Lesson 2: Discovering Plate Boundaries

Plate boundaries are where the action is. A large fraction of all earthquakes, volcanic eruptions, and mountain building occurs at plate boundaries. It is also where most of the people on Earth live. In this lesson, students use scientific data to learn how the scientific process works. They learn where the Earth's tectonic plates and their boundaries are, what happens at the boundaries, and how scientists classify plate boundaries. This curriculum encourages students to observe, describe, and classify scientific data to learn about a scientific process.

This activity is designed for three one-hour class periods over several days, but it can be done in a three-hour lab period.

This lesson is modified from curriculum developed by Dale Sawyer (Rice University, Houston).

Materials

Copies of Handout No. 2a: Plate boundary map (2 per student)
1 copy of Handout No. 2b: Seismology map showing earthquake locations and depths
1 copy of Handout No. 2c: Volcanology map showing recent volcanic activity
1 copy of Handout No. 2d: Geography map, showing topography and bathymetry
1 copy of Handout No. 2e: Geochronology map, showing seafloor age
1 copy of Graphic No. 2
Colored pencils

Introduction

1. Explain to students that the most important key to scientific progress is the ability to observe, describe, and classify information or data. Give them an example they can relate to (visiting a doctor when sick: a doctor observes, describes and classifies when making a diagnosis).

2. Tell them they are going to learn about the plate boundary processes. Based on Lesson 1, they should be able to tell you what plate boundaries are. Tell them they are going to discover on their own what takes place at the boundaries. They are going to observe, describe, and finally classify the data provided.

3. Tell students this allows them to learn about plate boundaries as a doctor learns about the human body.

4. Depending on your students' current level of Earth sciences knowledge, you might want to explain to them what the following terms mean: seismology, volcanology, geography, and particularly geochronology. They will be using these terms throughout this exercise.

Procedures

1. Hand each student a plate boundary map and a slip of paper with a Scientific Specialty (Seismology, Geochronology, Volcanology or Geography), and a plate name (Pacific Plate, North American Plate, India Plate, etc.). The goal is to have each student have a different combination of specialty and plate, and for all scientific specialties to be covered for each plate used in the exercise.

2. Then ask students to assemble in their specialty group at their respective maps: Seismologists at the earthquake map, volcanologists at the volcano map, Geochronologists at the sea floor age map, and geographers at the topography map.

3. Ask each group to become familiar with their map, and read the side label to see what is being displayed and how it is being displayed. They should work as a group to figure out what they are looking at. Circulate among the groups listening and clarifying misconceptions. This should take about 10-15 minutes. Remind students that they are to observe rather than describe or interpret.

4. Ask each group to start describing what they see. Their descriptions should include words like deep or shallow, active or inactive, ridge or valley, symmetric or asymmetric. Each group is to work only with its data map. Students should only be talking rather than writing.

5. Now ask them to classify their data. Each group is to come up with a classification of the plate boundaries of the world based on their data. They are to use up to five plate boundary type classifications. These are to be given numbers like boundary type 1, boundary type 2, etc. They are not to use plate tectonic terminology. Ask them to write a description of how they identified their plate boundary types.

6. Ask them to use color pencils to mark (on their individual plate boundary map) all plate boundaries in the world which fit that description. They should use different colored pencils for each of their boundary types. They will each be asked to turn in the marked maps at the end of the exercise (Day 3)

Caution! At first this might seem confusing. Get your students on track by asking someone in the group select a plate boundary segment. Ask them to tell you what their data show on or near that plate boundary segment. For instance, the seismologist might notice that there are only shallow earthquakes along that boundary and/or that the line of earthquakes and the plate boundary both have a zigzag pattern. Then suggest to them that they have just defined their type 1 boundary. Ask them to mark the boundary type identifications in colored pencil on the map. Ask them to find other plate boundary segments that fit this description. They should repeat this process by finding a plate boundary segment that they have not yet marked and repeat the whole process to define a type 2 plate boundary.

7. Move from group to group assisting and questioning where it seems appropriate. Ask students to keep their maps and plate boundary type classifications to be used later in the exercise. This is the end of Day 1.

8. On Day 2, assemble students in their plate groups. Each plate group should consist of a seismologist, a volcanologist, a chronologist, and a geographer. This will be a different group than they worked with on Day 1.

9. Tell them that each group contains experts on all the data types, but that each expert has only looked at data in their own specialty. Each group needs to work their way around the maps to become familiar with all the data. At each map, the expert on that map should make a brief presentation to the others in their group about their data. Each student is an expert and each gets to present their data when they arrive at their maps. Each presenter should first tell others what the data are and how they are symbolized, pointing at the most important features on their map. They should introduce the plate boundary types from Day 1 and where they can be found in the world. All presentations put together should not take more than 15 minutes.

10. The next step is to ask students to come up with a new classification scheme for the boundaries of their plate (not the whole world). This scheme should be called boundary type A, boundary type B, etc. Most importantly, the scheme should now be based on all four data types. For example, boundary type A might be described as having shallow earthquakes on the plate boundary, sparse or no volcanoes, lying on a topographic high, and following a line of young sea floor. Each student will have to make and turn in this new map, showing their boundary type descriptions on the back and colored boundaries on the map, at the end of the exercise (Day 3).

11. Towards the end of Day 2, tell the students that a spokesperson from each group will need to speak to the class at the beginning of Day 3. This is the end of Day 2.

12. On Day 3, students make their presentations. Ask them to describe their plate boundary classifications, and then to give a tour around their plate.

13. Spend the remainder of the class time discussing plate boundaries processes and introducing the terminology Earth scientists use to describe these plate boundaries. Use Graphic No. 2 to discuss convergent, divergent, and transform boundaries. Explain why each of these boundaries have the particular observable phenomena the students have seen.

14. Have the students turn in their two annotated plate boundary maps.

Useful Internet Resources

Teacher's Guide on this activity:
http://terra.rice.edu/plateboundary/tg.html