



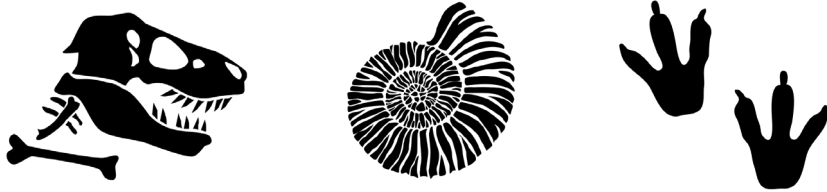
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ANCIENT ANIMAL PUZZLE

Grade Level
3-7

How do fossils form?

Fossils are traces of ancient plants and animals. Some fossils are remains and include bones, teeth, and shells. Other fossils are imprints of plants or even footprints.



Fossils form in different ways. For animals with backbones, the process that creates fossilized bones starts when the plant or animal dies. Soft tissues break down and leave only bones behind. Over time, the bones become buried. As layers of earth build up, they compress the layers below. As the layers and bones compress, they turn into rock.



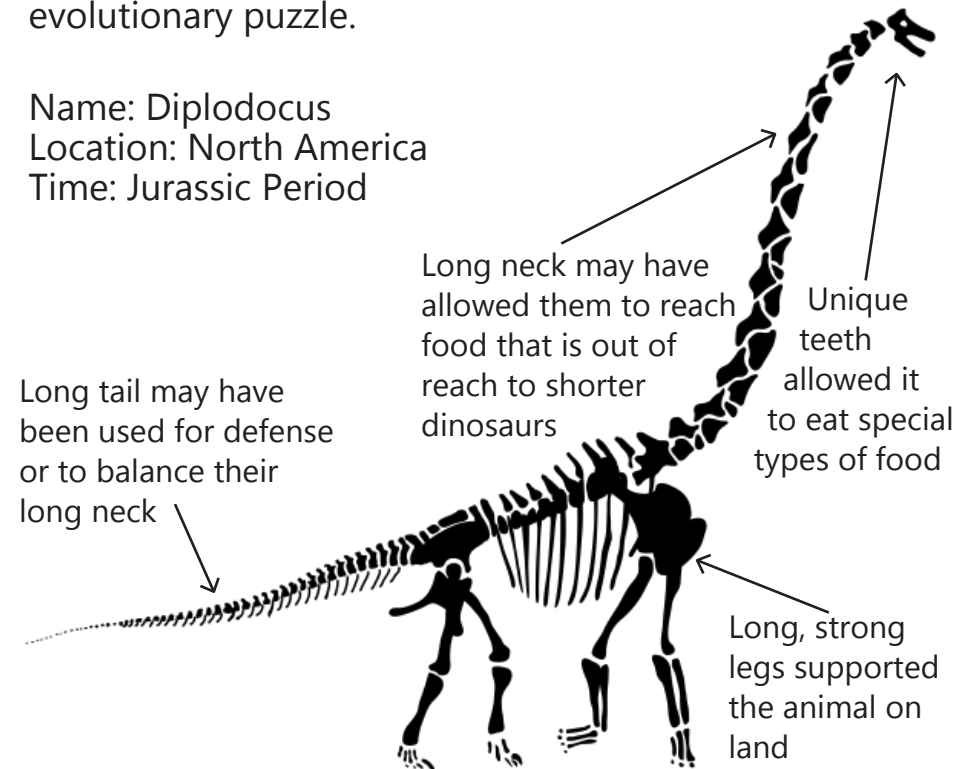
Not every plant or animal can become a fossil. Only organisms that were buried quickly become fossilized. Burial happens faster in the ocean than it does on land. Marine organisms that lived in the ocean were more commonly fossilized. Plants and animals that lived on land were less likely to be fossilized.

What can we learn from fossils?

We can learn a lot about ancient plants and animals by studying their fossil remains. Scientists can figure out what an animal looked like by looking at its fossil. We also use fossils to figure out where an animal lived or what it ate.

Scientists can also compare ancient animals to ones on Earth today. The species we see today evolved from ancient species. These comparisons can help us piece together the evolutionary puzzle.

Name: Diplodocus
Location: North America
Time: Jurassic Period

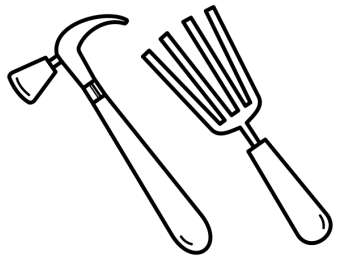




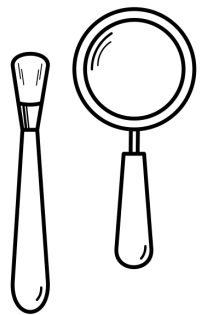
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Fossil Laboratory

Use this space to arrange your fossil pieces. Glue or tape them down once you are done. Look online to see if you can figure out the animal's name and to learn more about it.



Animal name: _____



NSF GLOBE SERIES: EARTH'S RELATIVE GRAVITY

See reverse side for assembly instructions

Paste or tape here



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EARTH'S RELATIVE GRAVITY

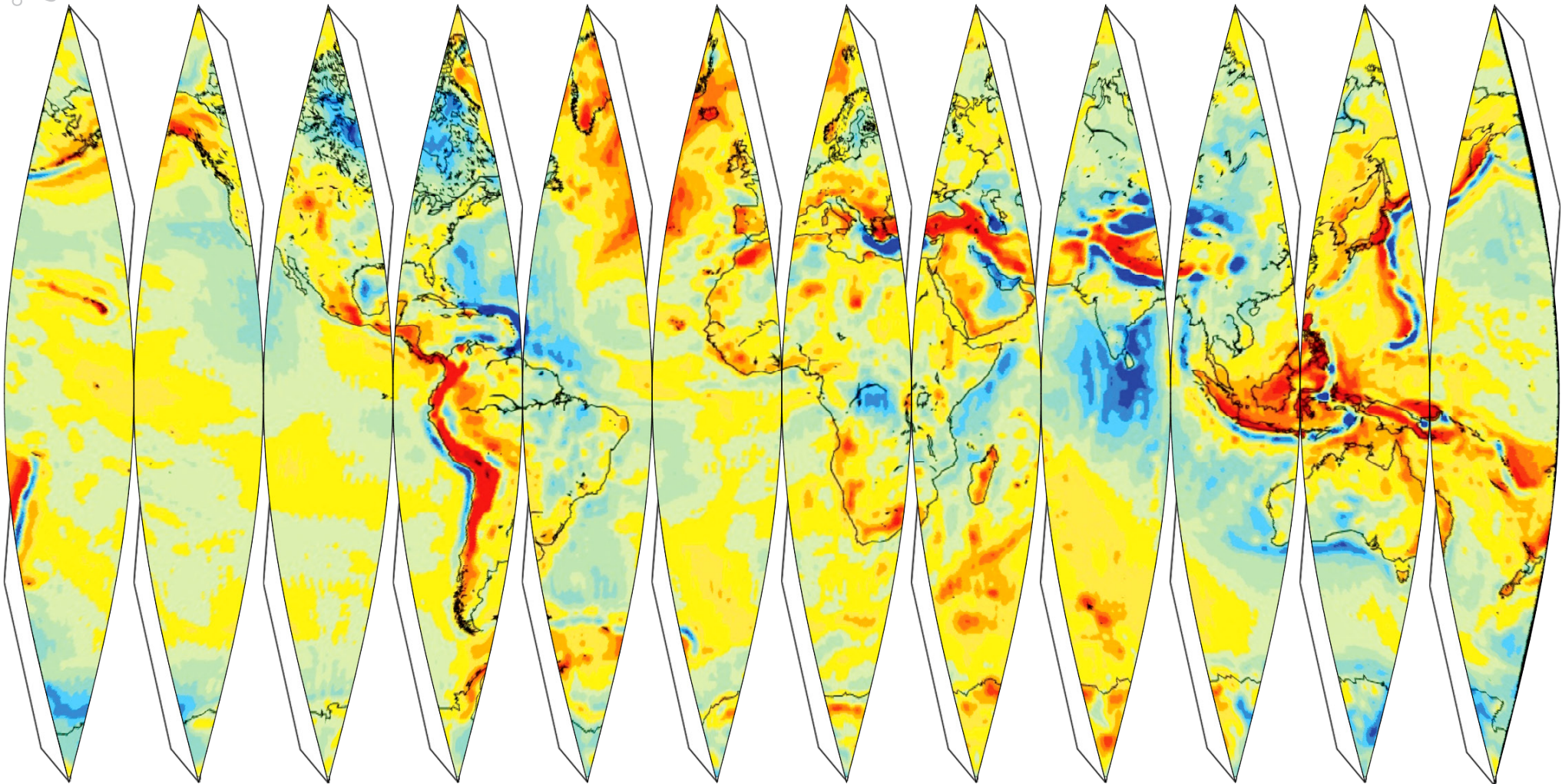
Gravity is an attractive force between objects that is determined by mass. Earth has an idealized gravity of 9.8 m/s^2 but because its mass is not evenly distributed, this value deviates at different locations. At large mountain ranges, gravity tends to be higher than average while at deep ocean trenches, gravity tends to be lower. NASA's GRACE satellite detects these minor gravitational anomalies. These observations have allowed scientists to detect previously unknown density anomalies within the Earth's deep interior.

