

## Coppell Nature Park Geology Kit Lessons

### First Grade Geology Lessons

#### Title: Soil Sorting

- **TEKS 1.7A** - observe, compare, describe, and sort components of soil by size, texture, and color
- **Essential Question:** How do different types of soil compare?
- **Background Information:** First grade students use their observational skills to sort and classify a variety of different substances throughout the year. Applied to soil types, students will generally be observing smaller sizes of particles than previously. The use of hand lenses and sieves as tools will help in this process. As students draw and label what they observe (in science journals, generally) we remind them to use the A, B, C, D's of drawing: Accurate, Big, Colorful, and Detailed. Even though the TEKS indicate "soils", this is meant to include pebbles, gravel, sand, silt, clay as well as potting soil, humus, or compost. First grade students in Coppell ISD also use a kit-based science program (FOSS) through which they will have studied Pebbles, Sand, and Silt. A nice extension at the Coppell Nature Park would be to use CNP soils, including small fossils.
- **Materials:** Provide samples of gravel, pebbles, sand, and soils from various locations, including samples from the Coppell Nature Park.
- **Procedures:** Students use sieves and magnifiers to sort and describe properties of each type of soil. You might begin by giving students a pile of mixed soils, then have them use stacked sieves of various screen sizes to sort the particles into different piles. Next, have students carefully observe the properties of each pile using magnifiers such as hand lenses and draw detailed drawings in their journals indicating the name and comparative sizes of each of the soil types. Work together to give each type of soil particle (pile) a name, such as: sand, gravel, etc.
- **Assessment:** when given a small sample of mixed particle sizes, students can correctly place each particle in the correct pile.
- **Reflection:** Students answer the essential question within their science journals, "How do different types of soil compare?"

#### Title: Sedimentation

- **Learning Target:** Observe and describe sediment transport and sorting in creek and/or settling tube.
- **Essential Question:** How do rivers and creeks carry rock particles of different sizes?
- **Objective:** Observe how river systems transport sediment and sort it as it gets dropped in temporary deposits along the way during its journey to the sea.
- **Background Information:** Carrying rocks and sediment requires energy, but creeks have high energy during floods and this is when most sediment transport occurs. After floods, creeks lose energy as the water flow diminishes and they begin to drop the sediment, largest and heaviest grain

sizes first and finally, there is not enough energy remaining to hold mud particles in suspension and even the very fine clay particles settle out and the water runs clear. Sediment is transported in streams as Bed Load, Suspended Load and Solution Load. The power of streams varies by the 6<sup>th</sup> Power of its velocity; in other words, as the velocity of a stream doubles, the size of particles that it can carry increases by 64 times. The importance of dissolved sediment transport: The Mississippi River carries 113 Million Tons of dissolved mineral matter to the Gulf of Mexico each year.

- **Materials:** Provide students with sieves, scoops and probe sticks to explore the gravel bars within the creek bed.
- **Procedure:** Students use tools to explore how mud, silt, sand and pebbles are sorted and deposited separately by the creek. Probe sticks can be inserted into the sediment below the water and moved back and forth, releasing very fine mud particles (“River Smoke”) into the water to flow downstream. This same lesson can be presented with a settling tube if a trip to the creek is unavailable: fill the settling tube with water, gravel, sand, silt and fine clay; shake vigorously (this represents flood stage as all particle sizes are carried about), then allow water to calm (this represents post-flood stage) and observe as sediments settle coarsest first and fine clays last.
- **Assessment:** Question the students and evaluate them on their ability to grasp the basic relationship between water flow volume (energy of stream) and sediment load transport capability.
- **Reflection:** After this lesson, students should understand that rivers and streams are very powerful during floods, but can no longer carry sediment loads during low flow / low energy episodes as the water in the stream “clears”.

