6-12 Plate Tectonics Activity

South Carolina Aquarium

Overview

Focus Question
What is plate tectonics? How do the Earth's plates fit together? What is the difference between a convergent, divergent and transform boundary?

Activity Synopsis
Students will puzzle together the earth's plates and discover where the continents are in relation to the plates. Then students will design their own examples of the different plate boundaries (convergent, divergent, transform).

Objectives
The learner will be able to:

- Understand plate tectonics
- Create a map of the earth by piecing together the Earth's plates
- Describe and illustrate the difference between convergent, divergent and transform plate boundaries

Time Frame
90 minutes (2, 45 minute sessions)

Key Terms
- plate tectonics
- core
- mantle
- crust
- Asthenosphere
- Lithosphere
- Mesosphere
- convergent boundary
- subduction zone
- divergent boundary
- rift
- rift valley
- transform boundary
- fossil

Standards

South Carolina College- and Career-Ready Science Standards 2021

6th Grade: 6-ESS1-4, 6-ESS2-1, 6-ESS2-2, 6-ESS2-3
7th Grade: 7-LS2-1, 7-LS2-2, 7-LS2-4, 7-ESS3-1
8th Grade: 8-LS1-5, **8-LS4-1,** 8-LS4-2
Biology: B-LS4-1, B-LS4-5
Earth and Space Science: E-ESS1-5, E-ESS1-6, E-ESS2-1, E-ESS2-2, E-ESS2-3, **E-ESS2-7**

***Bold standards are the main standards addressed in this activity**

2014 Academic Standards and Performance Indicators for Science

6th Grade: 6.S.1A.2, 6.S.1A.6, 6.S.1A.8

7th Grade: 7.S.1A.2, 7.S.1A.6, 7.S.1A.8
8th Grade: 8.S.1A.2, 8.S.1A.6, 8.S.1A.8, **8.E.5A.4, 8.E.5A.5, 8.E.5B.1**, 8.E.5B.2, 8.E.5B.3, 8.E.6A.3
Biology: H.B.1A.1, **H.B.1A.2, H.B.1A.6**, H.B.1A.7, H.B.1A.8, H.B.6A.1, H.B.6C.1
Earth Science: H.E.1A.1, **H.E.1A.2, H.E.1A.6**, H.E.1A.7, H.E.1A.8, H.E.2B.1, **H.E.3A.2, H.E.3A.3,** H.E.3A.6, H.E.3B.3, H.E.4A.2, H.E.4A.3

South Carolina College- and Career-Ready Science Standards 2021

Sixth Grade Performance Expectations

6-ESS1-4 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.
6-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
6-ESS2-2 Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
6-ESS2-3 Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

Seventh Grade Performance Expectations

7-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
7-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
7-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
7-ESS3-1 Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

Eighth Grade Performance Expectations

8-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
8-LS4-1 Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operated in the past as they do today.
8-LS4-2 Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer their ancestral relationships.

Biology Performance Expectations

B-LS4-1 Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
B-LS4-5 Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Earth and Space Science Performance Expectations

E-ESS1-5 Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
E-ESS1-6 Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
E-ESS2-1 Use evidence to argue how Earth's internal and external processes operate to form and modify continental and ocean-floor features throughout Earth's history.
E-ESS2-2 Analyze data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
E-ESS2-3 Develop a model based on evidence of Earth's interior that describes cycling of matter through convection processes.
E-ESS2-7 Communicate scientific information that illustrates how Earth's systems and life on Earth change and influence each other over time.