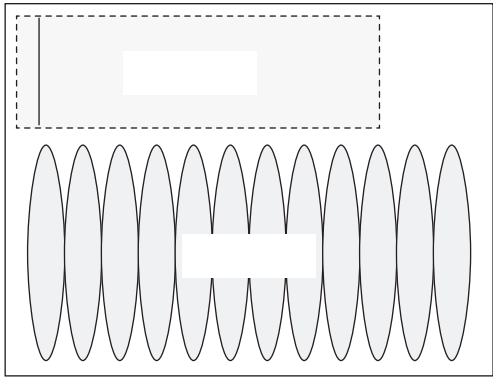


Gravity Anomaly (milliGal)



J. Ries, S. Bettadpur, R. Eanes, Z. Kang, U. Ko, C. McCullough, P. Nagel, N. Pie, S. Poole, T. Richter, H. Save, and B. Tapley (2016) Development and Evaluation of the Global Gravity Model GGM05, CSR-16-02, Center for Space Research, The University of Texas at Austin.

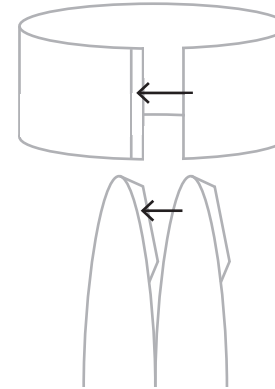




ASSEMBLY INSTRUCTIONS

Base: Cut along the dotted line and assemble by overlapping and taping or pasting the two ends as shown.

Globe: Cut out the sliced globe diagram and tabs as one piece. Assemble by pasting or taping each slice to the tab of the adjacent slice as shown.



NSF GLOBE SERIES: LAND CLASSIFICATION

See reverse side for assembly instructions

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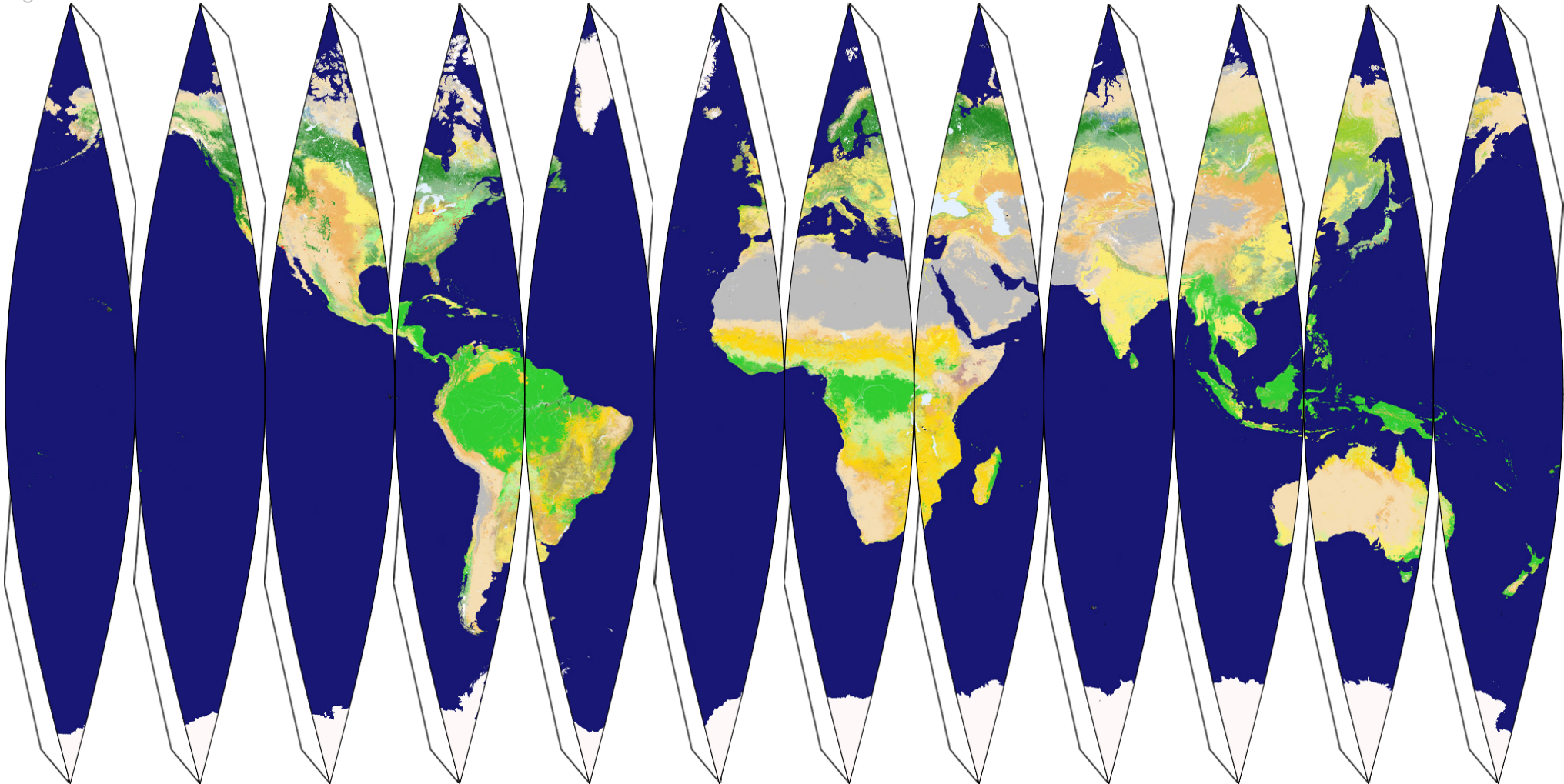
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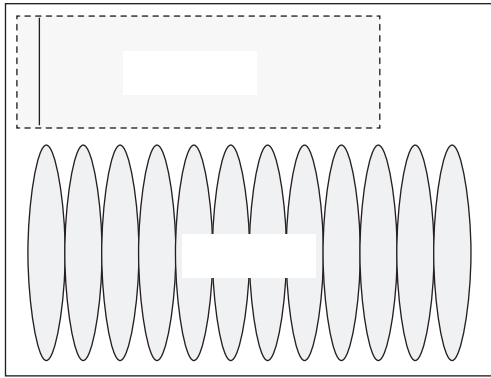
LAND CLASSIFICATION

Satellites that detect Earth's surface characteristics, like water levels, soil erosion and vegetation type, allow scientists to classify natural landscapes and the effects of humans on these landscapes. Mapping these landscape types allows scientists to track changes as a result of deforestation, urban expansion, desertification, natural, or other causes. These data also allow scientists to model hydrologic and carbon cycling, and other critical processes on a global scale in an effort to better understand and predict the effects of global climate change and human disturbance.

- | | | | |
|-----------------------------|------------------------------------|------------------------------|--------------------|
| Evergreen Needleleaf Forest | Mixed Forests | Snow and Ice | Woody Savannas |
| Evergreen Broadleaf Forest | Croplands | Barren or Sparsely Vegetated | Savannas |
| Deciduous Needleleaf Forest | Urban and Built-up | Close Shrublands | Grasslands |
| Deciduous Broadleaf Forest | Cropland/Natural Vegetation Mosaic | Open Shrublands | Permanent Wetlands |

Late 2011 Visualization created by Jesse Allen, NASA Earth Observatories, using data from MODIS Land Team and the Land Processes Distributed Active Archive Center

