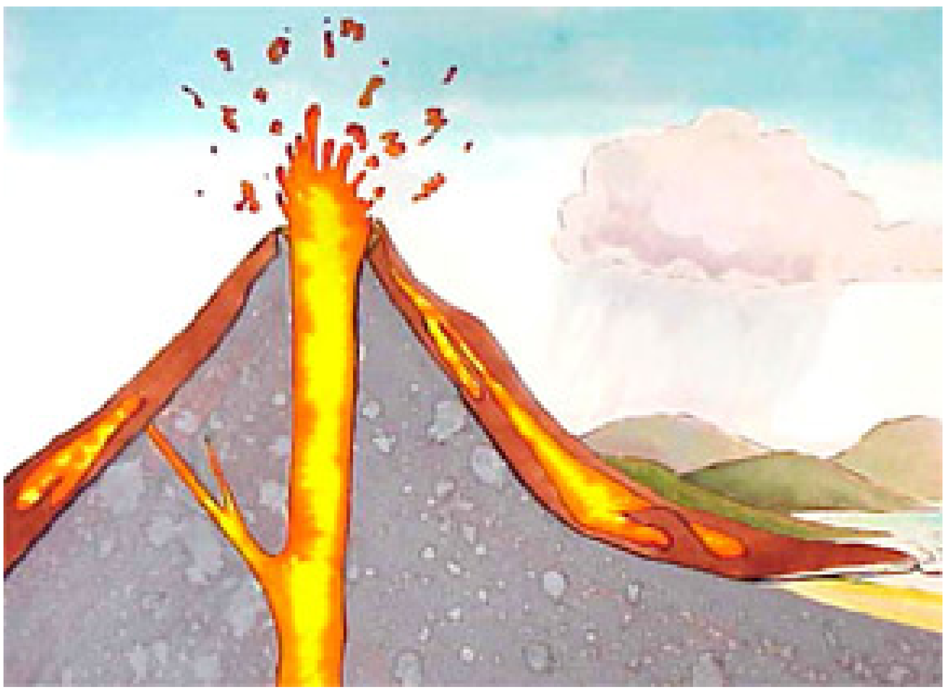
SHAKE RATTLE AND ROLL

Pre-Visit Activities

Grades 3 - 5



VIRGINIA AIR & SPACE CENTER

July, 2009

Standards of Learning

The following Standards of Learning are addressed in the “Shake Rattle and Roll” Program.

Grade Four

Science

Scientific Investigation, Reasoning, and Logic

4.1 The student will plan and conduct investigations in which

- a) distinctions are made among observations, conclusions, inferences, and predictions;
- b) hypotheses are formulated based on cause-and-effect relationships;
- c) variables that must be held constant in an experimental situation are defined;
- d) appropriate instruments are selected to measure linear distance, volume, mass, and temperature;
- f) data are displayed using bar and basic line graphs;
- g) numerical data that are contradictory or unusual in experimental results are recognized; and
- h) predictions are made based on data from picture graphs, bar graphs, and basic line graphs.

Grade Five

Science

Scientific Investigation, Reasoning, and Logic

5.1 The student will plan and conduct investigations in which

- a) rocks, minerals, and organisms are identified using a classification key;
- b) estimations of length, mass, and volume are made;
- e) data are collected, recorded, and reported using the appropriate graphical representation (graphs, charts,
  diagrams);
- f) predictions are made using patterns, and simple graphical data are extrapolated;
- c) manipulated and responding variables are identified; and
- d) an understanding of the nature of science is developed and reinforced.

Earth Patterns, Cycles, and Change

5.7 The student will investigate and understand how the Earth’s surface is constantly changing. Key concepts include

- a) the rock cycle including identification of rock types;
- b) Earth history and fossil evidence;
- c) the basic structure of the Earth’s interior;
- d) plate tectonics (earthquakes and volcanoes

Virginia Studies

Skills

VS.1 The student will demonstrate skills for historical and geographical analysis and responsible citizenship, including the ability to

b)determine cause-and-effect relationships;

d)draw conclusions and make generalizations;

e)make connections between past and present;

i)analyze and interpret maps to explain relationships among landforms, water features, climatic characteristics, and historical events.

