Ancient Landscapes of South Texas: A Teachers' Guidebook

Discovering the Rio Grande Valley

Reports from the

Community Historical Archaeology Project with Schools Program

Community Studies No. 1: Rio Grande Valley in the Time of the Pandemic: Community Responses to COVID-19

Community Studies No. 2: Ancient Landscapes of South Texas: Integrated Place-Based Learning Teachers' Guidebook

For more information on the **CHAPS** Program, visit us at www.utrgv.edu/chaps

Ancient Landscapes of South Texas: A Teachers' Guidebook

A report prepared for:

The Greater Rio Grande Valley Community

and for UTRGV and the CHAPS Program class titled:

Discovering the Rio Grande Valley: The Natural and Cultural History of South Texas

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Cover art by Ruben Lozano, MFA

Dedication

This book is dedicated to the regional teachers who have participated in all CHAPS Program endeavors since our inception in 2009. Hundreds of Rio Grande Valley educators have attended our professional development workshops throughout the years, along with countless special presentations at schools, in classrooms, and in the community. This book is dedicated to the teachers who played a role in the development of the TEKS-aligned lesson plans for this project and all teachers across the 32 school districts within Region One ESC who are utilizing these place- and community-based lesson plans and traveling educational trunks in their K-13 classrooms to the benefit of thousands of students across South Texas. Thank you for your time and attention! We could not have accomplished this without you.

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Foreword

The Rio Grande Valley is a region of extraordinary historical and cultural significance. Yet, at the same time, this significance is often unknown to those for whom it is perhaps most relevant: our local communities. The Community Historical Archaeology Project with Schools (CHAPS) Program, under the stewardship of Dr. Juan L. González, Dr. Christopher L. Miller, Dr. Russell K. Skowronek, Ms. Roseann Bacha-Garza, has championed public education initiatives since its inception over a decade ago, strengthening and curating an awareness of local history among RGV residents and institutions. While there is some familiarity with this history locally, it has largely been told and remembered in piecemeal fashion, recollected in fragments rather than a unified story. *Ancient Landscapes of South Texas*, the product of ongoing collaboration between faculty and students at UTRGV, aims to bring together this narrative, building an uninterrupted story across the ages of the region. It fully captures the past, present, and future of one of the most unique and historic regions of the United States, offering a truly panoramic view of the Valley throughout its storied history.

Spanning a range of key topics, *Ancient Landscapes of South Texas—Hiding in Plain Sight* introduces students to this story. Starting with the RGV's Eocene era, and ending with the Anthropocene, the text provides teachers with a comprehensive roadmap for cultivating an appreciation and enthusiasm for local cultural and natural history in the classroom.

A distinctive feature of the volume lies in its multidisciplinary approach. As noted in the foreword of the *Ancient Landscapes of South Texas* TEKS-aligned lesson plan book (2023), students oftentimes learn about the natural sciences in isolation from the social and cultural sciences. These disciplines are largely siloed, offering a somewhat narrow focus on complex issues. But we know that people and societies co-exist with the natural environment. People shape—and, in turn, are shaped by—the broader ecologies they inhabit. Understanding this connection is critical and provides students with a far more holistic way of thinking about the world and its inhabitants, one in which the parts do not simply act in isolation, but in tandem. One of the great successes of *Ancient Landscapes of South Texas* is how clearly it brings this principle to light.

In closing, this teachers' guidebook is an invaluable resource for its ability to weave together the history of the region through an interdisciplinary lens. Just as the RGV's history is diverse, so too must be the methods through which we seek to understand and appreciate it.

William Donner Professor of Sociology and Interim Director of The School of Interdisciplinary Programs and Community Engagement

Preface

Since 2011, the Community Historical Archaeology Project with Schools (CHAPS) Program at the University of Texas Rio Grande Valley has offered a unique course titled *Discovering the Rio Grande Valley*. This multidisciplinary course has centered on the historical and cultural heritage of the city of Edinburg, involving students in community-based, hands-on research. Through oral history interviews, archaeological fieldwork, and biological and geological surveys, students contribute valuable data and firsthand accounts that enrich the understanding of South Texas history.

Building on this foundation, CHAPS launched *the Ancient Landscapes of South Texas* initiative. The project set out to reveal and share over 50 million years of geological history and 15,000 years of human presence in the region. To make this information accessible and engaging, we developed a variety of educational tools including a bilingual website, audio podcasts, and an augmented reality poster featuring 3D renderings of projectile points from the Lower Rio Grande Valley.

In collaboration with regional K–12 educators, we created TEKS-aligned lesson plans and classroom kits that bring local geoheritage and public heritage to life for schoolchildren. Our goal has always been to connect community members, especially students, to the long, and sometimes complex geologic histories embedded in the landscape around them.

To make this work more accessible, we produced the award-winning documentary *Ancient Landscapes of South Texas: Hiding in Plain Sight*, published a richly illustrated companion photo book, and developed a traveling museum-quality exhibit. These materials were unveiled in a community-centered event held in Fall 2023 at the UTRGV Charles & Dorothy Clark Gallery.

At the same time, we redesigned the *Discovering the Rio Grande Valley* course to focus on the Ancient Landscapes project as a model of applied public heritage work. Students were immersed in lectures from faculty experts in anthropology, history, geology, and zooarchaeology, and they received guidance from museum professionals and public historians. Under this mentorship, students curated an exhibit that explored both geological epochs and human geography, gaining valuable experience in exhibit design and public interpretation.

As part of the course, students worked in research teams to develop final papers exploring six major geological epochs represented in the region. Their work, along with a classroom resource guide developed by graduate student and curriculum specialist Jackqueline Alejos (PSJA ISD), has been compiled into this teacher's guide. It is intended to support educators in teaching regional natural and cultural history through place-based, experiential learning strategies.

We hope this guidebook empowers teachers to foster a deeper understanding of South Texas heritage and inspires students to connect with the landscapes and stories of their communities.

Juan L. González, Christopher L. Miller, Russell K. Skowronek and Roseann Bacha-Garza Principal Investigators

UTRGV Community Historical Archaeology Project with Schools (CHAPS) Program

A Teacher's Guide to "Ancient Landscapes of South Texas"

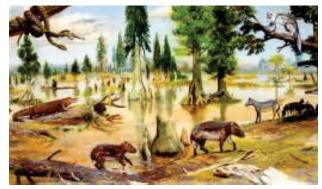
This Teacher's Guide to "Ancient Landscapes of South Texas" provides place based, epoch-centered lesson plans and classroom activities designed to bring geologic and cultural history to life. Organized by major geologic epochs—from the Eocene to the Anthropocene—this guide includes ready-to-use lesson plans, printable student worksheets, and university-student-generated readings developed in partnership with the University of Texas Rio Grande Valley.

Developed in collaboration with the Community Historical Archaeology Project with Schools (CHAPS), this resource also includes artifact-based learning tools and background information to support hands-on engagement with South Texas' ancient past. It serves as an educational companion to the book Ancient Landscapes of South Texas: Hiding in Plain Sight.

Jackqueline Alejos Social Studies Teacher/Curriculum Writer Pharr-San Juan-Alamo (PSJA) Secondary and Early College High School

NOTES

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1. South Texas During the Eocene

Lesson objective: The learner will be able to identify the unique geological features and natural resources of the Eocene epoch in South Texas.

Explore	Your Task
Explore the Eocene with these online videos:	Possible resources: Have students respond in a text box to questions about the video. An icon
Florida Museum Video – Eocene Epoch – Florida Fossils: Evolution of Life and Land	such as 🔌 lets students know they are expected to write/type something (example below).
PBS Eons Video – The Mystery of the Eocene's Lethal Lake	•
PBS – Climate Change in the Fossil Record Prehistoric Road Trip	For middle and high school, having students respond in a <u>Google Form</u> or on a <u>Padlet</u> helps with workflow. (example below).
	Google Form – The Mystery of the Eocene's Lethal Lake

Explain	Your Task
Explain the Eocene in South Texas using these reading and vocabulary resources:	Post learning expectations for students. Will they take notes? Possibly share their thinking digitally or on paper? A 3-2-1 reflection would work here.
Ancient Landscapes of South Texas: The Eocene Epoch	Cive students feedback during this tack either
	Give students feedback during this task either digitally or in person. Possibly give students the
PBS – Eocene Epoch	opportunity to give feedback to one another as well.
UTRGV CHAPS – Roma Sandstone	
Newsela – When Giant Penguins Roamed the Earth	

Apply & Share	Your Task
Post instructions for the method students will be using to apply their knowledge from the lesson and share with an authentic audience.	Include expectations for student creations. This could include due dates, links to rubrics, and instructions for turning work in. Give students feedback during this task either
National Park Service – Choose Your Own Eocene Adventure	digitally or in person. Possibly give students the opportunity to give feedback to one another as well.
Google Arts and Culture – Explore the Messel Pit Fossil Site in Germany	Extra resource: Include a link to a Show What you know BINGO board and have students practice their new vocabulary in the classroom!

********OPTIONAL******

Connect & Extend	Your Task
Project-Based Learning activities are a great way for students to continue their independent exploration of topics from the lesson that they really connected with. Check out the very last page of the Ancient Landscapes of South Texas: The Eocene Epoch resource for an example of how to implement these in your own classroom!	Add instructions or expectations for their extension activity. Possible resources: Have students paste an image of what they created at the end of their project in a box like the one in the example below. An icon such as lets students know they are expected to paste and image of something. For middle and high school having students respond in a Google Form helps with workflow. You can also use any of the templates in this Exit Ticket Builder to gauge student knowledge after the lesson!

^{**} Don't forget to have your students SHARE and REFLECT on their learning during and/or after!

Good old Think-Pair-Share and Turn and Talk is still important during tech time!

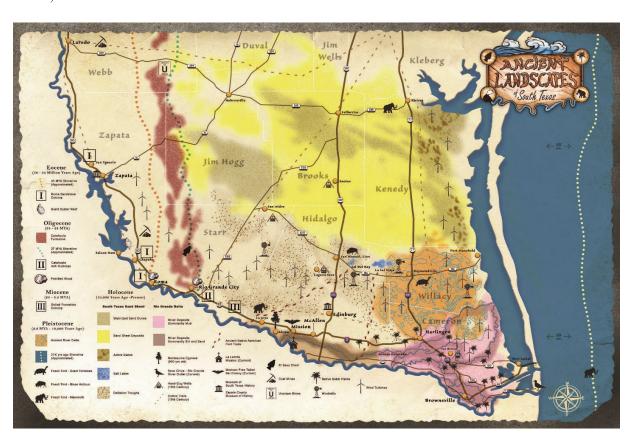
Ancient Landscapes of South Texas: The Eocene Epoch

Reading Practice:

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The Eocene epoch was a very important time in Earth's history, lasting from around 55 million years ago to 34 million years ago. During this period, the climate changed a lot, and new types of plants and animals appeared.

In the area that is now South Texas, a lot of changes were happening too. The shoreline of the ancient Gulf of Mexico reached much farther inland than it does today, stretching all the way into modern-day Zapata and Webb counties. Fossils from this time show that the region was full of life, both on land and in the water.



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Figure 1: Ancient Landscapes of South Texas Map

On land, the landscape changed from thick forests to open woodlands. Bigger animals like hippos, rhinos, and early versions of modern animals like pigs, horses, and camels started to live in these woodlands. In the water, whales that used to walk on land were now swimming and living in the ocean.

*********** *****

One of the best places to see what the Eocene was like in South Texas is the Roma sandstone bluff in the city of Roma. This sandstone has features like wave patterns and crab burrows that show what the ancient coastline looked like. The people of Roma used this sandstone to build their city, mixing it with fossilized oyster shells to make strong mortar and concrete.



Figure 2: John Vale/Noah Cox Historic Home in Roma, TX

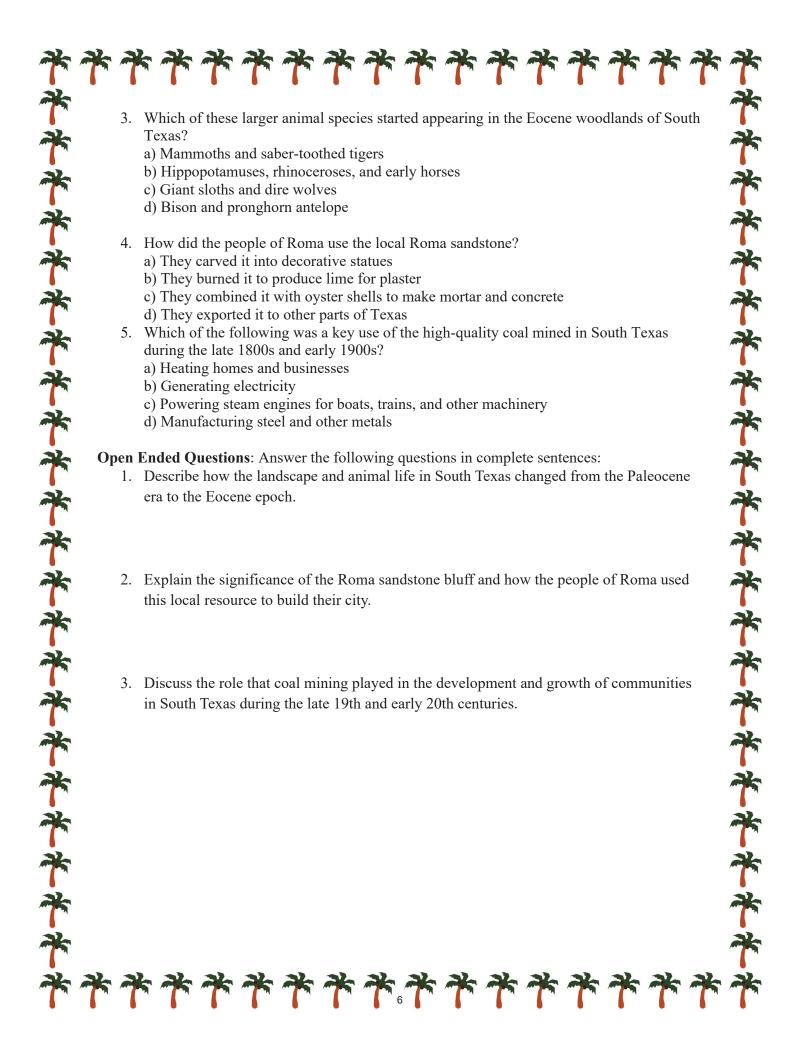
The Eocene epoch also left behind another important resource in South Texas - coal. Highquality coal was mined from places like the Dolores mines, and it was used to power the steam engines of boats, trains, and other machines that helped the region grow and develop in the late 1800s and early 1900s.



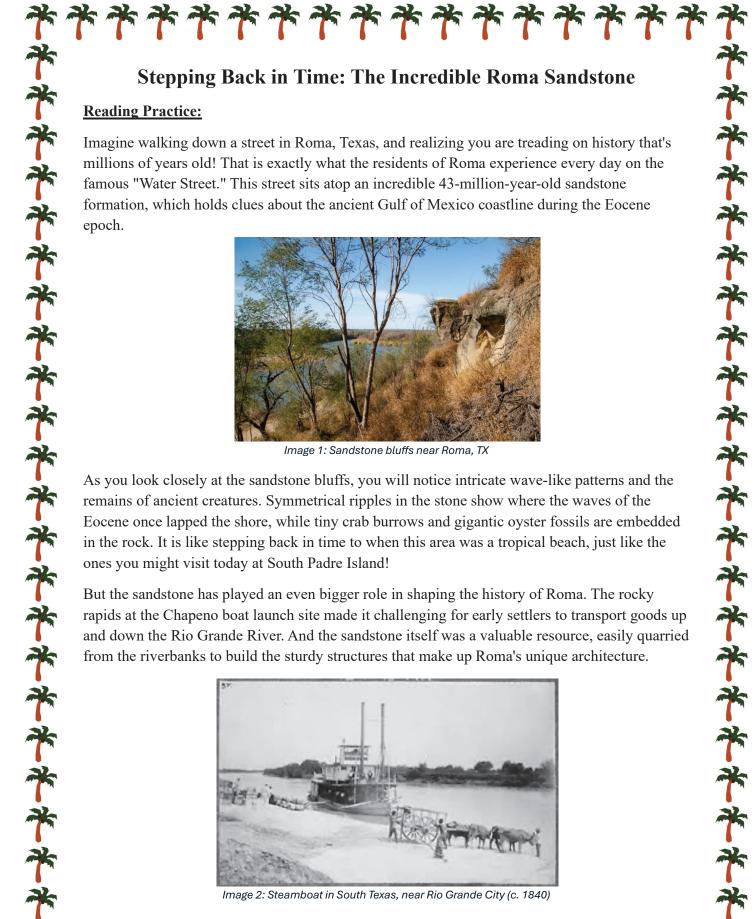
Figure 3: "Coal mine and loading chute, Minera, Webb County, Texas, ca. 1890."

Overall, the Eocene epoch was a time of major changes that shaped the landscape, ecosystems, and economy of South Texas in lasting ways. Understanding this ancient era is key to learning about the history and development of the region.

34,	Word Bank: Zapata, 55, boats, trains, Eocene, Dolores, horses, camels, land, ocean, Roma, rhinoceroses, pigs, sandstone, oyster, coal, Webb, forests, woodlands, hippopotamuses
1.	The Eocene epoch lasted from approximately million years ago to million years ago.
2.	During the Eocene, the shoreline of the ancient Gulf of Mexico reached as far inland as
4.	what modern-day counties? and On land, the Eocene landscape transitioned from to open Some of the larger animals that started living in the Eocene woodlands were,, and early versions of,
	, and Whales during the Eocene had adapted from walking on to living and swimming in the
6.	The sandstone bluff in Roma provides a window into what the ancient coastline was like during the Eocene.
	The people of Roma used the, combined with shells to build strong buildings and infrastructure.
	High-quality was an important resource mined in South Texas during the late 1800s and early 1900s.
9. 10.	The mines were a key source of the coal that powered, and other machines. Understanding the epoch is crucial for learning about the history and development of the South Texas region.
	During the Eocene epoch, the shoreline of the ancient Gulf of Mexico extended as far inland as what modern-day counties? a) Zapata and Webb b) Cameron and Hidalgo c) Starr and Willacy d) Maverick and Kinney
2.	Which of the following best describes the transition of the landscape in South Texas from the Paleocene to the Eocene? a) Forests became more dense and diverse b) Woodlands replaced the previous forests c) The landscape remained mostly unchanged d) Grasslands spread across the region



Directi	ons: Match the following terms with their correct definitions.
1.	Eocene Epoch
2.	Gulf of Mexico
3.	Woodlands
4.	Hippopotamuses, rhinoceroses, pigs, horses, camels
5.	Whales
6.	Roma sandstone bluff
7.	Oyster shells
8.	Coal
9.	Dolores mines
10.	Industrialization
B.C.D.E.F.G.H.I.	A geological feature in Roma that provides insights into the ancient Eocene coastline. A valuable natural resource that was mined in South Texas to power steam engines. An open, mixed forest habitat that replaced the previous dense forests in South Texas. Fossilized remains that were used by the people of Roma to make mortar and concrete. Larger mammal species that started appearing in the Eocene woodlands of South Texas. Marine mammals that adapted from walking on land to living fully in the ocean during this time. The ancient body of water whose shoreline extended into present-day South Texas during the Eocene. The period of geologic time lasting from about 55 million to 34 million years ago. The process of developing manufacturing, transportation, and other productive economic activities. The specific mines that produced high-quality bituminous coal in the region.
	acting their buildings and infrastructure.



Stepping Back in Time: The Incredible Roma Sandstone

Reading Practice:

Imagine walking down a street in Roma, Texas, and realizing you are treading on history that's millions of years old! That is exactly what the residents of Roma experience every day on the famous "Water Street." This street sits atop an incredible 43-million-year-old sandstone formation, which holds clues about the ancient Gulf of Mexico coastline during the Eocene epoch.



Image 1: Sandstone bluffs near Roma, TX

As you look closely at the sandstone bluffs, you will notice intricate wave-like patterns and the remains of ancient creatures. Symmetrical ripples in the stone show where the waves of the Eocene once lapped the shore, while tiny crab burrows and gigantic oyster fossils are embedded in the rock. It is like stepping back in time to when this area was a tropical beach, just like the ones you might visit today at South Padre Island!

But the sandstone has played an even bigger role in shaping the history of Roma. The rocky rapids at the Chapeno boat launch site made it challenging for early settlers to transport goods up and down the Rio Grande River. And the sandstone itself was a valuable resource, easily quarried from the riverbanks to build the sturdy structures that make up Roma's unique architecture.



Image 2: Steamboat in South Texas, near Rio Grande City (c. 1840)

If you look closely at the buildings around town, you'll notice hand-carved stone blocks, arched doorways, and decorative waterspouts. These architectural features were inspired by the lively Spanish culture, with designs reminiscent of bullfighting arenas and circuses. The stone blocks are made up of about 75% quartz, the same material used to construct historic landmarks like the Trevino Fort.



Image 3: Downtown view of modern-day Roma, TX

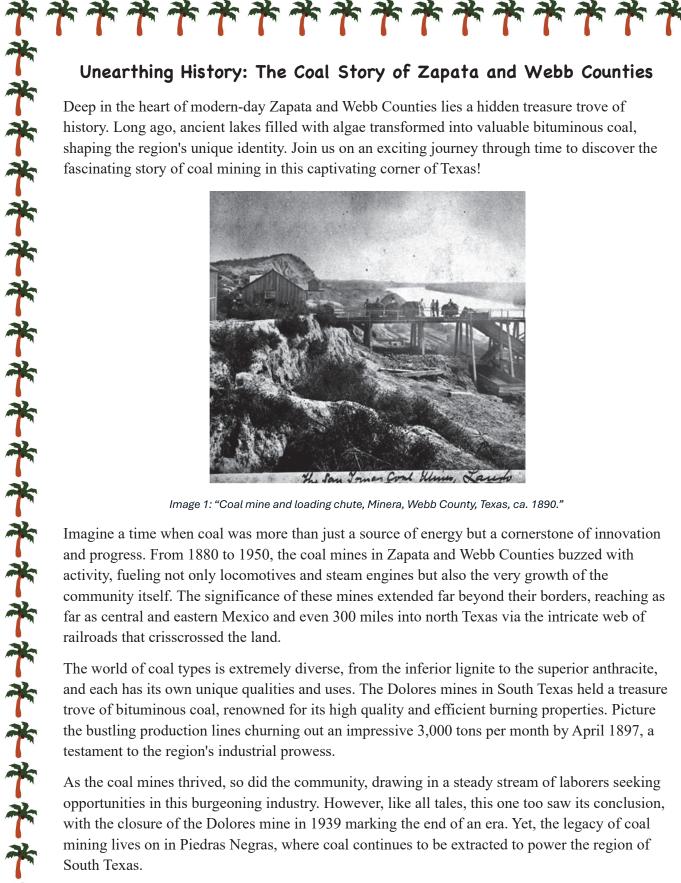
But the most fascinating clues to the past are the mortar holes carved into the sandstone. These were left behind by prehistoric people who used the stone to grind nuts, grains, and other materials. These ancient grinding holes are some of the only remaining evidence of the early human activities in the entire Rio Grande Valley.



Image 4: Mortar holes found in South Texas.

So, the next time you visit Roma, remember that you are walking on a 43-million-year-old natural wonder that has shaped the town's history in incredible ways. The Roma sandstone is truly a window into the past, waiting to be explored!

