Stokes Nature Center

Fantastic Forces

Teacher Post-visit

Target Grade: **5**
Science Standard 2: **Students will understand that volcanoes, earthquakes, uplift, weathering, and erosion reshape Earth's surface.**

Objective: Students will:
1. Research geologic features in Utah
2. Determine what forces created those features
3. Create a poster about the feature and how it was made

Materials: Web resources listed, school library books on Utah geology
Posterboard/large paper, markers, crayons

Time: Research: 1 - 2 class periods
Poster creation: 1 - 2 class periods
Presentation: 1 class period

Resources:

Lehi F. Hintze. 1988. Geologic History of Utah, A Field Guide to Utah's Rocks. Brigham Young University Geology Studies, Special Paper 7..
http://www2.nature.nps.gov/geology/parks/bystate.cfm#ut
http://opie.usu.edu/%7Esharohl/nutgeol.html
http://cc.usu.edu/~sharohl/FT3.html
http://cc.usu.edu/%7Esharohl/uthist.html

Lesson Plan:

Assign or have the students choose a geologic feature in Utah (see suggested locations and resources on following pages). You can have students work independently or in groups. Students should research:

1. how the feature was formed (uplift, volcanism, wind erosion, water erosion, weathering, etc.)
2. when it was formed
3. the names of the rocks (e.g. sandstone, limestone, granite) and what type of rocks they are (igneous, sedimentary, metamorphic)

Then, students will create a poster including an illustration of the feature, and a description of when and how it formed, including the different forces that combined for its formation (uplift, earthquakes, wind erosion, water erosion, weathering, volcanoes), and the names and types of rocks found in the formation.

Once the posters are done, students can present their work to each other, and hang the posters for display in the classroom or hallway.

Possible features/resources:

1. National Park geology described on this link for parks listed below:

http://www2.nature.nps.gov/geology/parks/bystate.cfm#ut

Arches National Park
Bryce Canyon National Park
Canyonlands National Park
Capitol Reef National Park
Cedar Breaks National Monument
Dinosaur National Monument
Glen Canyon National Rec. Area
Golden Spike NHS
Hovenweep National Monument
Natural Bridges National Monument
Rainbow Bridge National Monument
Timpanogos Cave National Monument
Zion National Park

2. Cache Valley/Logan Canyon/Bear Lake features listed below described at : http://cc.usu.edu/~sharohl/FT3.html (GEOLOGIC FIELD TRIPS IN NORTHERN UTAH: A WEB RESOURCE FOR EDUCATORS)

Logan Canyon
Bear Lake
Tony Grove Lake
Lake Bonneville benches/shoreline
Wellsville Mountains
Bear River Mountains.

For more general northern Utah geology information, see http://opie.usu.edu/%7Esharohl/nutgeol.html

Background Information

This information below, from http://cc.usu.edu/%7Esharohl/uthist.html gives a brief overview of Utah's geologic history. Where *Image* or other underlined word is indicated, it can be viewed by going to the original text on the above link.

Lehi Hintze of Brigham Young University has divided the last 1 billion years of Utah's geologic history into the six stages shown below (Hintze 1988). Although our modern landscape (valleys, benches, surrounding mountains) is the result of relatively recent processes, the rocks comprising the landscape possess a highly varied history.

Six Stages in the Geologic History of Utah

(refer to the Geologic Time Scale for approximate ages of the time intervals noted below)

I Quiet Shallow-Water Marine Conditions
Late Precambrian through Devonian (1,200 - 350 my)

Utah was located near the equator and covered by shallow seas. Initially sandstones were deposited, followed by shales, then limestones and dolostones. Superimposed on this pattern of quiet sedimentation were several advances and withdrawls of the sea, resulting in the stacking of various rock pages (e.g. sandstone, shale, limestone, shale). Rocks deposited in this interval are visible in Ogden, Box Elder and Logan Canyons (Image, Image). Many of these rocks are quite fossiliferous.

II Formation of Domes and Basins
Mississippian through Early Triassic (350 - 200 my)

During this interval broad uplifts (domes) and depressions (basins) were formed, including the Oquirrh Basin in northcentral Utah and the Paradox Basin to the south. Basins are usually characterized by very thick sedimentary sequences since there is space for sediments to accumulate. The very thick (20,000') thick Oquirrh Formation visible in Provo Canyon is a good example of this. The majority of the rock types were still shallow marine.

III The Sevier Orogeny
Jurassic through Cretaceous (200 - 80 my)

This was a major orogenic (mountain building) event caused by North America moving westward and colliding with the Pacific Ocean plate. Large sheets of rock (thrust sheets) were moved from west to east (up to 50 km or more). For example Cache Valley is located on the Willard thrust sheet, which is a separate thrust from that underlying the Ogden Valley. Considerable folding also occurred, such as the Logan Syncline in Logan Canyon and the "Z" fold in Ogden Canyon (Image) .

Rocks deposited during this interval include both marine and nonmarine rocks. The Jurassic age Navajo, Entrada, and Morrison Formations are good examples of the latter. The Navajo was deposited as windblown desert sand dunes (Image). These are well exposed in Zion Canyon National Part. The Morrison is famous for its dinosaur fauna and can be viewed at Dinosaur National Monument (Image). During the Cretaceous Period much of the coal mined in eastern Utah was deposited in deltaic and lagoonal conditions.

IV The Laramide Orogeny
Cretaceous through Paleocene (80 - 40 my)

The Laramide was a continuation of the earlier Sevier Orogeny. The deformation shifted further east, resulting in the uplift of the Uinta Mountains (Image) and Colorado Rockies. Sediments were deposited in the basins between the uplifts. These post-Laramide basin fills include the Wasatch and equivalent formations, which are usually a bright red conglomerate (Image) (visible above Tony Grove Lake in Logan Canyon and on I-80 east of Ogden), and the Green River Formation, which was deposited in a very extensive freshwater lake. The Green River Formation is famous for fossil fish, insects and plants, many of which are on display at Fossil Butte National Monument in Kemmerer, Wyoming (Image, Image).

V Acidic Volcanism
Oligocene (40 - 25 my)

Eventually the westward movement of the North American Plate resulted in the overriding of the Pacific spreading center. This resulted in partial melting of the crust and extensive volcanism

occurred. Extensive welded tuffs covered much of the area of Utah. Remnants are visible at Crystal Peak (Image) and Topaz Mountain. There were also granitic intrusions, for example the Little Cottonwood (Image) and Bingham Stocks (Image), which are the basis for Utah's mining industry.

VI Extension and Basic Volcanism
Miocene through Recent (25 - 0 my)

Over the last 15 million years the western United States has experienced both uplift and tensional (pull-apart) forces. This is due to the presence of a spreading center beneath us. This has resulted in the uplift of the Colorado Plateau and associated canyon cutting - for example, Zion (Image) and Bryce Canyons (Image), Canyon Lands (Image). Another consequence of the tensional forces is the development of the Basin and Range Province, which consists of a series of fault-bounded mountains and valleys extending from Utah to California. The Wasatch Fault (Image) is due to these tensional forces.

The style of volcanism shifted from welded tuffs and granitic intrusions to the formation of cinder cones (Image) and basaltic flows (Image).

Finally, during the last several hundred thousand years, Utah experienced the Pleistocene ice age. This resulted in alpine glaciation (its effects are beautifully exposed in Little Cottonwood Canyon - Image) and extensive lakes (collectively referred to as Lake Bonneville). The lake was quite deep (up to 1,000' deep in the Salt Lake valley), filling our valleys up to the 5,100' level and resulting in the familiar shoreline "benches" that are so desirable for home building (Image).