## Second Grade Geology Lessons

### Title: Rock Sorting

- **TEKS 2.7A** – Observe and describe rocks by size, texture, and color.
- **Essential Question:** How are properties used to classify rocks?
- **Background Information:** Students will not have background into the three types of rocks, but should be able to come up with their own classification schemes based on similar colors, shapes, sizes, or other characteristics.
- **Materials:** Each group will need a pile of mixed types of rocks without labels. Features of the rocks should vary by type, shape, color, and size. Some samples may be minerals.
- **Procedures:** Challenge students to sort rocks and group them according to similar properties, then describe the attributes of each group. Challenge students to break apart their groups and rearrange the rocks into a different set of groups and describe their properties.
- **Assessment:** When given a new rock sample, students are able to place it into one of their existing groups and justify their placement based upon evidence.

- **Reflection:** In science journals, students answer the question: How are properties used to classify rocks?
- **Extension:** If rock and mineral guidebooks are available, next challenge students to use the observed properties of the rocks at their table to identify them by name using information and photos within the guidebooks.

**Title: The Three Major Rock Types**

- **Essential Question:** What are the Three Major Rock Types and how do their different appearances reflect their origin?
- **Objective:** Observe samples of the three major rock types (Igneous, Metamorphic and Sedimentary) and learn to distinguish between them.
- **Background Information:** *Igneous* rock samples represent volcanic activity. Fine-grained igneous rocks represent “lava” that cooled quickly at the surface where crystals didn’t have time to grow. Coarse-grained igneous rocks represent “magma” that never made it to the surface and cooled very slowly deep underground. *Metamorphic* rock samples represent pre-existing rocks of any of the three major groups that have been subjected to extreme pressure and temperature and have responded by recrystallizing. Rocks of this type often display large crystals, which are banded. *Sedimentary* rocks are formed from broken down grains of any pre-existing rock. Sedimentary rocks are named for their grain size: Conglomerate is composed of pebble size grains; Sandstone is composed of sand size grains; Siltstone is composed of silt size grains; and Shale is composed of mud size grains. Limestone, however, represents a chemical composition (Calcium Carbonate), not any particular grain size.
- **Materials:** Sample sets of Igneous, Metamorphic and Sedimentary Rocks.
- **Procedure:** Students hold, inspect, describe and take notes on hand samples of each rock group. :
- **Assessment: Primary evaluation** ... Are students able to separate rock samples into Igneous, Metamorphic and Sedimentary categories? **Secondary evaluation** ... Are students able to grasp that crystal size within Igneous and Metamorphic rocks reflects cooling history, while grain size within Sedimentary rocks reflects energy of deposition. **Final evaluation** ... Are students able to identify common rocks (eg. granite, sandstone, shale) by name?
- **Reflection:** After this lesson, students should recognize that the appearance of a rock gives us much information about its origin and they should be able to use this understanding to discuss a rock’s history in basic terms.

**Third Grade Geology Lessons**

**Title: Soil Components**

- **TEKS 3.7A-** Explore and record how soils are formed by the weathering of rock and the decomposition of plant and animal remains.

- **Essential Questions:** What are the two main components of soil? How are soils classified?
- **Background Information:** Students in third grade would have studied types of soils such as gravel, sand, clay, pebbles, and potting soil. They would most likely not yet have learned about humus or compost or that soil is made from weathered rock as well as decomposed plants and animals.
- **Materials:** compost in various stages of development, angular pebbles, plastic jar with lid, various types of soil including: sandy, loam, sandy loam, clay, silt, clay loam, silty clay, etc. A Soil Texture Triangle chart, small beaker of water, dropper, a Soil Comparative Sizes chart.
- **Procedures:** Show different stages of compost development – dried leaves and grass, partially decomposed leaves and grass, and compost soil. Have students make inferences about how compost forms and how materials within compost can eventually become soil. Have students place small angular pebbles in a plastic jar with a lid and shake until pebbles form “sand” particles. Show various types of soil and explain that soils are made of different combinations of humus (decayed plant and animal remains) and weathered rock, but that the amount of each material varies. Demonstrate how to use the soil particle size and texture analysis charts to classify soils. Pour small amounts of different soils onto small plates. Also give each group a small beaker of water with a dropper.  
Students classify soils using the analysis charts as guides.
- **Assessment:** Draw pictures of each type of soil using the A, B, C, Ds of drawing (accurate, big, colorful, detailed) and label each type based on where it was collected, particle sizes, and texture analysis.
- **Reflection:** Students respond to the following questions in their science journals: What are the two main components of soils and how are soils classified?

