

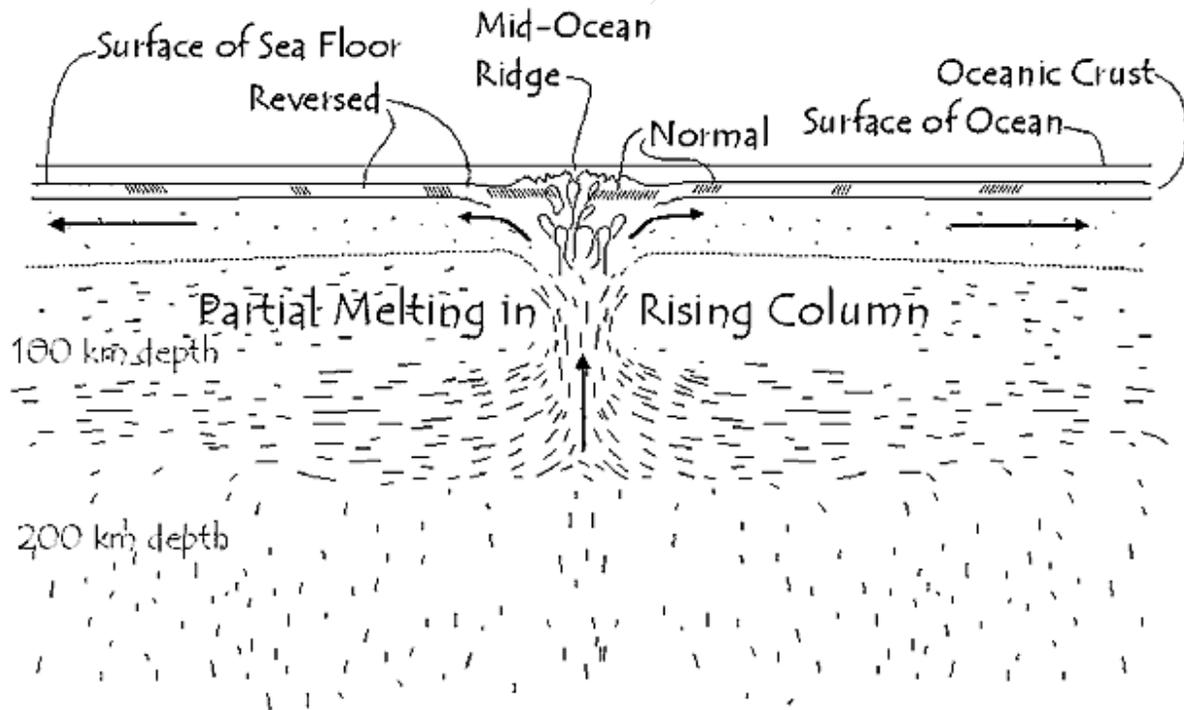
Modeling Seafloor Spreading

Adapted from a lesson developed by San Lorenzo USD Teachers: Julie Ramirez, Veenu Soni, Marilyn Stewart, and Lawrence Yano (2012)

Teacher Background

The process of seafloor spreading created the seafloor of the oceans. For example, in the Atlantic Ocean, North America and South America moved away from Europe and Africa and the resulting crack was filled by mantle material, which cooled and formed new lithosphere. The process continues today. Molten mantle materials continually rise to fill the cracks formed as the plates move slowly apart from each other. This process creates an underwater mountain chain, known as a mid-ocean ridge, along the zone of newly forming seafloor.

Molten rock erupts along a mid-ocean ridge, then cools and freezes to become solid rock. The direction of the magnetic field of the Earth at the time the rock cools is "frozen" in place. This happens because magnetic minerals in the molten rock are free to rotate so that they are aligned with the Earth's magnetic field. After the molten rock cools to a solid rock, these minerals can no longer rotate freely. At irregular intervals, averaging about 200-thousand years, the Earth's magnetic field reverses. The end of a compass needle that today points to the north will instead point to the south after the next reversal. The oceanic plates act as a giant tape recorder, preserving in their magnetic minerals the orientation of the magnetic field present at the time of their creation. Geologists call the current orientation "normal" and the opposite orientation "reversed."

