Physical Systems

The physical environment provides the backdrop for Earthly human activity. The physical systems create, maintain, and modify Earth's features. Knowledge of these processes, how they change and how they work, can influence people's decisions about where they live, work, travel, and even what they eat. This video demonstrates one way that geographers get their data and study physical systems.

Video 4.1: NASA Earth Right Now,

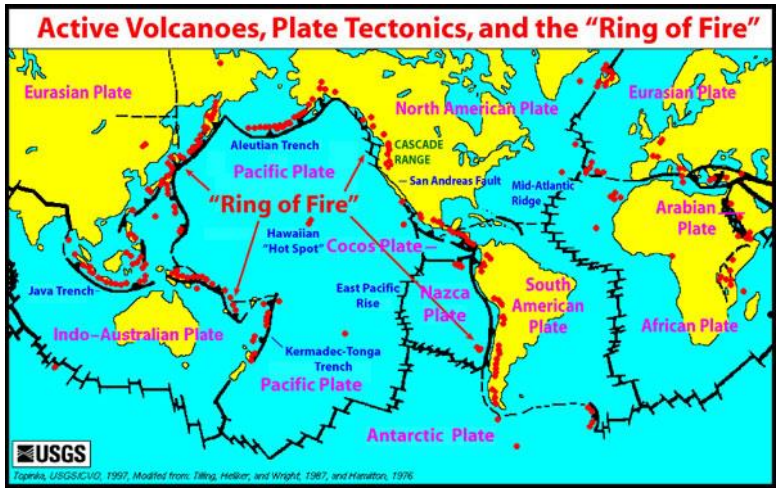
https://www.youtube.com/watch?v=wYho0LhUw3M&list=PLiuUQ9asub3SOdRC7ZHR8ocKHUcjlwtGW%3Fwmode%3Dopaque

This video portrays NASA's goal to understand the physical earth in which we live.

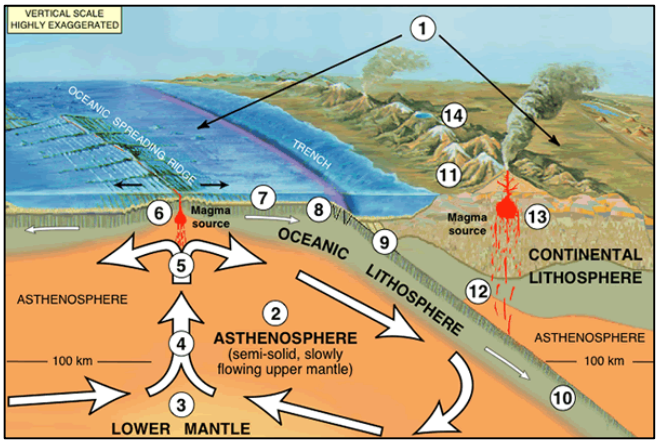
Introduction

Our earth is a dynamic place – constantly building and rebuilding itself. The landscape of the earth is being altered both by our presence and by the processes, which created the landscape in the first place. The shifting of the cultural landscape is easy to see, as human activities tend to be rather fast-paced. But the physical landscape is shifting, as well. These processes include movements of the earth's crust from the colliding and shifting of tectonic plates, volcanic activities creating and destroying land, and erosion from wind, water, ice, and waves. Many of these shifts are often difficult for us to perceive as they take place on a geologic rather than human time scale.

At times, these changes are dramatic and sudden. We tend to view these events as disasters, rather than as necessary changes in the earth's physical systems. Volcanic eruptions can cause devastating loss of life and property. In addition, the gas and ash they expel into the atmosphere can alter weather patterns thousands of miles away. In the Ring of Fire, located in the Pacific Ocean, several tectonic plates meet and create the most active volcanoes on Earth. As oceanic plates slide under continental plates, such as along the western coast of the US or the eastern coast of Japan, the edges of the oceanic plate heat and melt. This newly melted material rises to the surface, creating volcanic arcs like the islands of Japan or volcanic mountain chains like the Cascades. Over time, the solidified lava breaks down and mixes with decaying plant material to form some of the richest soil on earth.



Other times, changes in our earth's surface are excruciatingly slow. Mountain building, canyon carving, and glacial valley forming processes take millions of years. We may not have been around to see the glaciers that covered large parts of North America, but we depend upon the lakes they left behind for transportation, food, and water supplies. States without glacial pasts have to resort to dam building in order to artificially create what the glaciers left in other places. Mountains provide us with metals and other minerals which we need for everything from building skyscrapers to powering our homes. Finally, canyons, such as Bryce, Zion, and the Grand Canyon, attract tourists from around the world generating income in areas with little other potential for economic growth.