**Title: Weathering of Rock**

- **Objective:** To demonstrate that rocks, although appearing to be solid and strong, are actually physically and chemically weak when exposed at the earth’s surface over long periods of time.
- **Background Information:** There are three kinds of weathering: Mechanical Weathering involves breakdown by alternating heat and cold, as well as exposure to wind, water and ice. Chemical Weathering occurs when rain and groundwater containing active chemical agents (carbon dioxide, oxygen and acids) come in prolonged contact with rock and decompose it through dissolution.  
Organic Weathering occurs when rock is exposed to plant and tree roots containing corrosive acids. Once broken down, earthworms swallow earth fragments to extract nutritive organic matter, treat it with their digestive acids, grind it in their gizzards and void it in castings. On an average acre, earthworms break down more than ten tons of earth per year. Prolonged exposure to heat, cold, water, ice and wind weather the rocks and reduce

them to a mantle of rock waste which further breaks down into sediment. When organic material mixes with this rock waste, soil forms. When the rock waste is eroded, it gets carried away by rivers to be re-deposited in the sea. There it will transform into new sedimentary rock.

- **Materials:** Scoops, sieves and magnifying lenses.
- **Procedure:** Visit banks of sediment, which stand high above stream flood level. Scoop out rock fragments, sort the material with a sieve to remove the organics and use a magnifying lens to observe the effects of long term exposure on the rock fragments. A lab experiment can also be conducted wherein a rock sample is repeatedly subjected to heating by fire and then frozen. "Solid" rock will be seen to break down into its composite parts. And finally, the process of weathering can also be demonstrated by visiting old cemeteries and observing the effects of long-term exposure on headstones; many are so weathered that the inscriptions are no longer legible.
- **Assessment:** Question students concerning the "solidity" of rock and the origins of grains of rock waste in soils and stream sediments. Evaluate their understanding of the weathering process. Ask students to identify the components of an exposed soil profile beginning with rock in the creek, rock waste overlying this, subsoil and soil and humus at the forest floor level.
- **Reflection:** At the conclusion of this exercise, students should have gained an understanding that the term "rock solid" is a misnomer and that given the length of exposure through geologic time, forces of gravity, heating, cooling, wind, water and ice will break down all rock surfaces.

#### Fourth Grade Geology Lessons

##### Title: Porosity and Permeability of Soils

- **TEKS 4.7A** – Examine properties of soils, including color and texture, capacity to retain water, and ability to support the growth of plants.
- **Essential Questions:** How do the porosity and permeability of various soil types compare? How might these properties relate to groundwater/aquifers? Oil deposits? Watering the yard? Plant roots?
- **Background Information:** Students in fourth grade will have investigated types of soils based upon texture and composition. Porosity and permeability will be new for them.
- **Materials:** Several soil types, coffee filters (to fit in a funnel), funnels, graduated cylinder to measure water, cup or beaker to collect runoff from funnel, large rocks, sand, transparent container to hold rocks, sand and water, sponge, droppers.
- **Procedures:** Place each of several soil types in a filter-lined funnel. Pour a measured amount of water into each soil and collect the runoff. Demonstrate porosity using large rocks in a large transparent container. Pour in sand to fill in the pore spaces between rocks. Next pour in water to fill in the pore spaces between sand particles. Show a sponge – pore spaces. Introduce the concept of permeability by dripping water onto the sponge – not permeable. Compare by dripping water through rocks in a funnel – permeable. Compare

porosity (by sight) and permeability (by placing soils in filter-lined funnels and pouring water through) of various soils.

