

TEACHER NOTES: PLATE TECTONICS TENNIS BALL GLOBE

Overview

This activity creates a mini globe that shows the major plate boundaries of the world. It provides each student with his or her own physical model of the Earth's plates and helps teach how hard it is to accurately portray a sphere (three-dimensional) on a flat map (two-dimensional). See online materials <http://volcanoes.usgs.gov/about/edu/dynamicplanet>

Time frame

This activity should take 2 class periods. Younger students could take several class sessions to finish because of the cutting and gluing. If you would like to complete the exercise in one class period, create a few models beforehand and have the class do everything except for the cutting and gluing to the tennis balls.

Objectives

- Students will examine one method for creating a two-dimensional map of a spherical surface.
- Students will create a model of the earth that they can hold and examine.
- Students will examine plate boundaries, continents, and oceans on a map and globe.
- Students will examine divergent, convergent, and transform plate boundaries.
- Students will draw plate boundaries on a map and learn that more scientific data are needed to more accurately locate certain boundaries.
- Students will compare the features on a map that fits on a sphere with the same features on a more standard flat, two-dimensional, map to learn how our standard maps are distorted towards the poles.

National standards references

See Science and Geography Standards matrices on pages X- Y.

Links across the curriculum

- Art
- Geography
- Mathematics - Geometry

Materials

For teacher:

- This Dynamic Planet map
- This Dynamic Earth booklet
- Student Plate Tectonics Tennis Ball Globe handout
- Colored Simplified Plate Tectonics Map
- Completed tennis ball model

For each student:

- Student Plate Tectonics Tennis Ball Globe handout
- Simplified Plate Tectonics Map (not colored)
- Old tennis ball
- White glue
- Coloring items—pencils, markers, sharp crayons
- Scissors

Reference to Dynamic Earth booklet and Dynamic Planet map

- This Dynamic Planet map
- This Dynamic Earth: p. 2, 6, 7, 15, 16, 29, 30 – 38, 43, 50, 52, 56

Additional information for teacher

- The data on the small globe have been simplified for the small size of the project.
- Cutting the map takes dexterity and patience.
- Not all the plate boundaries are easy to see. For some, there is not enough scientific data to determine the precise locations. The students will need to use the insert Interpretive Map on the This Dynamic Planet map (available as a pdf at <http://volcanoes.usgs.gov/about/edu/dynamicplanet/ballglobe/interpretive.pdf>)
- New tennis balls will work, but since they are very fuzzy, they will be more difficult to glue onto. Tennis ball sizes vary slightly and the model may not fit exactly.
- Tennis balls are usually available if you have a tennis club or courts nearby and you let people there that you need them for a science project. A bag or box should be supplied to collect them.
- We recommend using six or more colors for coloring the map. The map can be colored with only four different colors but it's a classic logic puzzle and math problem (four color theorem) – see extensions below.

Instructions for activity

1. Photocopy the three student pages. If possible, make extra copies of the Student Plate Tectonics Tennis Ball Globe handout and the Simplified Plate Tectonics Map in case of error. Make sure all students have an old tennis ball.
2. Have the students color the plates on their copy of the Simplified Plate Tectonics Map. No touching plates should be the same color so some planning will be needed.
3. Have the students answer the questions on their Instruction Sheet throughout the activity.
4. Have the students color in the different plate boundaries in black referring to the Simplified Plate Tectonics Map. Then color in the plates making sure that touching plates are not the same color.
5. Students then cut out their map.
6. Apply glue across the back of the equator. Apply to center of the tennis ball making sure both poles cover the ball.
7. Carefully brush glue on a flap and press down to ball. Repeat to glue the rest of the

ball.

8. Cut out the base and glue ends together to form a ring. When dry, rest globe on base.

Questions from student instruction sheet and answers

After the students have colored the plates on their copy of the Simplified Plate Tectonics Map

1. Which plates look the largest to you?

There is no 'right' answer. Many plates may look large but the goal is to have the kids compare the polar regions on both maps. Make sure students notice that most plates contain both continental and oceanic material.

2. Plate boundary types are not always the same across the entire boundary. Suggested answers are given to each question below. The India – Australia and North America – South America boundaries are not well defined and should not be included in the answers to this set of questions.

List three divergent boundaries not including the example. Example: There is a divergent boundary between the Nazca and Pacific plates.

Antarctic and Australia, Pacific, South America, Nubia

Nubia and South America, India, Antarctic

Australia and Antarctic

North America and Nubia, Eurasia (on one side), Pacific (in two areas)

List two convergent boundaries.

Pacific and North America, Eurasia

India and Eurasia

Nubia and Eurasia

Australia and Eurasia, Pacific

Give an example of a transform plate boundary.

North America and Caribbean, Pacific

South America and Caribbean

Australia and Pacific

3. After coloring the plate boundaries on your Plate Tectonics Tennis Ball Globe handout in black.

Are all the plate boundaries easy to see? Compare your two maps to the This Dynamic Planet map. What boundaries are not as obvious as other boundaries?

No. The following are difficult to see: North America – South America, India – Australia. Scientists do not have enough data to determine the plate boundaries in those areas.

4. Color the plates on your Plate Tectonics Tennis Ball Globe following your Simplified Plate Tectonics Map such that no adjacent plates are the same color. **Which plates look the largest to you?**

Here only the plates near the equator should look large.

How are the plates near the north and south poles different on your Plate Tectonics Tennis Ball Globe map than on your Simplified Plate Tectonics Map?

The Plate Tectonics Tennis Ball Globe map is not a rectangle, it has multiple areas that are “cut out” to fit a sphere. Many students may not have seen the shape of a flattened sphere. This exercise will help reinforce geometry concepts about maps. In order to make a map from the flattened sphere, multiple calculations are used to “fill in” the spaces. The students should notice that the closer they look towards the poles, the more distorted the Simplified Plate Tectonics Map is.

What do your observations tell you about making maps?

It’s impossible to accurately represent an entire sphere on a flat map.

8. Compare your globe with the This Dynamic Planet Map. Where are the majority of the earthquakes and volcanoes?

The vast majority of earthquakes and volcanoes are near or at plate boundaries.

Assessment suggestions

The questions from the instruction sheet (answers above) can be used with this activity.

Extensions and Additional Resources

1. Exploring Maps Teacher packet
<http://egsc.usgs.gov/isb/pubs/teachers-packets/exploringmaps/index.html>
2. What do Maps Show packet
<http://egsc.usgs.gov/isb/pubs/teachers-packets/mapshow/>
3. Investigate how maps are made and different types of projections.
<http://egsc.usgs.gov/isb/pubs/MapProjections/projections.html>
4. Use clementines or other fruits that are easy to peel to show how difficult it is to go from a three-dimensional object to a two-dimensional map.
5. Talk about the accuracy of maps of different sizes, for example, a map of your school versus a map of the world.
6. Discuss the four-color theorem and let students try to figure out how to color the map using only four colors. Background: Francis Guthrie, in 1852, noticed that only four different colors were needed to color the map of counties of England such that no two adjacent regions are the same color. The Simplified Plate Tectonics Map can be colored using only four colors.