Virginia: The Physical Geography and Native Peoples

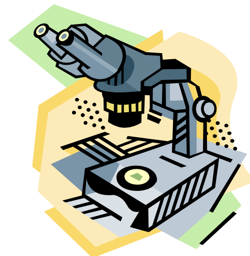
VS.2 The student will demonstrate knowledge of the physical geography and native peoples, past and present, of Virginia by

a)locating Virginia and its bordering states on maps of the United States;

b)locating and describing Virginia's Coastal Plain (Tidewater), Piedmont, Blue Ridge Mountains, Valley and Ridge, and Appalachian Plateau;

c)locating and identifying water features important to the early history of Virginia (Atlantic Ocean, Chesapeake Bay, James River, York River, Potomac River, Rappahannock River, and Lake Drummond and the Dismal Swamp);

Activities



These activities are intended for use before your visit to the Virginia Air and Space Center. It is beneficial for the students to have some prior knowledge about the content area covered in the program. All of the activities can be tailored to your specific classroom needs, and the procedures listed are suggestions for teaching.

Tasty Tectonics

Students create a tasty model that illustrates plate tectonic motions. They learn how Earth's tectonic plates (lithosphere) ride atop the slow flowing asthenosphere layer, and gain an understanding of how plates interact at their boundaries. Pictures to help with student instruction are attached.

Materials for each student: #

* One large graham cracker broken in half (two square graham crackers)
* Two 3-inch squares (approx.) of fruit roll up
* Cup of water
* Frosting
* Sheet of wax paper
* Plastic knife or spoon

1. Make the model
   A. Give each student about a square foot of wax paper and a large dollop of frosting. Instruct students to spread frosting into a layer about half a cm thick.
   B. Tell students that the frosting in this model represents the asthenosphere, the viscous layer on which Earth's plates ride. The plates in this model are represented by fruit roll up (oceanic crust which is thin and dense) and graham crackers (continental crust which is thick but less dense).
2. Divergent plate boundary
   A. Instruct students to place the two squares of fruit roll up (oceanic plates) onto the frosting right next to each other.
   B. Press down slowly on the fruit roll ups (because they are dense and will sink a bit into the asthenosphere) as you slowly push them apart about half a cm.
   C. Notice how the frosting is exposed and pushed up where the plates are separated? This is similar to how magma comes to the surface where real plates are moving apart at divergent plate boundaries. Most divergent plates boundaries are located within the oceanic crust. When plates begin to pull apart at continents, rift valleys are made, like the Great Rift Valley in Africa, which can become the bottom of the sea floor if the plates continue to pull apart.

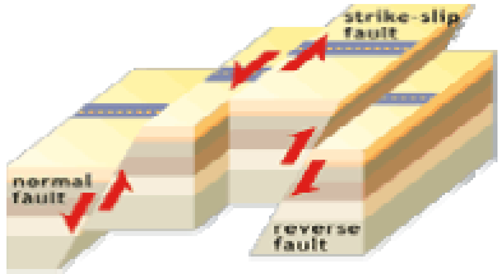
3. Continental-oceanic collision
   A. Instruct students to remove one of the fruit roll ups from the frosting. (They can eat it if they wish!)
   B. Tell students to place one of the graham cracker halves lightly onto the frosting asthenosphere next to the remaining fruit roll up piece. The graham cracker represents the continental crust, which is thicker and less dense than oceanic crust (fruit roll up). It floats high on the asthenosphere so do not push it down.
   C. Gently push the continent (graham cracker) towards the ocean plate (fruit roll up) until the two overlap and the graham cracker is on top. The oceanic plate is subducted below the continental one.
4. Continent-continent collision
   A. Tell students that they will next model what happens when two continents collide. Have them remove both the cracker and fruit roll up from the frosting asthenosphere. (Students can eat or discard the fruit roll up.)
   B. Place one edge of both crackers into the glass of water for just a few seconds.
   C. Place the crackers onto the frosting with the wet edges next to each other.
   D. Slowly push the graham crackers towards each other.
   E. Notice how the wet edges crumple. This is how mountains are made at convergent plate boundaries! When continents move towards each other there is nowhere for the rock to go but up!
5. Transform plate boundaries
   A. Pick the two crackers up off the frosting and turn them around so that two dry edges are next to each other.
   B. Push one cracker past the other to simulate a transform plate boundary like the San Andreas Fault.
6. Final step: eat all remaining model materials (except, of course, wax paper and plastic utensils!)