2014 Academic Standards and Performance Indicators for Science

Sixth Grade Performance Indicators

6.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
6.S.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
6.S.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs, or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

Seventh Grade Performance Indicators

7.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
7.S.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
7.S.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs, or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

Eighth Grade Performance Indicators

8.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
8.S.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
8.S.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs, or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.
8.E.5A.4 Construct explanations for how the theory of plate tectonics accounts for (1) the motion of lithospheric plates, (2) the geologic activities at plate boundaries, and (3) the changes in landform areas over geologic time.
8.E.5A.5 Construct and analyze scientific arguments to support claims that plate tectonics accounts for (1) the distribution of fossils on different continents, (2) the occurrence of earthquakes, and (3) continental and ocean floor features (including mountains, volcanoes, faults and trenches).
8.E.5B.1 Analyze and interpret data to describe patterns in the location of volcanoes and earthquakes related to tectonic plate boundaries, interactions, and hot spots.
8.E.5B.2 Construct explanations of how forces inside Earth result in earthquakes and volcanoes.
8.E.5B.3 Define problems that may be caused by a catastrophic event resulting from plate movements and design possible devices or solutions to minimize the effects of that event on Earth's surface and/or human structures.
8.E.6A.3 Construct explanations from evidence for how catastrophic events (including volcanic activities, earthquakes, climatic changes, and the impact of an asteroid/comet) may have affected the conditions on Earth and the diversity of its life forms.

Biology Performance Indicators

H.B.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge scientific arguments or claims.
H.B.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

H.B.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
H.B.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence and valid reasoning from observations, data, or informational texts.
H.B.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.
H.B.6A.1 Analyze and interpret data that depict changes in the abiotic and biotic components of an ecosystem over time or space (such as percent change, average change, correlation and proportionality) and propose hypotheses about possible relationships between the changes in the abiotic components and the biotic components of the environment.
H.B.6C.1 Construct scientific arguments to support claims that the changes in the biotic and abiotic components of various ecosystems over time affect the ability of an ecosystem to maintain homeostasis.

Earth Science Performance Indicators
H.E.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge scientific arguments or claims.
H.E.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
H.E.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
H.E.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence and valid reasoning from observations, data, or informational texts.
H.E.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.
H.E.2B.1 Analyze and interpret data to compare the properties of Earth and other planets (including composition, density, surface expression of tectonics, climate, and conditions necessary for life).
H.E.3A.2 Analyze and interpret data from ocean topography, correlation of rock assemblages, the fossil record, the role of convection current, and the action at plate boundaries to explain the theory of plate tectonics.
H.E.3A.3 Construct explanations of how forces cause crustal changes as evidenced in sea floor spreading, earthquake activity, volcanic eruptions, and mountain building using evidence of tectonic environments (such as mid-ocean ridges and subduction zones).
H.E.3A.6 Develop and use models to explain how various rock formations on the surface of Earth result from geologic processes (including weathering, erosion, deposition, and glaciation).
H.E.3B.3 Analyze and interpret data to explain how natural hazards and other geologic events have shaped the course of human history.
H.E.4A.2 Construct explanations for how various life forms have altered the geosphere, hydrosphere and atmosphere over geological time.
H.E.4A.3 Construct explanations of how changes to Earth's surface are related to changes in the complexity and diversity of life using evidence from the geologic time scale.

Cross Curricular Standards

South Carolina College and Career Standards for ELA
Inquiry (I) – 2.1, 5.1
Writing (W) – 1.1, 2.1, 3.1
Communication (C) – 1.1, 1.2, 1.4, 1.5, 2.1

Background

6-12 Plate Tectonics Activity

South Carolina Aquarium

Key Points
Key Points will give you the main information you should know to teach the activity.

- **Plate tectonics** is the theory that the Earth's surface (lithosphere) is made up of many plates that move over the Earth's inner mantle due to convection currents.
- The Earth is made up of 3 layers including the **core**, **mantle** and **crust**. The Lithosphere includes the crust and upper mantle.
- The **Lithosphere** is broken down into 7-8 major tectonic plates (depending on how they are looked at) and several smaller plates.
- Where plates meet is called a plate boundary. There are 3 types of plate boundaries; convergent, divergent and transform.
- **Convergent boundaries** are found when two plates are moving toward one another. **Divergent boundaries** are found when tectonic plates are moving away from each other. **Transform boundaries** are found when two plates slide past one another.
- Scientists can use not only the shape of the land, but **fossil** evidence to study earth's plate tectonic's past.