- **Assessment:** Provide each group of students the following prompt and have them generate solutions: "There is a problem with standing water on the school grounds for several days after a rain storm. How would you design an investigation to determine what soil type would result in less standing water?" Groups will write their plans on chart paper, then share with the whole class.
- **Reflections:** In science journals, students will answer the following questions: What is the difference between porosity and permeability of soils? How do permeability and/or porosity impact the use of sprinkler systems, the growth of plants, and the formation of aquifers?

**Title: Hydrosphere: Groundwater and Runoff**

- **Objective:** To give students an understanding of Groundwater vs. Runoff (Streams), the volumetric importance of groundwater, and the role it plays in sediment transport.
- **Background Information:** Much of the precipitation falling on the surface of the earth runs off into streams and rivers, but a large percentage of it falls on porous and surfaces, seeps into the ground and becomes groundwater. Groundwater commonly is contained within rocks in the upper 15,000 feet of the earth's crust, but can occur as deep as 30,000 feet. There is enough water within the soil and rocks of the earth's crust to cover the globe to a depth of 100 feet. Streams carry sediment as Bed Load, Suspended Load and Solution Load, although the latter is volumetrically a minor constituent. Groundwater, on the other hand, comes in contact with soluble minerals for long periods of time and is highly charged with dissolved mineral material. When groundwater comes to the surface in springs, much of this mineral content is released as it comes in contact with oxygen and bacteria, but most reaches streams where it contributes the majority of the stream's downstream solution load. The importance of dissolved sediment transport: The Mississippi River carries 113 Million Tons of dissolved mineral matter to the Gulf of Mexico each year.
- **Materials:** Powers of Observation, water sampling containers, means of evaporating water samples in the classroom or lab.
- **Procedure:** This is a lesson designed specifically for the Coppell Nature Park. Step 1, using powers of observation, visit the farthest upstream portion of the creek within Coppell Nature Park (this can be found at the bench along Parish Path that overlooks the creek. Observe the creek at this location and describe the volume of water flowing in the creek. Step 2, move farther downstream to where Hanson Trail crosses the creek in two places and describe the volume of water flowing in the creek here. Next, to understand the importance of dissolved mineral matter within the groundwater, collect and label a water sample from the center of the upstream portion of the creek. Then collect a water sample issuing directly from a spring. Allow the

two water samples to evaporate and observe the sides and bottom of the container for solid residue. Finally, go to a spring and inspect the opening for deposits of precipitating mineral matter.

- **Assessment:** Evaluate students on their understanding regarding volumetric importance of groundwater as observed within the Coppel Nature Park. The increased volume downstream is attributable to groundwater issuing from springs along the creek within the park. Secondly, question them regarding dissolved mineral content within groundwater and the importance of groundwater as a contributor to mineral transport.
- **Reflection:** After this lesson, students should understand two important properties of groundwater: 1) It is volumetrically important, and 2) It is responsible for the majority of the Solution Load of Streams and Rivers.

### **Fifth Grade Geology Lessons**

#### **Title: Sedimentary Rock Formation**

- **TEKS 5.7A** – Explore the processes that led to the formation of sedimentary rocks and fossil fuels.
- **Essential Questions:** What processes are involved in the formation of sedimentary rocks and fossil fuels? How might fossil fuels have formed? Why are fossil fuels considered nonrenewable resources?
- **Background Information:** Students will have used physical properties to sort and classify rocks. They may or may not have learned about the types of rocks: igneous, metamorphic, and sedimentary. The purpose of the TEKS is to focus on sedimentation as well as compaction and cementation as processes involved in sedimentary rock and fossil fuel formation. In most cases, students will not have learned about these processes previously.
- **Materials:** sand, gravel, silt, powdered clay, clear jar with a lid. Small plastic cup, Solution of Epsom salts and water, samples of banded sandstone, samples of shale, oyster shells, plaster of Paris, partially decomposed plants from a compost bin, model of fossil fuels within rock layers.
- **Procedures:** Place small amounts of sand, gravel, silt, and clay in a clear jar with a lid. Add water until almost full. Place lid on jar and shake vigorously. Allow jar to sit undisturbed and watch as the particles settle. After settling – describe the layers observed and infer how they might have formed. Take a sample of sand and place it in a small plastic cup. Add Epsom salt solution and allow the water to evaporate. (The evaporation takes awhile – allow overnight or a few days). Teacher could take samples back to class to evaporate in a windowsill. Compare the simulated sandstone to samples of (banded) sandstone. In another small cup, place silt and powdered clay. Add Epsom salt solution and allow water to evaporate. Compare the simulated shale to samples of (layered) shale rock. In another small cup, combine oyster shell fragments with plaster of Paris solution. Allow mixture to harden. Compare the simulated limestone to real (fossiliferous) limestone.