	<u>WORD BANK:</u> TRANSPORTATION, HUMAN, EOCENE, QUARRIED, QUARTZ
1.	The Roma sandstone bluff is evidence of the coastline for the ancient Gult of Mexico.
2.	The sandstone rapids found at the Chapeno boat launching site challenged the of goods up and down the Rio Grande River.
3.	The mortar holes in the sandstone stand as some of the few existing pieces of evidence of early activities in the entire Rio Grande Valley.
4.	The sandstone was easily from along the Rio Grande River and provided much-needed building materials.
5.	Many of the buildings around Roma are similarly adorned with hand-carved stone blocks that vary in shape and design, and roughly 75% of their integrity is
Iulti	ple Choice Questions: Choose the correct answer from the choices for each question.
1.	How old is the Jackson Formation of sandstone found in Roma? a) 43 thousand years old b) 43 million years old c) 43 billion years old d) 4.3 million years old
2.	What type of fossils are found in the Roma sandstone bluff? a) Dinosaur bones b) Shark teeth c) Crab burrows and oyster fossils d) Petrified wood
3.	What natural feature of the Roma sandstone provided building materials for the city? a) The mortar holes b) The symmetrical wave ripple formations c) The fossilized oyster shells d) The sandstone quarried from the Rio Grande River
4.	What Spanish cultural element is represented in the architecture of Roma? a) Haciendas b) Bullfighting arenas c) Flamenco dance halls d) Moorish courtyards



Unearthing History: The Coal Story of Zapata and Webb Counties

Deep in the heart of modern-day Zapata and Webb Counties lies a hidden treasure trove of history. Long ago, ancient lakes filled with algae transformed into valuable bituminous coal, shaping the region's unique identity. Join us on an exciting journey through time to discover the fascinating story of coal mining in this captivating corner of Texas!

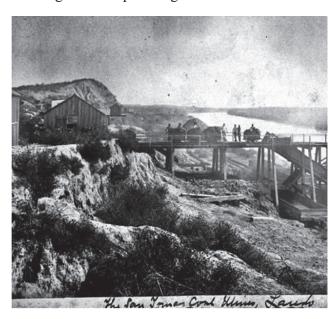


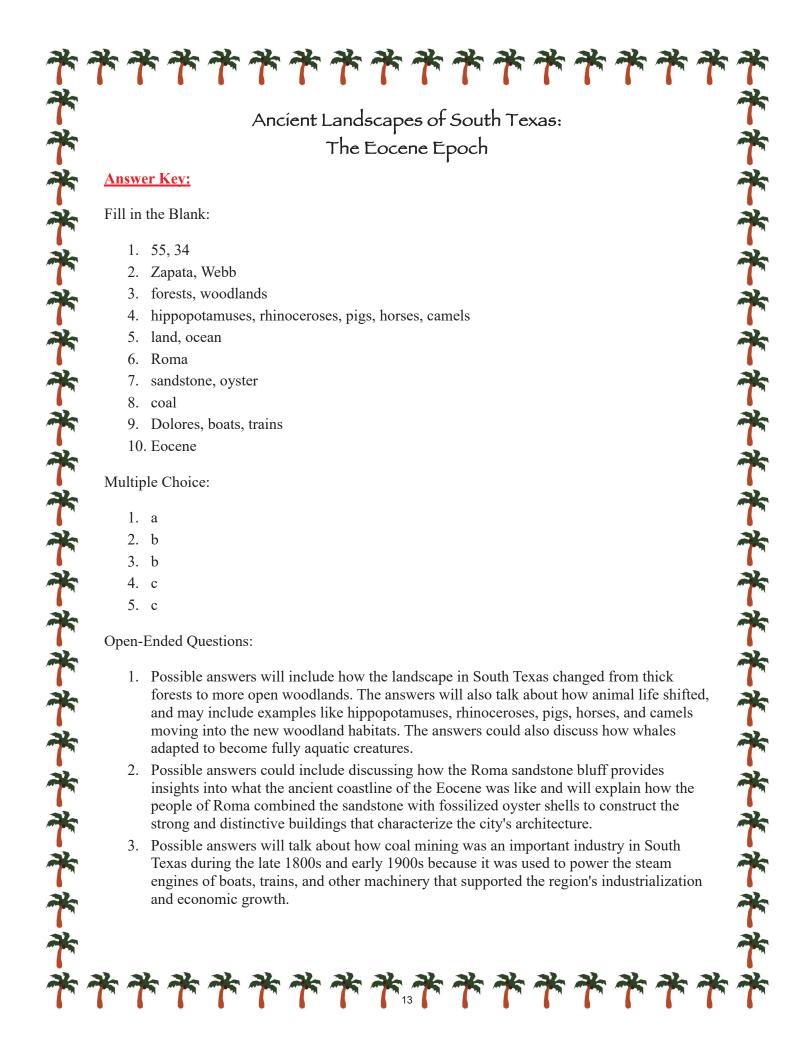
Image 1: "Coal mine and loading chute, Minera, Webb County, Texas, ca. 1890."

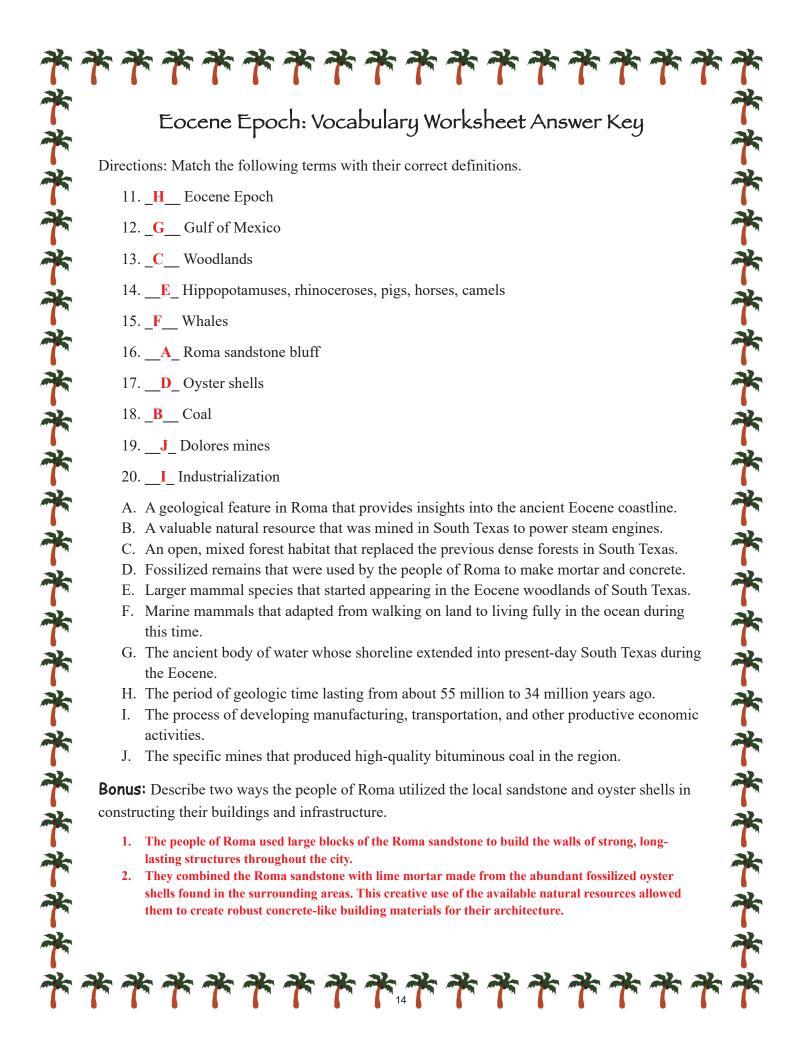
Imagine a time when coal was more than just a source of energy but a cornerstone of innovation and progress. From 1880 to 1950, the coal mines in Zapata and Webb Counties buzzed with activity, fueling not only locomotives and steam engines but also the very growth of the community itself. The significance of these mines extended far beyond their borders, reaching as far as central and eastern Mexico and even 300 miles into north Texas via the intricate web of railroads that crisscrossed the land.

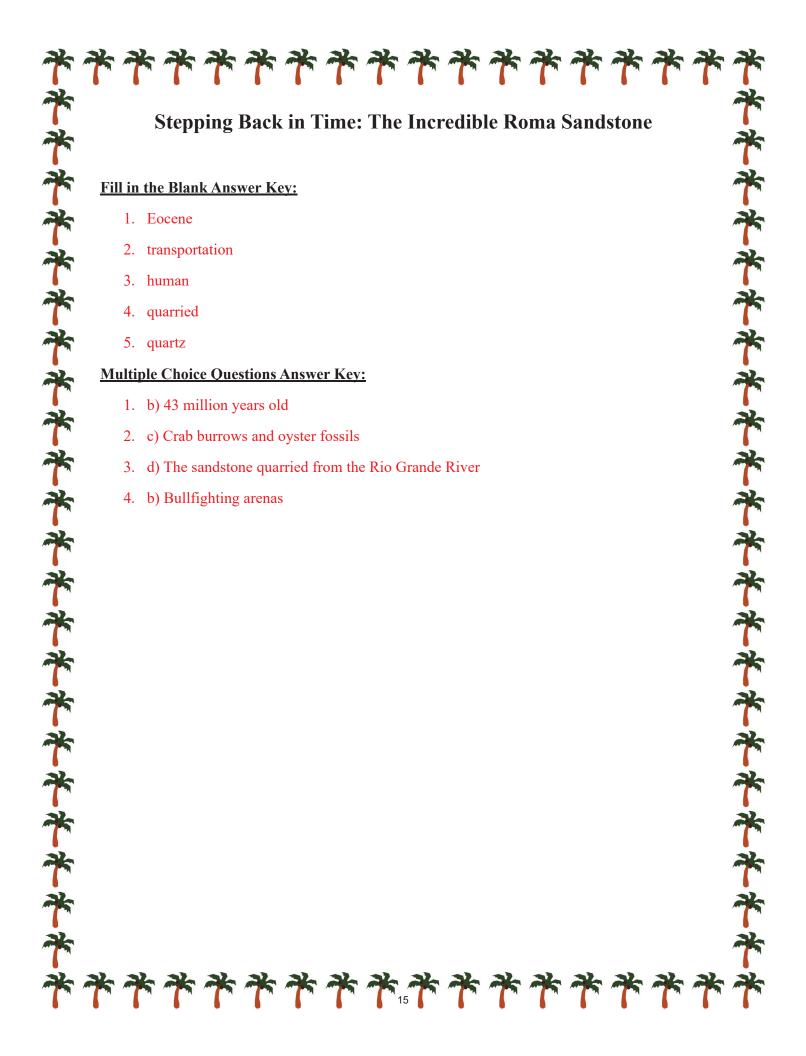
The world of coal types is extremely diverse, from the inferior lignite to the superior anthracite, and each has its own unique qualities and uses. The Dolores mines in South Texas held a treasure trove of bituminous coal, renowned for its high quality and efficient burning properties. Picture the bustling production lines churning out an impressive 3,000 tons per month by April 1897, a testament to the region's industrial prowess.

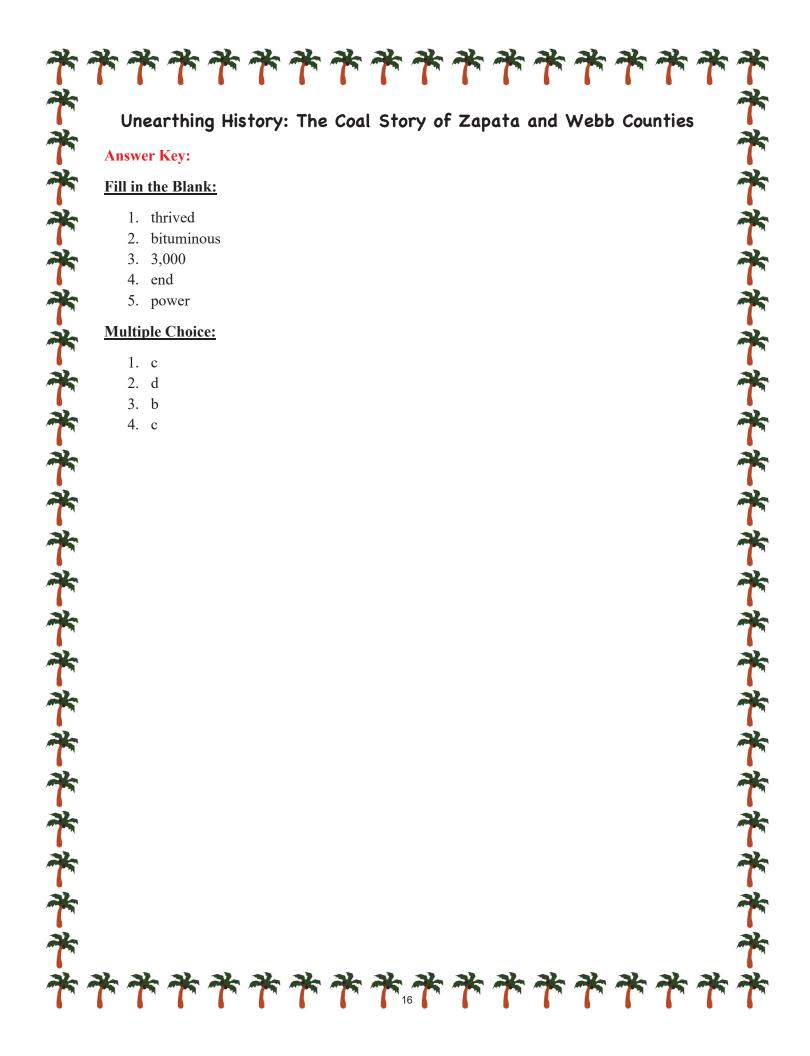
As the coal mines thrived, so did the community, drawing in a steady stream of laborers seeking opportunities in this burgeoning industry. However, like all tales, this one too saw its conclusion, with the closure of the Dolores mine in 1939 marking the end of an era. Yet, the legacy of coal mining lives on in Piedras Negras, where coal continues to be extracted to power the region of South Texas.

	Word bank:					
3,00	00	bituminous	end	power	thrived	
1. Fr	om 1880 t	to 1950, the coal min	nes in Zapata and V	Webb Counties	with	
	•	ling not only locomo	otives and steam er	ngines but also the v	very growth of the	
	mmunity i		rag hald a transura t	tmaxia af	anal manayyma	
		s mines in South Tex quality and efficient			coai, renowned	
		97, the Dolores min			tons pe	
•	-	tament to the region	_		1	
		of the Dolores mine				
		ies to be extracted in	n Piedras Negras to)	the region of South	
Te	xas.					
ultiple	Choice Q	uestions: Choose tl	he correct answer	from the choices f	or each question.	
1. W	hat type o	f coal was found in	the Dolores mines	?		
	a) Lign:					
	b) Anth	racite				
	c) Bitur	minous				
	d) Grap	hite				
		the intricate web of	railroads reach fro	om the coal mines in	n Zapata and Webb	
Co	ounties?	.,				
	a) 50 m					
	b) 100 r c) 200 r					
	d) 300 i					
3. W		ne significance of the	e coal mines in Zar	oata and Webb Cou	nties?	
		provided energy fo	-			
	b) They	fueled the growth	of the community a	and reached as far a	s central and	
	easte	ern Mexico.				
	,	were a source of in				
,	,	were a tourist attra	_	•		
4. W		al still being extract	ed today?			
		nta County b County				
		ras Negras				
	· ·	ral Mexico				
	a) com	141 1110/1100				











connect them to the historical narrative of coal mining in Zapata and Webb Counties,

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fostering critical thinking, research skills, and creative expression.

Lesson 1: Ancient Landscapes of South Texas During the Eocene Epoch Christopher Noe, Christopher Covarrubias, Louis Nave, Sebastian Gonzalez and Nicole Ramos

Introduction

The Eocene Epoch is part of the Paleogene Period and follows the Paleocene Epoch, preceding the Oligocene Epoch (Figure 1.1). It began around 56 million years ago (Ma) and ended around 34 Ma. The Eocene Epoch was a period of dramatic global change. During this time, Earth's climate shifted from extremely warm to gradually cooler conditions, influencing both the planet's surface and the evolution of life. This warming led to the extinction of many species but also allowed new mammals to thrive, including early horses, elephants, whales, dogs, and primates. As the continents moved toward their present-day positions, geological forces shaped the land masses, including Texas and the area known today as the Rio Grande Valley. Evidence from this epoch is found in rocks and fossils that tell the story of ancient environments, climates, and life forms. The end of the Eocene is marked by the formation of permanent ice sheets in Antarctica, signaling the beginning of Earth's cooling trend. These environmental changes directly influenced the evolution and spread of plants and animals, many of which began to resemble modern species (Palmer & Geissman, 2002).

In what is now South Texas, much of the region was submerged beneath a shallow sea connected to the ancient Gulf of Mexico. Today, the Rio Grande Valley (RGV) retains numerous geological features and fossil records that help scientists understand what life was like in the Eocene. From coastal sandstone bluffs to coal seams and oyster reef fossils, the evidence left behind provides valuable insight into the natural history and human use of these resources in recent times.

This section outlines the major features of the Eocene epoch in the RGV, including its climate, wildlife, and the significant formations such as the Roma Sandstone. It also highlights how these ancient landscapes influenced the cultural and economic development of South Texas.

Life During the Eocene: Flora and Fauna

The Eocene was a time of continental drift and shifting plate tectonics, which influenced both ocean currents and atmospheric circulation. As a result, the planet began to cool. The warm and humid climate that had once supported dense forests began to give way to more open woodlands, especially in mid- to high-latitude regions.

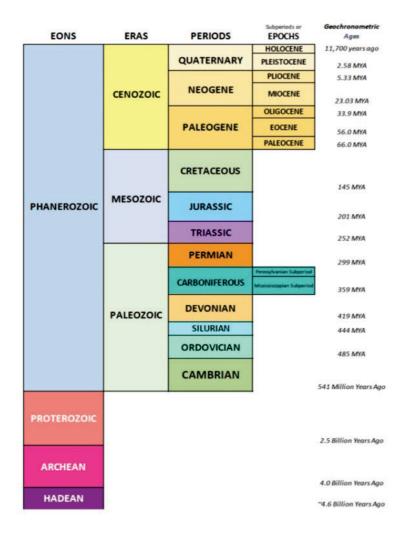


Figure 1.1. Simplified version of the Geologic Time Scale, showing all epochs of the Cenozoic Era

During this time, mammals rapidly diversified. Early ancestors of horses, camels, rhinoceroses, pigs, and hippopotamuses roamed the expanding woodlands. Many of these animals became larger in size than their Paleocene predecessors. Simultaneously, early whales, which had evolved from terrestrial, hoofed mammals, adapted fully to life in the sea. Fossils suggest that they transitioned to aquatic life in response to abundant marine food sources (PBS, 2001).

Around 40 million years ago, the continents approached their current positions. This tectonic movement triggered additional environmental changes, including cooler, drier weather. These shifts culminated in two extinction events between 37 and 33 million years ago, likely caused by climate cooling and the loss of forest habitats. Many species that had adapted to warm, tropical conditions—especially those living in higher latitudes—did not survive.

These changes in climate and biodiversity had long-lasting impacts on ecosystems and played a key role in shaping the plant and animal life we see today.

The Eocene in the Rio Grande Valley

Roma Sandstone and the Ancient Shoreline

One of the most visible and significant geological records of the Eocene in the RGV is the Roma Sandstone, a formation found along the banks of the Rio Grande River in Roma, Texas. This sandstone, part of the 43-million-year-old Jackson Formation, was formed along the ancient Gulf Coastline and serves as a natural archive of that distant past. In the Rio Grande Valley, evidence of the Eocene coastline is visible in the Roma Sandstone, shown in maps as the Jackson Group (Figure 1.2). Exposures of this sandstone are found at the observation deck at the birding center in the city of Roma.

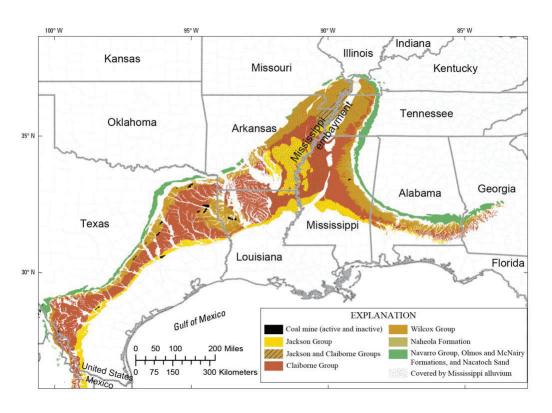


Figure 1.2. Map showing the location of the Gulf of Mexico shoreline from Cretaceous to Eocene times along the Gulf Coast. Coal mines are shown in black

The sandstone features wave ripple marks and fossil burrows, along with giant oyster fossils, indicating a once-thriving marine ecosystem. These features closely resemble those found on modern beaches, such as South Padre Island, giving us a glimpse of the Eocene shoreline.

In addition to its scientific value, the sandstone had practical uses. Early inhabitants of the region, including Native peoples, left behind mortar holes carved into the rock to grind nuts and grains. Later, settlers used this easily quarried stone to construct buildings in Roma. Mixed with lime derived from fossilized oyster shells, the sandstone was used to create durable mortar and concrete, shaping the city's distinctive architecture.

Many buildings in Roma reflect Spanish colonial influences, with features like canales (rain spouts), troneras (arched openings), and buttresses known as bollasters or contrafuertes. The sandstone, composed primarily of quartz grains, was also used in other historic structures, such as the Trevino Fort in San Ygnacio (1830) and the Vale/Cox home in Roma's historic district.

Coal Deposits and the Inland Eocene Landscape

Beyond the ancient shoreline, the Eocene mainland in what is now Zapata and Webb Counties featured shallow freshwater lakes and swamps. These algae-rich environments gradually formed layers of bituminous coal, a valuable energy resource.

One prominent location was the Dolores Mine, near Laredo (Figure 1.2). Coal from these deposits was mined extensively between 1880 and 1950, playing a key role in transportation and industrial development in South Texas and northern Mexico. The arrival of the railroad in 1881 accelerated coal distribution across the region, with shipments reaching central Mexico and North Texas.

This coal, often referred to as Santo Tomas cannel coal, was prized for its high heat, clean burn, and low sulfur content (Martinez, 2013). It is important to note that the Dolores mines produced bituminous coal. Bituminous is considered the second highest quality among the four, with anthracite being the highest and lignite the lowest. The quality of coal is determined by the amount of pressure and heat applied during its formation over time (USGS, 2004; see Figures 1.3 and 1.4). Bituminous coal ranks just below anthracite in quality and is especially suitable for steam engines that powered trains and riverboats.

By 1897, production reached as much as 600 tons per day (Figure 1.5), helping fuel the industrialization of northeastern Mexico and sustaining communities built around mining. While most mines shut down by the mid-20th century, coal continues to be mined across the border in Piedras Negras for electricity generation.

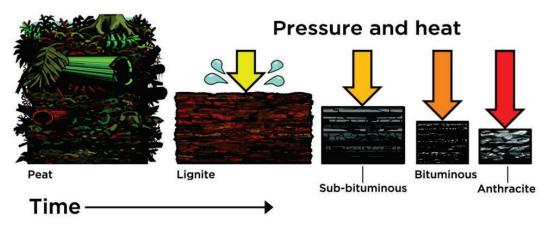


Figure 1.3. Coal formation starts with peat and with prolonged exposure to pressure and heat under anoxic conditions it compacts and turns into coal.