Detailed Information
Detailed Information gives more in-depth background to increase your own knowledge, in case you want to expand upon the activity or you are asked detailed questions by students.

Plate tectonics is the theory that the Earth's surface (lithosphere) is made up of many plates that move over the Earth's inner mantle due to convection currents. This theory was developed throughout the 1900s. Alfred Wegener first described it as the continental drift in 1912, but lacked evidence to support it. In the 1950s and 1960s the theory became more accepted and understood as seafloor spreading was discovered and convection currents were understood. Plate tectonics is the driving force for the science field of geology. Plate tectonics explains how the earth's crust is continually moving, growing, sinking and being regenerated.

The Earth is made up of many layers including the **core**, **mantle** and **crust**. The **Core** is the most inner part of the Earth and can be broken down to include the inner core and the outer core. The inner core is 800 miles thick and made up of iron and nickel in a solid state. The outer core is 1400 miles thick and made up of iron, nickel and sulfur in a liquid state. The **mantle** is 1800 miles thick, made up of magnesium, iron, aluminum, silicon and oxygen and is more solid than the outer core, but not completely liquid. The mantle can be broken down into 2 layers as well. The inner mantle is called the **Mesosphere** and is very hot and strong due to high pressure. The outer mantle is called the **Asthenosphere** which is also hot and semi-fluid. On top of the Asthenosphere is the Lithosphere which is cooler and more ridged. The **Lithosphere** includes the crust and upper mantle. The **crust** is 0-62 miles thick and includes oceanic crust and continental crust. Oceanic crust is more dense than continental crust.

The Lithosphere (crust and upper mantle) is broken down into 7-8 major tectonic plates (depending on how they are looked at) and several smaller plates. Where plates meet is called a plate boundary. There are 3 types of plate boundaries; convergent, divergent and transform. The type of boundary is determined by how the plates interact. When plates interact; earthquakes occur, volcanoes erupt, mountains are created and ocean trenches form.

Convergent boundaries are found when two plates are moving toward one another. As plates move toward each other, they either collide together or one goes beneath the other creating a **subduction zone**. At a subduction zone, one plate (more dense) moves beneath the other plate (less dense). If two oceanic plates merge, underwater volcanoes form and over time can create islands arcs. If one oceanic and one continental plate merge, the oceanic plate (more dense) goes under the continental plate (less dense) and volcanoes form on land and overtime become mountains. If two continental plates collide, mountains form due to the buckling of the land.

Examples of convergent boundaries are the Aleutian Islands formed from two oceanic plates merging (Pacific and NW North American plates), the Cascade mountain range on the Pacific coast of North America formed from an ocean plate subducting under North America (Juan de Fuca and North American plates), and the Himalaya Mountains formed from two continental plates colliding (Indian and Eurasian plates).

Divergent boundaries are found when tectonic plates are moving away from each other. As two plates slide apart, new crust fills in and a **rift** is created. Many times small volcanoes and earthquakes occur as plates move apart. When two oceanic plate slide apart, seafloor spreading occurs and new oceanic crust fills in and over time a ridge is formed. When two continental plates slide apart a rift forms and over time the rift grows and becomes a **rift valley**.

An example of two ocean plates splitting apart is the Mid-Atlantic Ridge in the Atlantic Ocean. The Mid-Atlantic Ridge is being created as the Eurasian and North American plates spread in the North Atlantic Ocean and the African and South American plates spread in the South Atlantic Ocean. Scientists think this longest mountain range in the world is growing at a rate of about 2.5 centimeters a year. Most of this massive mountain range is underwater, but some areas have grown above sea level (example: Iceland).

An example of two continental plates splitting apart is the Great Rift Valley in East Africa. The Great Rift Valley is being created as the African plate is dividing into two plates (Somali and Nubian plates). Scientists believe the rift valley is growing at a rate of 6-7 millimeters a year.

