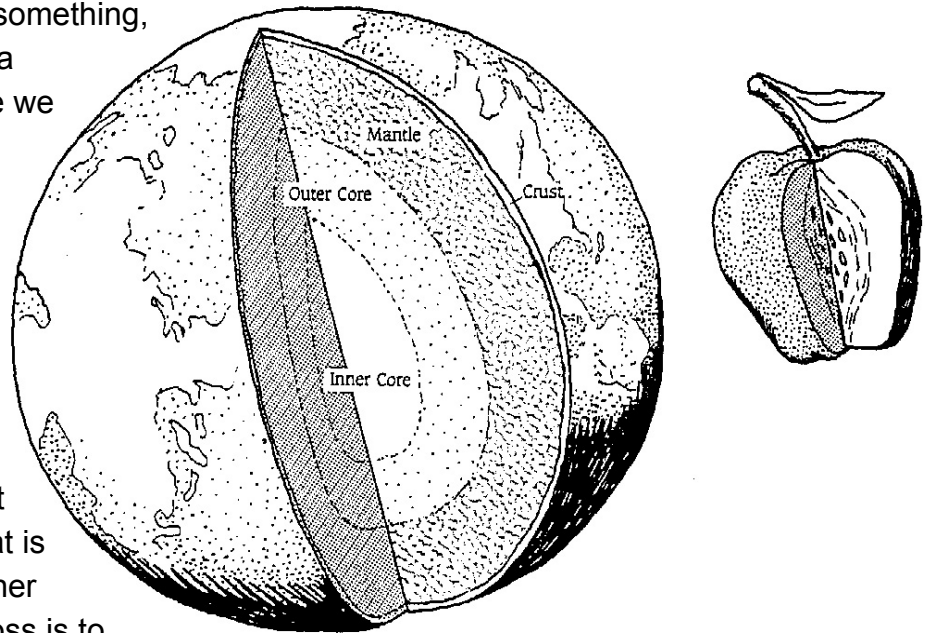
## Key

- Crust
- Mantle
- Outer Core
- Inner Core

# Visual Literacy: Making Comparisons Using Diagrams

When you try to explain something, it is a good idea to draw a diagram. This is because we are much better at learning when we use a visual aid that we just listen or read.

Even with a visual aid, it is not always easy to get your point across. This is especially true if it is difficult to imagine what is being represented. Another way to get you point across is to make a comparison between something you know with something you don't. This is being done in the diagram above. Examine the diagram carefully and answer the questions that follow.



1. What is being compared in the diagram above?

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2. What is this picture helpful when explaining the inside of the earth?

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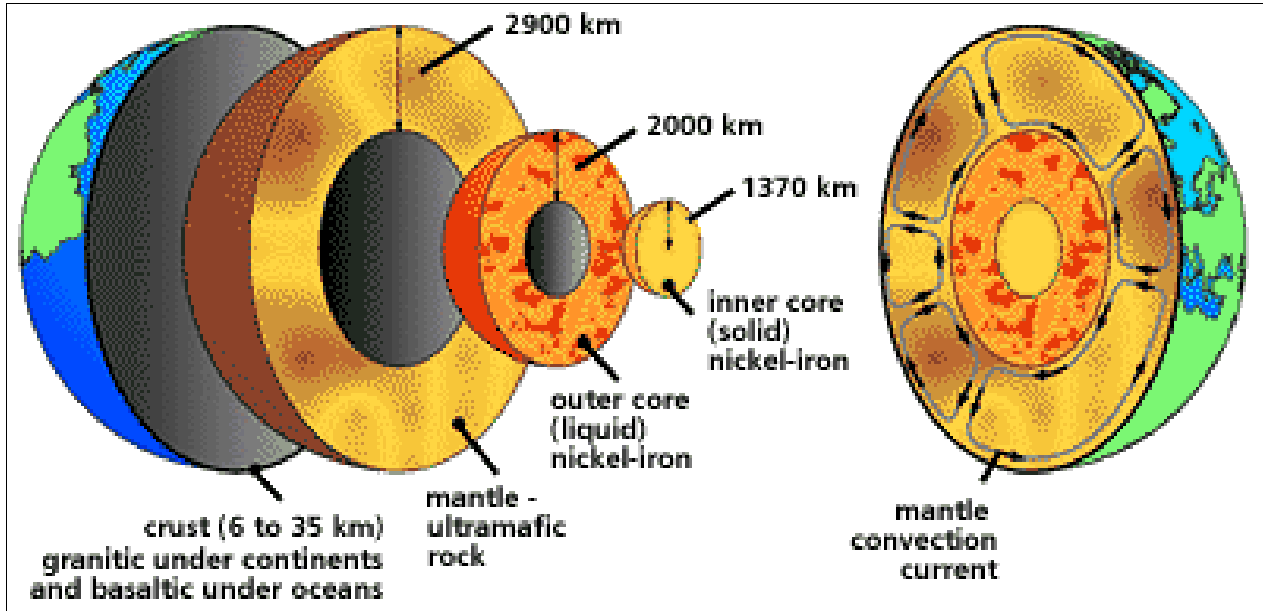
3. Match the layers of the earth with the parts of an apple (core, pulp, peel).

