

KNOW YOUR ROCKS

MIDDLE SCHOOL

Earth Science TEKS

<i>Sixth Grade:</i>	6.10B
<i>Seventh Grade:</i>	7.8B
<i>Eighth Grade:</i>	8.9C, 8.9B

Vocabulary

elements, erosion, geologist, igneous, limestone, magma, metamorphic, minerals, obsidian, rock cycle, sediment, sedimentary, topographic map, weathering

Pre-Show Activity

Pre-Show Lesson: Rock Cycle

Post this question on the board: “What are the forces that drive the rock cycle?”

Materials:

Per class: a metamorphic rock (marble, slate, schist), a sedimentary rock (sandstone, granite), an igneous rock (basalt, pumice, obsidian), copy of the Rock Cycle Game pages (Appendix A-1), 5 file folders, 5 dice

Per student: Rock Cycle Data Chart (Appendix A-2), Rock Cycle Diagram (Appendix A-3), copy of Rock Clue Cards (Appendix A-4)

Set-Up:

To set up the game, you will need to create five stations: sedimentary, sediment, igneous, metamorphic and magma. Attach a copy of each station’s instructions (using a paper clip) to a file folder. Instructions are provided below. Stand each file folder up at a different location in the room and put a dice in front of it.

Procedure:

1. Show students three rocks: a metamorphic, a sedimentary and an igneous. Ask, "How is it possible that a sedimentary rock can become igneous or metamorphic? Or how can a metamorphic rock become igneous or sedimentary?" Students will discuss this in small groups.
2. Tell students that to answer that question, they are going to become a rock. Students are going to pretend to be a rock and experience the processes that control the rock cycle.
3. Students will choose a station to start at and move through the rock cycle according to the roll of the die and the directions posted at each station. As they move through the cycle, they will need to record their movements on the Rock Cycle Data Sheet.
4. Students will roll the die at the station and record what happened to them in the next column. They will follow the directions on the station card according to their roll. Once they get to the next station, they will continue to record the information for that station. If they stay at that station, they will still record it for the next round.
5. Students are to imagine that 200,000 years have passed between each round. Record this in the time passed column. Students will go a total of eight rounds. Since they are acting as rocks, they should not be talking.
6. When students finish, they will discuss the activity in small groups. How were their travels similar and different from others in their group?
7. Students will create a rock cycle diagram depicting their travels using one color of pencil. Using a second color of pencil, students should show all the different options for travel through the rock cycle that they did not go through.
8. Debrief as a class. Students should understand that moving wind, water and ice cause weathering and erosion which fuel the rock cycle along with heat and pressure from the Earth. Be sure that students understand how the three types of rocks are formed:

Sedimentary: Sediment from erosion is pressed down over time to form rock.

Igneous: The cooling of magma inside Earth's crust is called intrusive igneous. The cooling of magma on top of Earth's crust, volcanoes, is called extrusive igneous.

Metamorphic: When a sedimentary or igneous rock is under extreme heat and pressure, it changes forms into a new rock creating a metamorphic rock.

9. Students will sort the rock clue cards into sedimentary, igneous or metamorphic. You can also use this as a grade (Appendix A-4).

Post-Show Enrichment Activities

Activity One: Rock Classification

Materials: rocks, rock guides, hand lens

Procedure:

Students will act like a geologist and classify rocks.

1. Students will get a variety of rocks.
2. They will use rock guides to try to identify them.
3. Students will explain how they are formed and classify them as metamorphic, sedimentary or igneous.
4. They can make a chart in their science notebook (Appendix A-5).

Activity Two: What Are Minerals?

1. Give students the checklist entitled *Is It Made From Minerals* (Appendix A-6), and tell them to mark the items that they think are rocks. You may need to have pictures of some of the items so they can see what they are.

1. Ask student what the definition of rock and what the definition of mineral is. Discuss in small groups. Students should understand the definition of rocks and minerals listed below.

Rocks

1. solid
2. made of one or more minerals
3. naturally occurring

Minerals

1. solid
2. made of one or more elements
3. naturally occurring
4. have a definite chemical compound and crystal structure.

Activity Three: Recreate the Geological History of Texas

Materials: Students will use the maps and information in Appendix A-7 to complete this activity. Students may work in partners or small groups to complete this.