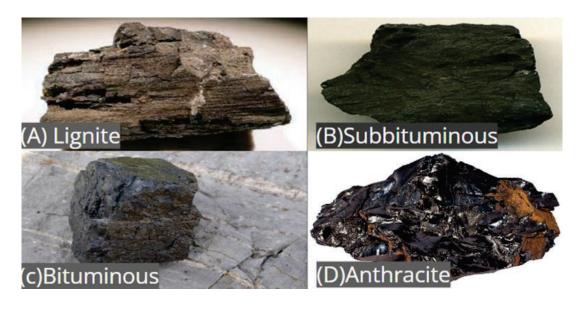


Figure 1.4. Four grades of coal



Figure 1.5. Old Santo Tomas Drift (horizontal access) Mine at Minera Circa 1890 (courtesy of the University of Texas at San Antonio Libraries Special Collections from the Institute of Texan Cultures)

Conclusion

The Eocene Epoch offers a fascinating chapter in the geological and ecological history of the Rio Grande Valley. During this time, South Texas was part of a warm, shallow sea with abundant marine life and rich inland environments that would eventually produce valuable natural resources.

Geological formations such as the Roma Sandstone and the coal beds of Zapata and Webb Counties tell a story of dynamic environmental change and resource use by ancient and modern communities. These resources not only reveal past climates and ecosystems but also played an essential role in the region's economic development during the 19th and 20th centuries.

Understanding the Eocene helps students and teachers appreciate the deep history beneath their feet—how the landscapes of today were shaped millions of years ago, and how those ancient environments continue to influence life in the Rio Grande Valley today.

Evidence for Eocene Rocks in the Rio Grande Valley

- 1. **Jackson Formation (Roma Sandstone)** Located in **Roma, Texas**, this formation features ripple marks, fossilized oyster beds, and marine burrows typical of Eocene coastal environments.
- Fossil Oyster Reefs Large oyster fossils embedded in sandstone and limestone layers throughout Starr and Zapata Counties offer strong evidence of ancient marine habitats.
- 3. **Bituminous Coal Deposits** Found in **Zapata and Webb Counties**, these coal layers originated from decayed plant material in freshwater lakes and swamps during the Eocene.

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Essay detailing the history of coal mining in Webb County during the late 19th and early 20th centuries. This source would be especially useful for students who want to research the history of coal mining in South Texas.

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This is an interactive map of the Rio Grande Valley created by the University of Texas Rio Grande Valley's CHAPS program. It contains QR codes to various websites and podcast episodes managed by the university on local historical sites around South Texas.

"Eocene Epoch". EVOLUTION. PBS. WGBH Educational Foundation and Clear Blue Sky Productions, Inc., 2002. Accessed on February 9, 2024. https://www.pbs.org/wgbh/evolution/change/deeptime/eocene.html

This website goes into detail about the fauna found in the Eocene era and the evolution of species during this epoch. It talks about how the drying and cooling trend happened in the Eocene and how animal migration continued to happen during this epoch.

"Evolution in the Cenozoic Era". *CK-12 College Human Biology*. FlexBooks 2.0. CK-12 Foundation. Accessed November 20, 2023. https://flexbooks.ck12.org/cbook/ck-12-college-human-biology-flexbook-2.0/section/6.9/primary/lesson/evolution-in-the-cenozoic-era-chumbio/

This is K-12-friendly information about the evolution in the Cenozoic era. On this website, you can find information about the Eocene. It also presents multiple choice questions at the end of the website for students to answer and it has educational YouTube videos attached at the bottom.

George, W. Eugene. Lost architecture of the Rio Grande borderlands (1st ed.). Texas A&M University Press, 2008.

A source that details the procedures and practices that masons of the lower Rio Grande Valley would employ in utilizing the Roma sandstone. These procedures also give light to connective points as these larger sandstone blocks would be held together by the ancient oysters.

González, Juan L., Roseann Bacha-Garza, Christopher L. Miller, and Russel K. Skowronek. Ancient Landscapes of South Texas: Hiding in Plain Sight. University of Texas Rio Grande Valley: Edinburg, TX, 2022.

This source is especially good for information concerning the formation of Roma sandstone. It provides in an easily accessible manner the information a student would need to understand how sandstone is formed and how it has been used in South Texas throughout history.

Palmer, A. R., and J. Geissman "The Eocene Epoch". *Geologic time scale*. University of California Museum of Paleontology, 2002. Accessed on February 9, 2024. https://ucmp.berkeley.edu/tertiary/eoc.html

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"Roma Historic District, Roma Texas". National Park Service. U.S. Department of the Interior. N.d. Accessed November 2023. https://www.nps.gov/nr/travel/american latino heritage/roma historic district.html

This excerpt from the website of the National Park Services provides a wealth of information illuminating the historic stages of the city of Roma. With information spanning from the settling of the area to the explanations of the unique architecture that may be found in Roma.

Strauss, Bob. "Prehistoric Life During the Eocene Epoch." ThoughtCo, August 16, 2019. Accessed November 20, 2023. https://www.thoughtco.com/the-eocene-epoch-1091365

This article talks about the climate in the Eocene and describes the terrestrial life of the Eocene. It also mentions how some marine life started to evolve during this epoch and describes the plant life in the Eocene.

Warwick, P. D., Hook, R. W., & SanFilipo, J. R.. Tertiary coals in South Texas: Anomalous cannel-like coals of Webb County (Claiborne Group, Eocene) and lignites of Atascosa County (Jackson Group, Eocene) (AAPG - EMD Field Trip, April 14-15, 1999). United States Geological Survey, 2019. Accessed November 2023. https://pubs.usgs.gov/pdf/of/ofr99301/introduction.pdf.

NOTES

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2. South Texas During the Oligocene

Lesson objective: The learner will be able to identify the unique geological features and natural resources of the Oligocene epoch in South Texas.

Explore	Your Task
Explore the Oligocene with these online videos:	Possible resources: Have students respond in a text box to questions about the video. An icon such as `\ lets students know they are expected
Oligocene Epoch - Florida Fossils: Evolution of Life and Land	to write/type something (example below).
Explified – The Oligocene Era	•
PBS Eons - The Rise and Fall of the Tallest Mammal to Walk the Earth	For middle and high school, having students respond in a <u>Google Form</u> or with a <u>K-W-L activity</u> helps with workflow.

Explain	Your Task
Explain the Oligocene in South Texas using these reading and vocabulary resources: <u>Ancient Landscapes – The Oligocene Epoch</u>	Post learning expectations for students. Will they take notes? Possibly share their thinking digitally or on paper? A 3-2-1 reflection or a Storyboard Activity would work here.
Fossil Horses – The Oligocene Epoch PBS evolution – The Oligocene Epoch	Give students feedback during this task either digitally or in person. Possibly give students the opportunity to give feedback to one another as well.

Original template created by HyperDocs LLC modified by Karly Moura

Apply & Share	Your Task
Have students review the vocabulary of the Oligocene epoch with the following games and resources!	Include expectations for student play. This could include due dates, links to review resources, and instructions for turning work in (take screenshot of grade, follow link on Google Classroom, etc.).
Blooket - The Oligocene	grade, follow link of coogle classicom, cto.).
Review Gimkit - The	Give students feedback during this task either digitally or in person. Possibly give students the opportunity to give feedback to one another as
Oligocene Epoch	well.
Quizlet – Ancient Landscapes: The Oligocene Epoch	Possible resources: Include a link to a Show What you know BINGO board and have students practice their new vocabulary in the classroom!

********OPTIONAL******

Connect & Extend	Your Task
Explorations Through Time: A series of interactive modules that explore the history of life on Earth, while focusing on the processes of science. Each module contains suggested lesson plans and an extensive teacher's guide. EXPLORATIONS THROUGH TIME is a project of the University of California Museum of Paleontology.	Add instructions or expectations for their extension activity. Possible resources: Have students paste an image of how their game develops in a box like the one in the example below. An icon such as lets students know they are expected to paste and image of something. For middle and high school having students respond in a Google Form helps with workflow. You can also use any of the templates in this Exit Ticket Builder to gauge student knowledge after the lesson!

^{**} Don't forget to have your students SHARE and REFLECT on their learning during and/or after! Good old Think-Pair-Share and Turn and Talk is still important during tech time!

Ancient Landscapes of South Texas: The Oligocene Epoch

Imagine traveling back in time to South Texas about 30 million years ago. You'd see a very different world! This was during a time called the Oligocene epoch, which lasted from about 34 to 23 million years ago.

During this time, South Texas looked nothing like it does today:

- Instead of dry scrubland, there were huge grasslands.
- Giant horses and elephants with short trunks roamed the land.
- The Gulf of Mexico's coast was much further inland than it is now.

About 27 million years ago, something amazing happened. A massive volcano in Mexico erupted! It sent tons of ash into the air, which fell like snow over South



Image 1- The Rio Grande Valley was covered in huge grasslands during most of the Oligocene!

Texas. This ash covered everything - trees, animals, and the whole landscape - in a thick blanket up to 60 feet deep!

This volcanic eruption changed South Texas forever. Here's what happened:

- 1. The ash hardened into a special kind of rock called the Catahoula Formation.
- 2. Trees buried under the ash slowly turned into stone. This "petrified wood" is now the official state stone of Texas!
- 3. The ash brought uranium to the area, which is now mined as a valuable resource.
- 4. A unique type of rock called El Sauz chert formed from the ash. Native Americans used this to make tools for thousands of years.
- 5. In modern times, people have used the ash to make bricks and even to help build Falcon Dam on the Rio Grande.



Image 2- Check out this picture of a petrified log!

Scientists study these rocks and fossils to learn about what South Texas was like millions of years ago. It's like putting together pieces of a really old puzzle!

By looking at petrified wood, ancient animal bones, and different types of rocks, we can imagine what it was like to stand in South Texas during the Oligocene epoch. It's amazing to think that all of this history is right under our feet!

Image 3 - Today El Sauz chert can be found in different parts of Starr County!

Multiple Choice Questions:

- 1. How long ago did the Oligocene epoch occur?
 - a) 3-2 million years ago
 - b) 34-23 million years ago
 - c) 100-90 million years ago
 - d) 1-0.5 million years ago
- 2. What major event changed the landscape of South Texas about 27 million years ago?

- a) A hurricane
- b) An earthquake
- c) A volcanic eruption
- d) An ice age

- 3. What is the official state stone of Texas that formed from buried trees?
 - a) Granite
 - b) Limestone
 - c) Marble
 - d) Petrified wood
- 4. What special type of rock formed from the volcanic ash and was used by Native Americans to make tools?
 - a) Sandstone
 - b) Obsidian
 - c) El Sauz chert
 - d) Quartz
- 5. How has the volcanic ash from the Oligocene been used in modern times?
 - a) To make computer chips
 - b) To create solar panels
 - c) To build roads
 - d) To make bricks and help build Falcon Dam

Ancient Landscapes of South Texas: The Oligocene Epoch

Fill in t	the Blank:
	Word Bank:
	Catahoula, grasslands, millions, Petrified, Sixty, 34, 23
	The Oligocene epoch lasted from about to million years ago.
	During the Oligocene, South Texas was covered in hugeinstead of dry scrubland.
	A massive volcanic eruption about 27 million years ago covered South Texas with ash up to feet deep.
	The hardened volcanic ash formed a special kind of rock called the Formation.
	wood, which is now the official state stone of Texas, was formed when trees were buried under volcanic ash.
	Scientists study rocks and fossils from the Oligocene to learn about what South Texas was like of years ago.
How d	-Ended Question: lid the volcanic eruption 27 million years ago change the landscape of South? Give two examples from the reading.

The Amazing Catahoula Volcanic Ash

Have you ever heard of the Catahoula Formation? It's a really cool layer of volcanic ash that you can find in parts of North America. This ash comes from a huge volcanic eruption that happened about 27.4 million years ago!



Imagine a volcano in Mexico exploding with so much force that

it sent ash flying into the air. This ash then fell to the ground, covering a huge area. It spread from northern Mexico into South Texas and all the way to Alabama. The ash layer is about 20 meters deep - that's as tall as a six-story building!

Scientists have studied this ash and found something interesting. The ash is the same from top to bottom, which means it probably all fell during one big event. It's like the volcano had one massive eruption instead of many small ones.

One of the coolest things about this ash is what it did to the forests it covered. The ash protected trees from rotting away like they normally would. Instead, over millions of years, the wood turned into stone! This is called petrified wood. The ash created perfect conditions for this to happen.





In Texas, they even found petrified palm trees. These are so special that petrified palm is now the official rock of Texas! You can find lots of petrified wood in a place called Starr County.

People have been using this petrified wood for a long time. Ancient Native Americans used it to make tools and arrowheads. They found that it was great for making sharp points. More recently, people have used pieces of petrified wood to decorate buildings. You can see it in some old churches in Texas, like Our Lady of Refuge in Roma and Our Lady of Lourdes Grotto in Rio Grande City.

Today, scientists are still studying the Catahoula Volcanic Ash. It helps them learn about what the Earth was like millions of years ago. They can discover what kinds of plants and animals lived back then, and how big volcanic eruptions can change the environment.

The next time you're in Texas or nearby states, keep an eye out for petrified wood. You might be looking at a piece of a forest that was alive millions of years ago, turned to stone by an ancient volcanic eruption!



Open-Ended Question:

Imagine you're a scientist studying the Catahoula Volcanic Ash. What are three things you would want to learn from this ash layer, and how might this information		
be useful today?		

The Amazing Catahoula Volcanic Ash

Multiple Choice Questions:

- 1. How old is the Catahoula Volcanic Ash?
 - a) 2.74 million years
 - b) 27.4 million years
 - c) 274 million years
 - d) 2.74 billion years
- 2. How deep is the Catahoula Formation ash layer?
 - a) 2 meters
 - b) 10 meters
 - c) 20 meters
 - d) 100 meters
- 3. Where did the volcanic eruption that created the ash likely occur?
 - a) Texas
 - b) Alabama
 - c) Mexico
 - d) Canada
- 4. What is petrified wood?
 - a) Wood that has been burned
 - b) Wood that has turned to stone
 - c) Wood that has been painted
 - d) Wood that has been frozen
- 5. What is the official rock of Texas mentioned in the summary?
 - a) Petrified oak
 - b) Petrified pine
 - c) Petrified palm
 - d) Petrified maple
- 6. In which county is petrified wood commonly found?
 - a) Palm County
 - b) Ash County
 - c) Starr County
 - d) Wood County
- 7. What did ancient Native Americans use petrified wood for?
 - a) Building houses
 - b) Making tools and arrowheads
 - c) Creating art
 - d) Cooking food

8.	How have people used petrified wood in recent times? a) As fuel for fires b) To make furniture c) To decorate buildings d) To pave roads
9.	What does the uniformity of the ash layer suggest? a) The volcano erupted multiple times b) The volcano had one massive eruption c) The ash fell over thousands of years d) The ash came from different volcanoes
10.	How tall is the ash layer compared to a building?
	a) As tall as a one-story house
	b) As tall as a three-story building
	c) As tall as a six-story building
	d) As tall as a skyscraper
ll In	The Blank:
	Word Bank:
	Petrified palm, Alabama, 27.4, stone, 20
1.	The Catahoula Formation is a layer of volcanic ash that is about meters deep.
2.	The volcanic eruption that created the Catahoula Formation happened

3. The ash layer spread from northern Mexico into South Texas and all the way

is the official rock of Texas, which was

, which is also known as petrified wood.

4. Over millions of years, the wood covered by the ash turned into

formed from trees buried by the volcanic ash.

5.

Lesson 2: Ancient Landscapes of South Texas during the Oligocene Epoch

Robert Paul Del Barrio, Jorge Alanis, April Rich, Mark Castillo, and Sara Garcia

Introduction

The Oligocene is the last Epoch of the Paleogene Period; it follows the Eocene Epoch, preceding the Miocene, the first Epoch of the Neogene Period (Figure 2.1). It lasted from 33.9 to 23 million years ago. During this time, the Earth experienced cooler and drier climates compared to the earlier Eocene. Vast grasslands began to spread across parts of the world, supporting new types of animals such as early elephants with trunks, giant horses, and early species of deer and camels.

In South Texas, the Oligocene was a time of dramatic change. What is now the Rio Grande Valley was once along the ancient Gulf of Mexico's shoreline. This area was covered in lush coastal forests, including sabal palms. Around 27.4 million years ago, a violent volcanic eruption in what is now Mexico sent a massive ash cloud across the region, transforming its landscape and preserving parts of it in remarkable ways.

This section will help educators explain why the Oligocene period is important to South Texas. During this time, distant volcanic eruptions deposited thick layers of volcanic ash across the region. Ancient forests were buried and preserved, with some trees turning to stone through petrification. Valuable minerals like uranium were also formed during this time, and they are still used in modern technologies. These ancient geologic events shaped the South Texas landscape and continue to influence the region's history, science, and culture today.

EONS	ERAS	PERIODS	Subperiods or EPOCHS	Geochronometric Ages
			HOLOCENE	11,700 years ago
	CENOZOIC	QUATERNARY	PLEISTOCENE	2.58 MYA
		NEOGENE	PLIOCENE	5.33 MYA
			MIOCENE	23.03 MYA
		PALEOGENE	OLIGOCENE	33.9 MYA
			EOCENE	56.0 MYA
			PALEOCENE	66.0 MYA
	MESOZOIC	CRETACEOUS		145 MYA
PHANEROZOIC		JURASSIC		
		Operation Control		201 MYA
l l		TRIASSIC		252 MYA
	PALEOZOIC	PERMIAN		299 MYA
		CARBONIFEROUS	Pennsylvanian Subperior Missississippian Subperior	359 MYA
		DEVONIAN		419 MYA
		SILURIAN	İ	444 MYA
			İ	0.0.0000000
		ORDOVICIAN	l	485 MYA
		CAMBRIAN		541 Million Years Ago
			•	
Charles Market And Delication of the				
PROTEROZOIC				
				2.5 Billion Years Ago
ADCHEAN				
ARCHEAN				4.0 Billion Years Ago
HADEAN				~4.6 Billion Years Ago

Figure 2.1. Simplified version of the Geologic Time Scale, showing all epochs of the Cenozoic Era

The Catahoula Volcanic Ash

One of the most significant geologic features from this period in what is now the Rio Grande Valley is the Catahoula Volcanic Ash, part of the larger Catahoula Formation. This thick layer of volcanic ash extends from northern Mexico through South Texas and eastward to Alabama (Figure 2.2).

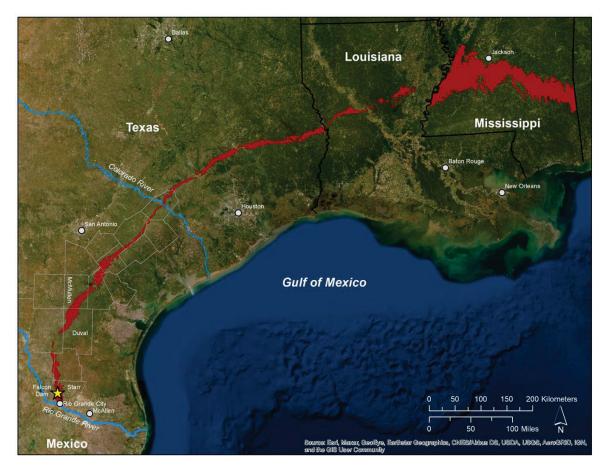


Figure 2.2. Satellite image of the northwestern Gulf of Mexico showing the extent of the Oligocene Catahoula Formation. Overlaid on the map are the counties in South Texas that are part of the South Texas Uranium province.

The ash is believed to have originated from a massive volcanic eruption in the Sierra Madre Occidental of Mexico, approximately 500 kilometers to the southwest. Carried eastward by high-altitude winds, the ash was dispersed widely and eventually settled over the region, including what is today Rio Grande City. The area was a coastal setting along the Gulf of Mexico covered by a maritime forest.

Within a short span, likely a few weeks to a few months, the falling ash buried the local forest under roughly 60 feet of volcanic material (Figure 2.3), dramatically altering the landscape.

Geochemical analysis of the ash layer has shown that its chemical composition is consistent from top to bottom. This uniformity strongly suggests it resulted from a single, catastrophic volcanic event.



Figure 2.3. Outcrop of the Catahoula Volcanic ash in Rio Grande City. At this location, the thickness of volcanic ash is 60 feet.

Petrified Wood and Ancient Forests

When the ash covered South Texas, it buried the coastal forests, creating perfect conditions for petrification. Trees that would normally rot were instead preserved as petrified wood when the organic material was slowly replaced with minerals like quartz and silica. This process, called silicification, takes millions of years.

Today, petrified wood from the Oligocene can be found in places like Starr County. Indigenous peoples used this stone to make tools, and in modern times, petrified logs have been used in architecture, such as fences, church grottos, and home decorations. One notable example is the Peña House in Roma, Texas, where whole petrified tree trunks form a fence.

Uranium in the Catahoula Formation

As volcanic ash formed in the magma chamber of a distant volcano, it trapped uranium atoms that were transported with the ash. Once the ash was deposited, groundwater remobilized the uranium from the ash into the surrounding rock layers over millions of years. Over time, this uranium collected and formed valuable deposits.

By 1954, large uranium deposits were discovered across South Texas, particularly in Starr, Webb, Jim Hogg, and Duval counties. These deposits became part of the South Texas Uranium Province, which covers 20 counties (Figure 2.2).

Mining began in the 1950s, and in-situ recovery methods are still used today. This process dissolves the uranium underground and brings it to the surface for processing. Though some mines have been abandoned, companies like Encore Energy continue to operate in the region. Restoration of mined lands is managed by agencies such as the U.S. Department of the Interior and the Texas Parks and Wildlife Department, with care taken to protect historical and environmental resources.

El Sauz Chert: A Unique Rock

As water moved through the volcanic ash, it carried silica and uranium oxides, which helped form a rare rock called El Sauz Chert. Unlike ocean-formed cherts, this one formed on land and is chemically unique. El Sauz Chert is usually light gray but may also appear in colors like red, orange, pink, or green.

It has a fine texture and can sometimes contain small glowing uranium veins. Indigenous peoples used this rock to make tools for thousands of years. Today, archaeologists have identified quarry sites in Starr County where this rock was collected and used for over 10,000 years.

Roman Concrete in the Rio Grande Valley?

The weathered Catahoula volcanic ash proved to be a valuable resource for making pozzolan, an essential ingredient in Roman-style concrete. When mixed with lime and other materials, pozzolan produces a strong and durable concrete, one of the reasons many ancient Roman structures have stood for over 2,000 years.

During the mid-20th century, local companies in South Texas mined this ash to manufacture bricks and pozzolanic cement. One notable project that used this material was the construction of Falcon Dam (Figure 2.4), completed in 1954 and officially dedicated by U.S. President Dwight D. Eisenhower and Mexican President Adolfo Ruiz Cortines.

Evidence for the Oligocene rocks and fossils in the Rio Grande Valley

Today, scientists and educators can observe clear evidence of the Oligocene in the Rio Grande Valley:

- Catahoula Formation: Ash layers are still visible in outcrops near Rio Grande City and other parts of Starr County.
- **Petrified Forests**: Petrified wood and palm, especially in Starr County, give insight into ancient coastal forests.
- **Uranium Deposits**: Traces of uranium, both in rock and groundwater, help geologists understand how elements moved after the eruption.
- **El Sauz Chert**: Unique chert deposits show how volcanic ash transformed into a useful toolstone.
- **Brickmaking and Pozzolan Mining**: Historical use of Catahoula ash in construction connects ancient geology with modern engineering.