Transform boundaries are found when two plates slide past one another. At this type of boundary, crust is not being made or destroyed. Instead plates grind past each other along transform faults. Earthquakes are very common a fault sites. Transform faults are also commonly found among seafloor spreading areas and subduction zones as plates move and rub against one another.

A good example of a transform fault is the San Andreas Fault in California. This fault is between the Pacific and North American plates for 810 miles of California. Scientists believe the plates are sliding at a rate of about 1.4 inches a year. The devastating San Francisco Earthquake of 1906 was a result of this fault area. The San Andreas Fault is being studied continuously to improve earthquake prediction.

The earth is about 4.5 billion years old. Because new oceanic crust is always being formed, the oldest ocean sediment is thought to be about 200 million years old. Continental sediment has been around much longer and some aged at 3.8 billion years old. Over very long periods of time and as continents move, the land all comes together to form supercontinents. Two examples of this are 300 million years ago Pangea was formed and 1 billion years ago Rodinia was formed.

Scientists can use not only the shape of the land, but fossil evidence to study earth's plate tectonic's past. **Fossils** are the remains of living thing from the past which includes all traces of their activities (for example, body parts, burrows and tracks). The discovery of remains of the same organisms, either terrestrial or at least incapable of traveling for long distances across the sea, in continents today separated by oceans provide evidence of plate tectonics. For example, fossils of *Lystrosaurus*, a typically terrestrial mammal-like reptile of the Permian period, have been found in Antarctica, India, South America and southern Africa, thereby indicating that these land masses were once joined together at the end of the Paleozoic era.

Procedures

Materials

Part 1: Plate Tectonics Puzzle

- Plate Tectonics Intro PowerPoint
- Earth's Puzzle Pieces (1 set per group)
- Scissors (1 per student)
- Construction Paper (1 large piece or 2 small pieces taped together - per group)
- Tape or glue
- The Earth's Plates Answer Key (for teacher only)

Part 2: S'more Plate Boundaries

- 2 jars marshmallow fluff
- 2 boxes graham crackers
- 2, 6 packs of Hersey's chocolate bars
- 1 bag chocolate chips

- 1 bag caramel or butterscotch chips
- Paper plates

Procedure

Part 1: Plate Tectonics Puzzle

1. Talk about the Theory of Plate Tectonics using the Intro PowerPoint. Intro will highlight the following:
    a. Plate tectonics
    b. Convergent boundaries
    c. Divergent boundaries
    d. Transform boundaries
    e. Plate tectonics evidence in fossils
2. Put students into groups of 3.
3. Give each group a set of the Earth's Puzzle Pieces, 3 pair of scissors, tape or glue and construction paper.
4. Have students cut out the Earth's plates.
5. Students should create the Earth's tectonic plates map by putting the puzzle pieces together.
6. Before taping or gluing the pieces on the construction paper, have the students figure out what the symbols on the edges of the plates mean.
7. They need to show, using their puzzle pieces, what is happening at the edges of each plate as they glue the plates down.
    a. Convergent boundary – place one plate edge under the other (ocean under land)
    b. Divergent boundary – leave a tiny space between
    c. Transform boundary – place plates right next to each other

Part 2: S'more Plate Boundaries

1. Keep students in groups of 3 for this activity.
2. Give each group 3 paper plates.
3. Have all the S'more materials ready for the students to access.
4. Let them know that each group needs to use the materials to design a model for convergent, divergent and transform boundaries. Label each plate with one type of plate boundary.
5. Let them know to use a graham cracker at the bottom of each model so that when done, they will be able to eat it.
6. After ample design time, have each group report to the class how the why they designed each type of plate boundary.

Note: Materials were picked with the following in mind. Don't let students know this. Allow them to design their own.