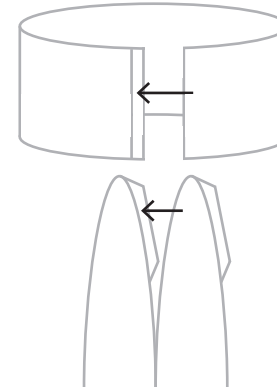




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NSF GLOBE SERIES: SEA FLOOR AGE AND PLATE TECTONICS

See reverse side for assembly instructions

Paste or tape here

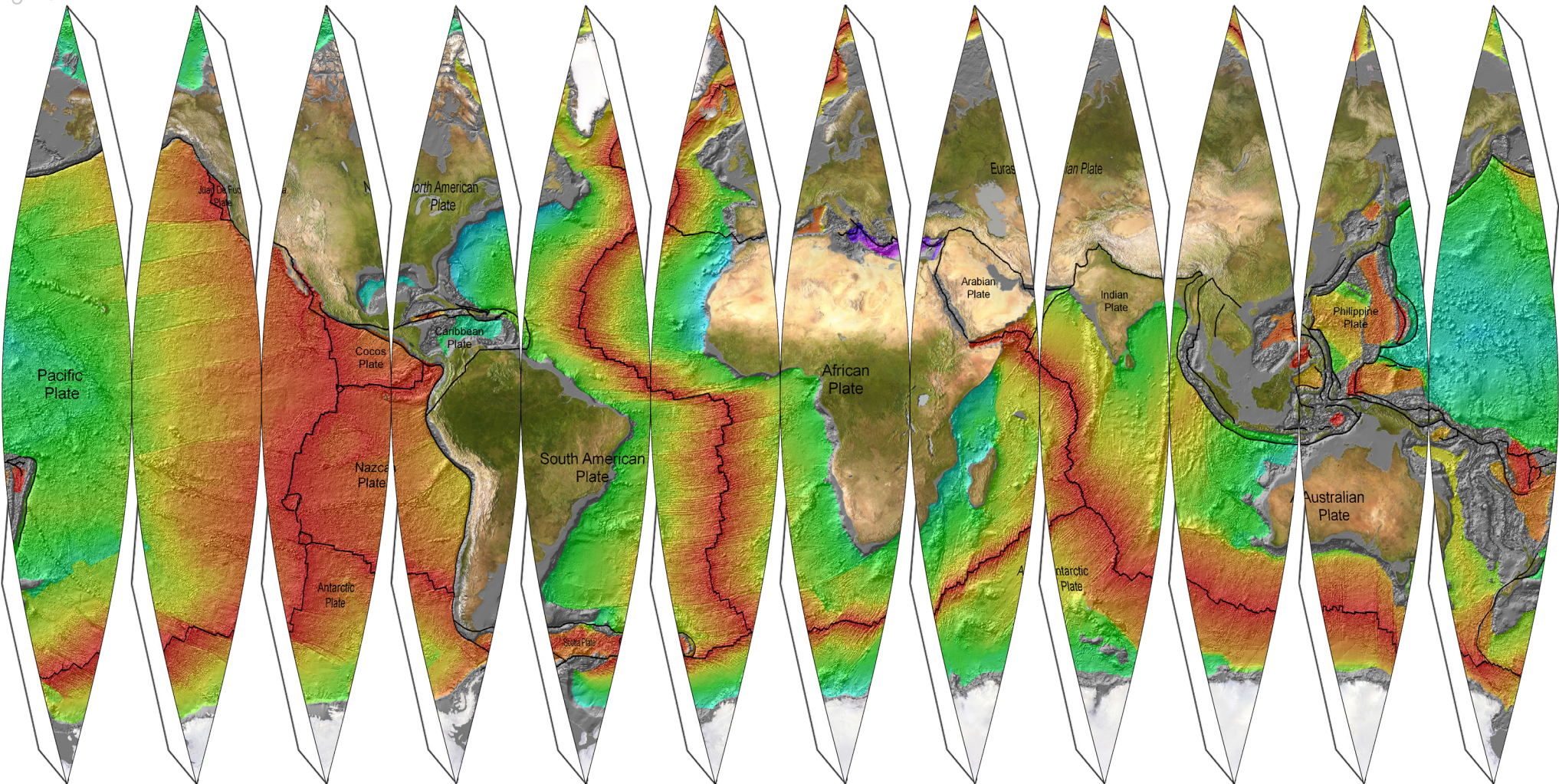


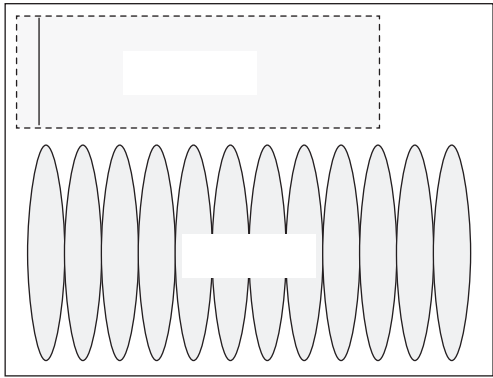
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SEA FLOOR AGE AND PLATE TECTONICS

The top layer of the Earth is comprised of several moving pieces called tectonic plates. Where these plates meet, different types of boundaries form. At convergent boundaries, plates collide and their edges are deformed as one plate is recycled into the mantle. At transform boundaries, plates slide past each other. At divergent boundaries, plates move apart from each other and new edges are created. The youngest sea floor can be found near divergent boundaries while the oldest sea floor can be found near convergent boundaries.

Sea Floor Age (millions of years)

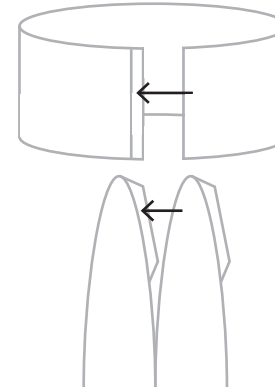




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NSF GLOBE SERIES: SOIL MOISTURE

See reverse side for assembly instructions

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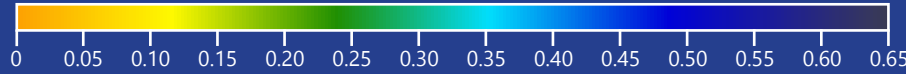


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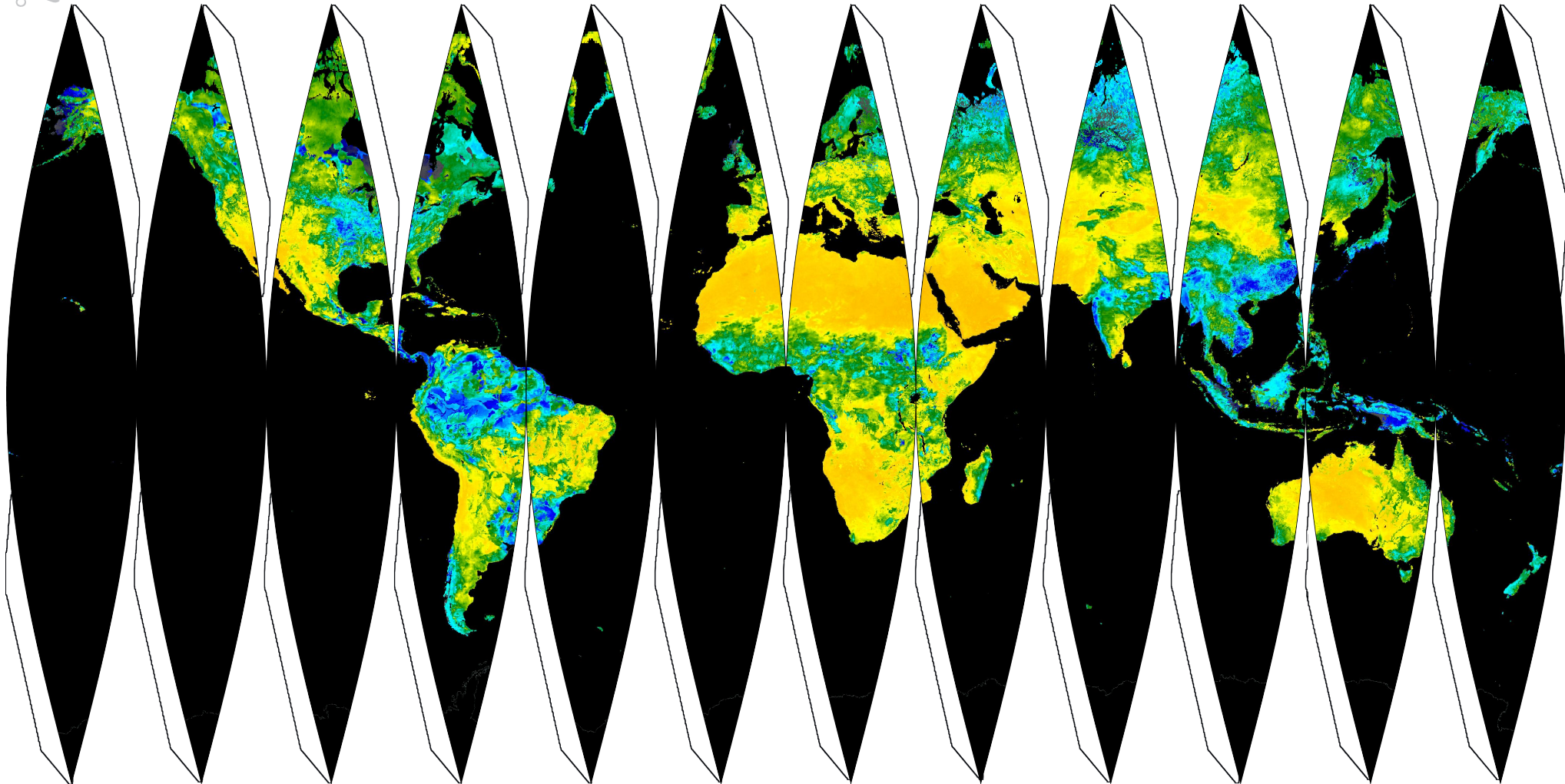
SOIL MOISTURE

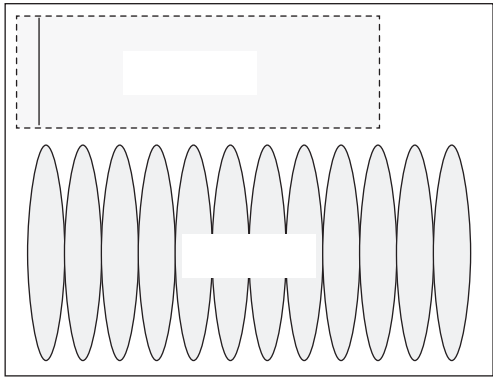
The amount of water in the topmost layer of soil affects life on Earth in a variety of ways including controlling vegetation type, the carbon and water cycles, and weather and climate patterns. Studying this layer allows scientists to better understand exchanges between the geosphere and atmosphere that affect the flow of water, carbon, and heat. Soil moisture measurements can inform geohazard predictions of droughts and floods as well as agricultural practices to improve global food production.

Soil Moisture (m^3 water/ m^3 soil)



Data: July, 2019 - Soil Moisture Active Passive (SMAP) 9km (L4, 12z Instantaneous, Model Value-Added), NASA/JPL-Caltech/GSFC

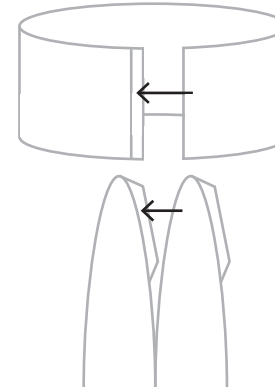




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THE SCIENCE OF ROCKS

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Do you know what it is made of?

[http://www2.csr.utexas.edu/
grace/gravity/](http://www2.csr.utexas.edu/grace/gravity/)



GRAVITY ON EARTH



Did you know that your weight is different depending on where you are on the surface of the Earth? While the Earth has an average gravitational force, different locations on Earth have gravitational forces that are larger or smaller than average. This is because each location has more or less mass than the average.

Gravity is a physical force of attraction between objects. Objects with a small mass have a weak gravitational force while those with a large mass have a strong force.