Show plants in various stages of decomposition within a compost bin and discuss the decomposition process. Connect this process to the formation of fossil fuels (decomposition after rapid burial). Show model of fossil fuel deposits under layers of rock. Connect to ideas of porosity and permeability and why oil and natural gas might become “trapped”.

- **Assessment:** When given samples of sedimentary rocks, groups of students generate stories of how each rock might have formed.
- **Reflections:** Students write in their science journals the answer to the following questions: How might fossil fuels have formed? Why are fossil fuels considered nonrenewable resources?

**Title: Modeling Erosion** (suitable for 4<sup>th</sup> or 5<sup>th</sup> grade)

- **TEKS 4.7B** – Observe and identify slow changes to Earth’s surface caused by weathering, erosion, and deposition from water, wind, and ice.  
5.7B – Recognize how landforms such as deltas, canyons, and sand dunes are the result of changes to Earth’s surface by wind, water, and ice.
- **Essential Question:** In what ways do running water, wind, and glaciers change the shape of landforms?
- **Materials:** Cardboard boxes or plastic bins, sand, hair dryers, goggles, small rocks, plants, stream table, long narrow tray (smaller than stream table). Photos of landforms that were formed by water, wind, or glaciers.
- **Procedures:** Model wind erosion by placing boxes or plastic bins on their sides and adding a layer of sand to the bottom edge. Use a hair dryer to blow “wind” across the sand and watch it move. Be sure to wear **goggles** to protect the eyes! Add small rocks or plants to the sand and repeat the investigation. Form sand into a “dune” and watch what happens in response to the wind. Set up a stream table to model erosion and deposition by running water. Identify the formation of canyons, valleys, sand bars, meanders, and deltas. During the stream table demonstration, point out areas where water is eroding material and where it is depositing material.  
**A few days prior to CNP visit**, place some rocks and sand in a long narrow tray, fill with water, and freeze. This will become a “glacier”. Use the stream table and model glacier to demonstrate the impact of a glacier on the land. Push the glacier over the streambed and watch as it changes a V-shaped valley into a U-shaped valley and forms moraines as well as glacial grooves. You might want to discuss the formation of erratics, kettle lakes and drumlins as well.
- **Assessment:** When given photos of landforms, students will infer whether each landform was most likely the result of erosion by wind, running water, or glaciers.
- **Reflection:** In science journals, students will answer the following reflection question: In what ways do running water, wind, and glaciers change the shape of landforms?

