**Soil & Erosion -**
**A River Bend Nature Center Field Study**

**Grade Level:** 5th

**Length of Lessons:**
Intro: 15 min
Field Stations: 65 min (approx. 10-15 min at each station)
Conclusion: 10 minutes

**Objectives:**
Students will:
1. Identify erosion and weathering as processes that change the landscape.
2. Identify limestone, shale, and sandstone as sedimentary rock.
3. Make observations about the different layers of soil.
4. Explain how erosion and weathering transform rocks into soil.

**Minnesota Academic Science Standards**
5.3.1.2.1 – Explain how, over time, rocks weather and combine with organic matter to form soil.
5.3.1.2.2 – Explain how slow processes, such as water erosion, and rapid processes, such as landslides and volcanic eruptions, form features of the Earth's surface.

**AAAS Project 2061 Benchmarks**
4C/E1 – Waves, wind, water, and ice shape and reshape the earth's land surface by eroding rock and soil in some areas and depositing them in other areas, sometimes in seasonal layers.
4C/E2 – Rock is composed of different combinations of minerals. Smaller rocks come from the breakage and weathering of bedrock and larger rocks. Soil is made partly from weathered rock, partly from plant remains—and also contains many living organisms.

**Core Knowledge Sequence for Science**
N/A

**Materials**
Intro – Soil layers poster
Field study – soil layers: 1 bucket w/ water, 1 water scoop, jars for each pair, dry erase marker, and shovels; 2 soil corer, measuring tape (1 for each group), student worksheets, laminated reference sheets, clipboards & pens
Conclusion – none

**Location**
Intro/ Conclusion – Trailside classroom
Field Study – outdoor classroom, Sandstone off Trout Lily Trail, Limestone Quarry, Glacial Granite Rock

**Background Information**

***Sedimentary rocks*** are types of rock that are formed by the deposition of material at the Earth's surface and within bodies of water. Sedimentation is the collective name for processes that cause mineral and/or organic particles (detritus) to settle and accumulate or minerals to precipitate from a solution. Particles that form a sedimentary rock by accumulating are called sediment. Before being deposited, sediment was formed by weathering and erosion in a source area, and then transported to the place of deposition by water, wind, ice, mass movement or glaciers which are called agents of denudation.

Limestone can be formed by the chemical precipitation of carbonates dissolved in aqueous solution. A common test for identifying limestone and other calcite/carbonate containing rocks is immersion in household acids (Vinegar or Lemon Juice) and observation of fizzing up of carbon dioxide.

The sedimentary rock cover of the continents of the Earth's crust is extensive, but the total contribution of sedimentary rocks is estimated to be only 8% of the total volume of the crust. Sedimentary rocks are only a thin veneer over a crust consisting mainly of igneous and metamorphic rocks. Sedimentary rocks are deposited in layers as strata, forming a structure called bedding. The study of sedimentary rocks and rock strata provides information about the subsurface that is useful for civil engineering, for example in the construction of roads, houses, tunnels, canals or other constructions. Sedimentary rocks are also important sources of natural resources like coal, fossil fuels, drinking water or ores.

The study of the sequence of sedimentary rock strata is the main source for scientific knowledge about the Earth's history, including palaeogeography, paleoclimatology and the history of life. The scientific discipline that studies the properties and origin of sedimentary rocks is called sedimentology. Sedimentology is both part of geology and physical geography and overlaps partly with other disciplines in the Earth sciences, such as pedology, geomorphology, geochemistry or structural geology.

***Metamorphic rocks*** arise from the transformation of existing rock types, in a process called metamorphism, which means "change in form". The original rock (protolith) is subjected to heat and pressure, (temperatures greater than 150 to 200 °C and pressures of 1500 bars) causing profound physical and/or chemical change. The protolith may be sedimentary rock, igneous rock or another older metamorphic rock.

Metamorphic rocks make up a large part of the Earth's crust and are classified by texture and by chemical and mineral assemblage (metamorphic facies). They may be formed simply by being deep beneath the Earth's surface, subjected to high temperatures and the great pressure of the rock layers above it. They can form from tectonic processes such as continental collisions, which cause horizontal pressure, friction and distortion. They are also formed when rock is heated up by the intrusion of hot molten rock called magma from the Earth's interior. The study of metamorphic rocks (now exposed at the Earth's surface following erosion and uplift) provides information about the temperatures and pressures that occur at great depths within the Earth's crust. Some examples of metamorphic rocks are gneiss, slate, marble, schist, and quartzite.

***Igneous rock*** (derived from the Latin word *ignis* meaning fire) is one of the three main rock types, the others being sedimentary and metamorphic rock. Igneous rock is formed through the cooling and solidification of magma or lava. Igneous rock may form with or without crystallization, either below the surface as intrusive (plutonic) rocks or on the surface as extrusive (volcanic) rocks. This magma can be derived from partial melts of pre-existing rocks in either a planet's mantle or crust. Typically, the melting is caused by one or more of three processes: an increase in temperature, a decrease in pressure, or a change in composition. Over 700 types of igneous rocks have been described, most of them having formed beneath the surface of Earth's crust.

A ***glacial erratic*** is a piece of rock that differs from the size and type of rock native to the area in which it rests. "Erratics" take their name from the Latin word *errare*, and are carried by glacial ice, often over distances of hundreds of kilometres. Erratics can range in size from pebbles to large boulders such as Big Rock (15,000 metric tons / 17,000 short tons) in Alberta.

Geologists identify erratics by studying the rocks surrounding the position of the erratic and the composition of the erratic itself. Erratics are significant because:

- Since they are transported by glaciers, they are one of a series of indicators which mark the path of prehistoric glacier movement. Their lithographic origin can be traced to the parent bedrock, allowing for confirmation of the ice flow route.

- They can be transported by ice-rafting. This allows quantification of the extent of glacial flooding resulting from ice dam failure which release the waters stored in proglacial lakes such as Lake Missoula. Erratics released by ice-rafts that were stranded and subsequently melt, dropping their load, allow characterization of the high water marks for transient floods in areas like temporary Lake Lewis.
- Erratics dropped by icebergs melting in the ocean can be used to track Antarctic and Arctic-region glacial movements for periods prior to record retention. Also known as "dropstones", these can be correlated with ocean temperatures and levels to better understand and calibrate models of the global climate.

An ***esker*** is a long narrow mound of material (as sand or gravel) deposited by a stream flowing on, within, or beneath a melting glacier. Eskers are frequently several kilometres long and, because of their peculiar uniform shape, are somewhat like railway embankments.

**Prior to visiting River Bend (for teachers)**
*Before your visit, please review with your students:*

- Basic principles of scientific investigation
- Types of rocks: igneous, metamorphic, and sedimentary
- Introduce the terms: weathering, erosion
- Importance of dressing for the day's weather conditions

**Extensions/Resources (for teachers)**

- Geological Society of America, Resources for K-12 Earth Science Educators http://www.geosociety.org/educate/resources.htm
- USGS Education Resources for Teachers http://education.usgs.gov/docs/USGSEducResources.pdf

**References**

Wikipedia – the Free Encyclopedia