Student Assessment:
Have students draw what each situation looks like in cross section (by looking at the edge of their model).

Teacher Notes:
The main force that shapes our planet’s surface over long amounts of time is the movement of Earth's outer layer by the process of plate tectonics.
The rigid outer layer of the Earth, the lithosphere, is made of plates that fit together like a jigsaw puzzle. These plates are made of rock, but the rock is, in general, lightweight compared with the denser, fluid layer underneath. This allows the plates to "float" on top of the denser material. The fluid dense material is called asthenosphere and in this activity, it is represented by the frosting. However, plates are not all the same. Plates made of continental crust are thicker but less dense than plates made of ocean crust, which are denser but thinner. In this activity, ocean plates are represented by fruit roll ups and continental crust is represented by graham crackers.

Movements deep within the Earth, which carry heat from the hot interior to the cooler surface, cause the plates to move very slowly on the surface, about 2 inches per year on average. There are several different hypotheses to explain exactly how these motions allow plates to move.

Interesting things happen at the edges of plates. At divergent plate boundaries, rift valleys and spreading ridges form as plates pull away from each other. At convergent plate boundaries, where plates are coming together, subduction zones form when an oceanic plate and a continental plate collide and mountains build when two continental plates collide. Large faults form when plates slide past each other making the Earth tremble with earthquakes.



Making Sandstone

In this activity, students will see how sedimentary rocks are formed when they make sandstone.

Materials:

- Paper cup
- Cementing solution (2 parts water to one part Epsom salt)
- Sand
- Hand lenses

Procedure

1. Fill the paper cup half full of sand. Pack the sand with your hand.
2. Slowly add cementing solution until all of the sand is wet.
3. Put the cup in a warm place until the sand dries completely.
4. Carefully tear away the paper cup.
5. Describe what you observe.

Teacher Hint:

1. Sedimentary rocks, including coal are packed together in layers. Water containing minerals seeps in between the pieces and then evaporates. The minerals that are left behind cement the particles together into a larger rock.
2. Cement is a powder made from crushed lime, silica, alumna, iron oxide and gypsum. Each of these minerals is mixed in the proper proportion and then mixed with water. When the water dries, a hard concrete “rock” is left behind.

Cookie Subduction

This activity shows how large amounts of rock and sediment are added to the edge of continents.

Materials:

* Cream centered cookie, such as an Oreo cookie

Procedure:

1. Pull apart the cookie.

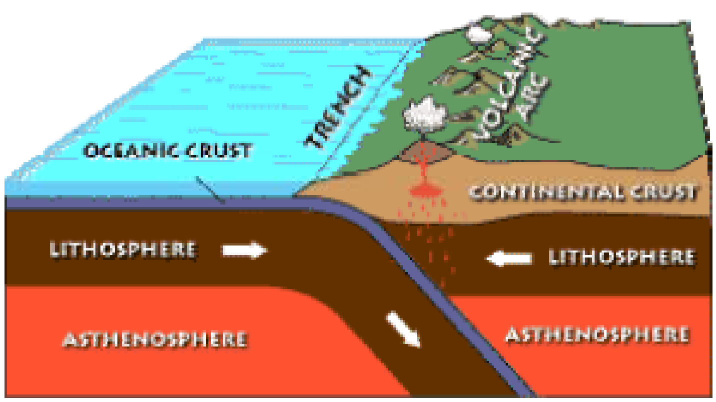
2. Use the part with the most cream center still attached.

