SURFACE FEATURES AND PLATE TECTONICS

INSTRUCTIONS

(MODIFIED FOR ADEED)

Science Concept:

There are three types of movements related to the motion of Earth's plates. Mountain Building, faults (which can generate earthquakes), and volcanoes are all surface features associated with the movement of the earth's plates.

Objectives:

The student will:

- correctly illustrate the motion of three types of plate motion. (transform, divergent, and convergent)
- draw arrows that correctly illustrate the motion of three types of plate motion (transform, divergent, and convergent); and
- write a compare and contrast essay describing the type of surface features found at each plate boundary.

Targeted Alaska Grade Level Expectations:

Science

[10] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, analyzing data, developing models, inferring, and communicating.

[10] SD2.2 Describe how the theory of plate tectonics explains the dynamic nature of the Earth's surface

Writing

[10] 4.2.2 Writing in a variety of nonfiction forms (e.g., letter, report, biography, autobiography, and/or essay) to inform, describe or persuade

Vocabulary:

asthenosphere - The somewhat fluid part of the Earth's mantle. The asthenosphere is the ductile part of the earth just below the lithosphere, including the lower mantle. The asthenosphere is about 180 km thick

compressional stress - The stress that squeezes something. It is the stress component perpendicular to a given surface, such as a fault plane, that results from forces applied perpendicular to the surface or from remote forces transmitted through the surrounding rock

convergent boundaries - where crust is destroyed as one plate dives under another

crust - The crust is the outermost major layer of the earth, ranging from about 10 to 65 km in thickness worldwide. The uppermost 15-35 km of crust is brittle enough to produce earthquakes

divergent boundaries - where new crust is generated as the plates pull away from each other

fault -a fault is a fracture along which the blocks of crust on either side have moved relative to one another parallel to the fracture

lithosphere – The lithosphere is the outer solid part of the earth, including the crust and uppermost mantle. The lithosphere is about 100 km thick, although its thickness is age dependent (older lithosphere is thicker).The lithosphere below the crust is brittle enough at some locations to produce earthquakes by faulting, such as within a subducted oceanic plate

magma - hot liquid rock formed under Earth's crust

mantel - the layer of Earth below the crust and above the core

oceanic spreading ridge - the fracture zone along the ocean bottom where molten mantle material comes to the surface, thus creating new crust. This fracture can be seen beneath the ocean as a line of ridges that form as molten rock reaches the ocean bottom and solidifies

oceanic trench - a linear depression of the sea floor caused by the subduction of one plate under another

plate – a large, rigid slab of rock

plate tectonics – The theory that explains that the Earth's outermost layer is fragmented into a dozen or more large and small plates that are moving relative to one another as they ride atop hotter, more mobile materials (magma)

plate boundary zones -- broad belts in which boundaries are not well defined and the effects of plate interaction are unclear

sea-floor spreading - happens at the mid-oceanic ridge where a divergent boundary is causing two plates to move away from one another resulting in spreading of the sea floor. As the plates move apart, new material wells up and cools onto the edge of the plates

shear stress - the stress component parallel to a given surface, such as a fault plane, that results from forces applied parallel to the surface or from remote forces transmitted through the surrounding rock

subduction zones – regions where portions of the Earth's tectonic plates are diving beneath other plates

tectonic – comes from the Greek root "to build"

tensional stress - the stress that tends to pull something apart. It is the stress component perpendicular to a given surface, such as a fault plane, that results from forces applied perpendicular to the surface or from remote forces transmitted through the surrounding rock

transform boundaries - here plates grind past each other side by side

Whole Picture:

Whole picture goes here. Text is formatted block-style. Paragraphs are separated with a space of 0p6.

Materials:

- Mini candy bar – Milky Way® is preferable
- Plastic tray, pan or box
- Plastic knife
- Sand
- Modeling clay
- Moon sand (purchased) or using recipe included on TEACHER INFORMATION SHEET: "Moon Sand"
- Wax paper
- STUDENT WORKSHEET: "Movement of Earth's Plates"

Activity Preparation:

Use TEACHER INFORMATION SHEET: "Moon Sand" to prepare moon sand, if not purchasing.