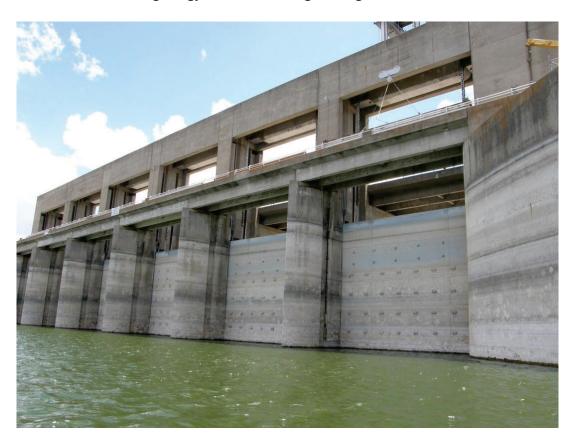


Figure 2.4. Image of Falcon Dam. Catahoula volcanic ash was used as pozzolan to give strength to the concrete

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https://www.utrgv.edu/ancient-landscapes-southtexas/landscapes/27-mya-catahoula-volcanic-ash/index.htm, accessed November 15, 2023.

Information gathered here will provide the reader with information regarding Catahoula volcanic ash. One of our region's most unique and important aspects is that its materials contain silica and traces of uranium that would eventually be mind and utilized as a resource in the region.

Cook, Scott 1998 *Mexican Brick Culture in the Building of Texas*, *1800s-1980s*. Texas A&M University Press, College Station.

González, Juan L., Roseann Bacha-Garza, Christopher L. Miller, and Russel K. Skowronek. Ancient Landscapes of South Texas: Hiding in Plain Sight. University of Texas Rio Grande Valley: Edinburg, TX, 2022.

The chapters that discuss the Catahoula Ash and El Sauz Chert were utilized to refer to information that led to the presence of uranium in the Rio Grande Valley. This book provides more detailed information about the zircon crystals and the groundwater in the area.

Websites

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https://www.cdc.gov/nceh/radiation/emergencies/isotopes/uranium.htm#:~:text=Whatw20is%20it%20used%20for,be%20used%20in%20nuclear%20weapons.

11/12/2013

This article helps break down and show people what uranium is, how it is used, and if it is dangerous to you.

Communications and publishing estimates of potential Uranium in South Texas Could Equal Five years of U.S. Need. DENVER, CO USGS Science for a changing world. https://www.usgs.gov/news/national-news-release/estimates-potential-uranium-south-texas-could-equal-five-years-us-needs. 11/7/2023

This is a great source because it tells me where the uranium deposits are in Texas and how many mines are in operation.

Emily Osterloff, Natural History Museum, The 330-million-year-old fossil tree that's stood the test of time, https://www.nhm.ac.uk/discover/the-fossil-tree.html#:~:text=Scientists%20can%20use%20these%20specimens,the%20future%20of%20our%20planet. 11/13/2023

This article helped me understand how to clean and care for petrified wood; it even talked about how strong and heavy these stones are.

enCore Energy Corporation. (2023, September 20). *South Texas Facilities*. enCore Energy. https://encoreuranium.com/projects/south-texas-facilities/

This website explains what uranium processing plants and mines still operate in South Texas. As well as when these mines first opened, how much uranium is collected every year from these plants, and what we will likely see collected in the future.

Geology Page 2016Oligocene Epoch. Geology Page.

https://www.geologypage.com/2014/04/oligocene-epoch.html, accessed November 12, 2023.

This source is useful for taking a deeper dive into the Oligocene Epoch. The site contains more information on the geological time scale, the relations of each epoch, and how they affect each other.

Great High Praire, https://thegreathighprairie.com/petrified-wood-

building/#:~:text=Not%20only%20is%20the%20building,hardwood%20floor%20in%20the%20world. 11/6/2023

This is a great source because it gave me information on how people view things that time have altered into something else and how people wish to share it with other people. It even gave me a glimpse into a new way that petrified wood could be used, which is an attraction.

Hoye Eargle, D. 1970 *USGS Publications Warehouse*. Uranium in Texas. Pg. (5-40) https://pubs.usgs.gov/of//1388MP/report.pdf

It has included this reference because it shows that a government body officially recognized the significance of uranium in South Texas as far back as the 1970s. The document mentions that the uranium found in South Texas could be dated back to the Oligocene.

King, Hobart M. N.d. What Is Petrified Wood? How Does It Form? Geology. https://geology.com/stories/13/petrified-wood/, accessed November 11, 2023.

This source gives detailed information on petrified wood and its components. The website includes information on how this fossil is formed and different places it can be found.

Kiffel-Alcheh, Jamie 2021 Petrified Forest National Park. Nature. National Geographic Kids. https://kids.nationalgeographic.com/nature/article/petrifiedforest, accessed November 13, 2023

This short article talks about Petrified Forest National Park and how wood petrifies when it is covered with Ash and is slowly replaced with silica. This article has an attached video aimed at a younger audience; the video is 4 minutes long and explains how an entire forest can suddenly be covered in Ash and petrified over time.

Reger, Brandi, Juan L. Gonzalez, and Russell K. Skowronek

2020 Lithic Raw Materials in the Lower Rio Grande Valley, South Texas, and Northeast Mexico. *Lithic Technology*

https://www.tandfonline.com/action/showCitFormats?doi=10.1080/01977261.2020.1765109

Ancient Landscapes of South Texas website housed at the University of Texas Rio Grande Valley N.d. UTRGV—https://www.utrgv.edu/ancient-landscapes-southtexas/landscapes/27-mya-catahoula-volcanic-ash/catahoula-volcanic-ash/index.htm#:~:text=There%20is%20a%2060-foot-thick%20deposit%20known%20in%20the,large%20volume%20of%20volcanic%20ash%20into%20the%20atmosphere., accessed November 12, 2023.

The official CHAPS website was useful in giving a detailed account of the ancient Rio Grande Valley. The website is useful in gaining more information about different parts of the Valley.

Saxton, J. (2022, October 28). *Rio Grande Resources Corporation – panna maria*. NRC Web. https://www.nrc.gov/info-finder/decommissioning/uranium/rio-grande-resources-corp.html

This short website highlights a uranium mine in Hobbson, Texas, located near the San Antonio River and operated until 1993. The license to process waste from uranium operations was revoked and instead proceeded with the reclamation of the land, which is now under the Texas Commission on Environmental Quality.

Video

Falcon Dam Proves Itself 2016 YouTube, YouTube.

https://www.youtube.com/watch?v=vAGKkB18fSY, accessed November 12, 2023.

This short film from the National Archives shows real footage of the dam and its construction. The video also shows how the community banded together during a natural disaster.

Gretlein, C. (2018, July 18). Railroad Commission of Texas. (2018). *Abandoned Mine Lands: Restoring Texas Beauty. YouTube*. Retrieved November 02, 2023, from https://youtu.be/Tt6wN8H9tHo?si=iKdaeu6O6VZKuAKs.

This reference provides information about South Texas's abandoned old uranium mines in Falls City by the San Antonio River. These uranium mines are being restored to a natural landscape after having determined that they carried high levels of uranium in the area due to the mines.

Keto, Eric, dir. 2017 What Is Volcanic Ash Made Of? YouTube. Alaska's Energy Desk. https://www.youtube.com/watch?v=SpY2gBOruRU, accessed November 13, 2023. This is a short 2-minute video about a volcanic eruption in Alaska, discussing what volcanic Ash is and how it behaves. This video demonstrates how far volcanic Ash

can move in a short time and shows its various properties (clumps of rocks near the volcano and a fine powder as the ash cloud travels)

Petrified Palmwood 2017State Symbols USA—https://statesymbolsusa.org/symbol-official-item/texas/state-dinosaur-fossil-state-rock-mineral/petrified-palmwood, accessed November 12, 2023.

This site was useful in finding information on the state stone and its significance. The interactive website allows you to enter any U.S. state to find each state stone.

Tashina J., U.S Department of Energy. (2020). Falls City, TX, Disposal Site (Office of Legacy Management Site Video). YouTube. Retrieved November 02, 2023, from https://youtu.be/AcVuav8rvjM?si=OGXh1xyjZHULPzuK
Included is a short video that discusses the presence of uranium mines in Texas, particularly the mine in Falls City, Texas, that operated from 1961-1973 due to public health hazard violations while these uranium mines were in operation.

The Oligocene Era 2022 YouTube. YouTube. https://www.youtube.com/watch?v=2QK2tSt41b0&t=8s, accessed November 15, 2023.

Information in this video provides a detailed description of the Oligocene Epoch and the types of animals that once roamed the North American continent. The video will give the information needed to gather a basic understanding of this epoch.

Articles

González, Juan L., James R. Hinthorne, Russell K. Skowronek, Thomas Eubanks, and Don Kumpe

2014 Characteristics and genesis of El Sauz chert, an important prehistoric lithic resource in south Texas. *Lithic Technology* 39(3):1-10.

Howard, Brian Clark 2021 Pictures: Volcano Covers Indonesian Cities with Ash. National Geographic. National Geographic.

https://www.nationalgeographic.com/science/article/140214-mount-kelud-volcano-eruption-indonesia-ash-science, accessed November 13, 2023.

An article discussed a 2014 volcanic eruption in Indonesia that covered entire cities and towns, and 100,000 people had to be evacuated from their homes to avoid the Ash. This article shows how quickly a volcanic eruption can occur and how far Ash can move and deposit itself after an eruption. It also contains photos of the incident and helpful maps showing how far the Ash moved.

Natalie Graham, A Closer Look at Petrified Wood, published on gemstones.com. https://www.gemstones.com/articles/gemstone-petrified-wood 11/13/2023

This article helps readers understand the difference between petrified wood and normal rock.

N.d.Texas Water Development Board.

https://www.twdb.texas.gov/surfacewater/rivers/reservoirs/falcon/index.asp, accessed November 12, 2023.

This citation is useful in gaining more historical context on Falcon Dam. The site gives deeper context on the dam's significance.

Strong, W.F. 2022 Falcon Lake, Now at Devastatingly Low Capacity, has a Storied History. Texas Standard. https://www.texasstandard.org/stories/texas-falcon-lake-dam-reservoir-history/, accessed November 12, 2023.

This article gives context to the communities affected by the dam's construction.

Raham, Fasi Ur 2018 Portland Pozzolana Cement - Manufacture, Properties and Uses. The Constructor. https://theconstructor.org/concrete/portland-pozzolana-cement/23161/, accessed November 12, 2023.

This citation is useful in understanding the type of cement that was used to construct Falcon Dam. The citation makes the connection to the Pozzolana cement along with the Volcanic Ash.



3. South Texas During the Pliocene

Lesson objective: The learner will be able to identify the unique geological features and natural resources of the Pliocene epoch in South Texas.

Explore	Your Task
Explore the Pliocene with these online videos:	Possible resources: Have students respond in a text box to questions about the video. An icon
When We First Walked PBS Eons	such as . lets students know they are expected to write/type something (example below).
Mammoth Graveyard PBS Great Mammoth Mystery	•
Hagerman Fossil Beds National Monument Discovery Education	For middle and high school, having students respond in a <u>Google Form</u> or on a <u>Padlet</u> helps
The Rocky Mountains and the Rio Grande: Colonies and Native Homes Discovery Education	with workflow. (example below). Video Questions: When We First Walked PBS Eons

Explain	Your Task
Explain the Pliocene in South Texas using these reading and vocabulary resources:	Post learning expectations for students. Will they take notes? Possibly share their thinking digitally or on paper? A 3-2-1 reflection would
Ancient Landscapes Pliocene Epoch Readings and Worksheets	work here.
Podcast Episode The Goliad Gravels	Give students feedback during this task either digitally or in person. Possibly give students the opportunity to give feedback to one another as
Rio Grande River Reading Comprehension Activity and Quiz	well.

Apply & Share	Your Task
Students are expected to create original works responding to the materials they reviewed on the Pliocene epoch. Post instructions for the method students will	Include expectations for student creations. This could include due dates, links to rubrics, and instructions for turning work in.
be using to apply their knowledge from the lesson and for them to share with an authentic audience.	Give students feedback during this task either digitally or in person. Possibly give students the opportunity to give feedback to one another as well.
Video Prompt: What do landmarks like the Rio Grande River and the Goliad Gravels teach us about the Pliocene Epoch?	Possible resources: Have students share their work on Wakelet or in a collaborative slides presentation. Students can give feedback to one another by using the commenting feature in Padlet and
Possible resources for sharing: Google Drawing, Wakelet, Collaborative Google Slides, Adobe Express	slides or by recording a response.

********OPTIONAL******

Connect & Extend	Your Task
Project-Based Learning activities are a great way for students to continue their independent exploration of topics from the lesson that they really connected with. Consider the following ideas on how to integrate project-based learning into your lesson on the Pliocene epoch: Extension Activity Pliocene Epoch Choice Board	Add instructions or expectations for their extension activity. Possible resources: Have students paste an image of what they created at the end of their project in a box like the one in the example below. An icon such as lets students know they are expected to paste and image of something. For middle and high school having students respond in a Google Form helps with workflow. (example below). All finished? Now add your (image, video, creation) to this form. (link to form).

^{**} Don't forget to have your students SHARE and REFLECT on their learning during and/or after!

Good old Think-Pair-Share and Turn and Talk is still important during tech time!

The Pliocene Epoch: Life on a Changing Earth

The **Pliocene Epoch**, which lasted from about 5.3 to 1.8 million years ago, was a time of big changes on Earth. The climate became cooler and drier. A new **land bridge** formed between North and South America, letting animals travel between the **continents** and separating the Atlantic and Pacific Oceans. In the north, **cold-tolerant plants** like sedges, mosses, and lichens spread across the tundra, while **forests** of evergreens grew in slightly warmer areas. Closer to the equator, **grasslands** expanded with fewer trees. These changes created new environments but also meant there was less food and fewer types of animals.



During the Pliocene, the first humanlike primates, called **hominids**, appeared in eastern Africa. These early hominids had large brains, walked on two legs, and probably lived in groups near forests. Some even made and used simple **tools**. Around this time, many large animals like elephants, horses, and huge sloths lived on the **continents**. They had to survive tough conditions and face dangerous predators like saber-toothed cats. By the end of the Pliocene, the first **global ice ages** began, covering the poles with ice and leading to cycles of glaciers spreading and retreating.

Fill in the Blank: Fill in the blank with the correct words.

Word bank:

drier, two legs, North America, hominids, cooler, South America, 5.3

- 1. The Pliocene Epoch lasted from about _____ million years ago to 1.8 million years ago.
- 2. The land bridge that formed during the Pliocene connected with .
- 3. In the Pliocene, early humanlike primates called _____evolved in eastern Africa.
- 4. During the Pliocene, the climate became _____ and
- 5. One adaptation of hominids was that they could walk upright on

Multiple Choice Questions: Choose the correct answer from the choices for each question.

- 6. What was one effect of the land bridge that formed during the Pliocene?
 - o A) It caused more rainfall
 - o B) It allowed animals to move between continents
 - o C) It made the oceans warmer
 - o D) It created new mountains
- 7. What important adaptation did hominids have?
 - o A) Flying
 - o B) Living underwater
 - o C) Walking on two legs
 - o D) Growing wings
- 8. When did the first global ice ages begin?
 - o A) About 10 million years ago
 - o B) About 2 million years ago
 - o C) About 5.3 million years ago
 - o D) About 1,000 years ago

	n-Ended Questions: Answer the following questions in complete ences.
sent	ences.
Desc	ribe how the climate changed during the Pliocene Epoch.
Why	was the ability to walk on two legs helpful for early hominids?
Nam	e one predator and one herbivore that lived during the Pliocene Epoch
and e	explain how they survived.

ANSWER KEY (Teachers: Please review the answers below for accuracy.)

Fill in the Blank

5.3

North America, South America

hominids

cooler, drier

two legs

Multiple Choice

- B) North America and South America
- B) It allowed animals to move between continents
- B) Sedges, mosses, and lichens
- C) Walking on two legs
- B) About 2 million years ago

Open-Ended Questions (Sample Answers)

The climate during the Pliocene became cooler and drier, with more ice at the poles and less rain in many areas.

Walking on two legs helped early hominids see over tall grass, travel more easily, and carry food or tools.

A saber-toothed cat was a predator that hunted other animals, while a giant ground sloth was a herbivore that survived by eating tough plants.

The Rio Grande: The Legendary River of the Southwest

Have you ever heard of a river that shapes entire lands and helps people survive? Meet the Rio Grande, one of North America's most legendary rivers! The Rio Grande starts its adventure high up in the snowy Rocky Mountains of Colorado: imagine a place so high that even in summer, there's still snow on the ground. This snow melts and becomes the very first drops of the Rio Grande, which then travels over 1,800 miles through mountains, deserts, and canyons.

As the river flows south, it winds through New Mexico and Texas, and even forms part of the border between the United States and Mexico. Along its path, the Rio



Grande is like a natural artist: it carves deep canyons and wide valleys into the earth. One of its most amazing creations is the Taos Gorge in New Mexico. In this spot, the river rushes between two giant, rocky cliffs that are taller than a 60-story building!

But the Rio Grande isn't just important for its beauty; it has always been a lifeline for people living nearby. Thousands of years ago, ancient Puebloan Peoples built their homes and farms along its banks. They depended on the river's floods to bring rich, dark soil that helped their crops grow. Sometimes, though, the river could be wild and unpredictable. It would overflow its banks, change direction, and even wash away anything in its path. Living close to the Rio Grande was both exciting and a little bit risky!

Today, the Rio Grande is still a superstar in the Southwest. Engineers built fifteen huge dams along the river to help control floods and make sure there's enough water for cities and farms. Even with all these changes, the Rio Grande still shows its power during big storms and hurricanes.

The Rio Grande is more than just a river. It is a living storybook! It tells the tale of ancient rocks, mighty floods, and people who have depended on its waters for thousands of years. The next time you see a river, think about the amazing journey of the Rio Grande and how it continues to shape the land and the lives of everyone who lives nearby!

Fill in the Blank: Fill in the blank with the correct words.

Word Bank:						
Pu	uebloan	1,800	dams	Rocky	Taos	

1.	The Rio Grande begins its jou	rney high up in the Mountains of
	Colorado.	
2.	The river travels over	miles through many kinds of land before
	reaching the Gulf of Mexico.	
3.	The	Gorge in New Mexico was carved by the Rio Grande
	rushing between giant cliffs.	
4.	Ancient	Peoples depended on the river's floods to bring rich
	soil for their crops.	
5.	Engineers built fifteen huge _	along the Rio Grande to help control
	its water.	

Multiple Choice Questions: Choose the correct answer from the choices for each question.

Where does the Rio Grande begin?

- A. In the deserts of Texas
- B. In the Rocky Mountains of Colorado
- C. In the Gulf of Mexico
- D. In the forests of New Mexico

What is one way the Rio Grande has shaped the land?

- A. By building bridges
- B. By carving canyons and valleys
- C. By planting trees
- D. By moving cities

Who depended on the Rio Grande's floods for farming long ago?

- A. Cowboys
- B. Ancient Puebloan Peoples
- C. Explorers
- D. Tourists

Why did people build dams on the Rio Grande?

- A. To make the river longer
- B. To catch fish
- C. To control floods and provide water

D. To create beaches

Open-Ended Ques	stions: Answer the following questions in complete sentences.
Why do you think ago?	the Rio Grande was both helpful and risky for people living near it long
Describe one way	the Rio Grande has changed the land as it flows through the Southwest.
How does the Rio	Grande continue to be important for people today?

ANSWER KEY

Fill in the Blank:

- 1. Rocky
- 2. 1,800
- 3. Taos
- 4. Puebloan
- 5. dams

Multiple Choice Questions:

- B. In the Rocky Mountains of Colorado
- B. By carving canyons and valleys
- B. Ancient Puebloan Peoples
- C. A deep canyon in New Mexico
- C. To control floods and provide water

Open-Ended Questions (example responses):

- The Rio Grande was helpful because it brought rich soil for farming, but it was risky because it could flood suddenly and wash everything away.
- The Rio Grande has carved deep canyons, like the Taos Gorge, and wide valleys as it flows through the land.
- The Rio Grande is still important because it supplies water to people and farms and helps control flooding with its dams.
- Teachers: Please review all answers, especially open-ended responses, to ensure accuracy and alignment with your classroom expectations.

Lesson 3: Ancient Landscapes of South Texas during the Pliocene Epoch

Christopher Noe, Alex Suedan, Selena Treviño, and Alberto Rodriguez

Introduction to the Pliocene Epoch

The Pliocene Epoch, which lasted from approximately 5.3 to 2.6 million years ago, was a time of significant global and regional change. Geologically, this epoch marked a shift toward cooler and drier climates, the development of modern ecosystems, and the early shaping of the landscapes we see today in South Texas and the Rio Grande Valley (RGV).

In the Rio Grande Valley, the Pliocene saw the deposition of important geological formations such as the Goliad Gravels, a mixture of gravel, sand, and clay carried and deposited by the ancestral Rio Grande. These deposits became critical resources for early humans and remain visible in the landscape today.

The ancestral Rio Grande River itself began to take its modern path during the Pliocene. As a powerful river, it cut through bedrock and deposited sediment along its path, leaving behind a geological record of its activity and contributing to the eventual human settlement of the region.

Climate, Flora, and Fauna During the Pliocene

Globally, the Pliocene was a time of cooling compared to the warmer Miocene Epoch. In South Texas, the climate during this period was cooler and drier, resulting in the expansion of grasslands and open woodlands. This supported the migration and adaptation of grazing animals, such as ancient horses, camels, and early elephants (gomphotheres), along with predators like saber-toothed cats.

One of the most important events during the Pliocene was the formation of the Isthmus of Panama, which connected North and South America. This land bridge allowed animals to migrate between the continents. As a result, animals such as armadillos, ground sloths, and opossums moved northward into what is now Texas, while bears, cats, and horses traveled southward into South America.

The Rio Grande

The Rio Grande originates in the Rocky Mountains of Colorado. During the Pliocene, it was a powerful and rapidly flowing river, carrying rocks and sediment downstream from the high mountains through New Mexico and into South Texas. Over time, this river carved valleys, filled basins with sediment, and created rich floodplains that later supported both

wildlife and human life. The Rio Grande deposited rounded gravels and sands, in what are now western Hidalgo County and eastern Starr County. These deposits are part of the Goliad Gravels (Figure 1). The ancestral river had a different course when it deposited the gravels than its present course. It also had a steeper gradient that would have resulted in a fast-flowing river capable of transporting pebbles and cobbles as bedload.

Evidence of the Pliocene in the Rio Grande Valley The Goliad Gravels

Today, the Goliad Gravels are caliche (a form of inorganic limestone or calcium carbonate (CaCO3) that forms in areas with arid climates where evapotranspiration exceeds precipitation) cemented and form resistant bluffs, 3 to 25 feet thick, with steep faces (Figure 2). The gravels comprise a mixture of well-rounded pebbles and cobbles of multicolor chert (70%), volcanic rocks, silicified wood, quartzite, agate, and limestone.

Prehistoric peoples widely utilized the Goliad Gravels as a source of material for making stone tools. Archaeological sites in these areas often contain lithic debitage, the leftover fragments from toolmaking, demonstrating how these ancient materials were used in daily life.

The Uvalde Gravels

To the west in Zapata County, Pliocene gravels known as the Uvalde Gravels are also found. These gravels tend to appear on hilltops and terraces, consisting of small, rounded cobbles and pebbles. The presence of flakes and tools with weathered exteriors at archaeological sites suggests that early inhabitants gathered these gravels directly from the land and modified them for tools, especially near rivers and outcrops.

These gravels and fluvial (river-deposited) sediments not only tell the story of how the land was formed but also how humans used those natural features for survival.