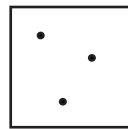
You are held down to the Earth's surface because it has a strong gravitational force. You actually exert a gravitational force on the Earth, but because your mass is many times smaller than the Earth's mass, your pull is much less than the Earth's.

Gravity is measured as how fast objects accelerate towards each other. The average gravitational pull of the Earth is 9.8 meters per second squared (m/s^2).

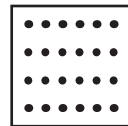
The Earth is made of different substances like air, rock, and water. These substances have a different amount of mass in a certain amount of space (density). For example, rock has a higher density than air.

This slice of the Earth's surface shows a mountain, an ocean, and the atmosphere. Section A is two thirds rock and one third air while Section B is one quarter rock, one quarter water, and one half air. The sections are the same size but Section A has more mass in the space so it has a stronger gravitational pull.

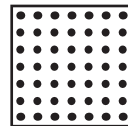
Density of:



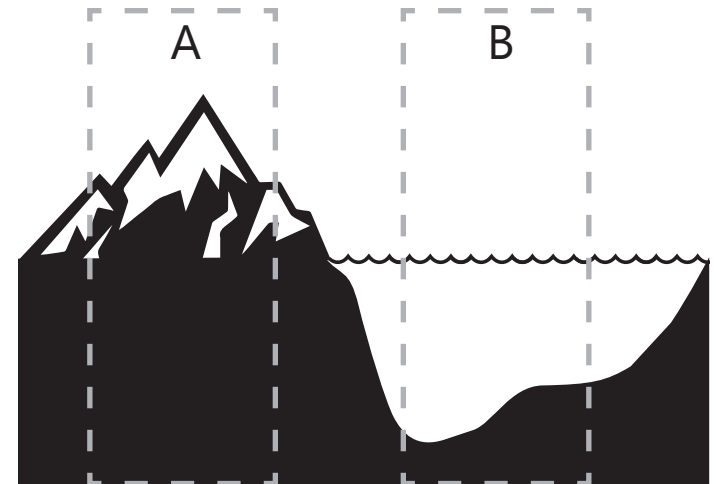
Air



Water



Rock



These differences in gravity are tiny so scientists have to use very sensitive satellites to measure differences around the world. These satellites can even detect dense features deep within the earth that increase the gravitational pull at the surface.

Construct the globe and use the key below to see how gravity varies around the world. Find a region with very high gravity. What features in that region might make the gravitational force stronger than average?

Gravitational force compared to the average

Lower

Average

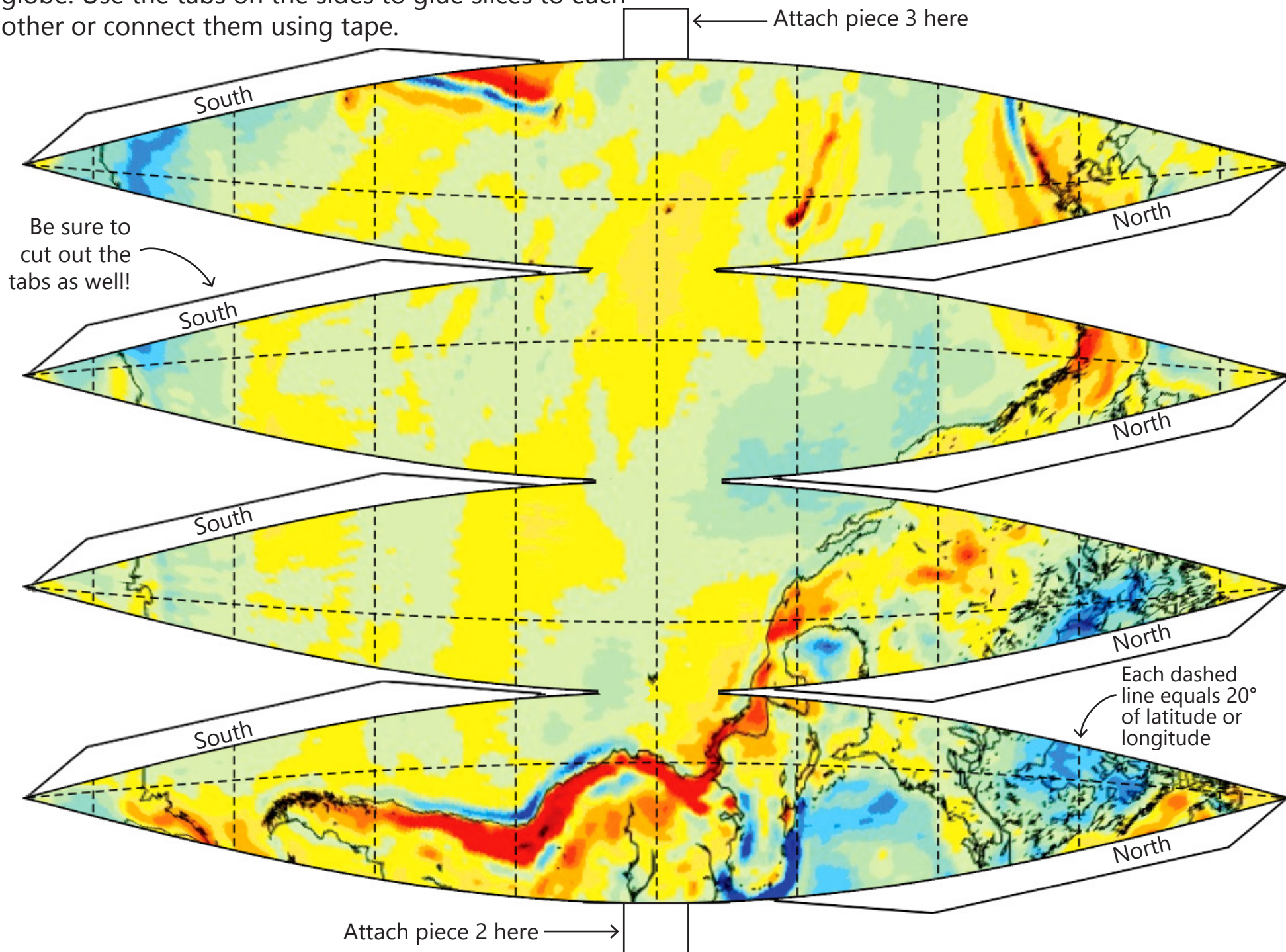
Higher

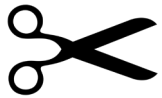


Cut out the three pieces of the Earth to assemble as a globe. Use the tabs on the sides to glue slices to each other or connect them using tape.

Piece 1

GRACE Gravity Model 05 - Center for Space Research at the University of Texas at Austin, J Ries et al. (2016)