3. With the cream side up, slowly slide the cookie into your mouth. While sliding, the upper front teeth should scrape off the creaming filling. The creamy filling should be plastered onto your front teeth when you are done.

Explanation:

When an oceanic plate dives under continental plates, layers of the sea floor are often scraped off and plastered onto the edge of the continental plate next to it. This process of adding oceanic material to the edge of a continental plate is called <u>accretion</u>. It is an important process in the building of continents. Much of the west coast of the Americas is composed of accreted rocks.

The diagram below shows how the edge of the continental crust bulldozes off the top layers of the subducting oceanic crust. In the cookie analogy, teeth do the bulldozing, scraping off cream filling rather than sediments.



This is a diagram of subduction. It shows how an oceanic plate dives under a continental plate. Lithosphere and asthenosphere are layers of the crust.

Websites to enhance learning

http://volcano.oregonstate.edu/vwdocs/vwlessons/lessons/Earths_layers/Earths_layers1.html

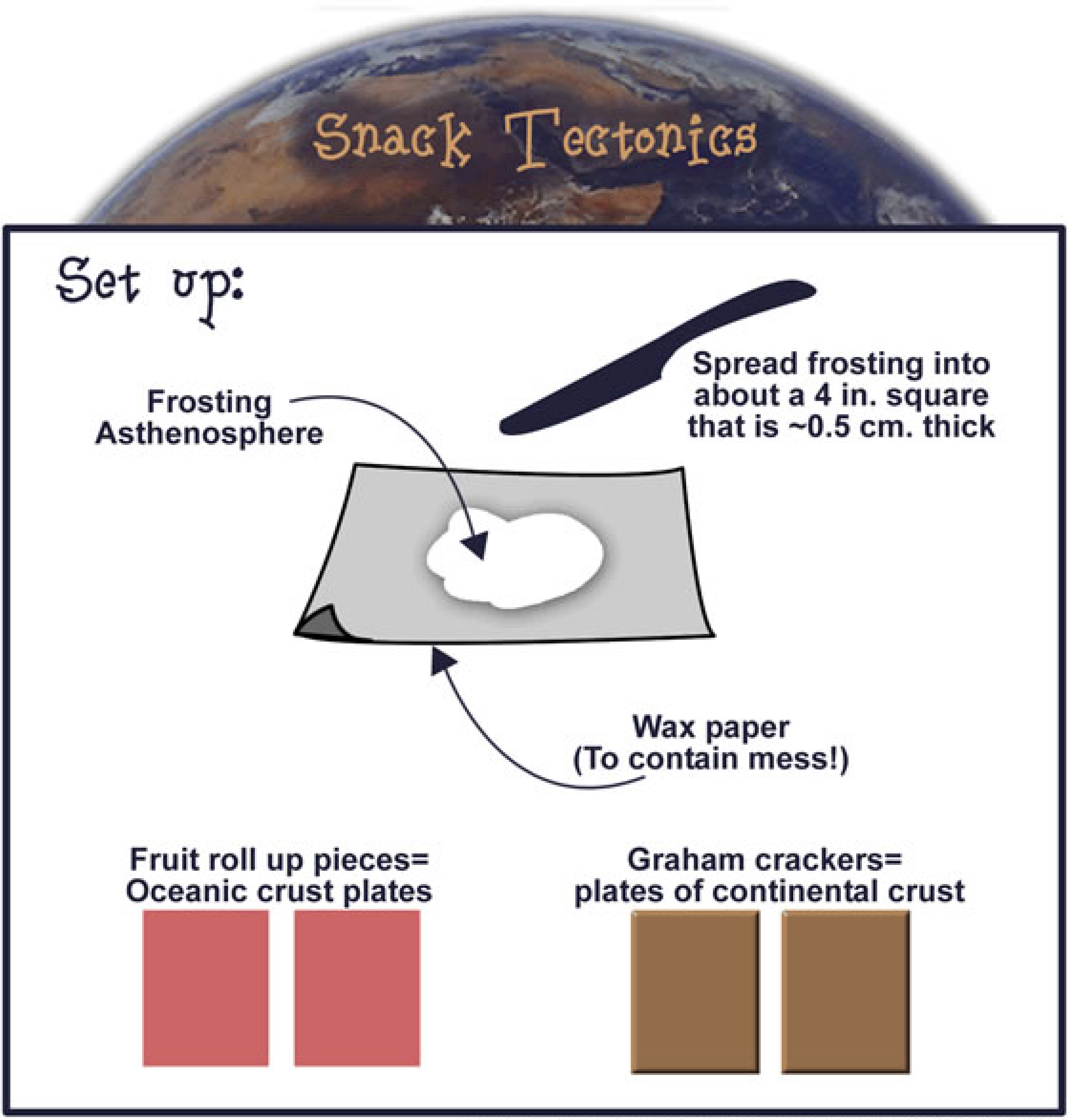
This website is very helpful. It clearly describes the earth's layers, and includes wonderful pictures. It also has a feature that allows the students to go back to review in the event that they do not understand a particular point. There are questions at the end to check for comprehension.