Teaching Physical Systems can be difficult for many geography/social studies teachers. First, few of us have had extensive training in Physical Geography, Geology, or other Earth Sciences. Second, as you will see in the state standards below, few of our courses in upper elementary or middle school have standards that cover physical systems at all. What you will find is that the standards covering the material in this module are often found just down the hall in your students' science classes. Physical systems can provide an excellent opportunity for cross-curricular study between social studies and science. In order to facilitate this, we have provided the Science TEKS for each grade level, which apply to the content of this module. This module also provides an excellent place to remind your students that geography is more than a social science – many geographers, especially physical geographers, are scientists who study geologic processes hand in hand with geologists. Finally, teaching Physical Systems gives us an opening to reach students who may feel they prefer science to social studies.

A Case Study: The Colorado Plateau

The Colorado Plateau is a particularly fascinating region of the United States. Shaped by a wide variety of the processes, the Colorado Plateau incorporates some of America's most scenic landscapes, including the Grand Canyon and Bryce Canyon National Parks. These areas well known for their majestic beauty, are some of the most visited areas in our country drawing visitors from around the globe.

The Colorado Plateau was formed millions of years ago, and is continually being subjected to creative and destructive forces. As a result, the landscape of the Plateau is constantly changing. The plateau is approximately 140,000 square miles and covers areas within four states – Colorado, Utah, Arizona, and New Mexico. The plateau is a high crustal block. Over millions of years, the area experienced cycles of uplifting, volcanic activities, and the presence of warm shallow seas. As these constructive processes wound down, the destructive processes have taken over – various types of erosion and weathering have shaped much of the area.

Sedimentary layers

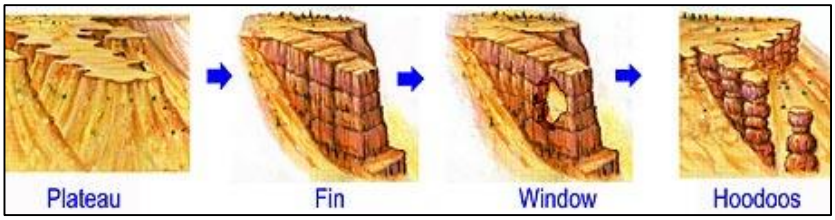
Sedimentary layers are easy to see. Evident in uplifting and faulting, the layers are tilted in various directions.

Rivers

Powerful rivers formed massive canyons through chemical weathering, physical weathering, and erosion.

Hoodoos in Bryce Canyon

One of the more interesting regional features are the hoodoos. Hoodoos are skinny rock towers that rise above basins. They are formed though frost wedging when water accumulates in rock cracks and crevices, then freeze. The slight acidity in the rain dissolves some of the rock, shaping the hoodoos.



Arches in Arches National Park

Arches are another unique feature of the region. They are made of very porous sandstone. Salt domes formed beneath the surface, bulged upwards, and created cracks. Rainwater dissolves the porous layers and collects along the tops of the impervious layers subjecting the layer to frost wedging.

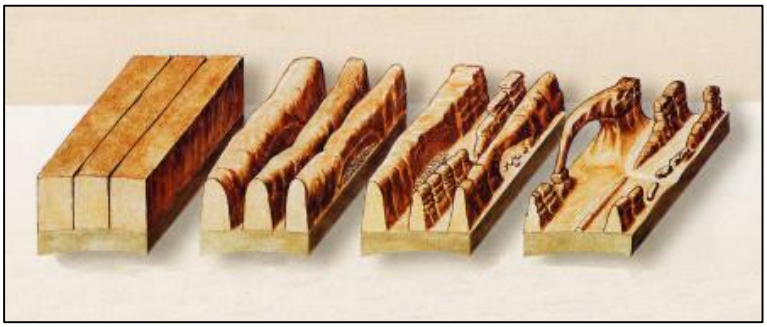


Figure 1 Photo by Ken Crane; Text Reference and Graphic: National Park Service http://www.nps.gov/arch/naturescience/geologicformations.htm

Ecosystems & Biomes

The plateau lies in the rain shadow of the Sierra Nevada. As a result, the climates found here are mostly desert and semiarid – with some alpine areas. The climates and high elevation mean that vegetation is sparse. The plants and animals which live in this environment have adapted to living with limited and sporadic supplies of water. For example, many of the animals in this area are nocturnal. Moving around only at night helps them conserve energy and keeps them cooler than movement during the day.