Procedure:

1. Students will read the geological history of Texas and compare it to the present day tectonic map.
2. On a blank Texas map, students will illustrate the geological happenings in each area. For example, if there was a volcano, they would draw a volcano in that area. If there were oceans, they would draw oceans.
3. Using an overhead transparency placed over their map, students will fill in the rocks that they would expect to see there today based on the geological occurrences (you may want to include illustrating where you would expect to find fossil fuels).

Activity Four: Map Study

Materials: Students can use the map and information in Appendix A-7 to complete this activity.

Procedure:

1. Students will create a T-chart. The left side is labeled “Geological Observations”. The right side is labeled “Explanations”.
2. Students will study the map and write a list of observations regarding elevations and other geological features on the map. If students do not have experience with topographical maps, you may need to explain how to read it first. You may also want to discuss the “Other Features” section on the map key with the students.
3. After students have created an appropriately sized list, give them the *Geological History of Texas* paper and have them try to write an explanation for each geological feature they observed.

A-1

Sedimentary Rock

Roll

1-2

You have been weathered off of a larger rock and are now **sediment**.

3-4

Due to heat and pressure from the Earth, you have changed into a **metamorphic rock**.

5-6

You have been pushed deep into the Earth's crust and have melted into **magma**.



Magma

Roll

Even You have been pushed through a volcano in Earth's crust and have cooled into igneous rock.

Odd You stay in the Earth's mantle as magma.



Metamorphic Rock

Roll

1-2

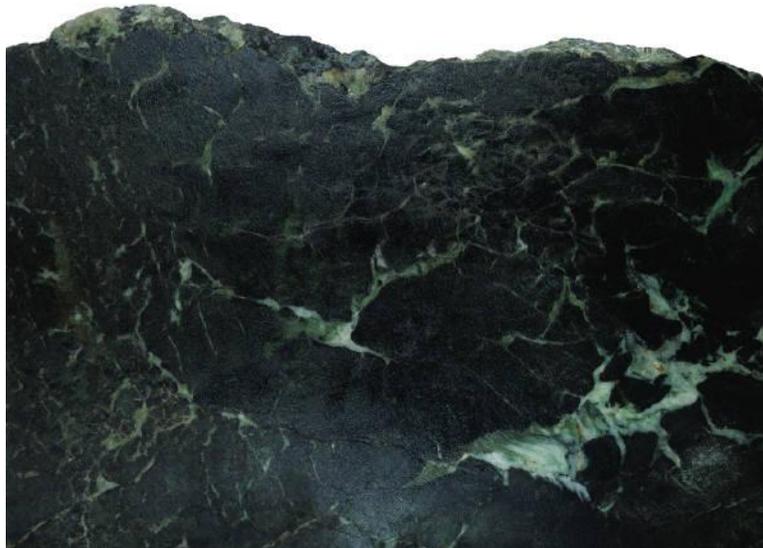
You have been weathered off of a larger rock and are now **sediment**.

3-4

Due to heat and pressure from the Earth, you have stayed as a **metamorphic rock**.

5-6

You have been pushed deep into the Earth's crust and have melted into **magma**.



Igneous Rock

Roll

1-2

You have been weathered off of a larger rock and are now **sediment**.

3-4

Due to heat and pressure from the Earth, you have turned into a **metamorphic rock**.

5-6

You have been pushed deep into the Earth's crust and have melted into **magma**.



Sediment

Roll

1-2

You continue to be weathered and remain as **sediment**.

3-4

Due to pressure from the Earth you turn into **sedimentary rock**.

5-6

You have been pushed deep into the Earth's crust and have melted into **magma**.