http://volcano.oregonstate.edu/kids/kurtz_stories/RockysRoots.html

Written by a famous author of books for young people, Jane Kurtz, this wonderful story about "Rocky" and his family of rocks helps students understand how rocks are formed.

http://earthquake.usgs.gov/learning/kids/

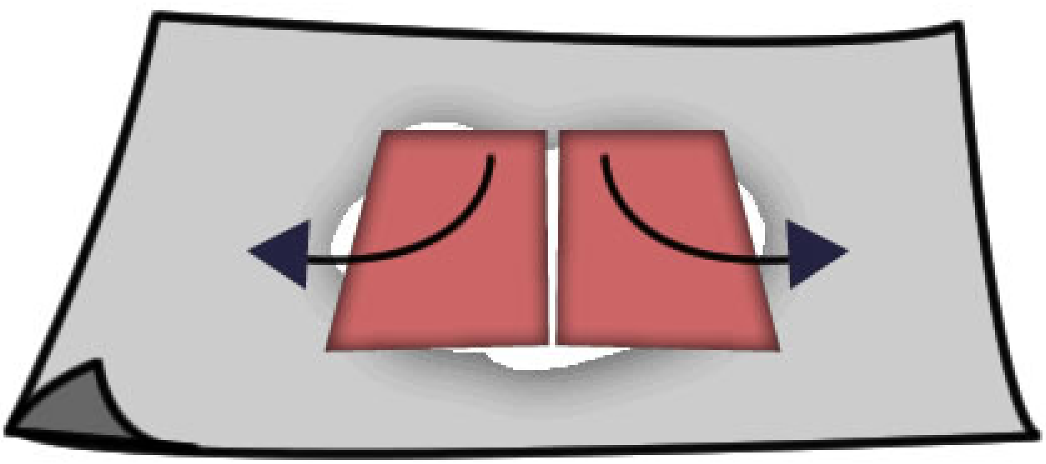
This site includes earthquake facts, information about earthquake history, puzzles, games, and earthquake animations.


Snack Tectonics
Set up:
Frosting
Asthenosphere
Spread frosting into
about a 4 in. square
that is ~0.5 cm. thick
Wax paper
(To contain mess!)
Fruit roll up pieces=
Oceanic crust plates
Graham crackers=
plates of continental crust

Divergent plate boundary

1. Place the two plates of oceanic crust (fruit roll up pieces) side by side lightly on the frosting asthenosphere.

2. Press down slowly on the oceanic plates (because they are dense and will sink a bit into the asthenosphere) as you slowly push them apart about half a cm.

