

Geological Processes

Standard II:

Students will understand that volcanoes, earthquakes, uplift, weathering, and erosion reshape Earth's surface.

Objective 2:

Explain how volcanoes, earthquakes, and uplift affect Earth's surface.

Objective 3:

Relate the building up and breaking down of Earth's surface over time to the various physical land features.

Intended Learning Outcomes:

1. Use science process and thinking skills
2. Manifest scientific attitudes and interests
4. Communicate effectively using science language and reasoning

Content Connections:

Life Skills; Thinking and Reasoning.

Science Standard

II

Objectives

2 & 3

Connections

Background Information

Earth's surface is constantly changing. Some changes happen very slowly over long periods of time, such as weathering, erosion, and uplift. Other changes happen abruptly, such as landslides, volcanic eruptions, and earthquakes. All around us, we see the visible effects of the building up and breaking down of Earth's surface.

This activity is designed as a game board that will allow students to deepen their understanding of the effects of weathering, erosion; uplift, sudden changes (e.g. flash flood, avalanche), earthquakes and volcanoes on the geological features of Earth. In this activity students will use a geological processes game board and game cue cards to try and build the biggest mountain. The game cue cards use science vocabulary and help students understand the impact of geological forces on the features of Earth's surface.

Research Basis

Balasubramanian, N., Wilson, B. G., & Cios, K.J.(2005) *Games and Simulations* Retrieved January 5, 2008, from [http://site.aace.org/pubs/foresite/GamesAndSimulations 1.pdf](http://site.aace.org/pubs/foresite/GamesAndSimulations%201.pdf)

This paper examines the opportunities and challenges that games can offer to enrich teaching and learning. Research is based on games developed by the Nobel games. Five guidelines are recommended for games to be meaningful and integrated into the classroom setting.

Teed, R. *Game-based Learning*. Retrieved January 5, 2008, from <http://serc.carleton.edu/introgeo!games/index.html>

This is an excellent resource for developing and creating games for the classroom. Elements that comprise well-developed games are explored. Information is based on current research.

Hogle, J. (1996-08-00) *Considering Games as Cognitive Tools: In Search of Effective "Edutainment"* ERIC #: ED425737 Retrieved January 5, 2008, from <http://twinpinefarm.comlpdfs/games.pdf>

This research paper reviews proposed benefits of using games as cognitive tools. Researchers have purported that the use of educational games has the potential to increase interest, motivation and retention, as well as improve higher order thinking and reasoning skills. This paper reviews the benefits of games and what is needed in order for games to be of value in the education setting.

Materials

- ☐ *Gameboard Cards*
- ☐ *Gameboard*
- ☐ Foam Dice
- ☐ Centimeter cubes or counters
- ☐ Utah Relief Map
- ☐ National Atlas Relief Map
- ☐ The Dynamic Planet Map



Invitation to Learn

Invite students to look at the Dynamic Planet Map. Facilitate discussion with the following questions: (Allow time for discussion and reflection).

- What do all the dots mean on the map?
- Why do you think that a lot of earthquakes and volcanoes are where they are on the map?
- Why do you think they call the area around the Pacific Ocean the "Ring of Fire"?
- What geological feature do you find at plate boundaries? (Mountains, volcanoes)
- What forces build up a mountain?
- What forces can break down Earth?
- What does erosion do to Earth's surface?
- Where do all the rivers drain?
- What role does water play in sculpting the surface of Earth?

Inform students that these are all geological processes. In order to deepening their understanding of how these processes impact Earth's surface, invite them to play the Geological Processes Game. Challenge them to be the one to build the biggest mountain.

Instructional Procedures

1. Students will get into teams of 4 or less. Each team will need a *Game board*, *Game board Cards*, one die (foam or other) and

container of centimeter cubes (about 120). If centimeter cubes are not available paper, counters or another pattern blocks can be used.

2. Directions for how to play the game are on the game board. Remind students they are to move in a forward (not backward) direction. Some adaptations (if needed):
 - Use a timer to identify length of playing time.
 - If area on game board is too small to build on, have students build on a piece of paper.
 - Students may need to count out their mountain pieces if a clear winner cannot be established.
 - Students might be able to work as teams if needed in order for all students to participate.
3. After game time has ended, have students return supplies to designated area. Initiate a group discussion about what they learned about geological processes as they played the game. In a journal or on the board, allow students to list several of their ideas about concepts they learned from doing this activity. Develop the idea that geological forces of erosion and uplift are responsible for much of Earth's features. Have students identify different types of erosion (wind, water) and weathering (mechanical –root pry, freezing and thawing; chemical weathering).
4. Review major concepts (volcanoes, earthquakes, uplift, weathering, and erosion reshape Earth's surface.)
5. To extend the activity have students view the Utah Relief Map, National Atlas Relief Map or the Dynamic Planet Map and see if they can find places on Earth where erosion (drainage basins), uplift (mesas, plateaus), volcanoes and earthquakes (Ring of Fire, plate tectonics) and deposition (deltas) have occurred.

Assessment Suggestions

- Participation in a team and successfully building a mountain.
- Group discussion participation and recorded list of main concepts.
- Ability to locate areas on map, explain what geologic feature is located in that area and what geologic forces impacted that area.
- Extension: Invite students to make more game cue cards with additional geologic processes, or have them write in a science

journal or notepad ideas for cards to be added to the geological processes cue cards.