A-2

Name _____

Date _____

Rock Cycle Data Chart

Roll #	Station Name	What Happened?	Time Passed

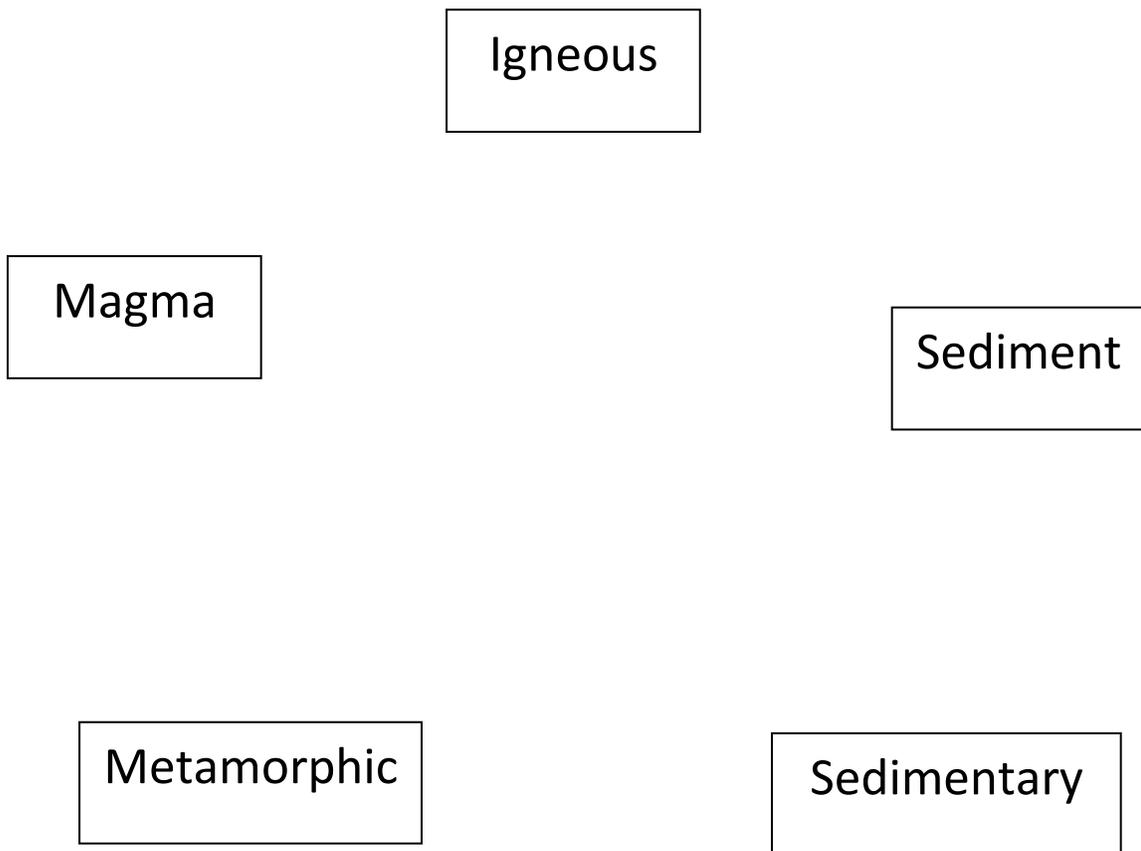
A-3

Name _____

Date _____

Rock Cycle

Diagram Your Travels as a Rock



Describe the forces that cause the rock cycle.

<p>Wind breaks small bits from large rocks. Rain takes the particles to a creek. They drop to the bottom and harden over time into limestone.</p>	<p>Space in packed sand on the sea floor fills with minerals in the water. These minerals over time become cemented and turn into sandstone.</p>
<p>A volcano sends lava out of its cone. The lava cools as falls and makes basalt.</p>	<p>Magma presses against limestone. Over time the limestone turns into marble.</p>
<p>A slow river puts soft, wet clay on a dead fish. The piled clay lies in place for years. The fish body is replaced with stone.</p>	<p>The continental plates move and make folds in the rock. This pressure can cause granite to form into gneiss.</p>
<p>Melted rock moves in the earth. It cools as it nears the earth's surface.</p>	<p>The ocean waves weather coral into bits which settle on old shells. The coral and shell particles build up. Over the years they harden together to form coquina.</p>
<p>Lava flows in huge sheets on the earth. It cools quickly forming obsidian.</p>	<p>The weight and pressure of a mountain over time turns shale into slate.</p>

Bonus: Make up two more rock clues that could be added to this activity.