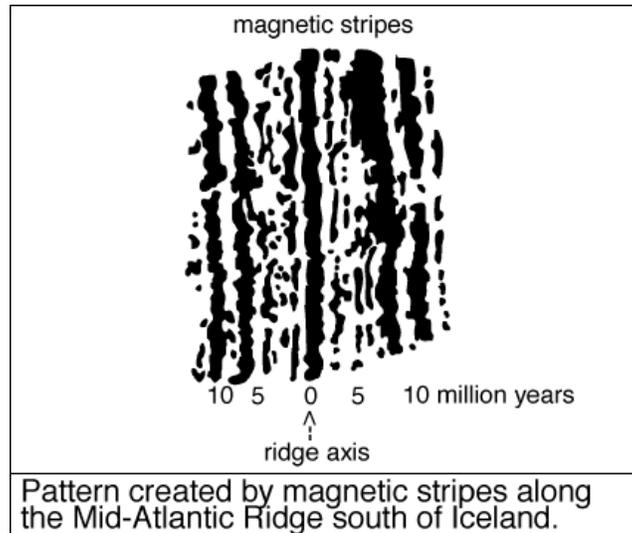


USGS

Teacher Instruction Sheet

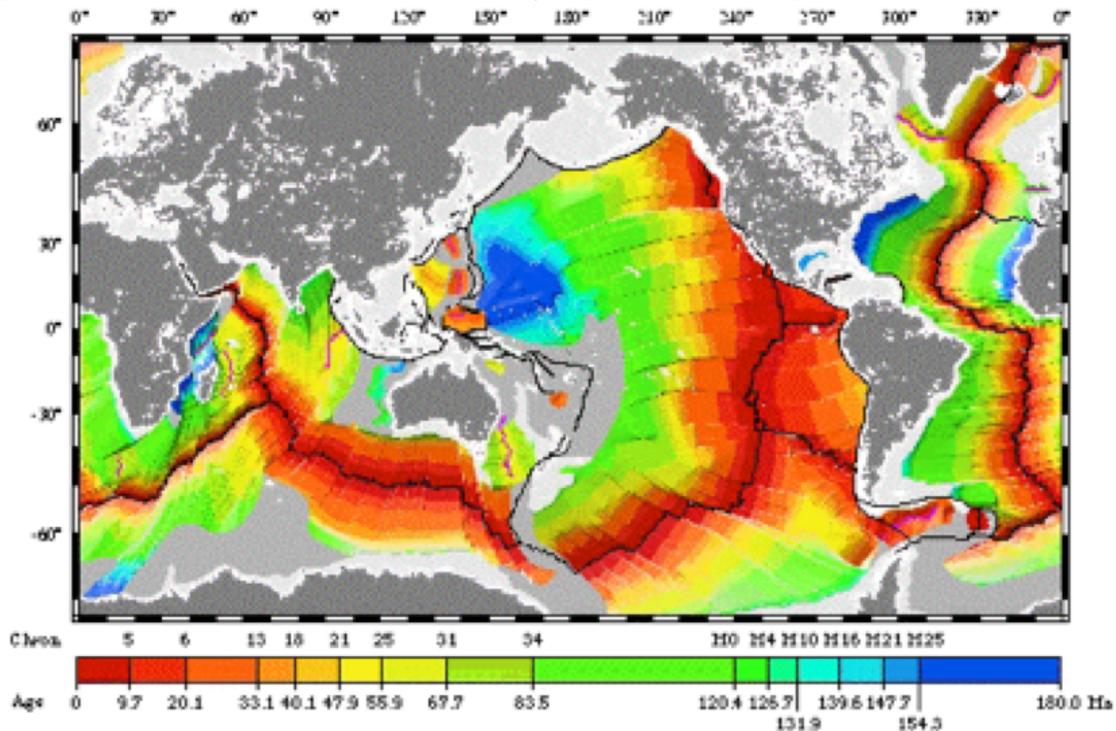
In the figure above, two plates are moving apart. A mid-ocean ridge marks the location where molten magma and lava are moving up, cooling, and forming new ocean floor. The zones of normal magnetization are indicated by // shading of the oceanic crust.

The figure below shows the observed magnetic pattern along the mid-Atlantic Ridge south of Iceland.



[Mattox \(1992\)](#)

Based on the pattern and spacing of the oceanic magnetic stripes and the inferred motion of the plates, the age of the ocean floor can be determined. In the figure below, the age of the ocean floor is depicted.



[Müller and others \(1997\)](#)

Teacher Instruction Sheet

Suggested time to complete this lesson is two 50-minute periods but may be adjusted for a longer class period.

DAY 1

- Show a video about Harold Hess and his discoveries.
<https://www.youtube.com/watch?v=GyMLLxbfa4>
- Ask students to talk to their elbow partner and discuss with each other who Wegener was. Have students call out what they remember about his discoveries.
- Ask students how Wegener must have felt when people did not support his idea about *Continental Drift*?
- Why did the scientific community initially dismiss Wegener's idea about *Continental Drift*?
- What did other scientists have issues with?
- How do Hess' discoveries relate to what Wegener's *Continental Drift*?