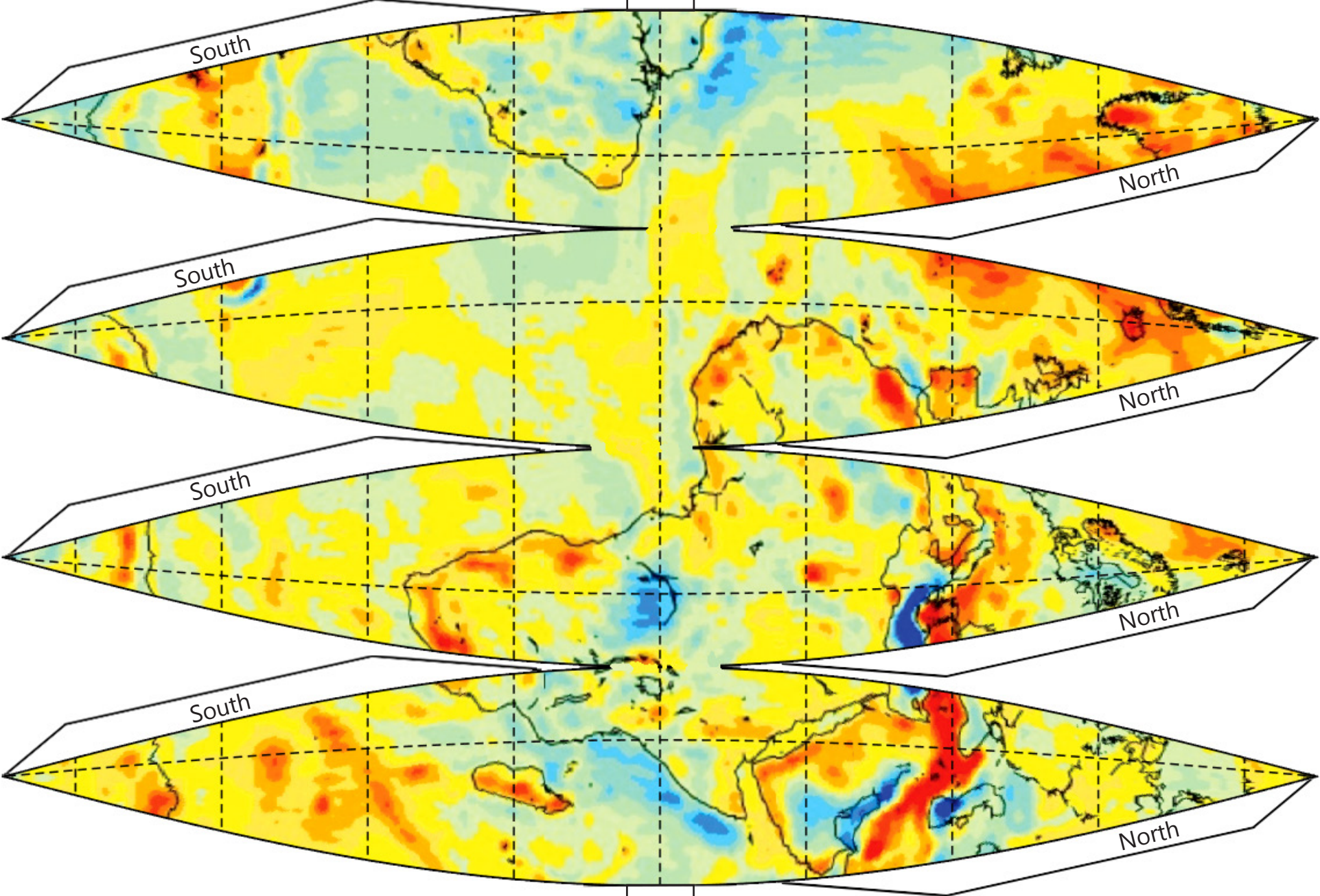




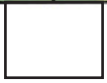
Piece 2

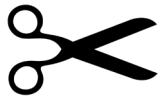


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Attach piece 3 here →

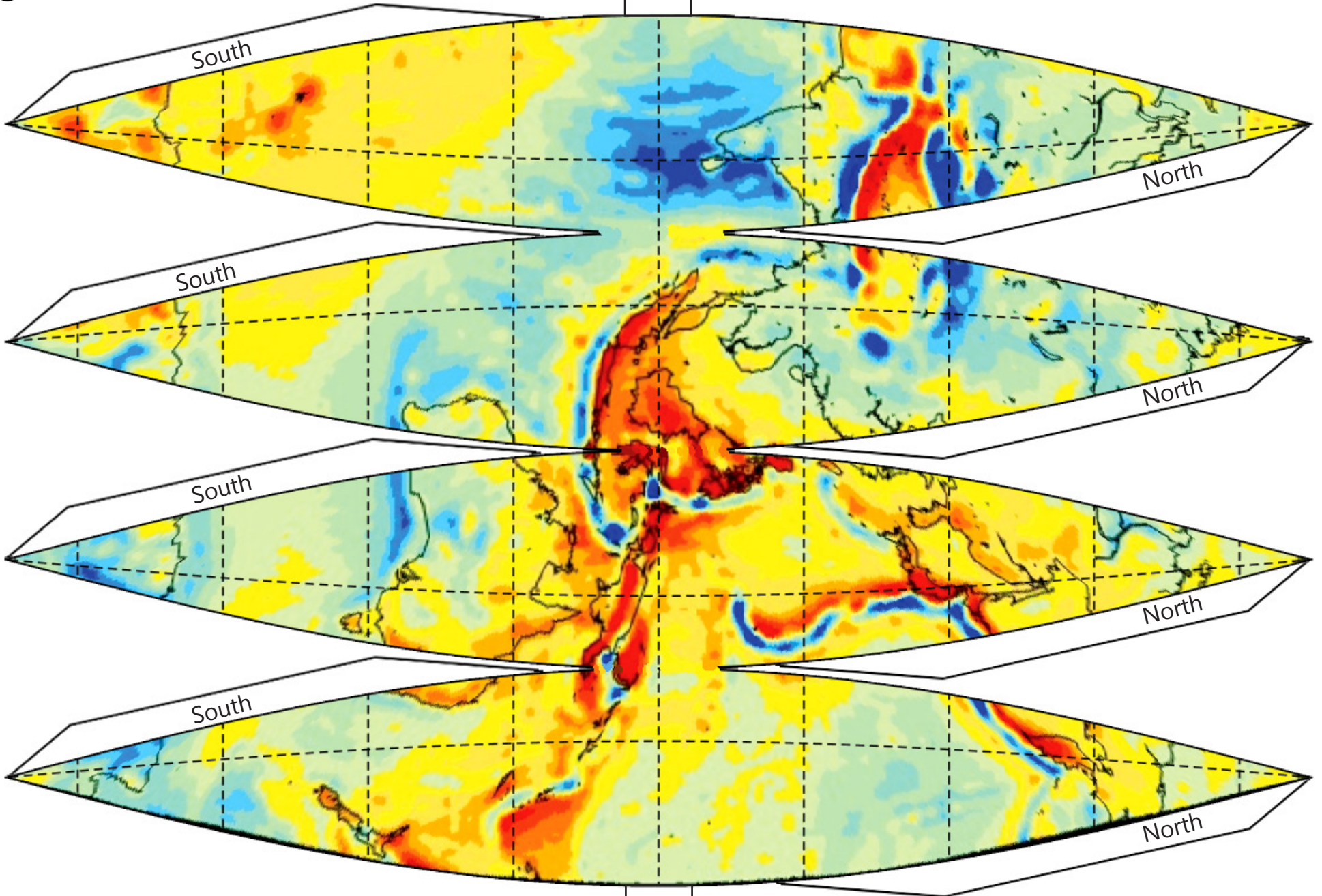




Piece 3



← Attach piece 2 here



Attach piece 1 here →





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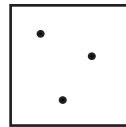
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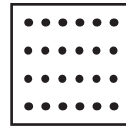
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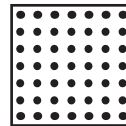
Density of:



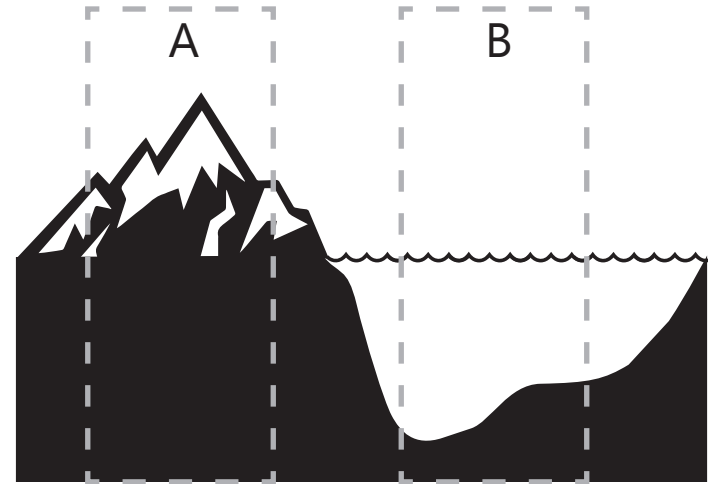
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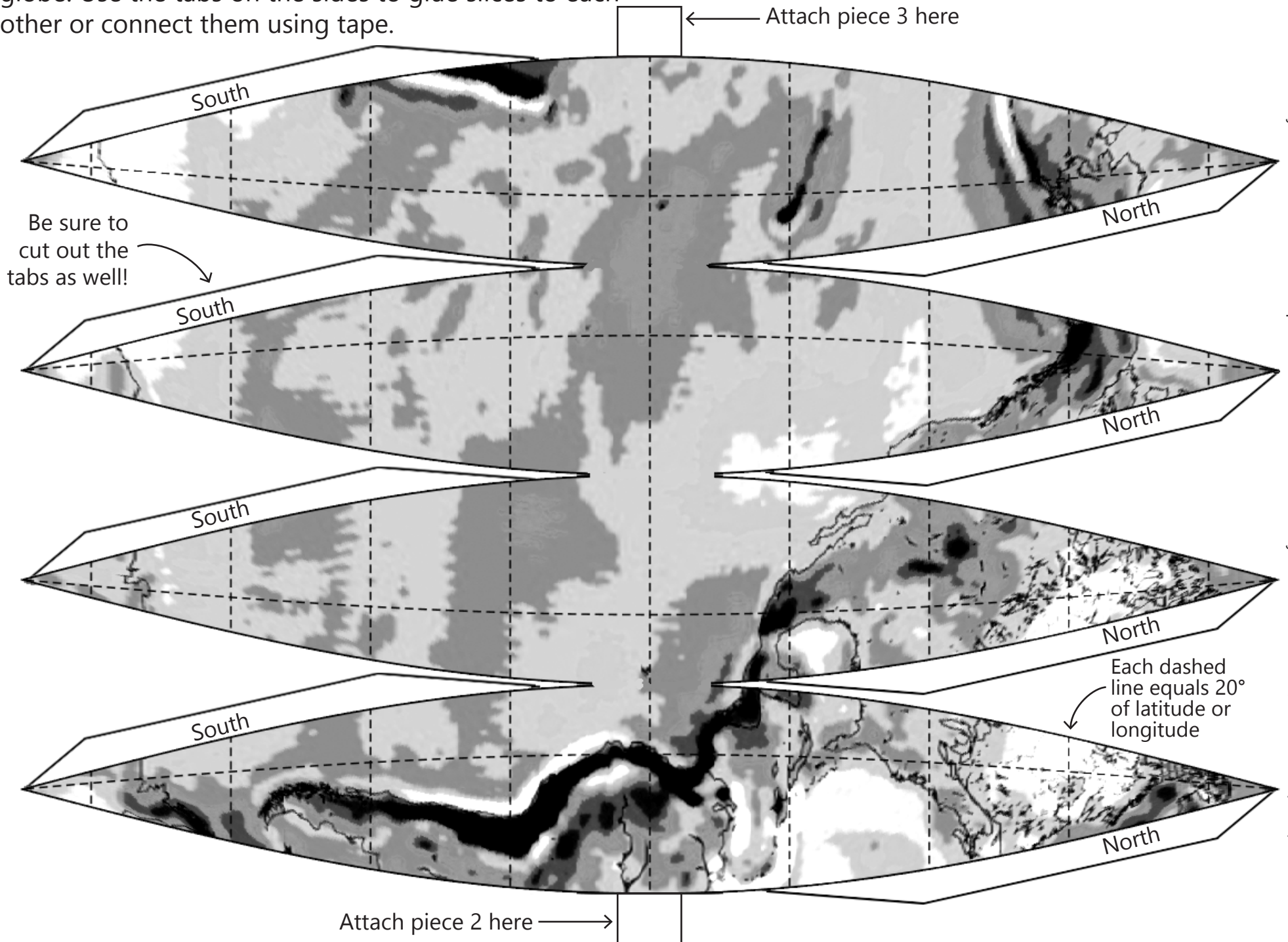
Average