Identifying Rocks

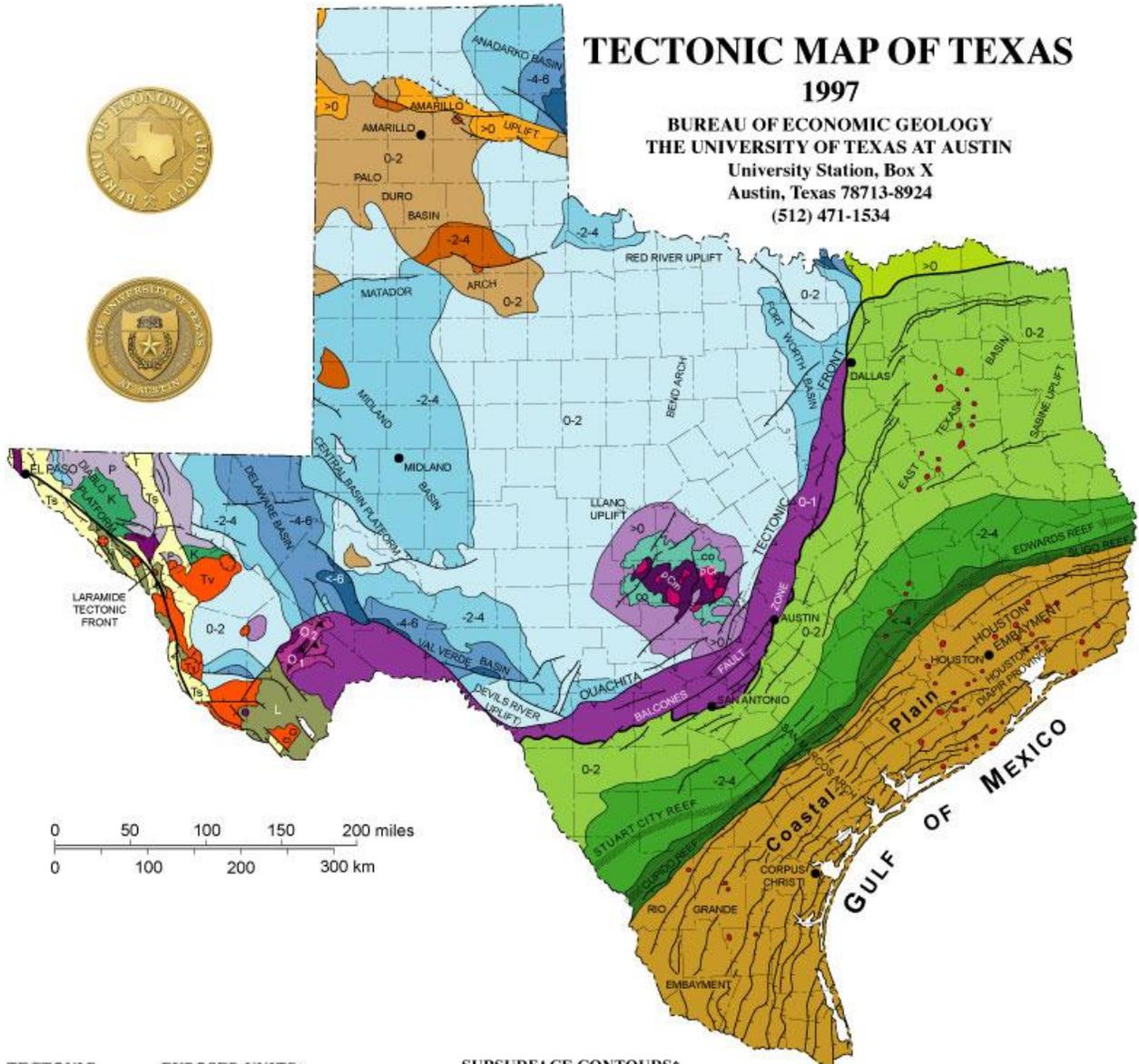
Rock Drawing	Properties (Description)	Rock Name	How was it Formed	Rock Classification (igneous, sedimentary, metamorphic)

Is It Made From Minerals?