DAY 2

- Students may need clarification about the magnetic pole reversals.
- Use a "**Steric Demonstrator of Magnetic Line-of-Force**" model to show the existence of the magnetic fields and the spatial distribution of magnetic lines of force.
- "Yesterday we talked about Harry Hess and his theory of seafloor spreading. What important discoveries did Hess and his fellow scientists make? "

Expected Student Responses

- Continuous chain of undersea mountains known as the mid-ocean ridge
- Symmetrical patterns of magnetic reversals shown by metal crystals embedded in rocks
- Rocks that were farther away from ridge were older (age of rocks)

Quick Write

Ask students why models are necessary for studying the Earth? Students may record their thoughts on the student data sheet.

Many Earth processes occur over very large distances and over a very long periods of time (millions of years). The scale of Earth processes makes it difficult to directly measure these processes. We have learned that scientists often use models to explain their thinking. We have used globes, maps, diagrams; charts etc. when size or safety issues keep us from viewing the real thing. So today we are going to consider how we might make a model that would explain or demonstrate sea floor spreading.

Think Pair Share

Turn and talk to your elbow partner: If you were making a model of sea-floor spreading, what are the important ideas that are associated with seafloor spreading? Share out.

Expected student answers:

- The mid-ocean ridge
- Symmetrical magnetic patterns

Teacher Instruction Sheet

- Age of rocks

Students should use the student data sheet to record their thoughts.

You have come up with some important ideas that need to be included. (If any parts are missing, ask “What about _____ do you think this should be included?”)

“Today we are going to create a model that I hope will incorporate all of your important points.”

1. Students will make their own models of seafloor spreading and the magnetic strips that occur in the seafloor. Have students work in groups of four.
2. Have students pick up materials needed for the activity.

Materials:

60 cm long paper strip	1 compass
1 box of markers	1 cardboard box lid
1 bar magnet	Meter Stick or ruler

3. Assign jobs:

- Student A: **Paper Puller**
- Student B: **Compass Reader**
- Student C: **Marker**
- Student D: **Magnet Manager**

The following directions have many steps. Since they are pulling, marking, flipping etc. it is recommended that the teacher demonstrate how to create the model by showing at least 2 examples of magnetic reversals.

4. **Paper Puller:** Measure and cut 60 cm of the paper strip. Fold the strip in half lengthwise so it is approximately 30 cm long. Push the ends of the strip through the slit in the lid of a cardboard box so that it is sticking out about 5 cm on the top of the lid. Leave the folded end of the strip underneath the box.
5. **Marker:** Draw a line in the center of the paper (where it is coming out of the box) making sure to mark both sides of the paper.
6. **Compass Reader:** Place the compass next to the paper where it is coming out of the box.
7. **Magnet Manager:** Place the magnet on the opposite side of the paper from the compass.
8. **Compass Reader:** Observe which direction is North and tell the Marker.
9. **Marker:** Draw an arrow pointing North on both sides of the paper. Label the first section on both sides with an “A”.
10. **Paper Puller:** pull out some more paper. **Marker:** draw a line in the center of the paper where it came out of the box. **Magnet Manager:** Flip the magnet in the opposite direction. **Compass Reader:** Read the compass. Tell the **Marker** to draw an arrow on pointing to the new North on both sides of the paper. Label the second section on both sides of the paper with a “B”.
11. Repeat step 10 until you reach the end of the paper. Make sure that the **Magnet Manager** flips the magnet each time.

Teacher Instruction Sheet

Looking at Parts of the Model

Have students record their ideas on the student worksheet.

1. What does the paper strip used in the model represent in real life? Paper strip represents seafloor
2. When the strips of paper are pulled out, what process does this represent? Pulling out the strips of paper represents the process of seafloor spreading
3. What does the magnet represent? The magnet represents the Earth's magnetic field
4. What do the sections with arrows represent? (Why are they pointing in different directions)? Arrows represent the different orientations of the Earth's magnetic field when the seafloor formed.
5. What do the different sections of the paper strip (A, B, C, etc.) represent? The different sections represent the magnetic stripes in the seafloor
6. In the model, what does flipping the magnet represent? Flipping the magnet represents the Earth's magnetic reversals
7. Did we include all the important elements needed to explain seafloor spreading? If yes, what are they? If no, what is missing?
8. Can you think of a way that we could add/delete/change items that would make this model more effective?
9. Can you think of a way that we could use this model to explain Wegener's idea of Continental Drift?

Exit Ticket In the space below, draw a diagram of seafloor spreading. Include as much detail as you can.

Vocabulary words – key vocabulary words that are targeted or taught as part of the lesson.

(Understanding these words is **essential** for students to understand the key concepts of this lesson.)

Seafloor Magnet Magnetic Field Mid-ocean Ridge

Potential Pitfalls

- Students should understand that there are not visible stripes on the seafloor. Magnetic stripes in diagrams portray the orientation of the magnetic field that is measured by scientific instruments that are preserved in the rocks and are not visible.
- Spreading at mid-ocean ridges is not a continuous process (like a conveyer belt) but occurs in episodes.