Earth, Space, & Environmental Science
HONORS

Independent Learning
Packet #4

Student Name: ______________________
Teacher: __________________________
Period: ___________________________

After completing the work in this packet, fill out the chart below.

<table>
<thead>
<tr>
<th>Concepts I understand well:</th>
<th>Concepts I’m still confused about:</th>
<th>Personal connections I can make to these concepts:</th>
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Sea Floor Spreading

Seafloor spreading is a geologic process in which tectonic plates—large slabs of Earth’s lithosphere—split apart from each other. Seafloor spreading and other tectonic activity processes are the result of mantle convection. Mantle convection is the slow, churning motion of Earth’s mantle. Convection currents carry heat from the lower mantle and core to the lithosphere. Convection currents also “recycle” lithospheric materials back to the mantle.

Seafloor spreading occurs at divergent plate boundaries. As tectonic plates slowly move away from each other, heat from the mantle’s convection currents makes the crust more plastic and less dense. The less-dense material rises, often forming a mountain or elevated area of the seafloor. Eventually, the crust cracks. Hot magma fueled by mantle convection bubbles up to fill these fractures and spills onto the crust. This bubbled-up magma is cooled by frigid seawater to form igneous rock. This rock (basalt) becomes a new part of Earth’s crust.

Mid-Ocean Ridges

Seafloor spreading occurs along mid-ocean ridges—large mountain ranges rising from the ocean floor. The Mid-Atlantic Ridge, for instance, separates the North American plate from the Eurasian plate, and the South American plate from the African plate. The East Pacific Rise is a mid-ocean ridge that runs through the eastern Pacific Ocean and separates the Pacific plate from the North American plate, the Cocos plate, the Nazca plate, and the Antarctic plate. The Southeast Indian Ridge marks where the southern Indo-Australian plate forms a divergent boundary with the Antarctic plate. Seafloor spreading is not consistent at all mid-ocean ridges. Slowly spreading ridges are the sites of tall, narrow underwater cliffs and mountains. Rapidly spreading ridges have a much more gentle slopes.

The Mid-Atlantic Ridge, for instance, is a slow spreading center. It spreads 2-5 centimeters (8-2 inches) every year and forms an ocean trench about the size of the Grand Canyon. The East Pacific Rise, on the other hand, is a fast spreading center. It spreads about 6-16 centimeters (3-6 inches) every year. There is not an ocean trench at the East Pacific Rise, because the seafloor spreading is too rapid for one to develop! The newest, thinnest crust on Earth is located near the center of mid-ocean ridge—the actual site of seafloor spreading. The age, density, and thickness of oceanic crust increases with distance from the mid-ocean ridge.
Geographic Features
Oceanic crust slowly moves away from mid-ocean ridges and sites of seafloor spreading. As it moves, it becomes cooler, more dense, and more thick. Eventually, older oceanic crust encounters a tectonic boundary with continental crust. New geographic features can be created through seafloor spreading. The Red Sea, for example, was created as the African plate and the Arabian plate tore away from each other. Today, only the Sinai Peninsula connects the Middle East (Asia) with North Africa. Eventually, geologists predict, seafloor spreading will completely separate the two continents—and join the Red and Mediterranean Seas.

Mid-ocean ridges and seafloor spreading can also influence sea levels. As oceanic crust moves away from the shallow mid-ocean ridges, it cools and sinks as it becomes more dense. This increases the volume of the ocean basin and decreases the sea level. For instance, a mid-ocean ridge system in Panthalassa—an ancient ocean that surrounded the supercontinent Pangaea—contributed to shallower oceans and higher sea levels in the Paleozoic era. Panthalassa was an early form of the Pacific Ocean, which today experiences less seafloor spreading and has a much less extensive mid-ocean ridge system. This helps explain why sea levels have fallen dramatically over the past 80 million years.

Seafloor spreading disproves an early part of the theory of continental drift. Supporters of continental drift originally theorized that the continents moved (drifted) through unmoving oceans. Seafloor spreading proves that the ocean itself is a site of tectonic activity.

Keeping Earth in Shape
Seafloor spreading is just one part of plate tectonics. Subduction is another. Subduction happens where tectonic plates crash into each other instead of spreading apart. At subduction zones, the edge of the denser plate subducts, or slides, beneath the less-dense one. The denser lithospheric material then melts back into the Earth's mantle.

Seafloor spreading creates new crust. Subduction destroys old crust. The two forces roughly balance each other, so the shape and diameter of the Earth remain constant.
1. Seafloor spreading is the result of ___.
   a. Core convection  
   b. Mantle convection 
   c. Weathering       
   d. Human activity

2. Convection currents “recycle” materials back to the mantle.
   a. true                  
   b. false

3. Sea floor spreading occurs at which plate boundary?
   a. convergent            
   b. transform             
   c. divergent            
   d. all of the above

4. Mid ocean ridges are ___.
   a. large mountain ranges
   b. underwater plateaus  
   c. similar to abyssal plains 
   d. man made

5. The Mid Atlantic Ridge has a slow spreading center.
   a. true                  
   b. false

6. How much does the Mid Atlantic Ridge move each year?
   a. 2-3 cm
   b. 2-3 feet               
   c. 2-3 yards              
   d. 2-3 meters

7. As oceanic crust moves away from mid ocean ridges, it becomes ___.
   a. cooler
   b. more dense
   c. more thick 
   d. all of the above

8. Scientist predict that one day, sea floor spreading will completely separate Africa from Asia.
   a. true
   b. false

9. Sea floor spreading has no influence on sea level rise.
   a. true
   b. false

10. Sea floor spreading actually disproves the early theory of continental drift.
    a. true
    b. false

11. Sea floor spreading ___ new crust.
    a. creates
    b. destroys
    c. all of the above
    d. none of the above

12. Subduction ___ old crust.
    a. creates
    b. destroys
    c. all of the above
    d. none of the above
Task #2

Correctly label the image below using the word bank.

Word Bank:
- convection currents
- mid ocean ridge
- sea floor spreading
- subduction
- continental crust
- oceanic crust

A: ________________________  
B: ________________________  
C: ________________________  
D: ________________________  
E: ________________________  
F: ________________________

Describe where the crust would be the oldest. Where would crust be the youngest?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
The map above shows all the mid ocean ridges around the world. Choose one mid ocean ridge and explain what you think will most likely happen in the next 50,000 years or so at this ridge. Use vocabulary from the article in your explanation.