How People Used Goliad Gravels

During prehistoric times, Goliad Gravels were one of the main sources of raw material for toolmaking. Early people shaped these stones into projectile points, and other tools essential for hunting and processing food (Figure 3). Today, the gravels are still valued for landscaping, for their natural colors and textures, for drainage and construction, and by rock collectors who tumble the stones to bring out their polished beauty (Figure 4)

The Pliocene Legacy in the RGV

The Pliocene Epoch left a lasting impact on the landscape, ecosystems, and human history of the Rio Grande Valley. The formation of the ancestral Rio Grande and the deposition of the Goliad Gravels shaped the region both physically and culturally.

These geological resources helped support early human life in the region by providing materials for tools and contributing to fertile floodplains. For teachers and students alike, exploring the Pliocene provides an opportunity to connect earth science to human history—and to understand how ancient landscapes continue to shape the lives of people today.

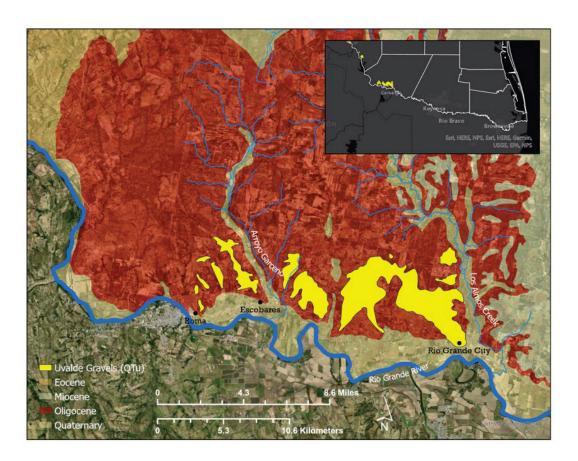


Figure 3.1 Generalized geologic map showing the patches of Goliad Gravel in Hidalgo County in yellow. The red unit represents the underlying Catahoula Formation. Image from authors' collection in collaboration with Sarah Fearnley Hardage.



Figure 3.2 An outcrop of the Goliad Gravels in Starr County. Image courtesy of the CHAPS Program at UTRGV.



Figure 3.3 Projectile points made from multicolor chert cobbles found in the Goliad Gravels. Image courtesy of the CHAPS Program at UTRGV.



 $Figure \ 3.4 \ Polished \ agates \ collected \ along \ road \ cuts \ that \ run \ on \ the \ Goliad \ Gravels. \ Image \ courtesy \ of \ Larry \ Ditto.$

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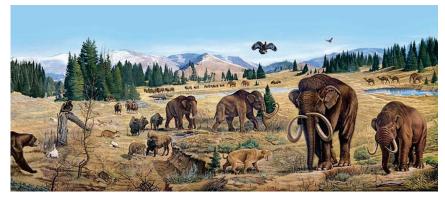
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NOTES

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4. South Texas During the Pleistocene

Lesson objective: The learner will be able to identify the unique geological features and natural resources of the Pleistocene epoch in South Texas.

Explore	Your Task	
Explore the Pleistocene with these online videos: Pleistocene Epoch - Florida Fossils: Evolution of Life and Land Wyoming PBS - Natural Trap Cave PBS - A Mammoth Surprise Prehistoric	Possible resources: Have students respond in a text box to questions about the video. An icon such as lets students know they are expected to write/type something (example below). For middle and high school, having students	
Road Trip	respond in a <u>Google Form</u> or with a <u>K-W-L activity</u> helps with workflow.	

Explain	Your Task
Explain the Pleistocene in South Texas using these reading and vocabulary resources:	Post learning expectations for students. Will they take notes? Possibly share their thinking digitally or on paper? A 3-2-1 reflection or a Storyboard Activity would work here.
Ancient Landscapes of South Texas: The Pleistocene Epoch	Give students feedback during this task either digitally or in person. Possibly give students the
Florida Museum of Natural History – The Pleistocene Epoch	opportunity to give feedback to one another as well.
PBS – Evolution: Pleistocene Epoch	

Apply & Share	Your Task
Post instructions for the method students will be using to apply their knowledge from the lesson and share with an authentic audience.	Include expectations for student play. This could include due dates, links to review resources such as this Quizlet resource, and instructions for turning work in (take screenshot of grade, follow link on Google Classroom, etc.).
Blooket Review: The Pleistocene in South Texas Poster Activity: Ancient Landscapes	Give students feedback during this task either digitally or in person. Possibly give students the opportunity to give feedback to one another as well.
<u>Pleistocene</u>	Possible resources: Include a link to a Show What you know BINGO board and have students practice their new vocabulary in the classroom!

********OPTIONAL******

Connect & Extend	Your Task
Move, Evolve, Go Extinct is a large group activity where students role-play as Ice Age mammals and model the Quaternary extinction. Students are tasked with evaluating animal adaptations and to discuss the various causes of extinction in order to advance and survive in this game. Indiana Geological & Water Survey –	Add instructions or expectations for their extension activity. Possible resources: Have students paste an image of how their game develops in a box like the one in the example below. An icon such as lets students know they are expected to paste and image of something.
"Move, Evolve, Go Extinct" game	For middle and high school having students respond in a Google Form helps with workflow. You can also use any of the templates in this Exit Ticket Builder to gauge student knowledge after the lesson!

^{**} Don't forget to have your students SHARE and REFLECT on their learning during and/or after! Good old Think-Pair-Share and Turn and Talk is still important during tech time!

Ancient Landscapes of South Texas: Journey Through the Pleistocene Wonderland

Imagine a time when the Rio Grande Valley was a vast, untamed wilderness - a land where giants roamed the earth! Welcome to the Pleistocene Epoch, a remarkable period of our planet's history that spanned from 2.6 million to 11,700 years ago.

Picture a landscape dominated by towering glaciers, carving deep troughs that would eventually become the Great Lakes. As these icy behemoths advanced and retreated, they transformed the southern regions into sprawling grasslands, known as "mammoth steppes." This oasis-like environment sustained a thriving ecosystem, supporting an incredible array of megafauna - from the mighty woolly mammoths and mastodons to the fearsome saber-toothed cats and giant ground sloths.

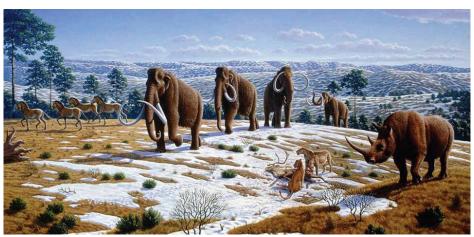


Figure 1: Pleistocene Megafauna in Beringia, National Park Service website.

Amidst the vast grasslands, pockets of gallery forests, lush with trees and vegetation, dotted the landscape. These linear ribbons of greenery along rivers and streams provided crucial resources and shelter for the Pleistocene creatures, creating a visually striking and ecologically vital aspect of the region.

Imagine stumbling upon the remains of these ancient giants - the fragmented bones, molars, and tusks that have been uncovered throughout the Rio Grande Valley. A shrimp boat's net snagging a mammoth femur, buried under 75 feet of water, or the discovery of a nest of giant gopher tortoise shells - these are the clues that paint a vivid picture of the Pleistocene past.

But the Pleistocene was more than just a time of incredible megafauna. It was also a period of dynamic change, as the climate fluctuated between frigid glacial periods and warmer interglacial eras. These environmental shifts shaped the landscape and influenced the behavior and distribution of the resident fauna, including the early human inhabitants of the region. So come with us on a journey through the Pleistocene wonderland of the Rio Grande Valley. Uncover the secrets of the past, and marvel at the resilience and diversity of the ancient creatures that once roamed this remarkable landscape. It's a story millions of years in the making, waiting to be discovered!

Fill-in-the-Blank Questions:

Word Bank:

2.6, 11,700, early human inhabitants, gallery, giant gopher tortoise, glacial, Great Lakes interglacial, mammoth, mammoth, mastodons, millions, resident fauna, saber-toothed cats woolly mammoths

	The Pleistocene Epoch spanned from million years ago ago.	o to years
	2. The towering glaciers during the Pleistocene carved deep troughs become the	that would eventually
	3. The vast grasslands of the Pleistocene, known as " a thriving ecosystem of megafauna.	steppes," supported
	4. The linear ribbons of greenery along rivers and streams were calle forests.	d
	5. A femur was discovered under 75 feet of water boat's net.	, snagged by a shrimp
6.	6. Researchers uncovered a nest of shells, the Pleistocene wildlife.	providing insights into
	7. The Pleistocene climate fluctuated between perioderas.	ds and
	8. The environmental shifts during the Pleistocene influenced the bel of and and	
9.	9. The Rio Grande Valley's Pleistocene past is a story	years in the making.
	10. The Pleistocene creatures that roamed the region included, and	,

Multiple Choice Questions:

- 1. The Pleistocene epoch spanned approximately how many years?
 - a. 1 million to 100,000 years ago
 - b. 2.6 million to 11,700 years ago
 - c. 10,000 to 1,000 years ago
 - d. 100,000 to 20,000 years ago
- 2. What type of landscape was characteristic of the Rio Grande Valley during the Pleistocene?

- a. Arid desert
- b. Dense rainforest
- c. Vast grasslands and gallery forests
- d. Mountainous terrain
- 3. Which of the following megafauna species is known to have inhabited the Rio Grande Valley during the Pleistocene?
 - a. Woolly rhinoceros
 - b. Saber-toothed cat
 - c. Giant ground sloth
 - d. All of the above
- 4. How did the glaciers during the Pleistocene affect the landscape of the Rio Grande Valley?
 - a. They melted, causing sea levels to rise
 - b. They carved deep troughs that formed the Great Lakes
 - c. They pushed the coastline further out into the Gulf of Mexico
 - d. They had no significant impact on the landscape
- 5. What purpose did the gallery forests serve in the Pleistocene landscape of the Rio Grande Valley?
 - a. They provided shelter and resources for the megafauna
 - b. They were used for agricultural purposes by early humans
 - c. They acted as barriers to prevent the spread of grassland fires
 - d. They were the main source of water for the region
- 6. What type of evidence has been found in the Rio Grande Valley that provides insights into the Pleistocene megafauna?

- a. Fossilized tracks and footprints
- b. Preserved nests and eggs of giant gopher tortoises
- c. Remains of large bones and teeth
- d. All of the above

7. What caused the sea levels to drop significantly during the Pleistocene glaciations?

- a. Increased evaporation from the oceans
- b. Tectonic plate movements
- c. Water being locked up in glaciers and ice sheets
- d. Volcanic activity and lava flows
- 8. Which of the following is NOT a characteristic of the Pleistocene landscape in the Rio Grande Valley?
 - a. Vast grasslands
 - b. Pockets of gallery forests
 - c. Tropical rainforests
 - d. Towering glaciers
- 9. How did the Pleistocene climate fluctuations influence the behavior and distribution of the resident fauna, including early human populations?
 - a. They had no significant impact
 - b. They caused the megafauna to migrate to more stable regions
 - c. They led to the extinction of all Pleistocene creatures
 - d. They shaped the landscape and resources available to the fauna and early humans
- 10. What is the overall message or theme conveyed in the summary about the Pleistocene epoch in the Rio Grande Valley?
 - a. It was a barren and inhospitable landscape
 - b. It was a period of ecological stability and minimal change
 - c. It was a "wonderland" of giant creatures and dynamic landscapes
 - d. It was a time of human expansion and technological advancement

Open-Ended Questions:

1. Describe the key characteristics of the Pleistocene landscape in the Rio Grande Valley, including the major features and the types of megafauna that inhabited the region.

2. Discuss the importance of preserved fossil evidence, such as mammoth remains and giant gopher tortoise nests, found in the Rio Grande Valley. How do they contribute to our understanding of the Pleistocene epoch?

Time Travel to the Ice Age: Exploring the Rio Grande Valley

Step into the Ice Age Adventure:

Welcome to the **Pleistocene Era**, also known as the "Ice Age," a thrilling period that took place from about 2.6 million years ago to around 11,700 years ago. Get ready to uncover the secrets of this icy time in Earth's history!

Chilling Adventures and Sea Mysteries:

Picture this: temperatures plummeted, massive ice sheets spread out, and about 30% of the Earth's surface was covered in ice during the **glacial** periods of the Pleistocene. This icy makeover led to lower sea levels, revealing hidden lands. Discoveries like mammoth bones found off the coast of South Padre Island are evidence of this huge change in our region's history!

Mystery of the Megafauna:

Meet the **megafauna** - giant creatures like mammoths, mastodons, and saber-toothed cats that roamed the Rio Grande Valley of South Texas during the Pleistocene. These colossal beasts ruled the land but mysteriously disappeared by the end of the era, leaving scientists puzzled about their extinction.



Discoveries in Dinosaur Valley:

In the Rio Grande Valley, fossil hunters have unearthed remnants of ancient animals like **mammoths**, **giant bison**, and even **giant gopher tortoises**. These exciting discoveries offer a peek into the vibrant wildlife that once roamed the valley thousands of years ago. Who knows what other treasures lie buried beneath our feet?

Journey through the Prehistoric Landscape:

If we could travel back in time to the Rio Grande Valley during the Pleistocene Era, we might see **grasslands** that stretched as far as the eye could see, dotted with lush **gallery forests** along rivers and streams. These unique ecosystems were home to a variety of megafauna, creating a vibrant and interconnected world.

Secrets of the Gallery Forests:

Gallery forests, with their strips of woodland along **waterways**, provided important habitats for Pleistocene creatures. These **riparian** areas not only offered shelter and food but also influenced the behavior of animals and early human populations, showcasing the deep connection between nature and culture.

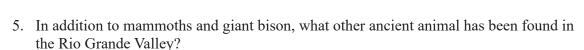
Unraveling the Mysteries of the Ice Age:

By delving into the adventures of grasslands, gallery forests, and ancient inhabitants, we unlock fascinating insights into the ecological wonders of this captivating period. Get ready for an unforgettable exploration of our prehistoric past!

Time Travel to the Ice Age: Exploring the Rio Grande Valley

Fill in the Blank: Fill in the blank with the correct words.						
				Bank:		
	glacial	huge	Ice A	1 ge	ruled	tortoises
1.	The Pleis	tocene Era, also kno ears ago to around 1	wn as the '	 s ago.	," took p	lace from about 2.6
2.	During the	ras covered in ice.	_periods of	f the Plei	istocene, about	30% of the Earth's
	Discoveri		ones found	off the c	oast of South P	adre Island are evidence
4.	Megafauı	na like mammoths, r	nastodons,			the
5.	Fossil hu		l remnants			nammoths, giant bison, ey.
Multi	ole Choice	Questions: Choose	e the corre	ct answ	er from the cho	oices for each question
1.	a) 2.b) 4.c) 1	tocene Era lasted fro 6 million to 11,700 y 6 million to 8,000 y million to 20,000 ye million to 15,000 ye	years ago ears ago	mately:		
2.	What per the Pleist a) 15 b) 30 c) 50 d) 75	ocene? 5% 0% 0%	's surface w	vas cove	red in ice during	g the glacial periods of
3.	a) Db) Mc) M	e of ancient animal l inosaurs lastodons lammoths aber-toothed cats	nas been di	scovered	off the coast of	f South Padre Island?
4.	Pleistocer a) M b) M	the following megane? [ammoths [astodons [aber-toothed cats]	fauna did r	ot roam	the Rio Grande	Valley during the

d) Velociraptors



- a) Giant sloths
- b) Giant gopher tortoises
- c) Giant ground sloths
- d) Giant armadillos

Open Ended Questions: Answer the following questions in complete sentences:

1.	Describe the unique ecosystems that existed in the Rio Grande Valley during the
	Pleistocene Era.

2. Explain the importance of gallery forests to the Pleistocene creatures that lived in the Rio Grande Valley.

3. What insights can we gain by studying the Pleistocene Era and the ancient inhabitants of the Rio Grande Valley?

Ancient Landscapes of South Texas: Journey Through the Pleistocene Wonderland - Answer Key

Fill in the Blank:

- 1. 2.6, 11,700
- 2. Great Lakes
- 3. mammoth
- 4. gallery
- 5. mammoth
- 6. giant gopher tortoise
- 7. glacial, interglacial
- 8. resident fauna, early human inhabitants
- 9. millions
- 10. woolly mammoths, mastodons, saber-toothed cats

Multiple Choice:

- 1. b
- 2. c
- 3. d
- 4. b
- 5. a
- 6. d
- 7. c
- 8. c
- 9. d
- 10. c

Open Ended Questions:

Ouestion #1:

Possible answers for the Pleistocene landscape of the Rio Grande Valley will discuss how the region was dominated by vast grasslands which supported megafauna. Students will probably name as examples mammoths, saber-toothed cats, and giant ground sloths. The answers could also discuss the gallery forests and the resources they provided, such as shelter and water for the resident Pleistocene creatures.

Explanation for Question #2:

Possible answers will talk about how fossil evidence discovered in the Rio Grande Valley, such as mammoth remains and giant gopher tortoise nests, help our understanding of the Pleistocene epoch and how it relates to the region of South Texas. These discussions might include how fossils provide clues into the diverse wildlife that once inhabited the region, or how they offer a window into the ancient ecosystem and the colossal creatures that roamed the land.

Time Travel to the Ice Age: Exploring the Rio Grande Valley

Answer Key:

Fill in the Blank:

- 1. Ice Age
- 2. glacial
- 3. huge
- 4. ruled
- 5. tortoises

Multiple Choice:

- 1. a) 2.6 million to 11,700 years ago
- 2. b) 30%
- 3. c) Mammoths
- 4. d) Velociraptors
- 5. b) Giant gopher tortoises

Open Ended Questions:

- 1. During the Pleistocene Era, the Rio Grande Valley was characterized by expansive grasslands dotted with lush gallery forests along rivers and streams. These unique ecosystems provided important habitats and resources for the diverse megafauna that roamed the region.
- 2. The gallery forests along waterways offered shelter, food, and influenced the behavior of the Pleistocene creatures in the Rio Grande Valley. These riparian areas were vital to the survival and interconnected nature of the ancient ecosystem.
- 3. By studying the Pleistocene Era and the ancient inhabitants of the Rio Grande Valley, we can unlock fascinating insights into the ecological wonders of this captivating period. These discoveries offer a glimpse into the vibrant wildlife and interconnected world that once existed, shedding light on the deep connection between nature and culture.

Lesson 4: Ancient Landscapes of South Texas during the Pleistocene Epoch

Robert Paul del Barrio, Joe C. Gonzales, Eduardo Diaz-Santana, Amanda L. Hernandez, and Jacob Garcia

Introduction

The Pleistocene Epoch, spanning from approximately 2.6 million years ago to 11,700 years before present (BP), is commonly known as the last Ice Age. This epoch is best known for dramatic climate fluctuations, repeated glaciations, and the emergence and eventual extinction of many large animals known as megafauna.

During this period, vast glaciers covered up to 30% of the Earth's surface, locking in ocean water and causing sea levels to drop by as much as 430 feet. The region of the Rio Grande Valley experienced significant ecological transformations during the Pleistocene. The climate was cooler and drier than today, and much of South Texas consisted of open grasslands called "mammoth steppes", with gallery forests lining rivers and streams. These supported large herbivores, such as mammoths, bison, horses, camels, and giant sloths, as well as predators like saber-toothed cats and dire wolves.

Importantly, *Homo sapiens* appeared and began spreading across the globe during the latter part of the Pleistocene, including into the Americas. Early humans in the RGV relied on the region's megafauna for survival.

Glacial Cycles and Sea Level Change

The Pleistocene Epoch consisted of as many as 20 glacial and interglacial cycles. During glacial periods, ice sheets several kilometers thick formed, covering much of Canada and the United States. Sea levels dropped as much as 300 feet, causing the continents to expand. An accidental find of a shrimper boat, a mammoth femur recovered 35 miles offshore and in 75 feet deep water in the Gulf of Mexico, provided evidence that the now-submerged continental shelves were once grasslands where megafauna roamed.

In contrast, interglacial periods brought warmer temperatures and melting glaciers, causing sea levels to rise and shorelines to retreat inland. These climate cycles profoundly shaped ecosystems and influenced the habitats of animals and early humans.

Pleistocene Ecosystems of the Rio Grande Valley

The Lower Rio Grande Valley was primarily a grassland ecosystem during the Pleistocene, supporting an array of megafauna. Fossils found in the region, including molars, bones,

tusks, and tortoise shells, offer valuable evidence of how the RGV landscape supported life during the Pleistocene. Among the Pleistocene fossil finds are:

- Mammoths: Roamed the RGV between 200,000 and 10,000 years ago. Fossils have been found across Cameron, Starr, and Hidalgo counties.
- Giant bison (*Bison latifrons*): Much larger than modern bison. Bones found north of Edinburg have been radiocarbon dated to around 22,700 years ago.
- Giant gopher tortoises: In 1986, a well-preserved nest was discovered in Willacy
 County during canal construction, a significant find that suggests rapid burial, likely
 due to a flash flood.
- Camels, horses, mastodons, sloths, and dire wolves also lived in the region.

Gallery Forests and Riparian Corridors

Unlike the open grasslands, gallery forests were narrow bands of woodland growing along rivers and streams. These ecosystems provided food, water, and shelter for wildlife and early humans. The contrast between grasslands and these wooded corridors added ecological diversity to the region.

Early Human Life in the RGV

As the Ice Age ended, early humans migrated into the RGV, utilizing the rich ecosystems to support their hunting and gathering lifestyles.

Paleo-Indian Period

- Early humans used tools like the atlatl (spear thrower) to hunt large game such as mammoths and Bison.
- These groups were mobile and relied on a wide range of natural resources for food, clothing, and tools.

Archaic Period

- Climate warming and increased drought led to changes in human behavior.
- People began making new types of projectile points for hunting smaller animals, such as deer.
- The use of earth ovens and gathering wild plants became common.
- Evidence of woven goods, pottery, and jewelry made from mussel shells suggests a growing cultural complexity.

Late Prehistoric to Historic Periods

- Bow and arrow technology replaced the atlatl.
- Tools evolved in sophistication; some projectile points were made from glass, iron, and copper introduced by Europeans.
- Despite these changes, many communities continued to be mobile hunters, adapting to shifting environmental conditions.

The Human and Natural Legacy of the Pleistocene

The Pleistocene Epoch transformed the landscape and ecosystems of the Rio Grande Valley. As glaciers advanced and retreated, sea levels rose and fell, shaping coastlines and opening new areas for life to flourish. In what is now South Texas, mammoths, camels, and other megafauna grazed across expansive grasslands while gallery forests lined rivers and streams.

By the end of the Pleistocene, approximately 12,000 years ago, humans had entered the region, utilizing the available natural resources for food, shelter, and the production of stone tools.

Studying the Pleistocene is crucial for understanding the connections between climate, ecosystems, and human culture. It also highlights how fossil evidence from the RGV helps us reconstruct the story of early humans adapting to an ever-changing environment.

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Books

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This source discusses the history of ancient landscapes throughout the Rio Grande Valley and how they have helped shape the region for millions of years. It also explains how early inhabitants of the area used resources from these landscapes to meet their needs and helped shape their culture.

Hein, Starr E. 2023 The First Peoples of The Lower Rio Grande Valley of Texas and Northern Mexico: An Interdisciplinary Approach to Defining the Paleoindian Period. Master's Thesis, The University of Texas Rio Grande Valley: Edinburg, TX (July):60-63

Starr Hein's essay talks about the people, land, and fauna in the Lower Rio Grande Valley; Starr briefly talks about the Megafauna that once roamed the valley, the Mammoth. In it, she spoke about where they came from, where the remains were found, and what may have made them go extinct.

Turner, E.S., Hester, T.R. and McReynolds, R.L. (2011) Stone artifacts of Texas Indians. Taylor Trade Publishing.

The book explained the projectile points in the Rio Grande Valley. It depicts the native changes in the projectile points and the uses.