Unique Soil Colonies

Arches National Park and the surrounding areas are home to biological soil crust. It is a combination of cyanobacteria, lichens, mosses, green algae, microfungi, and other bacteria. The bacterial colonies bind the soil together and help prevent erosion – even after they die.

http://www.nps.gov/arch/naturescience/soils.htm

The Issue: Roped Activities in Moab

Both Gemini Bridges and Corona Arch are outstanding geologic formations in spectacularly scenic settings at the end of hiking trails. Both features have been very popular destinations for hikers, sightseers and photographers for many years. It is estimated that 40,000 people visit Corona Arch and 50,000 people visit Gemini Bridges each year. Both geological features, but especially Corona Arch, are among the most often photographed sites on Bureau of Land Management lands. In recent years, however, Gemini Bridges and Corona Arch and their vicinities have been utilized by a small number of visitors engaging in Roped Activities. This had led to a number of complaints from the public about the Roped Activities diminishing the experience of hikers, photographers and sightseers.

Visitors approach the two arches by a foot trail that is approximately 1.5 miles long. As hikers round the last corner on the trail, Corona and Bowtie arches suddenly appear in a spectacular setting. There is often an atmosphere of quiet reverence on the part of visitors as they grasp the enormity of the view.

Corona Arch

Very few reports of Roped Activities on the arch were received prior to the posting (February 15, 2012) of a YouTube video entitled "World's Largest Rope Swing". In January of 2013, the State of Utah forbade commercial outfitters from rope swinging on Corona Arch, although private use of the arch for rope swinging was not disallowed. Roped activities in the rock bowl containing the two arches occur with some regularity, although the number of visitors engaging in these activities is estimated to be small. It is not uncommon that there is shouting or screaming that accompanies engagement in the Roped Activities.

There have been reported conflicts between hikers and people engaging in Roped Activities over the past few years. The most notable of these conflicts involved a permitted group (Adventure Rabbi) that was authorized to have Passover under the arch, but was impeded by the presence of a group of people utilizing the arch for rope swinging. This incident was investigated by the Grand County Sheriff's Department. On March 24, 2013, a man was killed while swinging on the arch in view of 70 people, including many children. Another man was severely injured while swinging on Corona Arch in May of 2014, again in view of many visitors.

Gemini Bridges

Highlining between the two rims of the canyon containing the Gemini Bridges is the primary rope activity that occurs in this location. Also occurring in this location is rappelling through the bridges as well as ziplining from canyon edge to under the bridges. It is estimated that a very small number of people engage in these activities. These types of activities are fully visible from the bridges. Visitors have also expressed concerns about the impacts to the rock from bolts, hardware and the scars made by the rope on the rock surface.

https://www.blm.gov/ut/enbb/files/Corona.Gemini_Temp_Restriction_EA_w_maps_-_08252014.pdf

Questions

A temporary restriction of roped activities is being proposed while the Bureau of Land Management conducts an Environmental Assessment to analyze the impacts of restricting the roped activities.

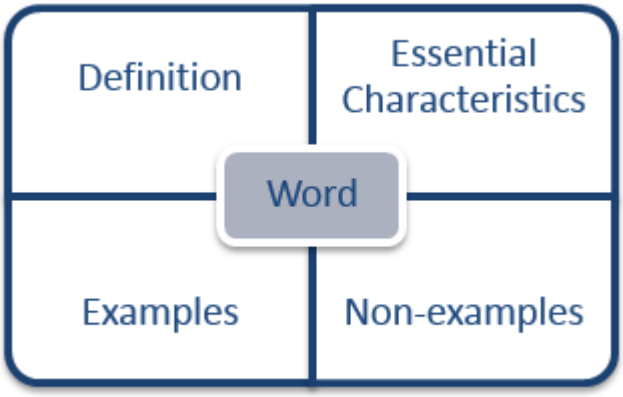
- What public comment would you make? (Appendix A in the above pdf includes a Checklist for reference or additional information)
- What are the pros and cons?
- Where is there an example of recreation activities affecting the physical landscape in your community?
- What measures are taken to protect the physical environment?