Higher



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Piece 1

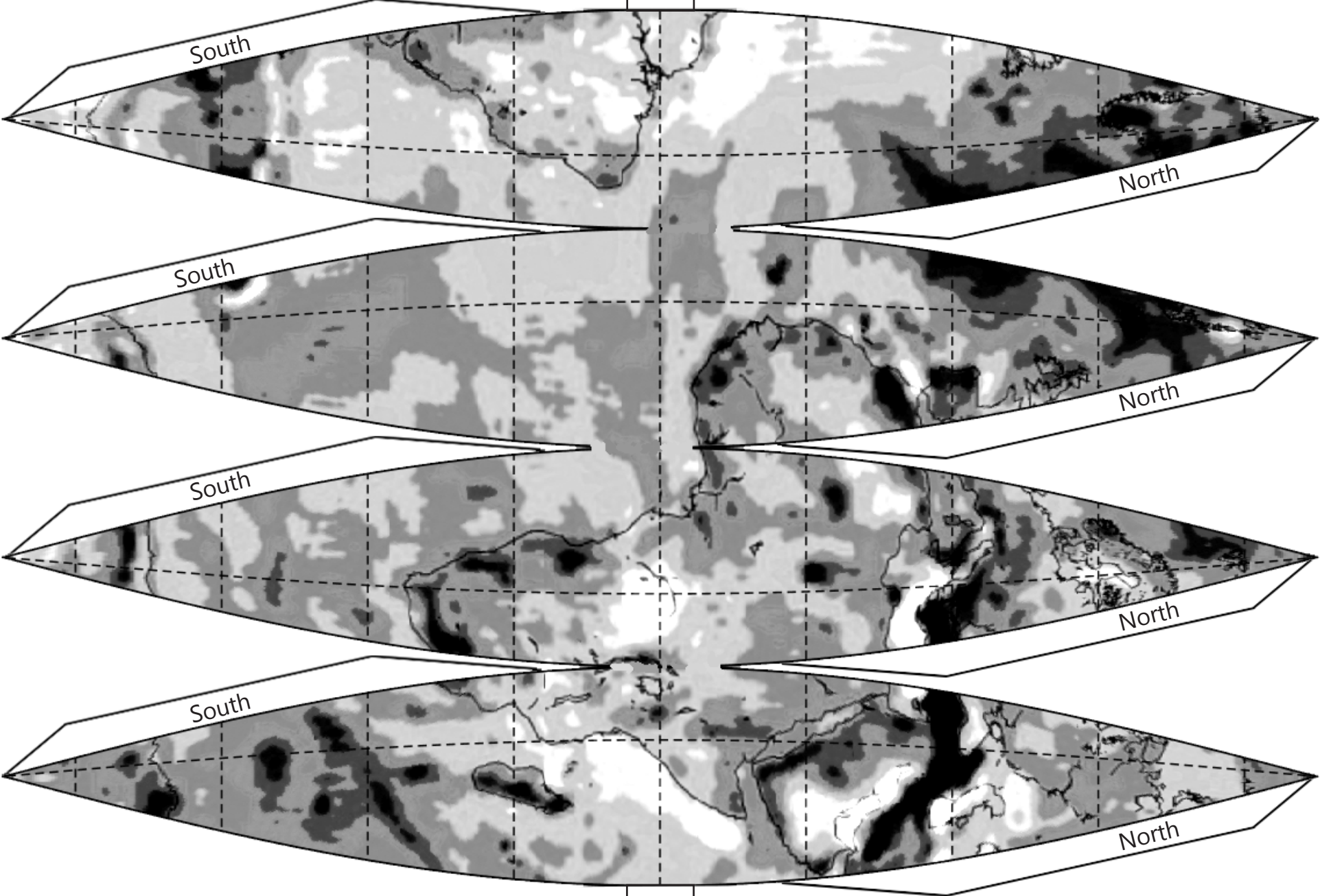




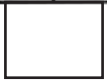
Piece 2

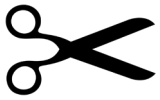


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Attach piece 3 here →

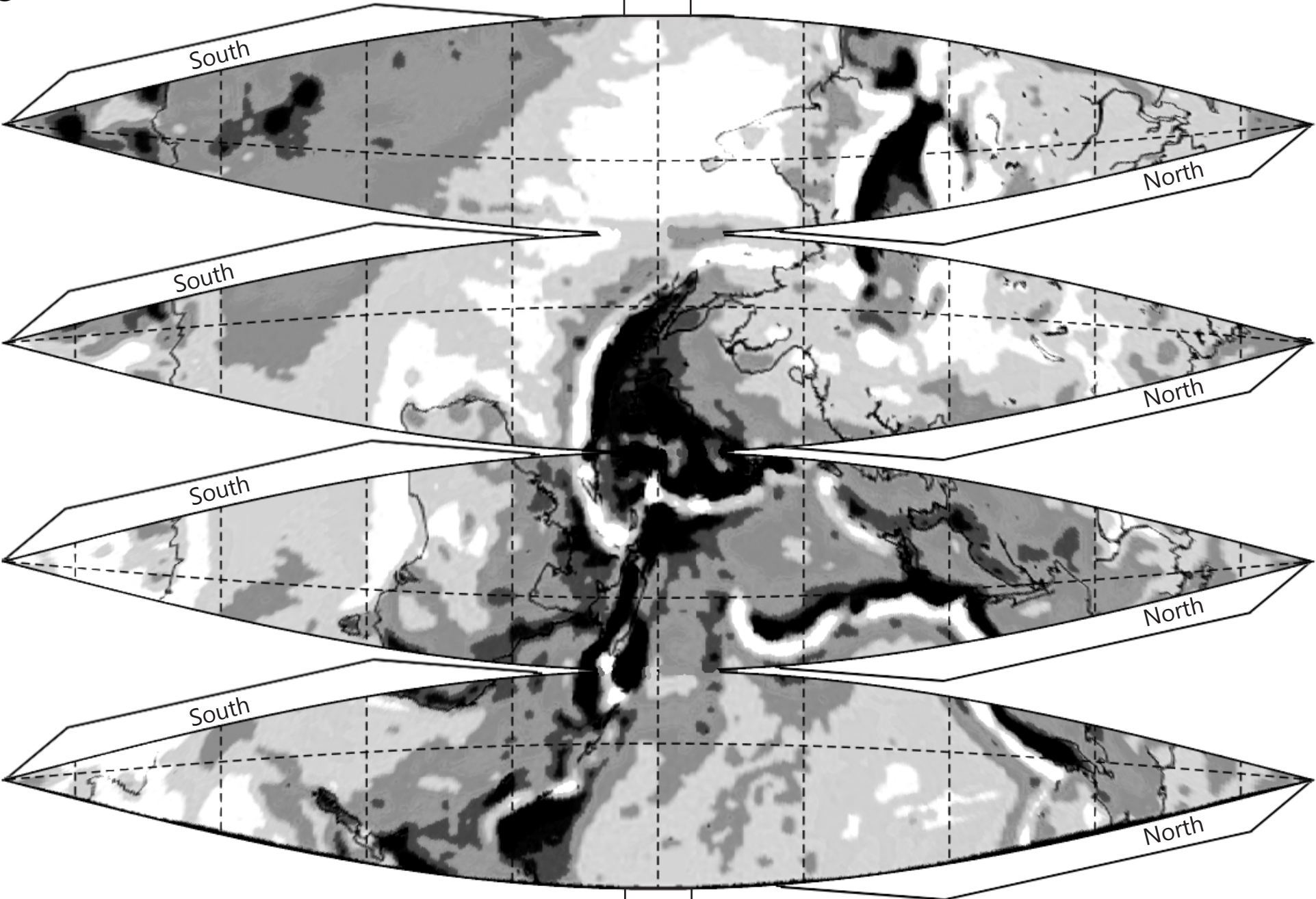




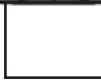
Piece 3



← Attach piece 2 here



Attach piece 1 here →





THE WATER CYCLE



Supplies needed: glue or tape, scissors, chalk (2 colors)

Location: driveway or dark pavement on a warm, sunny day

Instructions:

1. Make a small puddle of water on the pavement.
2. Use the chalk to trace around the edge of the puddle.
3. Wait 1 hour and trace the edge of the puddle again with a different color of chalk.

While you wait, look around you. What are 5 things you see that you think contain water?

1. _____
2. _____
3. _____
4. _____
5. _____

What happened to the puddle? Did it change size?

Read about the water cycle. Use the terms in **bold** to help you complete the water cycle diagram on the back of this sheet.

Water is one of the most important substances on Earth. It is found almost everywhere and in all living things. Water is found in three different phases. The phases are solid, liquid, and gas. All three phases are part of the Water Cycle. The Water Cycle shows how water moves on Earth.

Water in the atmosphere is a gas. It forms clouds and falls to earth as a liquid or solid. This is called **precipitation**. Precipitation can be rain, snow, or ice. Some of the precipitation soaks into the ground where it becomes **groundwater**. This process is called **infiltration**. Groundwater gets taken up by plants. Plants release water back into the atmosphere as a gas through **transpiration**.

The rest of the precipitation goes into **streams, lakes, and rivers** as **runoff**. These streams lead to the largest body of water: **the ocean**. Water from streams, rivers, and the ocean returns to the atmosphere through **evaporation** to start the cycle over again.