Curriculum Extensions/Adaptations/Integration

- Adaptations for learners with special needs: Have student work with a partner so they can play the game without limitations.
- Have a team competition and see who can build the biggest mountain.
- Social Studies Connection – Read about the 1906 San Francisco Earth, Mount St. Helens, Hurricane Katrina or other major disasters and examine what impact the geologic features of Earth had on that event.

Family connections

- Provide each student with a game board and black lines of the game board cards. Invite them to play the game at home.
- Have a classroom set of the *Geological Processes* game board available to use when appropriate time is available.
- Have a team competition and see who can build the biggest mountain.

Additional Resources

Web sites

Mountain Building/Orogeny Visualizations <http://serc.carleton.edu/NAGTWorkshops/visualization/collections/orogeny.html>

Natural Wonders of the World Field Trip <http://www.field-guides.com/sci/natwon/>

Plate Tectonics <http://scjgn.jpl.nasa.gov/learn/plate.htm>

Gameboard Cards

Geological Process	<p>Earthquake Card</p> <p>A 3.2 earthquake caused uplift in your area. Add 4 units to your mountain.</p>
--------------------	--

Geological Process	<p>Earthquake Card</p> <p>A 7.0 earthquake caused uplift in your area. Add 6 units to your mountain.</p>
--------------------	--

Geological Process	<p>Landslide in your area from heavy rain. Remove 2 units from your mountain.</p>
--------------------	---

Geological Process	<p>Landslide in your area eroded an entire hillside. Remove 4 units.</p>
--------------------	--

Geological Process	<p>Volcanic eruption, molten lava added to your mountain. Add 10 units.</p>
--------------------	---

Geological Process	<p>Wind and water erosion have removed material from an arch area and it collapsed. Remove 1 unit.</p>
--------------------	--

Geological Process	<p>Plate movement has caused uplift – add 2 units.</p>
--------------------	--

Geological Process	<p>Geologists have just discovered ancient evidence that your area was uplifted. Add 5 units.</p>
--------------------	---

Geological Process	<p>Avalanche caused a huge area to move down the mountain. Remove 3 units.</p>
--------------------	--

Geological Process	<p>A huge plate movement caused immediate uplift. Add 10 units.</p>
--------------------	---

Geological Process	A large area uplifted and formed a plateau (or mesa). Add 3 units.
--------------------	---

Geological Process	Earthquake Card A 2.2 earthquake caused rockslides. Remove 2 units.
--------------------	--

Geological Process	An ancient glacier moved through your mountain causing a U shaped valley. Remove 2 units.
--------------------	--

Geological Process	Two plates are moving away from each other creating a valley. Remove 3 units from mountain.
--------------------	---

Geological Process	Two plates are pushing together creating a higher mountain. Add 2 units.
--------------------	--

Geological Process	Bonus Card (10 units) Because you understand earthquakes, volcanoes and uplift cause a mountain to get bigger.
--------------------	--

Geological Process	Earthquake Card A 1.2 earthquake caused very little uplift. Add 1 unit to your mountain.
--------------------	---

Geological Process	A river cut between mountains forming a V-shape valley. Remove 2 units.
--------------------	--

Geological Process	Avalanche reported. Erosion happened. Remove 2 units.
--------------------	---

Geological Process	Wind erosion has been removing soil from the top of the mountain. Remove 1 unit.
--------------------	---

Geological Process	A large area uplifted and formed a plateau (or mesa). Add 3 units.
--------------------	---

Geological Process	Earthquake Card A 2.2 earthquake caused rockslides. Remove 2 units.
--------------------	--

Geological Process	An ancient glacier moved through your mountain causing a U shaped valley. Remove 2 units.
--------------------	--

Geological Process	Two plates are moving away from each other creating a valley. Remove 3 units from mountain.
--------------------	---

Geological Process	Two plates are pushing together creating a higher mountain. Add 2 units.
--------------------	--

Geological Process	Bonus Card (10 units) Because you understand earthquakes, volcanoes and uplift cause a mountain to get bigger.
--------------------	--

Geological Process	Earthquake Card A 1.2 earthquake caused very little uplift. Add 1 unit to your mountain.
--------------------	---

Geological Process	A river cut between mountains forming a V-shape valley. Remove 2 units.
--------------------	--

Geological Process	Avalanche reported. Erosion happened. Remove 2 units.
--------------------	---

Geological Process	Wind erosion has been removing soil from the top of the mountain. Remove 1 unit.
--------------------	---

Geological Process	A large area uplifted and formed a plateau (or mesa). Add 3 units.
--------------------	---

Geological Process	Flash Flood – water removed soil. Remove 2 units.
--------------------	---

Geological Process	Tectonic forces are causing your mountain to uplift. Add 2 units.
--------------------	--

Geological Process	No weathering, erosion, or uplift has taken place. Your mountain does not change.
--------------------	---

Geological Process	Two plates are pushing together creating a higher mountain. Add 5 units.
--------------------	--

Geological Process	No weathering, erosion, or uplift has taken place. Your mountain does not change.
--------------------	---

Geological Process	Deposition Card Several rivers have carried soil down the mountain from a river. Remove 2 units.
--------------------	---

Geological Process	No weathering, erosion, or uplift has taken place. Your mountain does not change.
--------------------	---

Geological Process	Deposition Card Several rivers have carried soil down the mountain from a river. Remove 2 units.
--------------------	---

Geological Process	Rock samples show that mountain folding has taken place. Add 2 units.
--------------------	---