### **Title: Meanders, Sedimentation, Erosion, Fluvial Mechanics, River Floods**

- **Objective:** To understand the ways in which streams erode their channels and transport sediment.
- **Background Information:** Sediment is transported in streams as Bed Load, Suspended Load and Solution Load. The power of streams varies by the 6<sup>th</sup> Power of its velocity; in other words, as the velocity of a stream doubles, the size of particles that it can carry increases by 64 times. The importance of dissolved sediment transport: The Mississippi River carries 113 Million Tons of dissolved mineral matter to the Gulf of Mexico each year.
- **Materials:** Powers of observation, notebooks, scoops and sieves.
- **Procedure:** Within Coppell Nature Park, stand at a place on Marshall Trail where you can look down at the bed of the creek in a place where it bends or curves. This bend or curve is called a “Meander” in Geology. Sketch the meander in your notebook using as much detail as you can, including the location of the water. Which bank of the meander does the water come in most contact with? Mark on your sketch where you see deposition of sediment happening. Mark where you see erosion happening. Continuing to hike along Marshall Trail, do you notice any place where an old meander has been abandoned and now stands high and dry above the creek? Sketch this landform feature and discuss how it got here and why it still exists. If it is safe to go down into the creek channel, use your scoops and sieves to examine the size of sediment grains, sketch this location and mark where coarse and fine sediments have been deposited. Discuss why this distribution of sediment has occurred.
- **Assessment:** Question and evaluate students on their ability to observe and study the creek morphology from a vantage point above and understand where and why erosion and deposition are taking place. Is it apparent to students that sediment transport is more akin to the movements of a frog rather than to those of a fish, and that the sediment load of streams makes many temporary stops on its way to eventual deposition in the sea. Ask students if any part of the sediment load of streams does not act in this way (dissolved mineral matter of the Solution Load does not precipitate along the way, but is carried directly to the sea). Ask students to discuss what happens in the creek channel during times of flood when rushing water fills the channel to the top. When does most sediment transport take place, during times of low water, or during times of flood?
- **Reflection:** At the conclusion of this exercise, students should have an understanding of the workings of a stream and the different behaviors of the three types of sediment load as well as of the morphology of a stream channel. They should also realize that most of the work of a river transporting sediment is done during flood stage.

### **Title: Fossils and Cues to Past Environments**

- **TEKS 5.7D-** Identify fossils as evidence of past living organisms and the nature of the environments at the time using models.

- **Essential Question:** Using cues from shapes and sizes of fossils, what inferences can you make about the different environments that existed here in the past?
- **Materials:** samples of fossils, models of fossils, chart comparing fossils with time periods during which the organisms lived.
- **Background Information:** Index fossils are widely distributed fossils that lived during a narrow range of time. They are useful in determining ages of surrounding rock formations. Fossils can be identified based upon their characteristics. They can also be used to make inferences about the environments of the past.
- **Procedures:** Match fossils and models of fossils to a chart of organisms and when they lived. Conduct research about the water/land areas in Texas during different time periods (possible resource: *The Roadside Guide to Texas Geology*). Make inferences about the environments that existed when each organism lived in this area.
- **Assessment:** Students respond to the following question in their science journals: "According to fossil evidence, what do you infer about the different environments that used to exist in Texas?"
- **Reflection:** Students discuss with partners and/or write in journals ways in which fossils are the key to understanding the past.

**Title: Sedimentation, Fossilization, and Fossil Examples**

- **Objectives:** Study fossils and gain an understanding of what they represent as the remains of life forms from the geologic past and indicators of the local environment during the time of deposition. Gain an understanding of the Geologic Time Scale and the length of time that it represents.
- **Background Information:** Fossils give valuable information regarding local environment during the time that the organism lived and died. Only about 1 in 1 million living organisms becomes fossilized upon death, but those that do provide us with the only information we have regarding depositional environment and age of the surrounding rock as well as the developmental path taken by the organisms themselves as they evolved through geologic time. Coppel Nature Park contains two sets of fossils: The primary set contains Cretaceous marine fossils of 92 million years of age. The most prevalent of this set is the Oyster, *Gryphaea*. The second set is more scarce, but consists of Ice Age fossils of 20,000 years ago. To date, teeth and bones from this set found within the park include Ice Age Deer and Bison.
- **Materials:** Geologic Time Chart. Fossil Identification Guides, particularly those that focus on the Cretaceous Period of North Texas. Scoops and sieves. Sample containers. Magnifying lenses. Footwear that can go in water.
- **Procedure: Step 1)** Go to a low-water creek and explore the gravel bars as well as the creek banks and bottom for fossils. Collect samples of as many different kinds as possible. Materials for step 1: Water shoes, sample containers, magnifying lenses, scoops and sieves. **Step 2)** Take these to a location for study and analysis. Materials for step 2: Notebooks and pencils,

magnifying lenses and/or binocular microscopes, fossil identification guides, Geologic Time Chart. Analyze the fossils that have been collected. Draw them in your notebooks and name and label all anatomical features that you see. Using fossil identification guides, name the fossil at least to the Genus level. Record in your notebook facts about the environment in which the organism lived. Also record the approximate age of the fossil and (by inference) the rock in which it was found.