- Marshmallow fluff – asthenosphere (mantle)
- Graham crackers – continental crust
- Hersey's bars – oceanic crust
- Chocolate chips – volcanoes/mountains in ocean
- Caramel/butterscotch chips – volcanoes/mountains on land

7. If you have time, allow them to modify their designs after hearing all of the student reports.
8. Last step, let them eat their designs!

Follow-up questions

1. What do you think the Earth will look like in the year 3000?
2. Does climate change affect plate tectonics?

Assessment

Assessment 1

Grade students on their Earth's Tectonic Plates Map.

Scoring rubric for out of 100 points

Puzzle pieces are cut neatly	**8 points**
Correct placement of each puzzle piece	**42 points (3 pts each, 14 pieces)**
Correctly indicates plate edges	**50 points**

Assessment 2

Essay on "Where I Would Live" Assessment. Give each student a "Where I Would Live" worksheet so they can write an essay on where they would live and why. In their essays they will to describe each plate tectonic boundary and explain which boundary they would choose to live near as well as why.

Scoring rubric for out of 100 points

Explain why they chose that location	**20 points**
Explain why they didn't choose the other locations	**20 points**
Correctly describe a convergent boundary	**20 points**
Correctly describe a divergent boundary	**20 points**
Correctly describe a transform boundary	**20 points**

Cross-Curricular Extensions

STEAM Extension

Have students use clay to create the Earth's plates. They should indicate which type of boundary is found at the edge of each plate using their clay. Have them be proportionate to each actual plate in regards to surface area (for example the Antarctic Plate is the largest and the Juan de Fuca Plate is the smallest). Using a different color per plate would make a nice art piece.

Resources

Teacher Reference Books

Frisch, Wolfgang, Martin Meschede and Ronald C. Blakey. *Plate Tectonics: Continental Drift and Mountain Building*. Springer-Verlaf Berlin Heidelberg, 2011

Kearey, Philip, Keith A. Klepeis and Frederick J. Vine. *Global Tectonics*. Wiley-Blackwell, 2009

Cox, Allan and Robert Brian Hart. *Plate Tectonics: How it Works*. Blackwell Scientific Publications, 1986.

Relevant Articles

Scientific American – Google Maps and Plate Tectonics
http://blogs.scientificamerican.com/critical-opalescence/what-happens-to-google-maps-when-tectonic-plates-move/

Smithsonian
http://www.smithsonianmag.com/science-nature/when-continental-drift-was-considered-pseudoscience-90353214/?no-ist

Adult Reference Websites

Live Science

http://www.livescience.com/37706-what-is-plate-tectonics.html

University of California Museum of Paleontology
http://www.ucmp.berkeley.edu/geology/tectonics.html

PBS – A Science Odyssey
http://www.pbs.org/wgbh/aso/tryit/tectonics/

Enchanted Learning
http://www.enchantedlearning.com/subjects/astronomy/planets/earth/Continents.shtml

Student Reference Websites

Rader's Geography 4 Kids
http://www.geography4kids.com/files/earth_tectonics.html

Kids Geo
http://www.kidsgeo.com/geology-for-kids/0043-plate-tectonics.php

Easy Science for Kids
http://easyscienceforkids.com/all-about-tectonic-plates/

Virtual plates interactive
http://www.amnh.org/ology/features/plates/loader.swf

PBS Learning Media
http://www.pbslearningmedia.org/asset/ess05_int_shake/

Videos

Make Me Genius
https://www.youtube.com/watch?v=tcPghqnnTVk

https://www.youtube.com/watch?v=ELd3ebldSTs

PBS Learning Media
http://www.pbslearningmedia.org/resource/ess05.sci.ess.earthsys.plateintro/plate-tectonics-an-introduction/

http://www.pbslearningmedia.org/resource/ess05.sci.ess.earthsys.wegener1/plate-tectonics-the-scientist-behind-the-theory/

Games

Dynamic Earth Interactives
http://www.learner.org/interactives/dynamicearth/plate2.html

Sporcle
http://www.sporcle.com/games/g/tectonic_plates

Quia
http://www.quia.com/jg/262313.html