Activity Procedure:

Gear Up

Process Skills: observing, generalizing, and inferring

1. Ask students if Earth is flat. Ask students what causes the cshapes and features found on the surface of Earth. Ask students to record as many ideas as possible in their science notebooks.
2. Ask students to share their ideas with the class. Explain geologists use the theory of plate tectonics to explain how surface features form on Earth.
3. Start an observation chart on the board titled "Surface Features and the Movement of the Earth's Plates." Place the terms "divergent", "convergent", and "transform" into three columns. Make sure students understand these three types of motion.
4. Tell students that these three types of movements give geologists clues to how the movements of plates form the surface features on Earth.
5. Explain students will be using a model to help them understand more about these three types of movement.

   Candy Bar Model
6. Distribute a miniature candy bar to each student. Ask students to unwrap their cand bar and use their fingernail to mark a line in the middel of the candy bar to represent the boundary between two plates.
7. Ask students to pull the candy bar apart gently and watch what happens to the chocolate. What part of the Earth does the chocolate coating represent? *(lithosphere)*. How does the chocolate crust change as you pull

it apart? Ask students what the nougat and caramel represent (*asthenosphere*). Ask students which type of plate movement this represents (*divergent plate motion*). What types of surface features are forming?

8. Ask students to gently push their candy bar together. Askt hem which type of motion this is (*convergent motion).* What types of surface features are forming?
9. Ask students to shear the plates of their candy bar using a plastic knife. Ask them to model transform motion. Ask them what kind of features would form on the surface with this type of movement.

Explore

Process Skills: observing, inferring, predicting, generalizing, modeling, and describing

10. Divide students into groups of three. Assign each student a role: materials manager, with the job of collecting and keeping track of supplies; engineering, to do the testing; and architect, to build the two plates for each trial.
11. Distribute STUDENT WORKSHEET: "Movement of Earth's Plates" to each group.
12. Challenge each group to create three models that simulate the three types of plate movement with sand and clay. Explain the lithosphere can be made of different rock layers with different properties. Challenge groups to test different materials. They can build their rock layers out of sand, clay and moon sand in different combinations. Remind them that each model will start with two plates. Ask them to test each of their rock layer models with each of the three plate motions. Groups should record their observations on their worksheet as they experiment with different models.
13. Specifically, ask students to observe cracks in their layers. Ask them what these cracks can connect to or allow to flow to the surface.

Generalize

Process Skills: inferring, describing, making generalizations, and communicating

14. Ask the following questions and discuss as a group:
    a. What did you observe with each plate movement?
    b. How did the different plate motions affect the surface of your models? Convergent? Divergent? Transform?
    c. How did different rock materials affect the appearance of surface features moving in a convergent direction?
    d. How did different rock materials affect the appearance of surface features moving in a divergent direction?
    e. How did different rock materials affect the appearance of surface features moving in a transform direction?
    f. Are there are other materials you could test or other ways to test the materials you have to learn more?

Apply

Process Skills: inferring, making generalizations, describing, and communicating

15. Instruc students to draw a map of a pretend world with at least three moving plates. Ask students to draw arrows on the map to show each direction the plates are moving in Students should label the type of movement and draw the features they would find on the surface of this world.

Assessment Task:

1. Distribute STUDENT WORKSHEET: "Movement of Earth's Plates." Ask students to draw directional arrows to describe each motion and draw at least one surface feature for each motion. Students should label the surface features they recognize.
2. Instruct students to use their notes to write a compare and contrast essay that includes at least two similarities and two differences to describe the three types of plate movement and include at least one surface feature associated with each type of plate boundary.