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# Visual Literacy: Using Information on a Diagram

Use the diagram below to answer the questions that follow.



1. What information is included on the diagram above?

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2. Arrange the layers of the earth from thickest to thinnest.

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## Map Skills: Using an Atlas

Continental Drift has been responsible for the formation of the world's great mountain ranges. They exist along the edges of plates that have or are still colliding. Using page 8-9 of the Classroom Atlas, locate the mountains ranges listed below. Using a different colour for each range, colour the portion of the world map below to indicate the location and size of the ranges. The continents on which these mountain ranges are located are given to help you narrow your search.

- |               |                          |                       |
|---------------|--------------------------|-----------------------|
| North America | <input type="checkbox"/> | Rocky Mountains       |
|               | <input type="checkbox"/> | Appalachian Mountains |
| South America | <input type="checkbox"/> | Andes Mountains       |
| Europe        | <input type="checkbox"/> | Alps                  |
| Asia          | <input type="checkbox"/> | Urals                 |
|               | <input type="checkbox"/> | Himalayas             |



|   |  |  |  |  |  |   |  |  |  |  |  |  |    |
|---|--|--|--|--|--|---|--|--|--|--|--|--|----|
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| 2 |  |  |  |  |  | r |  |  |  |  |  |  | 11 |
| 3 |  |  |  |  |  | l |  |  |  |  |  |  | 5  |
| 4 |  |  |  |  |  | o |  |  |  |  |  |  | 1  |

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| 10 |  |  |  |  |  | l |  |  |  |  |  |  | 5  |
| 11 |  |  |  |  |  | c |  |  |  |  |  |  | 5  |
| 12 |  |  |  |  |  | t |  |  |  |  |  |  | 4  |
| 13 |  |  |  |  |  | i |  |  |  |  |  |  | 3  |
| 14 |  |  |  |  |  | s |  |  |  |  |  |  | 4  |
| 15 |  |  |  |  |  | r |  |  |  |  |  |  | 9  |
| 16 |  |  |  |  |  | e |  |  |  |  |  |  | 10 |
| 17 |  |  |  |  |  | e |  |  |  |  |  |  | 12 |
| 18 |  |  |  |  |  | o |  |  |  |  |  |  | 11 |

1. The name of the east coast of North American mountain range formed by the collision of continents.
2. This work refers to the shape of the land.
3. The thick layer of the earth below the crust.
4. The scientific study of the earth's rocks and land forms.
5. The outer layer of the earth.
6. Much of Labrador belongs to this ancient land mass.
7. This popular place in Newfoundland has rocks similar to the ones in northwestern Africa.
8. The name given to the super-continent millions of years ago.
9. The name of the ancient ocean that once covered central Newfoundland.
10. The name given to rocks in a liquid form.
11. Form when lava and ash pour onto the earth's surface.
12. Large cracks in the earth's surface.
13. These huge land masses are moved like items on a conveyor belt.
14. Large sections of the earth's crust.
15. This continent was once connected to Newfoundland.
16. Today's landscape was formed by glaciers of this recent geological event.
17. This shape of the hills and mountains of Newfoundland is evidence of being eroded by glaciers.
18. The wearing down and washing away of the earth's surface.