- **Assessment:** Question students regarding the identification of the fossils collected. Ask them to discuss what information these fossils provide regarding the local environment during the time frame that they lived and died. What information do fossils provide regarding the age and depositional environment of the surrounding rock? Would the rock itself provide this same information without the fossils being present?
- **Reflection:** At the conclusion of this exercise, Students should understand that fossils are not simply interesting artifacts that are fun to collect; they are messengers from the geologic past and they carry valuable information regarding the age and depositional environment of the surrounding rock, information that would not be available without them. Also, studying a particular genus or species collected from rocks of broad ranging ages provides an understanding of how this organism evolved through time and provides an opportunity to accurately date new rock formations on the basis of contained fossils and an understanding of this evolutionary progression.

### Sixth Grade Geology Lessons

#### Title: Rock Classification

- **TEKS 6.10B** – Classify rocks as metamorphic, igneous, or sedimentary by the processes of their formation.
- **Essential Question:** How are rocks classified? What are the characteristic features of igneous, sedimentary and metamorphic rocks?
- **Background Information:**
- First direct students to readers or handouts explaining type of rocks, how they form, and key characteristics of igneous, sedimentary, and metamorphic rocks.
- Give students a pile of unsorted rocks and have them separate the pile into igneous, metamorphic, and sedimentary.
- Use Rock and Mineral Identification books to name each of the samples.

#### Title: Rock Classification, including sub-types

- **Objective:** Demonstrate how study of rock samples yields much information regarding their origin, including cooling history for igneous rocks, degree of exposure to extreme pressure and temperature for metamorphic rocks and water energy of deposition for sedimentary rocks.
- **Materials:** Notebooks and pencils. Rock Identification Guides. Magnifying lenses and/or binocular microscopes.

- **Procedure:** Separate rock samples by grain size, color, outward appearance (for example; banded, layered, homogeneous?). Using magnifying lenses, further study rock samples within each of the groupings that you have created and then further subdivide the rock samples as appropriate. Use your notebooks to sketch the samples and document the rock features that you used to separate the samples into groupings with similar characteristics. Have you identified and separated examples of Igneous, Metamorphic and Sedimentary rocks? If so, turn to your igneous rock samples and separate them by color and then by grain size. Turn to Metamorphic rock samples and separate them according to banding or layering. Next, separate sedimentary rock according to grain size. Take notes and describe reasons for your subcategorizing each sample.
- **Assessment:** Ask students what color of igneous rock tells about its origin. Ask them what mineral size tells us about the origin of igneous rocks. Ask students to describe what information is gained by study of the banding and layering of metamorphic rocks. Ask students to explain why grain size of sedimentary rocks is important.
- **Reflection:** This lesson teaches students that Igneous rocks are categorized and named according to color (an indicator of the chemistry of the magma from which they were derived) and then mineral size (an indicator of the cooling history of the rock; the larger the minerals, the slower the cooling history). They should now be familiar with the igneous rocks Granite, Rhyolite, Gabbro and Basalt. Students should grasp that within metamorphic rocks, banding and layering tell us of the degree of pressure and temperature regimes the rocks have been exposed to and are named accordingly and should be familiar with the metamorphic rocks Gneiss, Schist and Slate. Sedimentary rocks are classified and named according to grain size and composition. Students should now know Sandstone, Siltstone, Shale, Conglomerate and Limestone.