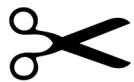
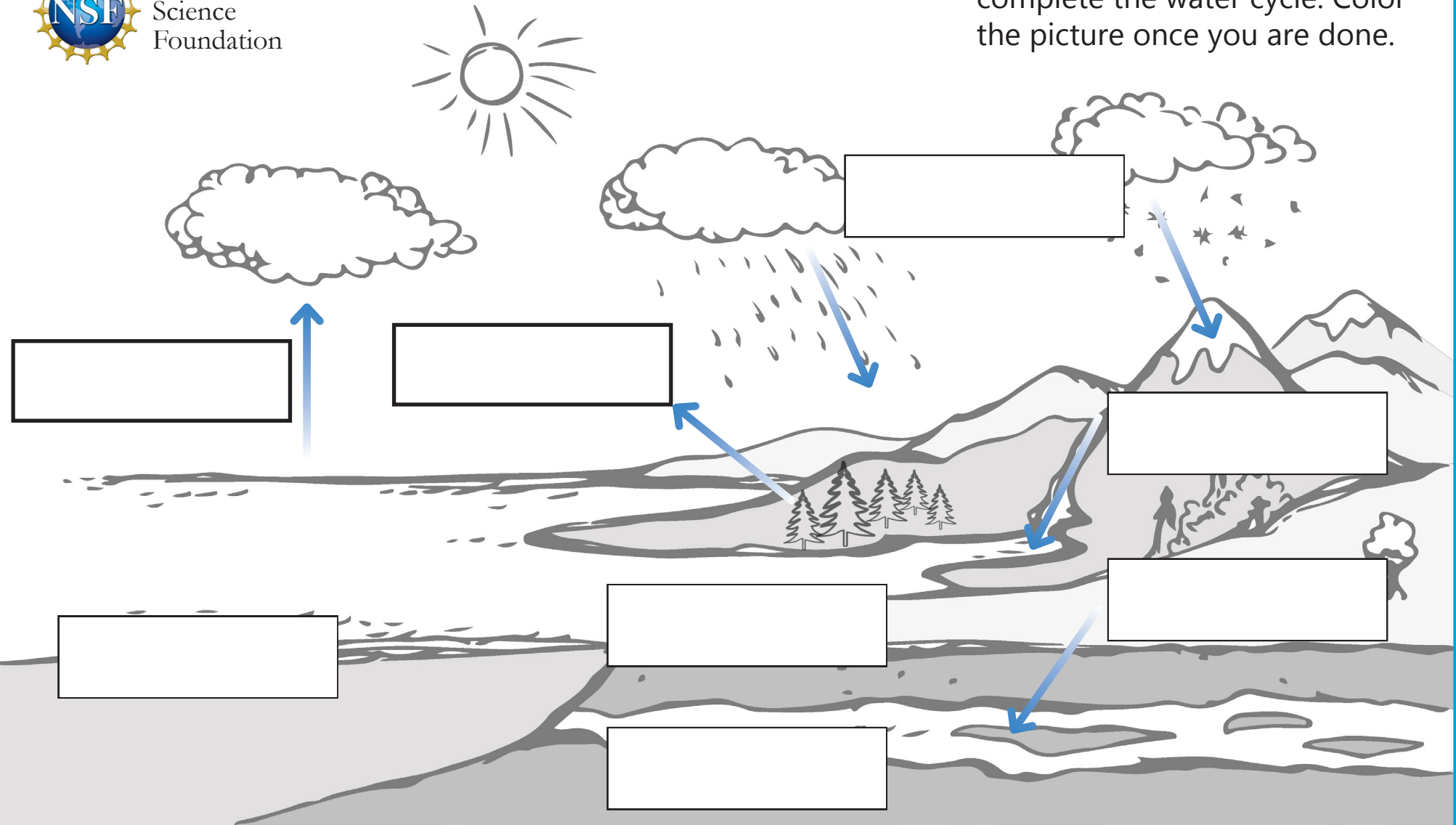
DO NOT WRITE IN THIS SPACE



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THE WATER CYCLE

Cut and paste the words below to complete the water cycle. Color the picture once you are done.



Transpiration

The Ocean

Streams, Lakes,
and Rivers

Runoff

Infiltration

Groundwater

Precipitation

Evaporation

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below to complete the water
cycle. Color the picture once
you are done.

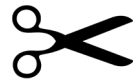
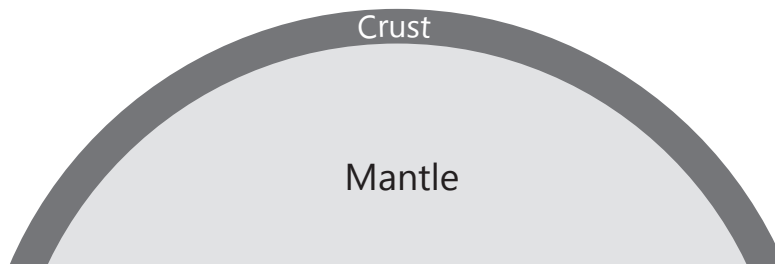


PLATE TECTONICS PUZZLE

The Earth is divided into several layers. The surface layer we live on is called the crust, which sits on top of a lower layer called the mantle. Together, the crust and top part of the mantle make up the Earth's tectonic plates, which fit together like puzzle pieces.



There are many forces which drive plate movement in the Earth. The places where tectonic plates meet are called plate boundaries.

Volcanic eruptions and earthquakes often happen at plate boundaries. Islands, mountain ranges, and deep ocean trenches also form at these boundaries.



There are 15 different tectonic plates:

1. Caribbean plate
2. Cocos plate
3. Nazca plate
4. Juan de Fuca plate
5. North American plate
6. Pacific plate
7. Philippine plate
8. Arabian plate
9. Eurasian plate
10. Australian plate
11. Antarctic plate
12. Scotia plate
13. South American plate
14. African plate
15. Indian plate

Refer to these numbers and names when you are completing your plate tectonics puzzle.

Use this space to create your
world map of tectonic plates



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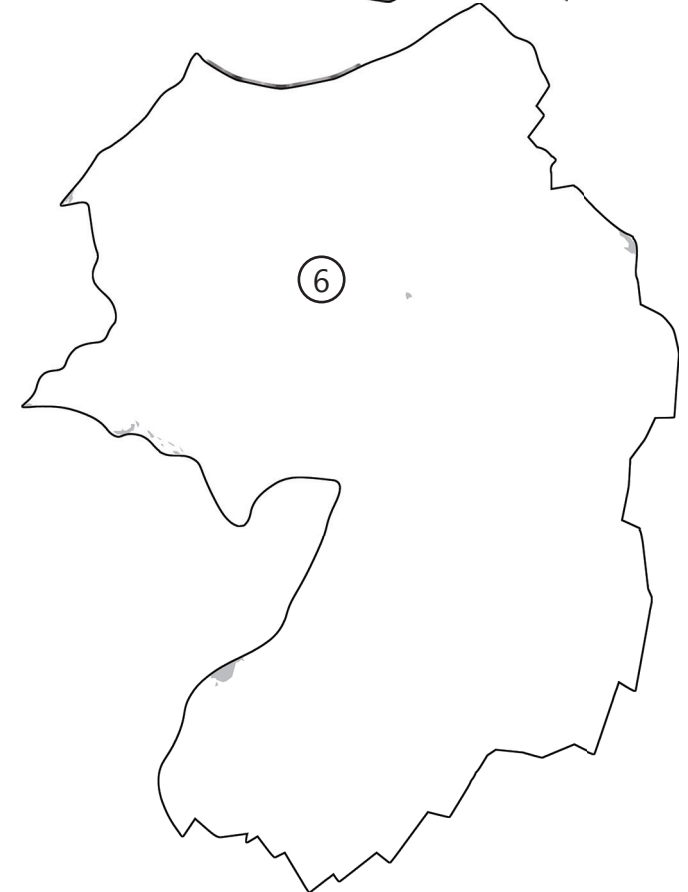
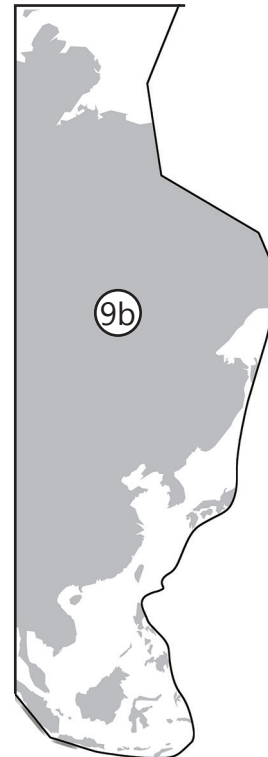
Supplies Needed: scissors, tape
or glue stick, colored pencils or
markers or crayons