- _____ computer
- _____ television
- _____ brick house
- _____ carpet
- _____ windows
- _____ make-up
- _____ car
- _____ telephone
- _____ sheet rock
- _____ paper
- _____ toothpaste
- _____ faucet

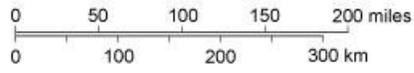
Answers Key to *Is It Made From Minerals?*

Computer	Includes gold, silica, nickel, aluminum, zinc, iron, petroleum products, and about thirty other minerals.
Television	Includes aluminum, copper, iron, nickel, silica, rare earths, and strontium.
Brick house	Bricks and tiles are made from clay minerals. When wet, the clay can be shaped, and then fired to make floor, wall, and roof tiles, as well as house bricks.
Carpet	Includes limestone, petroleum products and selenium.
Windows	Includes silica, feldspar, soda ash, coal and salt.
Make up	Includes clay, mica, talc, limestone and petroleum products.
Car	Many minerals are needed to make a car. Iron is used to make steel. It makes up the bulk of the car, and comes from minerals like magnetite and hematite. Bumpers, badges, and door handles are often coated in chromium to prevent them rusting - this comes from the mineral chromite.
Telephone	Includes copper, gold and petroleum products.
Sheet rock used to make the walls in your house	When powdered gypsum is heated and then mixed with water, it can set into a solid mass. This makes it a very useful building material, producing the plaster and plasterboard that form the walls around you.
Paper	Paper is usually made of wood pulp mixed with minerals like clays, mica, talc and barite.
Toothpaste	Includes fluorite, barite and calcite. The container is made of petroleum products or aluminum.
Faucets	Includes iron, nickel and chromium.



TECTONIC MAP OF TEXAS 1997

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TECTONIC EPISODE	EXPOSED UNITS*	SUBSURFACE CONTOURS* (elevation in kilometers**)	OTHER FEATURES
Tertiary	Ts Late Tertiary extensional basin	Top of pre-Tertiary <-4	Caldera
	Tv Trans-Pecos igneous	Base of Austin Chalk or Top of Edwards Group Cretaceous >0 0 to -2 -2 to -4 <-4	Salt diapirs
Laramide	L Deformed Cretaceous strata	Top of Ellenburger Paleozoic >0 0 to -2 -2 to -4 -4 to -6 <-6	Lower Cretaceous reef trend
Gulf Coast	K Cretaceous strata	Top of Precambrian >0 0 to -2 -2 to -4	Normal fault, indicating downthrown side
Ouachita	Foreland:	Buried Ouachita facies Paleozoic 0 to -1	Thrust fault, teeth on upper plate
	P Upper Paleozoic		
	CO Lower Paleozoic		
	Marathon:		
	O₂ Upper Paleozoic flysch		
	O₁ Lower Paleozoic		
Llano	pCi Precambrian igneous		TECTONIC FRONTS
	pCm Precambrian metamorphic		Laramide tectonic front
			Ouachita tectonic front
			Gulf Basin margin

* Note changes in mapped horizon.
** >0, elevation greater than sea level;
<-6, depths greater than 6 km below sea level

The Geological History of Texas

Written by the Bureau of Economic Geology, University of Texas Austin

The geologic history of Texas is recorded in the rock strata that fill the many subsurface sedimentary basins and crop out across the state. The origin of these strata documents a changing geography that began several billion years ago in the Precambrian Era. Mountains, seas, rivers, volcanoes, and earthquakes are part of the geologic story of Texas, and the resources produced by geologic phenomena (petroleum, coal, lignite, metals, ground water, salt, limestone, ceramic clays, and various soils) are the legacy of the state's changing face.

Texas is underlain by Precambrian rocks more than 600 million years old. The deformed ancient volcanic and intrusive igneous rocks and sedimentary rocks were formed early in the Earth's history. They are now exposed in the Llano Uplift and in a few small areas in Trans-Pecos Texas.

During the early Paleozoic, broad inland seas inundated the stable West Texas region (Texas Craton), depositing widespread limestones and shales. Lower Paleozoic rocks are now exposed around the Llano Uplift and in the mountains of Trans-Pecos Texas. The Texas Craton was bordered on the east and south by the Ouachita Trough, a deep-marine basin extending along the Paleozoic continental margin from Arkansas and Oklahoma to Mexico. Sediments accumulated in the Ouachita Trough until late in the Paleozoic Era when the European and African continental plates collided with the North American plate. Convergence of the North and South American plates in this area produced fault-bounded mountainous uplifts (Ouachita Mountains) and small basins filled by shallow inland seas that constituted the West Texas Basin.