Smith, Dave 2011 Geological Time Scale. International Stratigraphic Chart. International Commission on Stratigraphy.

This source provides an overview of the geological time from Precambrian to Cenozoic periods.

Websites

Bagley, Mary 2014 Quaternary Period: Climate, Animals & Other Facts. Live Science, February 6. http://www.livescience.com/43151-quaternary-period.html, accessed October 18, 2023.

This material summarizes the Quaternary Period, consisting of the Pleistocene and Holocene Epochs. It includes brief discussions covering the climate, animals, early humans' emergence, and migration from Africa to America.

International Museum of Art and Science. 2023. Our Museum. McAllen Public Utility BioZone. https://theimasonline.org

This unique facility offers an interactive experience, allowing students to connect with the region's diverse wildlife while fostering a deeper understanding of the Pleistocene epoch.

Johnson, Hilton 2023 Pleistocene Epoch. Encyclopædia Britannica. Encyclopædia Britannica, inc. https://www.britannica.com/science/Pleistocene-Epoch, accessed November 2, 2023.

Information within this text pertains to the Pleistocene Epoch. Climate facts and subtropical conditions in RGV once supported unique Megafauna are just some topics covered in this article.

Johnson, W. Hilton 2023 Pleistocene Epoch. Encyclopædia Britannica. Encyclopædia Britannica, inc. https://www.britannica.com/science/Pleistocene-Epoch, accessed November 1, 2023.

Comprehensive overview of the Pleistocene Epoch that covers various aspects including geological history, climate changes, and the evolution of flora and fauna.

Polly, David. 1995. The Pleistocene Epoch. The Pleistocene Epoch. https://ucmp.berkeley.edu/quaternary/ple.html, accessed November 1, 2023.

Covers a wide range of information about the Megafauna and the landscape of the Pleistocene epoch. The goal is to provide the reader, especially students, with a clear understanding of the Pleistocene Epoch and the diverse array of animals that roamed the North American region during this significant period.

Quaternary -- Britannica Online Encyclopedia 2023 Encyclopaedia Britannica. Encyclopaedia Britannica, Inc. https://www.britannica.com/science/Quaternary, accessed October 18, 2023.

Overview of the Quaternary Period of the Cenozoic Era consisting of the Pleistocene and Holocene Epochs. Basic information is provided on the climate, environment, fauna and flora, geologic history, and human evolution during this period. It is written in a manner that can be easily understood, with no prior knowledge needed on the topic.

Quaternary Period 2017 National Geographic, January 6.

http://www.nationalgeographic.com/science/article/quaternary, accessed November 1, 2023.

This short newsletter from National Geographic can be used as a quick reference to the Quaternary Period. It contains short paragraphs that focus on the general facts of this period, including climate and geologic changes, the land and sea animals, and the emergence of early humans.

Articles

Elias, S.A. 2013 The Quaternary. *In* Reference Module in Earth Systems and Environmental Sciences. Elsevier. http://dx.doi.org/10.1016/b978-0-12-409548-9.05350-1, accessed October 26, 2023.

This source Discusses climate and environmental changes during the Quaternary Period. The author also discusses the responses of the physical and biological world to these changes.

Geggel, L. (2015) 10 extinct Giants that once roamed North America, LiveScience. Available at: https://www.livescience.com/51793-extinct-ice-age-megafauna.html

This article gave multiple animals that roam the North America region. It gave quick information of what type of animals lived and when some of the first fossils where found.

King, Barbara 1986 August Giant tortoises fossils called 'significant' find—the Monitor (McAllen, Texas).

This article speaks about the nest of giant gopher tortoises that was discovered in the north of Edinburg

Native American peoples of South Texas - UTRGV. Available at:

https://www.utrgv.edu/chaps/_files/documents/native-american-peoples-of-south-texas-pdf.pdf (Accessed: 15 November 2023)

This article details the stages of the different periods of time that the native lived. It elaborates on the regions history.

Pester, Patrick, and Kim Ann Zimmermann. 2022. "Pleistocene epoch: The last ice age." Live Science. https://www.livescience.com/40311-pleistocene-epoch.html, accessed November 1, 2023.

This source offers comprehensive knowledge in an easy to digest blog style with continuous updates and additions to the pleistocene Epoch.

Pleistocene Epoch N.d.FactMonster.

https://www.factmonster.com/encyclopedia/earth/geology-oceanography/info/pleistocene-epoch, accessed November 11, 2023.

This website compiles information regarding Megafauna, climate, and the topographical changes during the Iceage. It serves an important purpose of outlining the Pleistocene in a way anyone can understand.

Reger, B., González, J.L. and Skowronek, R.K. (2020) 'Lithic raw materials in the Lower Rio Grande Valley, South Texas and Northeast Mexico', Lithic Technology, 45(3), pp. 184–196. doi:10.1080/01977261.2020.1765109.

This article gives the archaeological sites that the Lower Rio Grande has excavated. It also gives the geological information of the region.

Shepard, F.P. (1956) 'Late pleistocene and recent history of the Central Texas Coast', The Journal of Geology, 64(1), pp. 56–69. doi:10.1086/626316.

This article gave a more detailed understanding of the landscape of Texas. It gave precises dates on when the water levels were and the geological levels of the region.

Strom, Caleb 2018 Pleistocene Epoch: Humans, Welcome to Earth. Ancient Origins, October 19. http://www.ancient-origins.net/history-important-events/pleistocene-0010865, accessed October 29, 2023.

Overview of the Pleistocene Epoch that briefly discusses geology and climate. Pleistocene animals and humans are also discussed with accompanying paintings depicting how they would have appeared. The question of a possible connection between the extinctions of Megafauna shortly after the appearance of humans is addressed and concludes this article.

The University of Texas Rio Grande Valley (no date) UTRGV. Available at: https://www.utrgv.edu/chaps/ (Accessed: 14 November 2023).

This is the link to the CHAPS website. This website gives more information of the Native Americans of South Texas.

Video

How horses took over North America (twice) (2018) YouTube. Available at: https://www.youtube.com/watch?v=kZoTvXvV02A (Accessed: 14 November 2023). This YouTube video gives the history of the horses that roam North America. It gives the evolution perspective and the downfall of the animals.

How to Pronounce Pleistocene? (CORRECTLY) 2021YouTube. YouTube. https://www.youtube.com/watch?v=HSLU4eVdvWI, accessed November 1, 2023.

The video was chosen to depict the proper pronunciation of the word Pleistocene.

The Humans That Lived Before Us 2019 PBS. Public Broadcasting Service. https://www.pbs.org/video/the-humans-that-lived-before-us-qtix2f/, accessed November 11, 2023.

Video depicting *homoerectus* and their involvement during the time of the Pleistocene Epoch. Information will provide knowledge of early human evolution alongside Megafauna during this period. This also displays information regarding stone tools and the progression of humanity.

The mysterious *gigantic* lions that used to Roam North America (2020) YouTube. Available at: https://www.youtube.com/watch?v=dIR_FqxUNKI (Accessed: 14 November 2023).

This YouTube video gives the history of the lions that roamed North America. It gives the perspective of evolution and information on how this animal ceased to exist in the region.



5. South Texas During the Holocene Lesson objective: The learner will be able to identify the unique geological features and natural resources of the Holocene epoch in South Texas.

Explore	Your Task
Explore the Holocene with these online videos:	Possible resources: Have students respond in a text box to questions about the video. An icon such as ' lets students know they are expected to write/type something (example below).
YouTube – The Holocene Era PBS: How Long Have Humans Lived in North America? Ice Age Footprints	
PBS: Mammoths Science Trek	For middle and high school, having students respond in a <u>Google Form</u> or with a <u>K-W-L activity</u> helps with workflow.

Explain	Your Task
Explain the Holocene in South Texas using these reading and vocabulary resources:	Post learning expectations for students. Will they take notes? Possibly share their thinking digitally or on paper? A 3-2-1 reflection or a
Ancient Landscapes - Holocene	Storyboard Activity would work here.
Readings Reading Worksheet - The	Give students feedback during this task either digitally or in person. Possibly give students the
Holocene Epoch PBS Website -	opportunity to give feedback to one another as well.
The Holocene Epoch	won.

Apply & Share	Your Task
Have students review the vocabulary of the Holocene Epoch with the following games and resources! Blooket – Ancient Landscapes Holocene	Include expectations for student play. This could include due dates, links to review resources, and instructions for turning work in (take screenshot of grade, follow link on Google Classroom, etc.).
Review Quizizz – Ancient Landscapes – The Holocene Quizlet – Ancient	Give students feedback during this task either digitally or in person. Possibly give students the opportunity to give feedback to one another as well.
<u>Landscapes Holocene Review</u>	Possible resources: Include a link to a Show What you know BINGO board and have students practice their new vocabulary in the classroom!

********OPTIONAL******

Connect & Extend	Your Task
In this activity, students will explore how Ice Age mammals adapted to their environment until the climate changed, and how as this change was occurring the animals had to either move or adapt to survive. Mammal Adaptation Game	Add instructions or expectations for their extension activity. Possible resources: Have students paste an image of how their game develops in a box like the one in the example below. An icon such as lets students know they are expected to paste and image of something. For middle and high school having students respond in a Google Form helps with workflow. You can also use any of the templates in this Exit Ticket Builder to gauge student knowledge after the lesson!

^{**} Don't forget to have your students SHARE and REFLECT on their learning during and/or after! Good old Think-Pair-Share and Turn and Talk is still important during tech time!

Ancient Landscapes of South Texas During the Holocene Epoch

The Holocene epoch is the time period we're living in right now. It started about 11,000 years ago when the last Ice Age ended. During this time, South Texas has changed a lot!

Long ago, South Texas looked very different from how it does today. There were thick forests

along the rivers, curved lakes called *resacas*, and wide grasslands. Many plants and animals lived here, like *roadrunners* and *bobcats*.

One big change was the spread of *mesquite trees*. In the past, there weren't as many mesquite trees as there are now. When Spanish settlers came in the 1700s, they brought cattle with them. The cows ate grass and spread mesquite seeds in their poop. This helped mesquite trees grow all over the place!

People also cut down many trees along the rivers. They used the wood to build things and to fuel *steamboats*. This hurt the homes of many animals that lived in these forests.

Salt was very important to people in South Texas.

There's a big salt lake called *La Sal del Rey*. People used this salt to keep food fresh and to trade. During the Civil War, salt from here was really valuable.

The Spanish gave out land to settlers in long, narrow strips called *porciones*. These were usually near rivers so people could get water easily. Settlers built houses using a local material called *caliche*, which is a type of chalky rock.

The *Rio Grande* has changed a lot too. It used to flood every year, which helped fill up the

resacas. But now, because of dams and irrigation, the river has much less water than it used to.



There used to be more wild animals in South Texas. *Jaguars* and *ocelots* lived here, but now they're very rare. Some animals, like *javelinas* and *white-tailed deer*, are still around.

People have changed South Texas a lot over the past 11,000 years. We've cut down forests, built cities, and changed how water flows. This has made life harder for many plants and animals. Today, some people are trying to protect what's left of the old South Texas environments.

Ancient Landscapes of South Texas During the Holocene Epoch

Multiple-Choice Questions

- 1. How long ago did the Holocene epoch begin?
 - a) 5,000 years ago
 - b) 11,000 years ago
 - c) 20,000 years ago
 - d) 100,000 years ago
- 2. What are the curved lakes in South Texas called?
 - a) Resacas
 - b) Lagoons
 - c) Bayous
 - d) Ponds
- 3. Which of these animals was NOT mentioned as living in South Texas?
 - a) Roadrunners
 - b) Bobcats
 - c) Elephants
 - d) Mesquite trees
- 4. What helped mesquite trees spread across South Texas?
 - a) Birds eating the seeds
 - b) Wind blowing the seeds
 - c) Cattle spreading seeds in their poop
 - d) People planting more trees
- 5. Why did people cut down trees along the rivers?
 - a) To make farmland
 - b) To build things and fuel steamboats
 - c) To make paper
 - d) To create roads
- 6. What is La Sal del Rey?
 - a) A big salt lake
 - b) A Spanish fort
 - c) A type of tree
 - d) A Native American tribe
- 7. What were the long, narrow strips of land given to settlers called?
 - a) Ranchos
 - b) Haciendas
 - c) Porciones
 - d) Pueblos

- 8. What material did settlers use to build houses?
 - a) Wood
 - b) Brick
 - c) Caliche
 - d) Steel
- 9. How has the Rio Grande changed over time?
 - a) It has more water now
 - b) It has less water now
 - c) It flows in the opposite direction
 - d) It has become wider
- 10. Which of these animals is still common in South Texas?
 - a) Jaguars
 - b) Ocelots
 - c) White-tailed deer
 - d) Woolly mammoths

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Word Bank: resacas, salt, 11,000, cattle, porciones

1.	The Holocene epoch started aboutended.	years ago when the last Ice Age
2.	Curved lakes in South Texas are called	·
3.	Spanish settlers broughtspread mesquite trees.	with them in the 1700s, which helped

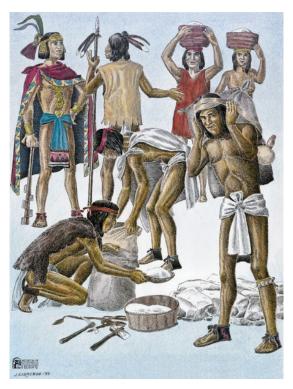
- 4. La Sal del Rey is a big _____ lake that was very important to people in South Texas.
- 5. The Spanish gave out land to settlers in long, narrow strips called _____

Open-Ended Question:

Describe three ways in which human activities have changed the landscape of South Texas during the Holocene epoch. Explain how these changes have affected the plants and animals in the region.

La Sal Del Rey: The Importance of Salt Throughout History

Salt has played a crucial role in human history. It has been used for many purposes, including preserving food and trading goods. In ancient times, salt helped people keep their food from spoiling, which was important during hard times when food was scarce. Native peoples living in the Rio Grande Valley relied on salt to stay away from the river, which often flooded and destroyed their homes.



As time went on, the need for salt continued, especially during the Spanish Colonial era. To find salt, settlers moved inland to places like **La Sal del Rey**, where they used traditional methods such as solar evaporation. This process involved letting the sun heat up water from salt lakes until the water evaporated, leaving behind salt crystals. The settlers built roads to transport the salt, showing how important it was for trade and the economy.

However, mining salt was not always easy. The Spanish Crown placed restrictions on mining, which included salt. Land grants, like the one given to Juan Jose Balli in 1798, did not allow him to mine minerals. Instead, the Crown allowed certain agents, known as **salineros**, to manage the salt mining. The Crown also collected a tax of 20 percent from the salt harvested. Disputes over mineral rights often led to legal battles, highlighting how valuable salt was.

During the **American Civil War**, salt became even more important. It was essential for preserving food and curing leather for the Confederate army. General William T. Sherman even called salt "contraband" because he knew that an army with access to salt could feed its soldiers.

In 1979, the land owner of La Sal del Rey nominated it to the **National Register of Historical Places**. The area is now known for its rich archaeological history, with many artifacts from both ancient and modern times being found. This shows that La Sal del Rey has had constant human interaction, making it a significant site for historical discovery.

Overall, La Sal del Rey demonstrates the vital role that salt has played in human survival, trade, and history. Its significance has endured through time, impacting various cultures and events.

La Sal Del Rey: The Importance of Salt Throughout History

Fill-in-the-Blank Questions:

Word Bank:

1979, 20, archaeological, contraband, leather, river, salineros, solar, spoiling, trading

1.	Salt was used for preserving food and	goods.
2.	In ancient times, salt helped people keep their food from	·
3.	Native peoples used salt to stay away from the	, which often flooded
4.	Settlers used evaporation to get sale	t from lakes.
5.	The Spanish Crown allowed certain agents calledmining.	to manage salt
6.	The Crown collected a tax of percent f	rom the salt harvested.
7.	During the American Civil War, salt was essential for preserv	ving food and curing
8.	General William T. Sherman called salt "feed soldiers.	" because it could help
9.	In, La Sal del Rey was nominated to the Nati Places.	onal Register of Historical
10.	La Sal del Rey is now known for its richbeing found.	history, with many artifacts

Open-Ended Question:

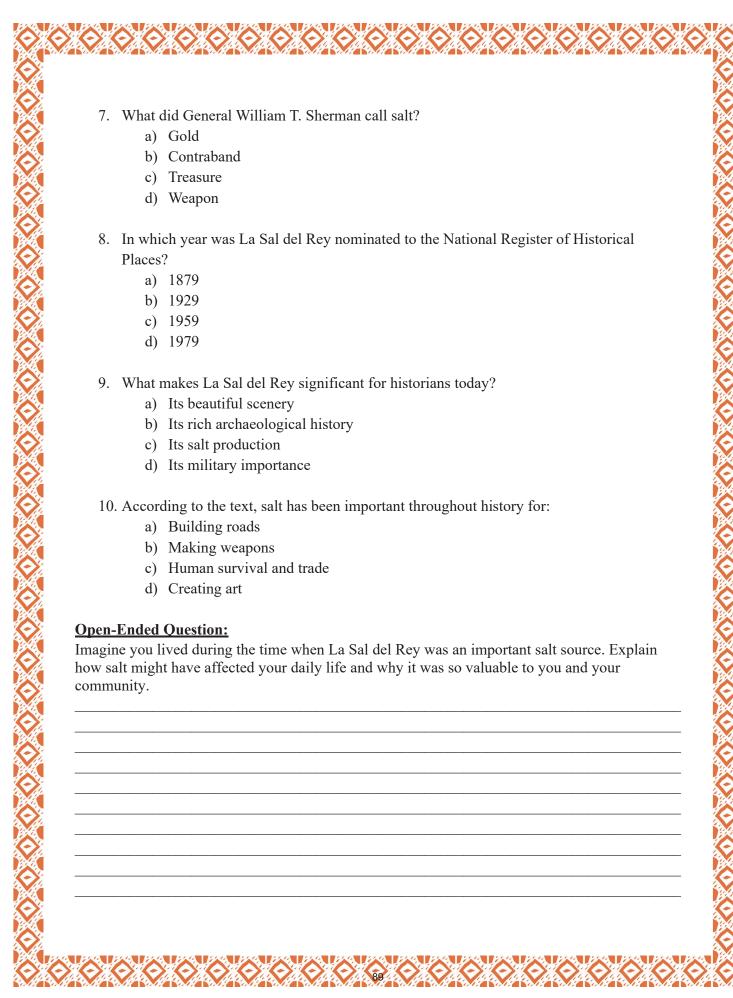
Salt played a big role in many different time periods, from ancient civilizations to the Civil War. Choose one time period mentioned in the text and describe why salt was important during that time. How did people use it, and what problems might they have faced if they didn't have access to salt?

La Sal Del Rey: The Importance of Salt Throughout History

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Multiple Choice Questions:

- 1. What was salt primarily used for in ancient times?
 - a) Building materials
 - b) Preserving food
 - c) Making clothes
 - d) Starting fires
- 2. Why did native peoples in the Rio Grande Valley use salt?
 - a) To trade with other tribes
 - b) To flavor their food
 - c) To stay away from the flooding river
 - d) To build stronger houses
- 3. What method did settlers use to get salt from lakes?
 - a) Boiling
 - b) Freezing
 - c) Solar evaporation
 - d) Chemical extraction
- 4. Who was allowed to manage salt mining under Spanish rule?
 - a) Anyone who wanted to
 - b) Only the Spanish Crown
 - c) Salineros (special agents)
 - d) Native Americans
- 5. How much tax did the Spanish Crown collect on harvested salt?
 - a) 10%
 - b) 15%
 - c) 20%
 - d) 25%
- 6. During which war did salt become especially important?
 - a) World War I
 - b) American Revolution
 - c) Mexican-American War
 - d) American Civil War



The Rio Grande: A River with a Long History

The Rio Grande, a remarkable river with a history stretching back over two million years, has been a crucial part of the landscape it flows through. This ancient waterway has played a vital role in supporting plant and animal life in the region for countless generations.

Throughout its long history, the Rio Grande has been slowly but constantly changing. It gradually shifts its course at a rate of 12 centimeters per kilometer. This slow migration has created unique features in the landscape, such as **resacas**. These distributor channels, formed by the river's movement, were important sources of freshwater for both humans and animals 10,000 years ago.



In the past, the river had a natural cycle of spring and summer **floods**. These annual floods were essential to the ecosystem, replenishing the resacas with fresh water and spreading sediment across the land. This process contributed to the gradual change in the river's path over time. However, human activities in recent history have significantly altered this natural rhythm.

Since the early 1900s, people have been using more and more of the river's water for **irrigation**. The construction of dams has further reduced the water flow. As a result, the Rio Grande now only carries about 20% of the water it did before the 1890s. This dramatic decrease has had a major impact on the surrounding environment.



The banks of the Rio Grande were once home to many **Montezuma Cypress** trees. In the Nahuatl language, these trees were called "ahuehue," meaning "old man on the river." These impressive trees thrived in the wet soil along the riverbank. Unfortunately, most of these trees were cut down for wood to build things in nearby towns or to fuel steamboats.

Today, only one ancient Montezuma Cypress remains as a living link to the river's past. This tree, nicknamed "**Old Monty**," is over 900 years old and is considered the oldest living thing in the Valley. Interestingly, because the river has changed its course over time, Old Monty now stands in a dry farm field, a full mile away from where the river flows today. The farmers who own the land now use an irrigation system to water this ancient tree, helping it survive in its changed environment.

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The Rio Grande Valley was also once home to a variety of wildlife, including several species of wild cats. The **jaguarundi**, a small wild cat related to the jaguar, used to be common in the area. These agile hunters were active during the day, hunting in the bushes and trees. They often preyed on birds; in fact, a jaguarundi examined in 1948 was found to have eaten a Harris hawk.

Other animals mentioned in historical records include **javelinas** and **white-tailed deer**. These species have managed to survive and can still be seen in the region today, providing a glimpse into the valley's rich natural history.

The story of the Rio Grande is one of constant change, both natural and man-made. From its ancient beginnings to the present day, this mighty river continues to play a crucial role in the ecology and human activities of the region.



As we look to the future, understanding and preserving the Rio Grande's legacy becomes increasingly important for maintaining a balance between human needs and the natural world.

Open-Ended Question:

The Rio Grande has undergone significant changes due to human activities, particularly in was usage and flow. How might these changes impact the ecosystem and local communities in the long term? Consider both environmental and economic factors in your response.	

The Rio Grande: A River with a Long History

Fill in the blanks using words from the word bank:

Word Bank:

resacas, irrigation, two million, Montezuma Cypress, ahuehue, jaguarundi, 12, steamboats, 20%, javelinas

1.	The Rio Grande has been a part of the landscape for over years.
2.	The river slowly changes its course at a rate of centimeters per kilometer.
3.	were distributor channels that provided freshwater 10,000 years ago.
4.	The Montezuma Cypress trees were called "" in the Nahuatl language.
5.	Most Montezuma Cypress trees were cut down for wood and to fuel
6.	The oldest living organism in the Valley is a tree nicknamed "Old Monty."
7.	Today, the Rio Grande carries only of the water it did before the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second
8.	The, a small wild cat, was once common in the Rio Grande Valley.
9.	Human activities like and dam construction have altered the river's natural rhythm.
10.	and white-tailed deer are animals that can still be seen in the region today.