Instructional Strategy: Vocabulary Square/Modified Frayer Model

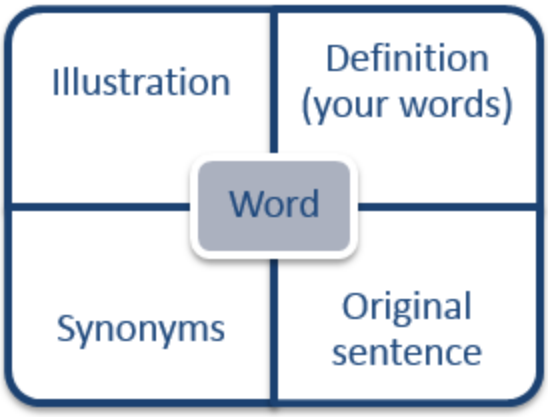
The instructional strategy highlighted with this module focuses on vocabulary development. Vocabulary is especially problematic when teaching physical systems. Many of the terms are specialized words your students may not understand. As we build our students' geographic vocabulary, it is essential that we help our students understand the words well enough to incorporate them into their own academic vocabulary – enough that they begin to feel comfortable using the words in their own writing. The Vocabulary Square/Modified Frayer Model as described below is one way to move our students' understanding of a word from knowledge to application level.

Vocabulary Square/Modified Frayer Model – Developing a strong vocabulary is critical to student success in geography and its specialized vocabulary. Simply copying definitions does not help most students recall those definitions later, and it rarely helps the students move beyond knowledge level of the word to being able to apply the word in their own studies of geography. One of the strategies used in the lessons in this model help students develop their vocabulary skills. The Reading Educator (http://www.readingeducator.com/strategies/frayer.htm) has a thorough description of how a Frayer Model is used.

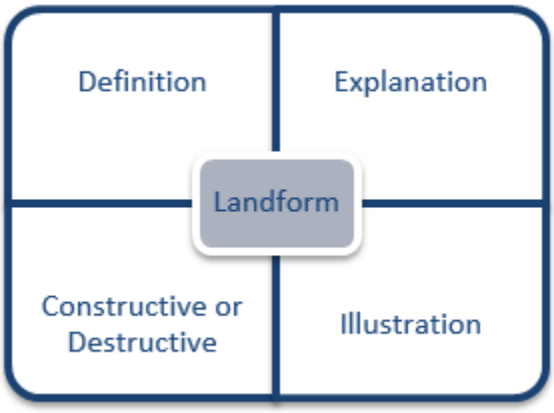
The standard matrix for a Frayer Square:



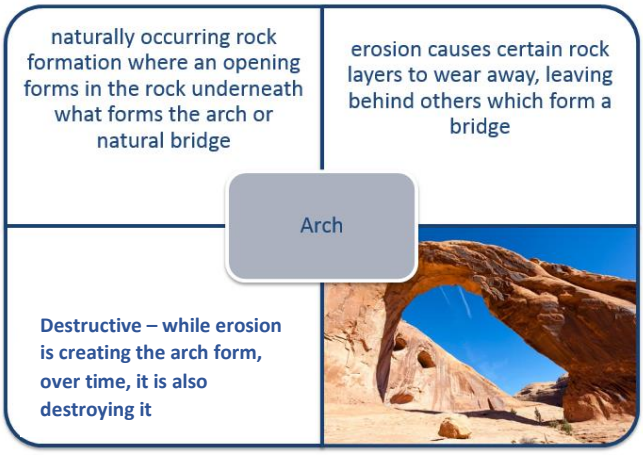
A vocabulary square uses the same matrix, but the categories are a bit different:



Modified Frayer Model:



The students will define the landform in the top left hand corner. In the top right hand corner, they will explain how the landform was created. In the bottom left, the students will state whether the processes which created the landform are constructive or destructive and in the bottom right, they will draw or place an illustration of the landform. The name of the landform goes in the center.



This method of vocabulary development is used in a variety of ways within the geography classroom. In a study on regions, the region name goes in the center, with a map, a description, type of region (formal/functional/perceptual or physical/cultural), and major defining characteristics in the surrounding boxes. Below are additional examples:

- City name: map and/or photo, human characteristics, physical characteristics, similar cities or cities within the same region/ connected cities,
- Country name: similar to cities, include global connections
- Concepts: use the standard Frayer Model, but combine definition and characteristics, and include an example, illustration or map

Instructional Materials

The lessons provided in this module come from different sources. The 6th grade lesson, *Lotsa Landforms*, was written especially for this module and provides students with a brief introduction to how landforms are created. The lessons for the other grades come from the Environmental Protection Agency on teaching students about groundwater and from National Geographic on landforms in the United States. The Additional Resources page has links to additional maps, diagrams, and lesson plans.

Download Instructional Materials and Resources