Broad limestone shelves and barrier reefs surrounded the deeper parts of the marine subbasins. Rivers flowed to the landward edges of the basins, forming deltas, and coastlines shifted repeatedly as nearshore sediments were deposited and then eroded by marine processes. Pennsylvanian strata that are products of these processes are exposed today in North-Central Texas. Near the end of the Paleozoic Era, the inland seas retreated southwestward, and West Texas became the site of broad evaporite basins where salt, gypsum, and red muds were deposited in a hot, arid climate. The strata originally deposited in the Permian Basin are exposed in the Rolling Plains of West and Northwest Texas and in Trans-Pecos Texas.

The Mesozoic Era in Texas began about 245 million years ago when the European and African plates began to break away from the North American plate, producing a belt of elongate rift (fault-bounded) basins that extended from Mexico to Nova Scotia. Sediment from adjacent uplifts was deposited in these basins by streams. While Europe and Africa drifted farther away, the basins were buried beneath marine salt as the East Texas and Gulf Coast Basins were created. During the rest of the Mesozoic Era, broad limestone shelves were periodically buried by coastal plains and deltaic deposits as the Texas continental margin gradually shifted southeastward into the Gulf of Mexico. In the East Texas Basin, deeply buried salt deposits moved upward forming salt ridges and domes, providing a variety of folded structures and traps for oil and gas.

In West Texas, during the early Mesozoic Era, a large shallow lake occupied the abandoned site of the Permian Basin, but eventually waters from the Gulf of Mexico encroached and flooded West

Texas beneath a shallow sea. Dinosaurs roamed the land and shallow waters, and marine reptiles dominated the Mesozoic seas until the waters withdrew from West Texas, near the end of the era. Mesozoic strata are exposed along the western and northern margin of the Gulf Coast and East Texas Basins and extensively across West Texas.