### **Eighth Grade Geology Lessons**

#### **Title: Representing Landforms**

- **TEKS 8.9C** – Interpret topographic maps and satellite views to identify land and erosional features, and predict how these features may be reshaped by weathering.
- **Essential Question:** How do topographic maps and satellite images compare with the landforms they represent?
- **Procedures:** Show models of topographic maps together with the models of the landforms that they represent (such as with Geoblox models). Look at topographic maps (available through USGS) of various locations. Using the map key and a general understanding of contour lines, describe the features of the landforms depicted in the maps. View samples of satellite photographs of famous landforms. Compare these to the topographic maps. Try to match satellite images to topographic maps

and describe what the depicted feature would look like close up. **Linda needs to finish this!**

**Topographic Map of CNP, Brunton Compass, Stereo-paired photos and glasses I will develop this exercise later. I have ordered some educational materials from Brunton.com. The kit will include CD instruction, compasses and exercises for twelve students on how to use a compass and topographic maps. I'll also locate copies of the Topo Sheet that includes CNP. David**

### **High School Earth and Space Science Geology Lessons**

- TEKS ESS.7A
- **Essential Question:** How can we use clues such as fossils, exposed rock layers, unconformities and rock samples to piece together the geologic history of the area making up the Coppel Nature Park?
- **Procedures:** Use fossils of the CNP, maps, photos or rock layers, unconformities, and rock samples along with books about the geology of Texas to piece to together the history of the area now making up the Coppel Nature Park.

### **Cretaceous Geology History of Texas**

- **Essential Question:** How can we use clues such as fossils, exposed rock layers, unconformities and rock samples to piece together the geologic history of the area making up the Coppel Nature Park?
- **Objective:** Use fossils of the CNP, maps, photos or rock layers, unconformities, and rock samples along with books about the geology of Texas to piece to together the history of the area now making up the Coppel Nature Park.
- **Materials:** Powers of observation, scoops, sieves, magnifying lenses, sample bags, fossil identification guides, rock identification guide, notebooks, pencils.
- **Procedure:** Visit Coppel Nature Park and examine the rock in the bed of the creek and collect a small sample for examination in the classroom or lab. Explore for fossils and sketch in your notebook what you find. Collect one sample specimen for examination and identification in the classroom. Continue this process at several locations along the bed and banks of the creek. Explore for and record in your notes any other geologic features that you encounter. In the classroom, carefully examine the rock sample and fossil sample(s) that you have collected. Record detailed notes as your study leads you to identification of the rock type and fossil name. Record in your notes any and all information the rock and fossil identification yield regarding the geologic history of Coppel Nature Park and the surrounding region. Research all information regarding deposition of the rock type and the environmental conditions preferred by living examples of the fossil type.

Write a detailed report of your findings and include an interpretation of the geologic conditions that existed at the time(s) of deposition.

- **Assessment:** Question students regarding the Depositional Environment of the Cretaceous Shale in the bed of the creek. Ask them to discuss the environment preferred by living oysters and by any other fossil type they may discover. Did they deduce that an ocean existed at this location at the time of deposition? Did they go further to understand that the water was deep and quiet (of low energy)? Did they note the dark color of the shale being indicative of high organic content (This is the Eagle Ford Shale and it is a producing oil reservoir in other parts of Texas). Did they discover an unconformity at the upper surface of the shale? 92 million years of earth history is missing at this surface. Did they explore the younger sediment in the banks of the creek? This is Ice Age river deposited sediment of only 20,000 years of age and it has yielded Ice Age deer and bison fossils from within Coppell Nature Park. Did they note the location of natural springs along the unconformity surface? Most of the water volume within the creek comes from springs (except, of course, during flood stage).
- **Reflection:** The Geologic Features present within Coppell Nature Park yield information regarding the most recent 300 million years of Geologic History of the earth, beginning with Pangaea and extending through the breakup of the continents, the opening of the Atlantic Ocean, the time of dinosaurs and finally the Ice Age. How much of this did the students deduce and understand from their study of the rocks and fossils within Coppell Nature Park?