The Rio Grande: A River with a Long History

Multiple Choice Questions:

- 1. At what rate does the Rio Grande shift its course?
 - a) 12 meters per kilometer
 - b) 12 centimeters per year
 - c) 12 centimeters per kilometer
 - d) 12 kilometers per century
- 2. What percentage of its pre-1890s water flow does the Rio Grande currently carry?
 - a) 50%
 - b) 35%
 - c) 20%
 - d) 5%
- 3. What is the nickname of the oldest living organism in the Rio Grande Valley?
 - a) Old Timer
 - b) Old Monty
 - c) Ancient One
 - d) River Elder
- 4. Which of the following animals was found to have eaten a Harris hawk in 1948?
 - a) Jaguar
 - b) Javelina
 - c) White-tailed deer
 - d) Jaguarundi
- 5. What does "ahuehue" mean in the Nahuatl language?
 - a) River guardian
 - b) Old man on the river
 - c) Tree of life
 - d) Water spirit

Open Ended Response:

The story of "Old Monty," the ancient Montezuma Cypress tree, illustrates how the landscape around the Rio Grande has changed over time. What does this example teach us about the relationship between rivers and their surrounding environments? How might this knowledge be applied to current river management practices?

Lesson 5: Ancient Landscapes of South Texas During the Holocene Epoch

Jackqueline Alejos, Cassandra Castillo, Paloma De Los Santos, Andrik Gonzalez, Arian Perez, Ryan Torres, and Miranda Vasquez

A New Epoch Begins

The Holocene epoch marks the most recent chapter in Earth's geological history, beginning approximately 11,700 years ago after the end of the Pleistocene. This epoch continues to the present day and encompasses all recorded human history. It is a period defined by dramatic environmental shifts, the retreat of glaciers, rising global temperatures, and the expansion of human civilization across the planet.

In the Rio Grande Valley, the transition from the cold, glacial landscapes of the Pleistocene to the warmer, more stable climate of the Holocene brought significant changes to the region's ecosystems and the ways in which early peoples interacted with their environment. Over thousands of years, the Rio Grande built its delta, forests grew and receded, and human activity increasingly shaped the landscape.

Although written records in South Texas begin only with European settlement in the 1700s, archaeological evidence suggests that indigenous peoples thrived in the region for thousands of years. They adapted and benefited from the local ecosystems that included flood-fed forests, resacas (oxbow lakes), and expansive prairies rich with wildlife and native plants. However, as human populations grew and technologies advanced, environmental changes, both intentional and unintentional, transformed the region's ecology in lasting ways.

The South Texas Sand Sheet

As the last Ice Age came to an end, rising global temperatures caused glaciers to retreat and sea levels to rise. These changes reshaped coastlines and redistributed sediments throughout southern Texas. One result was the formation of the South Texas Sand Sheet, a vast region of windblown sands that now covers more than two million acres at the southern tip of the state.

This area is characterized by shifting dunes and sandy soils that host a unique and fragile ecosystem. Dune formation is influenced by wind patterns and weather conditions, making the landscape a constantly dynamic one. Despite the challenges posed by persistent wind-blown sand and limited water, several plant species have adapted to thrive here, including morning glory, mesquite, and prickly pear cacti. Animal life also adapted to these conditions, with species such as the Texas horned lizard and various birds finding niches in the sand dunes.

The Sand Sheet illustrates how geology and climate interact to shape ecosystems, and how species must adapt to survive in changing environments.

From Grasslands to Brush Country

Much of South Texas was once an expansive prairie, dominated by grasses that covered the landscape. Mesquite trees, though present, existed mainly in small clusters. That began to change in the 1700s with the arrival of Spanish settlers who introduced livestock ranching to the region.

Overgrazing by cattle reduced native grasses, which in turn prevented natural wildfires from spreading, fires that had once controlled the growth of woody plants. As a result, mesquite trees and shrubs began to spread rapidly. Cattle also played an unexpected role in this expansion: they consumed mesquite pods, and their digestive systems helped distribute the seeds widely across the region.

By the 19th century, mesquite had become one of the dominant plant species in South Texas. Although it provided food and shelter for some animals, it also reduced grassland habitat and made the land more difficult for ranching. Ranchers today still attempt to manage the spread of mesquite by reseeding with native grasses and removing brush.

This transformation from grassland to brush country illustrates the profound impact that human activity can have on ecosystems, even when unintentional.

Gallery Forests and the Decline of Riparian Ecosystems

In the Holocene, dense forests known as gallery forests once lined the banks of the Rio Grande and its tributaries. These forests played a vital role in supporting regional biodiversity, providing habitat for countless plant and animal species.

However, human settlement in the 19th and early 20th centuries brought widespread deforestation. Trees were harvested for construction materials and as fuel for steamboats, which became a popular means of transport along the Rio Grande. The large-scale removal of forest cover disrupted the delicate balance of riparian ecosystems, resulting in habitat loss and reduced ecological diversity.

As the gallery forests disappeared, so too did many of the species that depended on them. Deforestation serves as a clear example of how human development, without conservation, can rapidly and permanently alter the natural environment.

La Sal del Rey: Salt and Settlement

Salt has long been a valuable resource for human societies, used for food preservation, animal nutrition, leather processing, and trade. In South Texas, natural salt lakes such as La Sal del Rey offered an abundant supply of this mineral, making them important sites for both indigenous peoples and later settlers.

Native communities collected salt using techniques like solar evaporation and traded it over long distances. Archaeologists have uncovered stone tools and projectile points around La Sal del Rey, suggesting that the lake was an important center for prehistoric life and commerce.

During the Spanish Colonial period, the significance of these salt lakes grew. Settlers mined salt and transported it along established roads, despite restrictions imposed by the Spanish Crown. In the 1790s, the Crown began issuing specific permits for salt mining, often accompanied by taxation and legal oversight. During the American Civil War, salt became even more vital, especially for preserving food and curing hides for the Confederate army. Its strategic importance made control over salt resources a key concern for military leaders.

La Sal del Rey remains a site of archaeological and historical importance today, offering insight into how natural resources influenced patterns of settlement, trade, and survival during the Holocene epoch.

Spanish Land Grants and the Shaping of the Landscape

The Spanish land grant system played a critical role in the development of South Texas during the last 250 years, the latter part of the Holocene. Beginning in the 18th century, grants were issued to encourage settlement, often in the form of long, narrow parcels known as *porciones* that extended from rivers or other water sources (Figure 4.1).

Settlers built homes, dug wells (called *norias*), and constructed ranches using local materials such as caliche, a sedimentary rock formed by the accumulation of calcium carbonate in the soil. Caliche was cut into blocks (Figure 4.2), hauled by oxen, and used in the construction of fine homes, churches, and wells. It was also crushed and burned to make mortar and plaster. It was used in the construction of what the Spanish termed *casa mayores* (fine homes) (Figure 4.3). This style of construction reflected settlers' adaptation to the environmental conditions of South Texas. As the use of caliche declined in later years, its legacy remains in historic structures across the region.

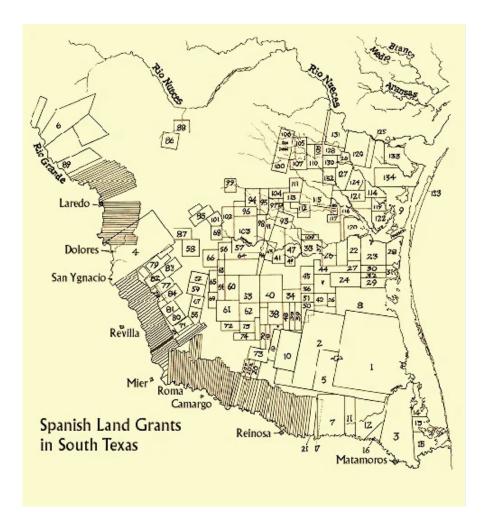


Figure 5.1: Spanish Land Grants in South Texas (Jackson 1986). https://www.texasbeyondhistory.net/forts/clark/images/grants.html.



Figure 5.2: "Casting Yard for Caliche Crete Blocks, Lake Corpus Christi State Park, c. 1934." Texas Park and Wildlife Department. http://texascccparks.org/archive/lake-corpus-christi-caliche-blocks-105/



Figure 5.2: Two-story Spanish colonial "casa mayor" made of "sillares" (caliche blocks). "Two-Story Spanish Colonial House," Stanley, n.d. University of North Texas Libraries. https://texashistory.unt.edu/ark:/67531/metapth1010987/

The land grant system and the vernacular architecture it inspired illustrate how humans adapted to the challenges posed by an environment with limited water, just as the pressures of human activity shaped the land itself.

The Rio Grande in the Holocene Epoch

The Rio Grande has been present in the landscape for over two million years, providing sustenance for flora and fauna where it now flows. Though the slow-flowing, meandering river regularly migrates. Ten thousand years ago, distributor channels called resacas were sources of freshwater for humans and animals alike. Annual floods in the spring and summer would provide water to these channels. Irrigation projects beginning in the early 1900s have appropriated the water flow, decreasing the water available to the resacas. Further construction of dams has decreased the water flow to just 20% of pre-1900s levels.

Montezuma Cypress trees were abundant on the banks of the Rio Grande, flourishing from the constant flow of water and the heavily saturated soils. They are called *ahuehue* in the Nahuatl language, meaning "old man on the river." Most of the trees were cut down to supply wood for construction projects in Brownsville and to burn as fuel in steamboats. Today, there is a lone Montezuma Cypress in Abram, Texas, that is 900 years old. As a result of the meandering of the river, it sits in a dry agricultural field a mile away from the river. Old Monty, as it's colloquially known, is the oldest living organism in the Valley. The farmers who own the land water the tree using an irrigation system.

The Rio Grande Valley was also home to several wild cats and other fauna. Jaguarundis, small cats related to the also previously common jaguar, were adept day hunters that prowled along the bush and in the trees. Some animals noted in the journals of conquistadores and surveyors, such as javelinas and white-tailed deer, are still seen today.

Conclusion: The Legacy of the Holocene

The Holocene epoch in the Rio Grande Valley tells the story of a landscape in transition—from natural ecosystems shaped by climate and geology to human-influenced environments defined by agriculture, industry, and settlement. The forests, grasslands, salt lakes, and sand dunes of South Texas have all been reshaped over thousands of years, through both gradual and sudden changes.

Today, understanding the geological and environmental history of the Holocene is crucial for teaching students about the processes by which landscapes evolve, the impact of human actions on ecosystems, and the importance of conservation and sustainable land use. The story of the Holocene in South Texas is not just a record of the past, it is a guide for the future.

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ANNOTATED BIBLIOGRAPHY

Primary Sources

Kirsch, B. W., "El Sal del Rey Archeological District", National Register of Historic Places Nomination Form (Washington, D.C.: U.S. Department of the Interior, National Park Service, 1979).

This form is the original nomination form for La Sal del Rey to be introduced into the National Register of Historic Places. This source would be especially helpful for 9-12 students interested in local historical sites and for educators who are introducing skills such as analyzing a primary source.

Leslie, D. M., Jr. Tamaulipan Brushland of the Lower Rio Grande Valley of South Texas: Description, Human Impacts, Management Options. Biological Report 88 (36), 17-19. Washington, DC: US Fish and Wildlife Service, 1988. https://apps.dtic.mil/sti/pdfs/ADA322826.pdf

This report describes the Tamaulipan brushland of South Texas as a unique ecosystem located in South Texas and how it has been affected by human-environment interactions. Of particular interest are pages 17-19, which discuss the human impact of agriculture and urbanization on the region, specifically how construction and clearing efforts have decimated local wildlife populations.

Books

González, Juan L., Roseann Bacha-Garza, Christopher L. Miller, and Russel K. Skowronek. Ancient Landscapes of South Texas: Hiding in Plain Sight. University of Texas Rio Grande Valley: Edinburg, TX, 2022, pp. 87–94.

Published in early 2022, Ancient Landscapes of South Texas shows the changing landscape of South Texas, from before the solar system formed to the current state of the region.

Morgan, M. J. *Border Sanctuary: The Conservation Legacy of the Santa Ana Land Grant.* First edition. College Station, Texas: Texas A&M University Press, 2015.

This source is a book that recounts the efforts taken by a group of conservationists to protect the land that would become the Santa Ana Wildlife Refuge in South Texas. Written in 1955, it covers more than one hundred years of South Texas history and explains the importance of protecting one of the last remaining areas left untouched by human expansion efforts in the region. It emphasizes how the story of humans in South Texas is deeply tied to and influenced by the unique ecosystem of the region.

Journal Articles

Brannstrom, Christian, and Matthew Neuman 2009 Inventing the "Magic Valley" of South Texas, 1905–1941*. Geographical Review 99(2): 123–145. https://www.tandfonline.com/doi/full/10.1111/j.1931-0846.2009.tb00423.x

The history of how the Rio Grande Valley came to be known as it is today discussed by the Geographical review. Within it, the history of land development, irrigation farming, and the effect on local culture are gone over.

Nunez, Christina. "Why deforestation matters – and what we can do to stop it". National Geographic. December 2022. Accessed November 15, 2023. https://www.nationalgeographic.com/environment/article/deforestation

This article from National Geographic explains the process known as deforestation and the implications it can have on large-scale ecosystems. It includes a video which can be used in a K-12 setting as an introductory resource for students learning about human-environment interactions.

Pierce, Jason E. 2014. "Marvelous, Maligned, and Misunderstood: The Strange History of the Mesquite Tree in Texas." Southwestern Historical Quarterly 117(4): 346–370.

This source discusses the story of the mesquite rapidly spreading throughout South Texas, which illustrates how people change the environment around them, and how they, in turn, are changed by it. It includes journal excerpts, information about how different peoples used the mesquite, adapted to changing landscapes, and how humans caused the mesquite to spread rapidly.

Online Sources

Bacha-Garza, R. and Skowronek, R. (no date) The University of Texas Rio Grande Valley, UTRGV. https://www.utrgv.edu/civilwar-trail/civil-war-trail/hidalgo-county/la-sal-del-rey/index.htm

This source provides a short summary of La Sal Del Rey and its involvement in the Civil War. It includes an audio recording that further explains the relationship between Sal Del Rey and the Civil War. This source was a part of the Rio Grande Valley Civil War Trail created and provided by the UTRGV CHAPS Program.

Campbell, Eloise. 1952 *La Sal Del Rey*. Handbook of Texas Online. Texas State Historical Association. Accessed November 13, 2023. https://www.tshaonline.org/handbook/entries/la-sal-del-rey

This source is an electronic version of the book "The Handbook of Texas", which describes the features of La Sal Del Rey, as well as a detailed history of Spanish settlement, management, and changes in ownership of this resource. The source would most benefit K-12 students as a resource to learn about the history of a local landform in the Rio Grande Valley.

Carr R. William. The Nature Conservancy of Texas and Research Affiliate. Plant Resources Center. The University of Texas at Austin. <u>Plants of the South Texas Sand Sheet (utexas.edu)</u>

This source is an ounline article that talks about the different plants that can be found in the South Texas Sandsheet. This article includes the specific details on the types of plants that grow in the region and which plants adapted to the conditions that they were in. This article also defines the South Texas Sand Sheet itself.

Central and South Texas Coastal Fringe Forest and Woodland. Texas Parks and Wildlife. n.d. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/emst/forests-woodlands-and-savannas/central-and-south-texas-coastal-fringe-forest-and-woodland

This source consists of a detailed explanation of the central and south Texas forest and woodland systems currently spread throughout the region, along with four detailed maps of oak forests and woodlands, mesquite woodland distributions, shrublands, and swale marshes. This source would be an especially useful resource for 9-12 students who are learning about the ecosystems present in South Texas.

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It details the use and value of La Sal del Rey by natives, its name comes from, salt mining, up to a federal nature preservation to this day by the National Wildlife Refuge.

Cough-Schulze, Chantal. 2021. How the Rio Grande Came to Be. Texas Water Resources Institute. Texas Water Resources Institute. https://twri.tamu.edu/publications/txh2o/2021/winter-2021/how-the-rio-grande-came-to-be/

The Texas Water Resources Institute discusses the history of the Rio Grande from when it first formed 36 million years ago to the effects that human use and occupation have had on the natural resource.

Fort, Karen Gerhardt, and Tom Fort. N.d. "Early Ranching on the Northern Frontier of New Spain." Texas Beyond History. Accessed November 6, 2023. https://www.texasbeyondhistory.net/st-plains/images/he14.html

This source is a brief overview of the history of cattle ranching in South Texas. It begins with the coming of early Spanish settlers and how their descendants adapted to the arid and flat landscapes north of the Rio Grande. It discusses the different components that made up early *ranchos* and includes appropriate Spanish terms.

Fort, Tom A. N.d. *La Sal Del Rey Lake: Salt Mining and Trading near the Rio Grande*. La Sal Del Rey. Museum of South Texas History. Accessed November 13, 2023.

https://www.texasbeyondhistory.net/st-

plains/images/he5.html#:~:text=Throughout%20%20historic%20times%20%20and%20%20likely,preserving%20me%20and%20animal%20hides

The article discusses La Sal del Rey in salt mining and trade near the Rio Grande during the prehistory and Spanish colonial period. From the introduction to salt to the natives up to the use of salt by Spanish settlers by the late 1800's.

Lower Rio Grande Valley National Wildlife Refuge N.d.FWS.Gov. U.S. Fish & Wildlife Service. Accessed November 13, 2023. https://www.fws.gov/refuge/lower-rio-grande-valley/what-we-do

This website, managed by the LRGV National Wildlife Refuge, describes what local conservation groups and environmentalists are working on to preserve and document the ecosystems around the salt lake. This source would be especially helpful for individuals interested in learning more about the efforts around the Rio Grande Valley to protect the wildlife and habitats that exist in the region.

Montezuma Cypress Tree. UTRGV N.d. https://www.utrgv.edu/ancient-landscapes-southtexas/landscapes/the-rio-grande/montezuma-cypress-tree/index.htm

A small history of Montezuma bald cypress trees is given on the ancient landscapes of South Texas website. The small article also gives attention to Old Monty, the oldest living organism in the Rio Grande Valley.

Noss, Reed N.d. "Tamaulipan Mezquital." One Earth. Accessed November 12, 2023. https://www.oneearth.org/ecoregions/tamaulipan-mezquital/

This source is a factual overview of the ecoregion of which South Texas is a part of. Presents geographical and geological data of the region. It provides information regarding native plants, grasses, and animals as well as an overview of the typical climate.

Resacas. UTRGV N.d. https://www.utrgv.edu/ancient-landscapes-southtexas/landscapes/the-rio-grande/resacas/index.htm

The article published on the ancient landscapes website briefly discusses the resacas in the Rio Grande, both from their formation and their current state.

Rozeff, N. (2017a) "A treasure in salt", MyRGV.com. Accessed 13 November 2023. https://myrgv.com/uncategorized/2017/06/11/a-treasure-in-salt/

This news article provides a summary of the historical background of La Sal del Rey in a concise, easily readable manner. This source would be especially helpful for 8-12 students interested in learning more about the history of local resources within the Rio Grande Valley.

"South Texas Vegetation." N.d. South Texas Wildlife Management. Texas Parks & Wildlife. Accessed November 12, 2023.

https://tpwd.texas.gov/landwater/land/habitats/southtx_plain/vegetation/

This resource provides a summary of the changing vegetation of South Texas due to human occupation. It briefly mentions modern efforts to reverse past ecological issues. It also discusses the importance of habitat health for native species and humans.

"Tamaulipan Mezquital." N.d. World Species. Accessed November 12, 2023. https://worldspecies.org/ecoregions/display/NA1312

Provides a visual map that outlines the Tamaulipan Mezquital region. It also includes links to quantitative data about climate, land use, and a comprehensive list of animal and plant species native to the region.

Ancient Landscapes of South Texas website. The CHAPS Program at the University of Texas Rio Grande Valley. https://www.utrgv.edu/search/?q=south+texas+sandsheet

This source is an online resource that talks about how the South Texas Sand Sheet (STSS) formed over the years. It continues to talk about the details of the sand sheet including how long the sheet is and how far it is spread throughout the South Texas area. It also talks about when the STSS was formed which was in the late Pleistocene era.

Waggoner, Ben M. and Dave Smith. "The Holocene Epoch". *Geologic time scale*. University of California Museum of Paleontology, 2011. Accessed on November 13, 2023. https://ucmp.berkeley.edu/quaternary/holocene.php

This source is a website that explains in simple terms the various epochs and periods of the Earth's history, from the Hadean to the Holocene. This source would be especially helpful to students who are just beginning to learn about the geologic history of the Earth.

Winckler, Suzanne. 1982. "Texas Primer: Mesquite." Texas Monthly. Accessed November 12, 2023. https://www.texasmonthly.com/being-texan/texas-primer-mesquite/

This resource offers a history and description of the Mesquite as a reflection of the people and landscape of Texas. It provides information on the mesquites' unique adaptations which allows it to survive in an arid climate and to become a staple plant of South Texas.



6. South Texas During the Anthropocene

Lesson objective: The learner will be able to identify the unique geological features and natural resources of the Anthropocene epoch in South Texas.

Explore	Your Task
Explore the Anthropocene with these online videos:	Possible resources: Have students respond in a text box to questions about the video. An icon such as % lets students know they are expected
Crash Course Big History: The Anthropocene and the Near Future	· · · · · · · · · · · · · · · · · · ·
PBS Learning Media: 100,000,000 Years from Now It's Okay to Be Smart	
Island Biodiversity: Tracking Human Influences Smithsonian Science How	For middle and high school, having students respond in a <u>Google Form</u> or with a <u>K-W-L activity</u> helps with workflow.

Explain	Your Task
Explain the Anthropocene in South Texas using these reading and vocabulary resources: Ancient Landscapes: The Anthropocene Newsela: The Anthropocene – A New Epoch of Human Control Over the Planet	Post learning expectations for students. Will they take notes? Possibly share their thinking digitally or on paper? A 3-2-1 reflection or a Storyboard Activity would work here. Give students feedback during this task either digitally or in person. Possibly give students the opportunity to give feedback to one another as
Khan Academy: The Anthropocene	well.

Original <u>template</u> created by <u>HyperDocs LLC</u> modified by <u>Karly Moura</u>

Apply & Share	Your Task
Post instructions for the method students will be using to apply their knowledge from the lesson and share with an authentic audience.	Include expectations for student play. This could include due dates, links to review resources, and instructions for turning work in (take screenshot of grade, follow link on Google Classroom, etc.).
Activity: The World in 2050 Activity: Climate Change Elevator Pitch Activity: Graphing Population	Give students feedback during this task either digitally or in person. Possibly give students the opportunity to give feedback to one another as well.
Growth	Possible resources: Include a link to a Show What you know BINGO board and have students practice their new vocabulary in the classroom!

********OPTIONAL******

Connect & Extend	Your Task
A central topic within the Anthropocene is the impact humans have on their surroundings. If possible, have your students play a few rounds of The Urban Game! Simulation: The Urban Game In this activity, students create their version of the perfect little town. However, when the town begins to industrialize, they must quickly make decisions that will deplete their resources, affect the townspeople, and	Add instructions or expectations for their extension activity. Possible resources: Have students paste an image of how their game develops in a box like the one in the example below. An icon such as lets students know they are expected to paste and image of something. For middle and high school having students
completely change their little cities.	respond in a Google Form helps with workflow. You can also use any of the templates in this Exit Ticket Builder to gauge student knowledge after the lesson!

^{**} Don't forget to have your students SHARE and REFLECT on their learning during and/or after! Good old Think-Pair-Share and Turn and Talk is still important during tech time!

The Changing Landscapes of South Texas: The Anthropocene

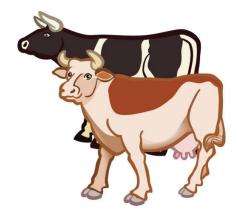


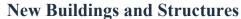
Long ago, the land in South Texas looked very different than it does today. Over time, people have made big changes to the area. Scientists call this time of big human changes the "Anthropocene." Let's explore how South Texas has changed!