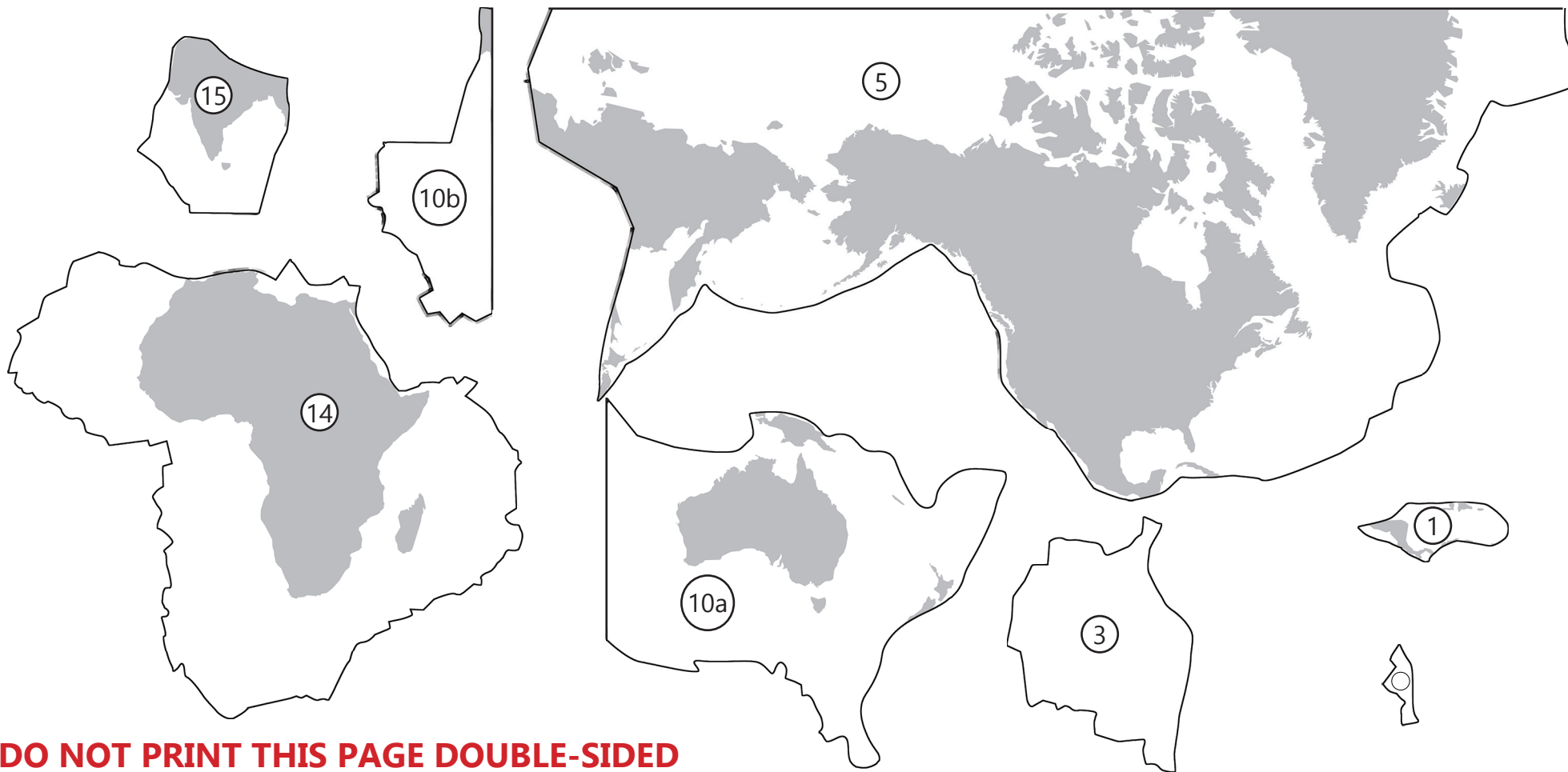
Instructions:

1. Color each tectonic plate a different color.
2. Cut along the black outlines to cut out the different tectonic plates.
3. Arrange and then paste the plates on the blank page to create a world map.

Hint: Use the land masses and the shape of each plate to fit the plates together.



DO NOT PRINT THIS PAGE DOUBLE-SIDED



DO NOT PRINT THIS PAGE DOUBLE-SIDED



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THE SCIENCE OF ROCKS

Grade Level
K-3

Go outside and find a rock. Look at it closely with a magnifying glass if you have one! Do you know what it is made of?

How would you describe your rock?

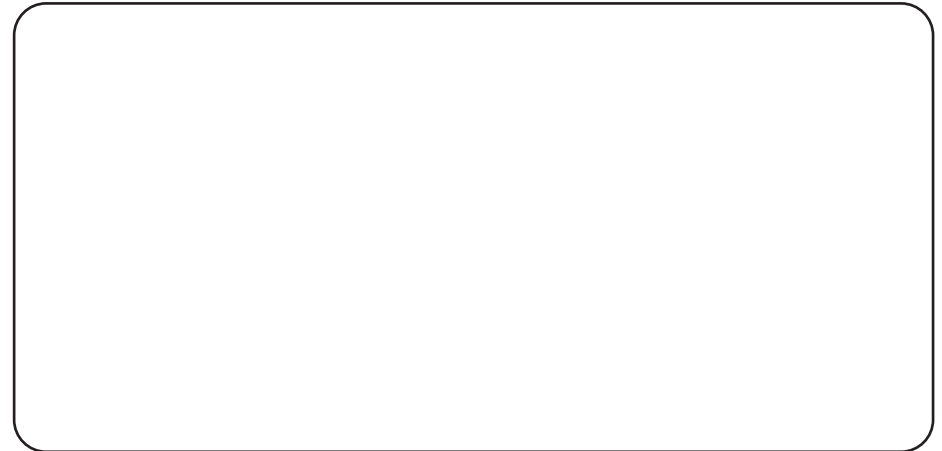
Shape: _____

Color: _____

Texture: _____

Size: _____

Use this space to draw a picture of your rock.



How do you think scientists figure out what a rock is made of?

The type of science that studies rocks is called

Petrology
(rock) (science)

If we know what rocks are made of, we can learn about where they came from. We can also learn about the processes that made them.

Rocks are made of types of minerals. Minerals show different colors when they are under a special type of light.

Scientists take very thin slices of rocks and look at them under a microscope with special light. The slices are the same diameter as a piece of your hair!



The photos the scientists take are called

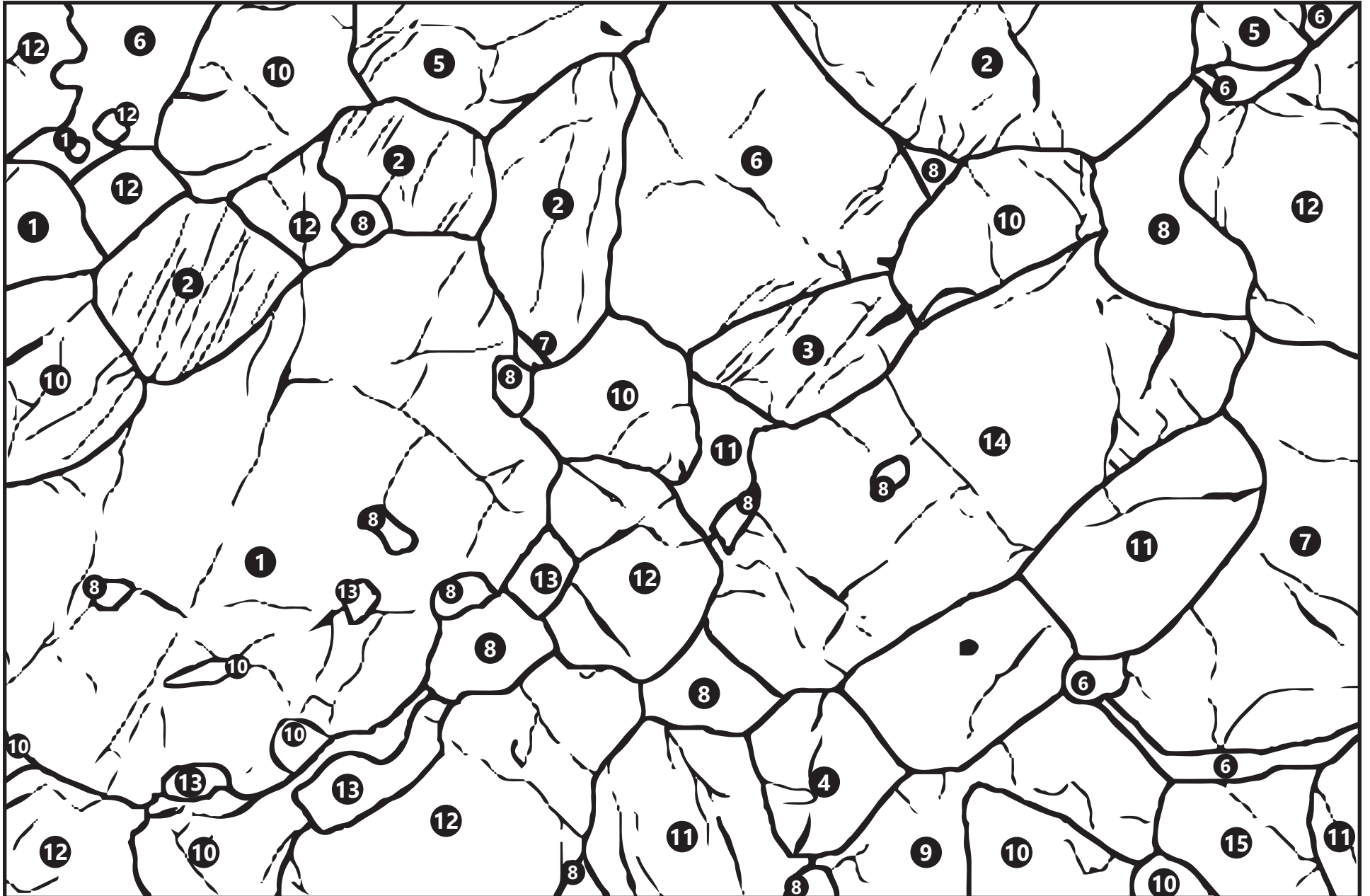
Photomicrographs
(light) (small) (something recorded)

The scientists use the different colors to determine which minerals a rock is made of.



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Color in the rock slice using the key to discover what a scientist sees in a photomicrograph!





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Fill in the key with 15 different colors. Color in the rock slice using the key to discover what a scientist sees in a photomicrograph!