Clue Words: \_\_\_\_\_

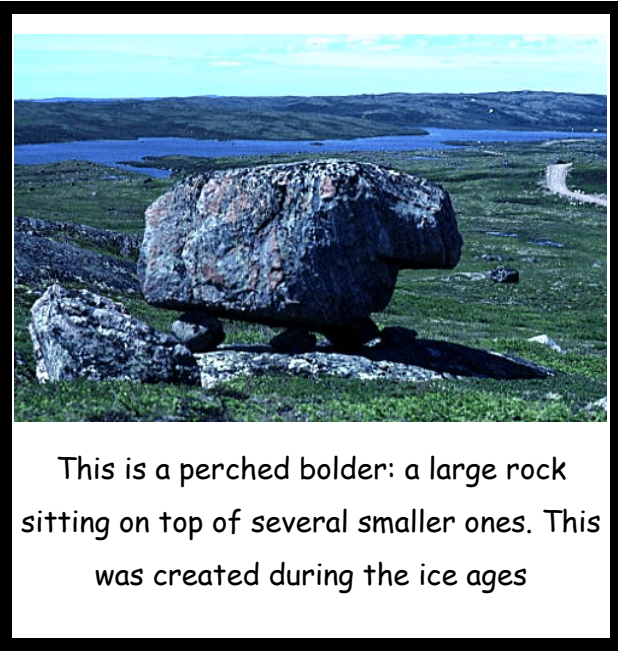


# Geological History of Newfoundland

## Word Search Puzzle

|           |            |          |            |            |             |
|-----------|------------|----------|------------|------------|-------------|
| geology   | earth      | tectonic | continent  | crust      | faults      |
| plates    | mantle     | molten   | collisions | geologists | earthquakes |
| volcanoes | tablelands | Pangea   | erosion    | topography | glaciers    |
| landscape | rounded    | fjords   | fossils    | remnants   | theory      |

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | p | p | m | a | l | m | o | a | c | s | e | o | n | a | c | l | o | v | f |
| c | p | r | o | p | a | n | g | e | a | u | s | t | p | a | n | e | a | e | a |
| r | l | t | l | h | q | u | a | k | g | e | o | l | o | g | y | e | r | r | u |
| e | a | r | t | h | a | r | s | r | e | i | c | a | l | g | e | n | o | o | l |
| m | t | a | e | e | z | t | e | c | t | o | n | i | c | q | c | r | u | s | t |
| t | e | c | n | a |   |   |   |   |   |   |   |   |   |   | o | o | n | i | s |
| o | s | l | l | r |   |   |   |   |   |   |   |   |   |   | n | i | d | o | s |
| p | o | n | s | t |   |   |   |   |   |   |   |   |   |   | t | n | e | n | w |
| o | f | o | s | h |   |   |   |   |   |   |   |   |   |   | i | u | d | n | d |
| g | l | a | t | q |   |   |   |   |   |   |   |   |   |   | n | r | a | d | o |
| r | e | e | n | u |   |   |   |   |   |   |   |   |   |   | r | e | o | e | s |
| a | t | l | a | a |   |   |   |   |   |   |   |   |   |   | n | e | h | e | n |
| p | o | i | n | k |   |   |   |   |   |   |   |   |   |   | t | p | r | y | o |
| h | f | s | m | e |   |   |   |   |   |   |   |   |   |   | s | a | a | s | i |
| y | s | s | e | s |   |   |   |   |   |   |   |   |   |   | i | c | l | s | s |
| f | j | o | r | d | s | v | o | t | h | e | o | r | y | l | c | s | a | n | i |
| t | o | f | d | g | e | o | l | o | g | i | s | t | s | e | r | d | a | s | l |
| i | o | n | r | e | g | r | o | m | e | n | w | o | u | n | t | n | a | i | l |
| v | a | z | w | y | f | t | a | b | l | e | l | a | n | d | s | a | q | u | o |
| e | l | t | n | a | m | s | c | t | h | k | w | e | u | n | g | l | t | y | c |



This is a perched bolder: a large rock sitting on top of several smaller ones. This was created during the ice ages