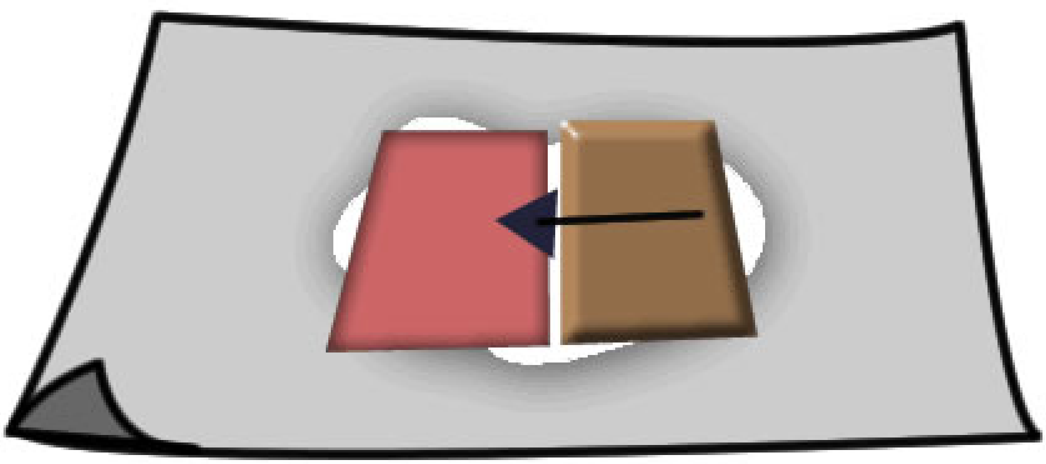


Continental–oceanic collision

1. Remove one of the fruit roll ups from the frosting.

2. Place one graham cracker lightly onto the frosting asthenosphere next to the remaining fruit roll up. Continental crust is less dense than oceanic crust. It floats high on the asthenosphere so don't push it down.

3. Gently push the continent (graham cracker) towards the ocean plate (fruit roll up) until the two overlap and the graham cracker is on top. The oceanic plate has been subducted!



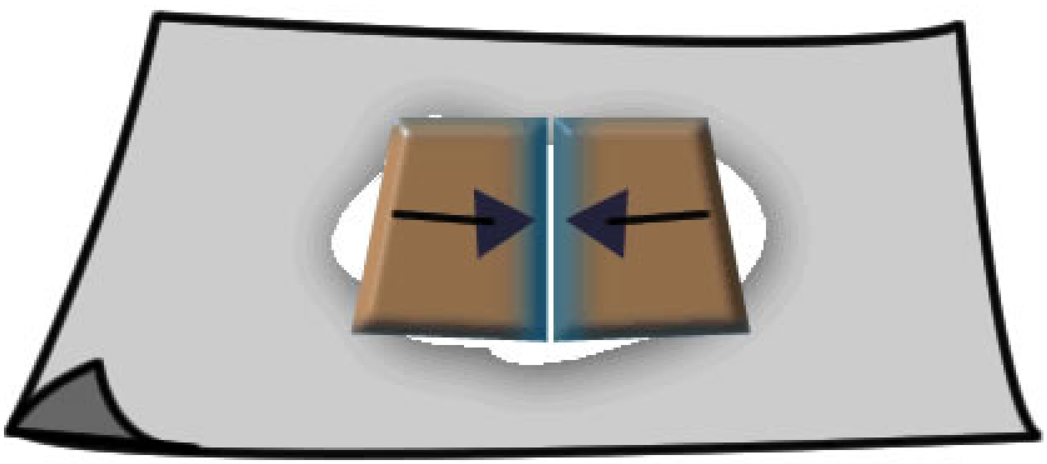
Continent-continent collision

1. Remove both the cracker and fruit roll up from the frosting asthenosphere.

2. Place one edge of both crackers into the glass of water for just a few seconds.

3. Place the crackers onto the frosting with wet edges next to each other.

4. Slowly push the graham crackers towards each other.



Transform plate boundaries

1. Pick the two crackers up off the frosting and turn them around so that two dry edges are next to each other.

2. Push one cracker past the other to simulate a transform plate boundary like the San Andreas fault!

Final step: Eat all remaining model materials (except, of course, wax paper and plastic utensils!)