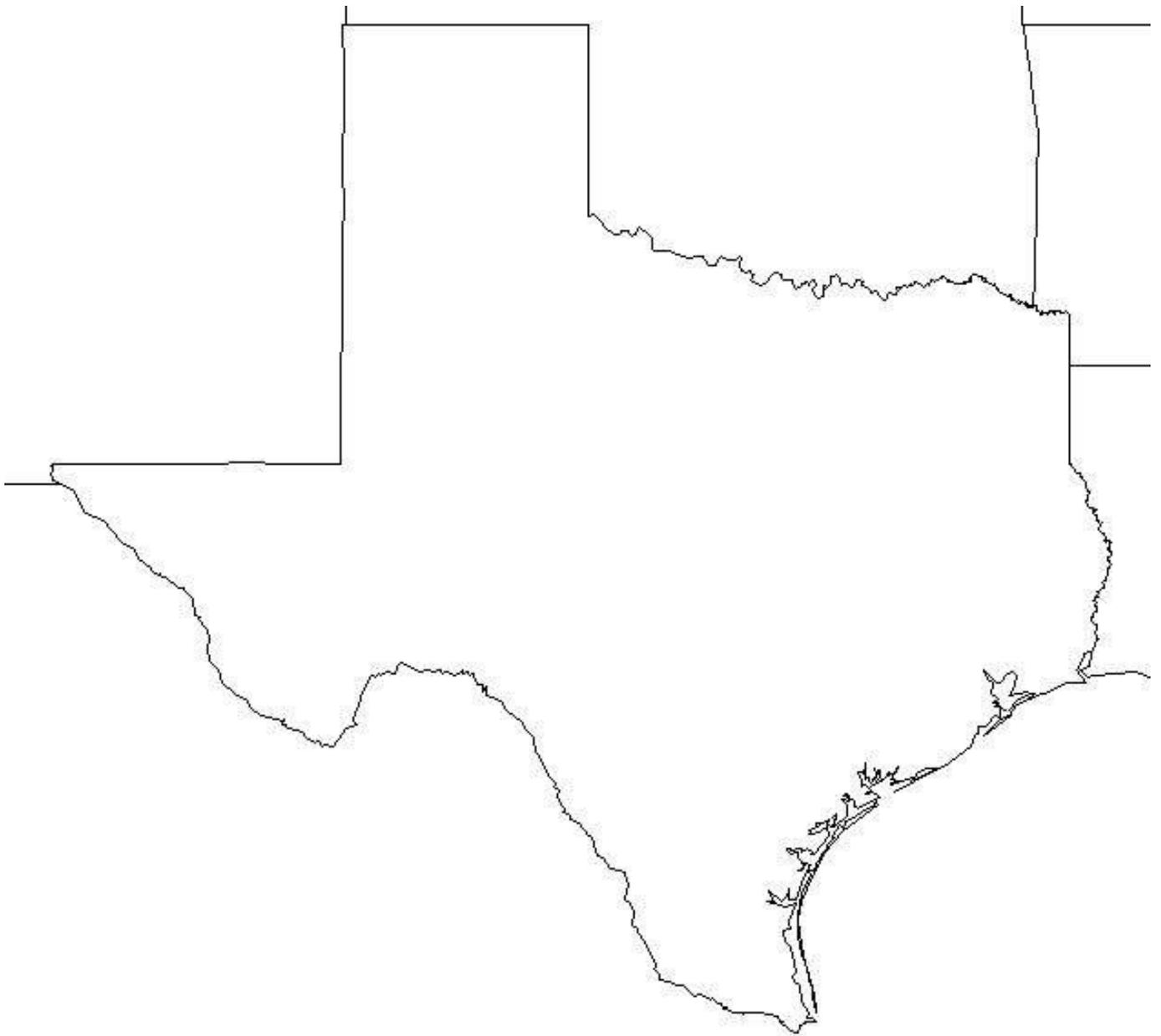
When the Cenozoic Era dawned in Texas, about 66 million years ago, the East Texas Basin was filling with lignite-bearing deposits of river and delta origin. The early Cenozoic Mississippi River flowed across East Texas, and a large delta occupied the region north of Houston. Smaller deltas and barrier islands extended southwestward into Mexico, very much like the present Texas coast. Delta and river sands were transported southeastward into progressively deeper waters of the Gulf of Mexico. In the Gulf Coast Basin, deeply buried lower Mesozoic salt moved upward to form domes and anticlinal structures. Now, Cenozoic strata are exposed throughout East Texas and in broad belts in the coastal plain that become younger toward the Gulf of Mexico.

In Trans-Pecos Texas, extensive Cenozoic volcanoes erupted, thick lava flows were deposited over older Mesozoic and Paleozoic strata, and rift basins were formed. Cenozoic volcanic rocks are now well exposed in the arid region of Trans-Pecos Texas.

In northwestern Texas, late Cenozoic streams deposited gravel and sand transported from the Rocky Mountains of southern Colorado and northern New Mexico. During the Ice Age (Pleistocene Epoch, beginning about 2 million years ago) the Pecos River eroded northward into eastern New Mexico and isolated the alluvial eolian deposits of the Texas High Plains from their Rocky Mountain source. The isolated High Plains were eroded by several Texas rivers during and since the Ice Age, causing the eastern margin (caprock) to retreat westward to its present position.

While the northern part of the continent was covered by thick Pleistocene ice caps, streams meandered southeastward across a cool, humid Texas carrying great volumes of water to the Gulf of Mexico. Those rivers, the Colorado, Brazos, Red, and Canadian, slowly entrenched their meanders as gradual uplift occurred across Texas during the last 1 million years. Sea-level changes during the Ice Age alternately exposed and inundated the continental shelf. River, delta, and coastal sediments deposited during interglacial (high-sea-level) stages are exposed along the outer 80 kilometers of the coastal plain. Since sea level reached its approximate present position about 3,000 years ago, thin coastal-barrier, lagoon, and delta sediments have been deposited along the Gulf Coast.

Texas is a composite of nature's processes. Texas today is but one frame in a dynamic geological kaleidoscope of changing rivers, subsiding basins, shifting beaches, uplifting mountains, and eroding plateaus. The face of modern Texas is the link that connects its geologic past to its inevitable future.



Graphic source: About Geography