Objective	GLE	Below Proficient	Proficient	Advanced
Student will draw arrows that correctly illustrate the motion of three types of plate motion. (Transform, divergent, and convergent)	[10] SA1.1	Student draws less than 2 arrows that correctly illustrate the motion of three types of plate motion.	Student draws arrows that correctly illustrate the motion of two of three types of plate motion.	Student draws arrows that correctly illustrate the motion of three types of plate motion.
Student will draw and label each of the surface features associated with the three types of plate motion.	[10] S.D 2.2	Student draws less than 3 surface features for the types of plate motions and does not label features.	Student draws at least one surface feature associated with each type of plate motion. Each surface feature is accurately labeled.	Student draws at least two or more surface features associated with each type of plate motion. Each surface feature is accurately labeled.
Student will write a compare and contrast essay that describes each type of plate movement. They will describe surface features that are associated with each of these.	[10] W4.2.2	Student does not describe three different types of plate movements. They cannot list at least two similarities and differences.	Student describes three different types of plate movements. They accurately explain at least two similarities and differences.	Student describes three different types of plate movements. They accurately explain three or more similarities and differences. Their description includes examples of three different surface features.

NAME: _____ STUDENT WORKSHEET

MOVEMENT OF EARTH'S PLATES

Transform Plate Boundary:

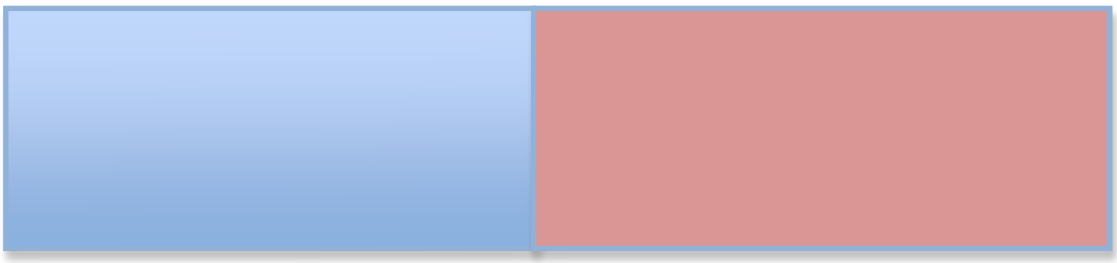
- Draw arows to describe which way these plates move
- Draw another drawing that illustrates what these plates will look like when they move in a transform direction.
- Label land features you would find at these boundaries (faults, mountains, volcanoes, trenches, or other formations).

Divergent Plate Boundary:

- Draw arrows to describe which way these plates move.
- Draw another drawing that illustrates what these plates will look like when they move in a transform direction.
- •Label land features you would find at these boundaries (faults, mountains, volcanoes, trenches or other formations.

Convergent Plate Boundary

- •Draw arrows to describe which way these plates move
- •Draw another drawing that illustrates what these plates will look like when they move in a transform direction.
- •Label land features you would find at these boundaries (faults, mountains, volcanoes, trenches or other formations.



Recipe for homemade moon sand (1 batch)

- 3 cups of play sand
- 1 1/2 cups of cornstarch
- 3/4 cups of cold water
- 1-gallon resealable bag to mix sand in
- 1 teaspoon cream of tartar

Instructions:

Mix the water and cornstarch together thoroughly; this will take a few minutes to get it nice and smooth. You can mix this in a one-gallon resealable bag.Gradually mix in the sand, one cup at a time. You'll need to really work it in with your fingers. When you're all done, pop it in an airtight container. When you next play with it, you'll need to revive it with 2-3 tablespoons of water. Just sprinkle it over and work it in.

Kool-Aid® Modeling Clay

- 1 cup flour
- 1/2 cup salt
- 1 package unsweetened Kool-Aid®
- 3 tablespoons oil
- 1 cup boiling water

Instructions:

Mix together the flour, salt, and Kool-Aid®. Add the oil and the boiling water. Stir the mixture until well blended. Remove the dough from the bowl and knead until soft dough forms.