Grasslands to Farms

In the past, South Texas had lots of grasslands. Cattle used to roam freely and eat the grass. But when people started building fences, the cows stayed in one place. This led to too much grass being eaten, which allowed bushes to grow instead.

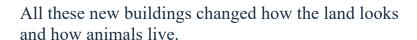
Later, many grasslands were turned into farms. Farmers needed water for their crops, so they built dams on rivers. These dams changed how water flowed and affected the plants and animals that lived there.





As more people moved to South Texas, they built new things:

- A **border wall**: This big wall might make it hard for some animals to move around.
- **Wind turbines**: These tall structures make electricity from wind.
- Water wells: People dug deep holes to get water from underground.





Changes in the Water

The ocean near South Texas is changing too. The sea level is slowly rising because of climate change. This could cause more flooding on the coast in the future.

Why These Changes Matter

It's important to understand how people have changed South Texas because:



- 1. It helps us protect animals and plants.
- 2. We can learn how to take better care of the land.
- 3. It helps us make smart choices about building new things.

By learning about these changes, we can help make sure South Texas stays a great place for people and nature!

The Changing Landscapes of South Texas: The Anthropocene

Fill In The Blank: Fill in the blanks with the correct words from the word bank:

Word Bank

animals, border wall, building, dams, flooding, grasslands, sea level, water wells, wind turbines, Anthropocene

1. Scientists call the time of big human changes the "			
2. In the past, South Texas had lots of			
3. Farmers built on rivers to get water for their crops.			
4. The might make it hard for some animals to move around			
5. Tall structures that make electricity from wind are called			
6. People dug deep holes called to get water from underground			
7. The near South Texas is slowly rising because of climate change.			
8. Rising sea levels could cause more on the coast in the future.			
9. Understanding these changes helps us protect and plants.			
10.Learning about changes helps us make smart choices about new things.			
Open Ended Questions:			

- 1. How do you think the changes in South Texas, like building dams and turning grasslands into farms, might affect the animals that live there? Explain your thoughts.
- 2. If you were in charge of protecting the environment in South Texas, what would you do to help balance the needs of people and nature? Give at least two ideas.

How Human Activities Have Changed South Texas



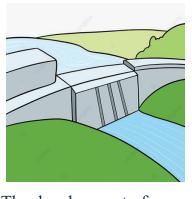
South Texas has undergone significant changes due to human activities since the early 1800s. As people settled in the region, cattle ranching and agriculture became major industries, profoundly affecting the local ecosystems, vegetation, and water resources. The introduction of barbed wire fencing, the construction of dams, and the implementation of irrigation systems have all played crucial roles in shaping the landscape of South Texas.

In the early 1800s, as settlers began establishing cattle ranches in South Texas, the impact on local vegetation was initially minimal. Cattle would roam freely, grazing across vast areas without causing permanent damage to the ecosystem. However, the invention of barbed wire in the late 19th century dramatically altered this balance. Ranchers could now confine their cattle to specific areas, leading to overgrazing. This practice severely impacted the grasslands, as the lack of grass gave way for brush and mesquite trees to invade without restriction. Today, conservation groups are working to restore these grassland ecosystems, which have been reduced to less than 1% of their original extent and continue

to diminish by 1-5% annually.

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The shift from cattle ranching to agriculture in the Rio Grande Valley brought new challenges, particularly regarding water resources. To meet the increasing demand for irrigation, the region's first major water dam, Falcon Dam, was constructed in the early 1950s. While the dam serves its primary purpose of collecting and storing



water for irrigation and generating hydroelectric power, it has had unintended consequences on the coastal ecosystem. By holding back water, the dam has also blocked the natural flow of sediment deposits that would typically reach South Padre Island. This interruption in sediment flow has led to increased shoreline erosion, as the ocean erodes the coastline faster than it can be replenished with new sediment.

The development of commercial irrigation played a pivotal role in the growth of the Lower Rio Grande Valley's economy in the late 1800s and early 1900s. B.F. Yoakum, recognizing the region's agricultural potential, devised an ambitious irrigation project. By 1910, 50 steam-engine pump houses had been built along the Rio Grande to irrigate farmland. This infrastructure set the stage for large-scale irrigated farming, which began in earnest around 1908.

The promise of agricultural prosperity attracted farmers from various parts of the United States to South Texas. Additionally, the region saw an influx of Mexican immigrants seeking refuge from the violence in their home country at the turn of

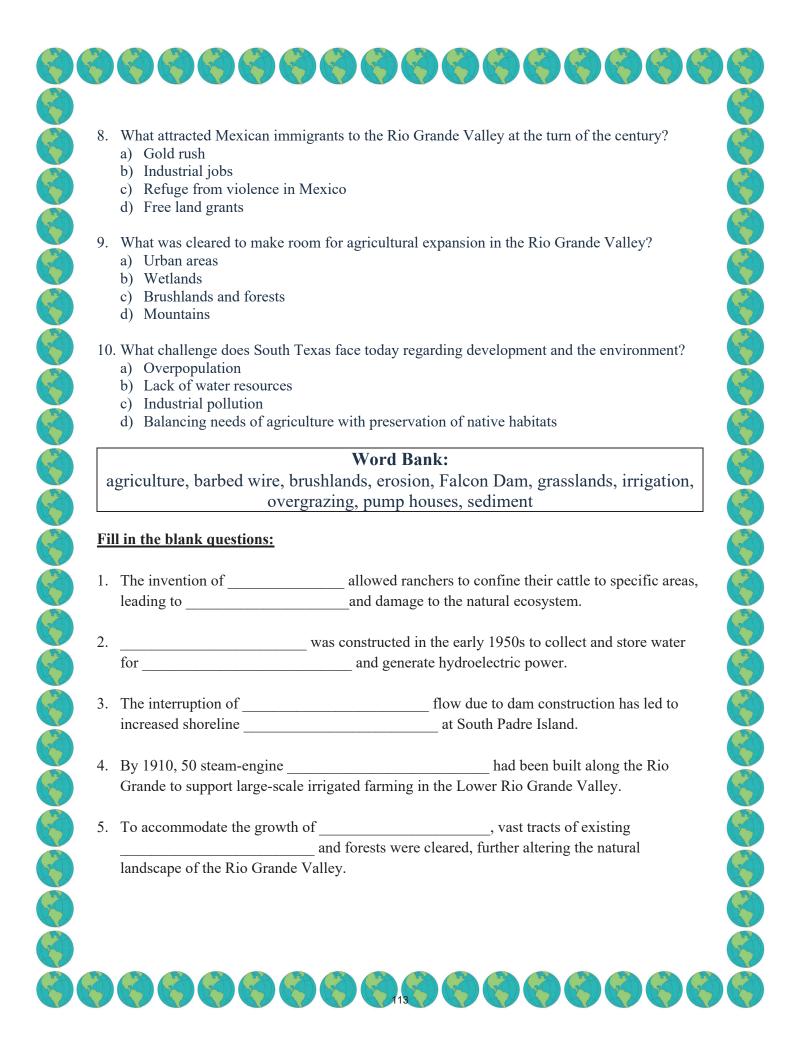
the century. This combination of skilled farmers and a substantial labor force fueled the rapid expansion of agriculture in the area. To accommodate this growth, vast tracts of existing brushlands and forests were cleared, further altering the natural landscape of the Rio Grande Valley.

These human activities have had lasting and often unforeseen impacts on the South Texas environment. While they have contributed to economic growth and development, they have also led to



significant changes in the region's ecosystems. Today, efforts are being made to balance the needs of agriculture and human settlement with the preservation and restoration of native habitats, highlighting the ongoing challenge of sustainable development in this unique and ecologically important region.

Review: How Human Activities Have Changed South Texas **Multiple Choice Questions** 1. When did people begin settling in South Texas and impacting the local ecosystems? a) Early 1700s b) Early 1800s c) Late 1800s d) Early 1900s 2. What invention significantly altered the balance of cattle grazing in South Texas? a) Steam engine b) Barbed wire c) Irrigation pump d) Electric fence 3. What percentage of the original grassland ecosystems in South Texas remains today? a) Less than 1% b) About 5% c) Around 10% d) More than 20% 4. What is the name of the first major water dam constructed in the Rio Grande Valley? a) Hoover Dam b) Rio Grande Dam c) Falcon Dam d) South Texas Dam 5. What unintended consequence did the construction of dams have on the coastal ecosystem? a) Increased flooding b) Improved water quality c) Enhanced sediment flow d) Blocked sediment deposits leading to shoreline erosion 6. Who devised the ambitious irrigation project for the Lower Rio Grande Valley? a) John Deere b) B.F. Yoakum c) Thomas Edison d) Henry Ford 7. By what year had 50 steam-engine pump houses been built along the Rio Grande? a) 1900 b) 1905 c) 1910 d) 1915



Wind Turbines and Old Water Wells: How the Rio Grande Valley Has Changed

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The Rio Grande Valley in Texas has changed a lot over the years. Let's look at how people have used water and made energy in this area.

Long ago, in the 1800s, ranchers (called rancheros) needed water for their farms and animals. They dug deep holes in the ground to find water. These holes were called *norias*. The smart ranchers dug these wells near special trees that had very long roots. These trees, called phreatophyte trees, helped the ranchers know where to find water underground.



The *norias* were very important. Ranchers could get about 15 to 20 gallons of water at a time. This water helped them grow crops and give their cows something to drink. Both the ranchers and the American settlers who came later used these wells.

But using so much water for so long caused problems. Now, people have to dig even deeper to find water. This shows how our actions can change nature over time. Today, when you look at the Rio Grande Valley, you'll see something very different: big wind

turbines. These tall structures with spinning blades make electricity from the wind. They started building these in the 2010s, and now you can see them everywhere.

Wind turbines aren't just in the Rio Grande Valley. They're all over Texas. In fact, Texas makes more electricity from wind than any other state in the country!





Wind Turbines and Old Water Wells: How the Rio Grande Valley Has Changed **Multiple Choice Questions:** 1. What did ranchers in the 1800s dig to find water in the Rio Grande Valley? a) Windmills b) Norias c) Turbines d) Ponds 2. Near which type of trees did ranchers dig their water wells? a) Oak trees b) Pine trees c) Phreatophyte trees d) Palm trees 3. How much water could ranchers get from their wells at one time? a) 5 to 10 gallons b) 15 to 20 gallons c) 25 to 30 gallons d) 35 to 40 gallons 4. What new structures now dominate the landscape of the Rio Grande Valley? a) Skyscrapers b) Water towers c) Oil rigs d) Wind turbines 5. When did they start building the new energy structures in the Rio Grande Valley? a) In the 1800s b) In the 1950s c) In the 2010s d) In the 2020s **Open Ended Question:** How did the ranchers in the 1800s show cleverness in finding water? Explain why their method was smart and how it helped them.



Lesson 6: Ancient Landscapes of South Texas During the Anthropocene Epoch

Jackqueline Alejos, Jose Garcia, Amanda Hernández, Erika Gomez Pizanna, Christian Saldaña, and Savannah Treviño

What Is the Anthropocene?

The Anthropocene is a proposed new epoch in Earth's geological timeline. It follows the Holocene, which began about 11,700 years ago after the end of the last Ice Age. While the Holocene was marked by a relatively stable climate and the rise of human civilizations, the Anthropocene represents a time in which human activities have become the dominant force shaping the Earth's surface, atmosphere, oceans, and ecosystems.

The term *Anthropocene*, derived from *anthropos*, meaning "human," was introduced in the early 2000s to reflect the growing evidence that humans have altered the Earth in ways that rival natural geological processes. This includes changes in land use, biodiversity, climate, and atmospheric chemistry. Many scientists believe the Anthropocene began in the mid-20th century, during a period known as the "Great Acceleration," when population growth, industrial activity, and fossil fuel use dramatically increased. However, there is no consensus on when it began.

In the Rio Grande Valley, the last century has seen intense environmental change due to development, agriculture, energy production, and urbanization. Understanding these changes helps us make informed decisions about how to care for the region's ecosystems and resources in the future.

Transforming the Land

Grasslands and Ranching

Human settlement in South Texas expanded rapidly during the 19th century. One of the first major land use changes was the introduction of cattle ranching. Early on, cattle roamed freely, and the natural prairie grasses were able to recover between grazings. However, with the invention of barbed wire (Figure 1), ranchers began fencing off large areas, which led to overgrazing. As a result, native grasses disappeared, and thorny shrubs and mesquite trees began to dominate the landscape. Today, over 99% of the native grasslands in the Rio Grande Valley have been lost, and efforts are underway to restore some of these ecosystems.

Agriculture and Irrigation

In the early 1900s, the Lower Rio Grande Valley shifted from ranching to agriculture. Farmers recognized the fertile soils and warm climate as ideal for growing crops, but the region needed a reliable water source. By 1910, steam-powered irrigation pumps were drawing water directly from the Rio Grande, and large irrigation systems transformed the region into a productive agricultural zone (Figure 2).

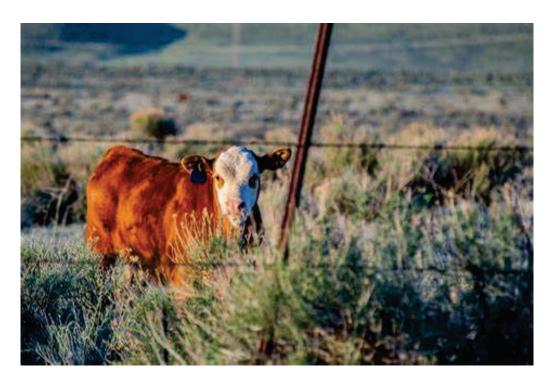


Figure 6.3: A fenced-in cow grazing on grasslands, photograph, Pxhere, n.d., https://pxhere.com/en/photo/1507423.

To manage water flow and support farming, major infrastructure projects were developed. Falcon Dam (Figure 3), completed in the 1950s, provided water for irrigation and hydroelectric power. However, dams also trap sediment that would otherwise flow downstream and replenish coastal areas. This loss of sediment has contributed to shoreline erosion along South Padre Island and the Gulf Coast.



Figure 6.2: First pumping plant for the American Rio Grande Land & Irrigation Company, 1930. Source: Watson, Lower Rio Grande Valley and Its Builders.



Figure 6. 3: Arial image of Falcon Dam. Image courtesy of the CHAPS Program at UTRGV.

Norias and Wind Energy

Before large-scale irrigation systems, ranchers relied on shallow hand-dug wells, known as *norias* (Figure 6.4), which tapped into underground water reserves. These wells were often placed near certain deep-rooted trees that signaled the presence of groundwater. While essential at the time, overuse of these wells has since lowered the water table, making it harder to access groundwater today.



Figure 6.4: Noria de San Isidro. Image courtesy of Larry Ditto.

In recent years, the Rio Grande Valley has become a leader in renewable energy. Since the 2010s, wind farms have become increasingly prevalent across South Texas (Figure 6.5), generating clean energy and altering the visual landscape with towering wind turbines.



Figure 6.5 Wind turbines in Cameron County, South Texas.

Barriers and Borders: Levees and the Border Wall

To control flooding, levees were constructed along portions of the Rio Grande. These structures channel the river during heavy rains, but they also disrupt natural floodplain processes, which in turn affect habitat and water distribution.

More recently, the construction of a border wall along the U.S.-Mexico border has raised environmental concerns. While built for security purposes, the wall fragments habitats, restricts wildlife movement, and affects seasonal migrations. Over 1,500 species of plants and animals, including several that are endangered, may be impacted. In flood-prone areas, the wall may even worsen conditions by blocking natural water flow and increasing erosion.

Rising Seas and Climate Change

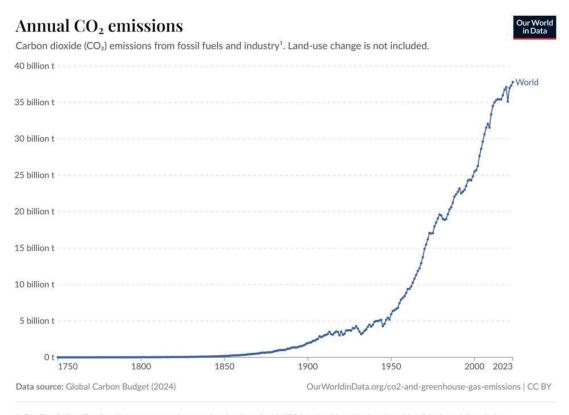
During the Holocene, melting glaciers led to rising sea levels. Today, that trend is accelerating due to human-caused climate change. Coastal areas, such as South Padre Island, are particularly vulnerable to flooding and beach erosion during hurricanes, as exemplified by Hurricane Ike in 2008 (Figure 6), which serves as a poignant reminder of how rising sea levels and powerful storms can reshape coastal communities. The effects of climate change are being felt not only globally but also locally.

Fossil Fuels and Their Legacy

Fossil fuels have powered much of human progress, from industrialization to transportation. However, their use has come at a cost. Burning these fuels releases greenhouse gases, such as carbon dioxide (Figure 7) and methane, which contribute to global warming. Mining and drilling for fossil fuels also damage landscapes, pollute water, and threaten wildlife habitats.



Figure 6: South Padre Island coastal flooding after Hurricane Ike, 2008. Source: NOAA



^{1.} Fossil emissions Fossil emissions measure the quantity of carbon dioxide (CO_2) emitted from the burning of fossil fuels, and directly from industrial processes such as cement and steel production.

Fossil CO_2 includes emissions from coal, oil, gas, flaring, cement, steel, and other industrial processes.

Fossil emissions do not include land use change, deforestation, soils, or vegetation.

Figure 7: Annual CO₂ Emissions.

Coal, the dirtiest of the fossil fuels, has declined in use in the U.S. but is still heavily used in many parts of the world. Its extraction and combustion are major contributors to air pollution and climate change. Although fossil fuels formed naturally over millions of years from the remains of ancient plants and animals, their rapid use in just a few centuries has caused a significant imbalance in the Earth's climate system.

Today, scientists and policymakers emphasize the importance of sustainable development—meeting our needs without compromising the ability of future generations to meet theirs. Transitioning to renewable energy, conserving water, and protecting natural ecosystems are vital steps toward a more balanced and sustainable future.

The Landscape of the Anthropocene

In the Anthropocene, human activity has become an inseparable part of the landscape. In South Texas, evidence of this transformation is everywhere: from hand-dug wells and historic ranches to sprawling agricultural fields, wind farms, dams, and border infrastructure.

Where once the forces of geology, rivers, wind, and time shaped the land, today it is humans who leave the most visible mark. Understanding how this region has changed, and continues to change, helps us teach students not only about geology but about the responsibilities we carry as caretakers of our environment.

Looking Ahead

The Anthropocene challenges us to rethink our place in Earth's history. In the Rio Grande Valley, the last century has witnessed dramatic transformations, including altered landscapes, depleted resources, and shifting ecosystems. These changes are the result of decisions—some made long ago, others still unfolding today.

As educators, helping students explore the concept of the Anthropocene encourages them to see the connections between geology, history, and human responsibility. The goal is not only to understand the past, but to inspire action that protects the future, for the people, plants, animals, and landscapes that make South Texas unique.

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Assuming the teachers have or can request access to this resource it is an easy-to-comprehend introduction to learning about not just the current state of our climate but science in general. It discusses geological processes, the scientific method/community, and reflects on our place and influence on the environment. No matter the interests of the students, the book inspires and informs the reader on how they can reduce their carbon footprint, understand the true culprits of climate change, and participate in politics/policy change. The 2 chapters listed discuss non-renewable resources (chp.19) and the qualities/process of global warming (chp.15).

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This news article discusses how a border wall affects rivers, the flow and quality of water, and treaties with Mexico. It includes an image of the rivers in the U.S. near the border with Mexico with some information below to understand it better.

Willis, Joshua K, Andrew Kemp, and Benjamin H. Strauss. "Sea Level Rise." Ocean, May 11, 2023. https://ocean.si.edu/through-time/ancient-seas/sea-level-rise

A high school reading comprehension level article about sea level rise in historical contexts as well as why it happens. This article contains many photos and diagrams to better explain the methods of how they can measure the sea level so accurately. It also discusses the rising sea levels dating back to the last ice age to now and how this data was able to be collected. The article also talks about the political and human problems that can come from sea level rise as well as the possible impact on storms we may see come around in the near future.

WIND ENERGY IN RIO GRANDE VALLEY TX. Town Square Publications. 2023. https://townsquarepublications.com/wind-energy-in-rio-grande-valley-tx/

This article goes into detail about the mechanics, placement and costs of wind turbines in the Rio Grande Valley. It also talks about why there are so many wind turbines in the Rio Grande Valley.

Online Sources

CHAPS Program. *Norias- Hand dug water wells*. Ancient Landscapes of South Texas website. The University of Texas Rio Grande Valley. <a href="https://www.utrgv.edu/ancient-landscapes-southtexas/landscapes/south-texas-sand-sheet/norias-hand-dug-water-wells/index.htm#%3A~%3Atext%3D19th%20century%20farmers%20built%20hand%2Cland%20which%20lacked%20flowing%20water

This source details the historical significance of hand dug water wells in the Rio Grande Valley and discusses the noria's significance and the archeological remnants of these artifacts. This source would best serve students who are beginning to study the local archeological sites existing in the Rio Grande Valley.

CHAPS Program. San Isidro Water Wells Podcast. Ancient Landscapes of South Texas website. The University of Texas Rio Grande Valley.

https://rgvtrails.stqry.app/story/265185 https://rgvtrails.stqry.app/story/265219

This is a two-and-a-half-minute podcast that describes the hand-dug water wells contents, placement and its uses. As well as an image of one of the hand-dug water wells and the phreatophyte trees.

CHAPS Program. *Wind Energy in the Rio Grande Valley of Texas podcast.* Ancient Landscapes of South Texas website. The University of Texas Rio Grande Valley. https://rgvtrails.oncell.com/en/wind-turbines-315049.html

This podcast is a minute and a half long description explaining the upbringing of the windmill in the Rio Grande Valley. It emphasizes how many wind turbines have sprung up in the region since 2010.

Elmer, MacKenzie. 2023. "Environment Report: EPA Maps Reveal Flood Impact from Border Wall." Voice of San Diego, April 24. Accessed November 10, 2023. https://voiceofsandiego.org/2023/04/24/environment-report-epa-maps-reveal-flood-impact-from-border-wall/

This is a report that contains maps that reveal the impact of a border wall on the Tijuana River and explain why it would be dangerous for the people living there. It is useful to get to know more about the possible outcomes of a border wall.

Falcon Dam. (n.d.). Texas Archive of the Moving Image. https://texasarchive.org/taxonomy/term/116211

This resource provides a quick and easy overview of Falcon Dam, when it was constructed, its height and length, and the purpose it serves. This resource also provides videos about the dam that a teacher could show to go along with the lecture.

Hulse, James. 2021. "The American Rio Grande Land and Irrigation System." HMdb.org, January 30. Accessed November 10, 2023. https://www.hmdb.org/m.asp?m=165812

This short but informative page includes a transcript from a marker located in the Rio Grande Valley, and a photo is also available. The marker provides valuable information that does not take long to read.

Kinsler, Ro. "How Did the Ice Age End? A Geologist Explains." American Museum of History. Accessed November 10, 2023. https://www.amnh.org/explore/ology/earth/ask-a-scientist-about-our-environment/how-did-the-ice-age-end.

This is a short article aimed towards elementary school students who want to learn a bit more about what ice ages are. Kinsler mentions about how ice cores are one way we can test past climates to learn more about how the earth might have been thousands of years ago. She also talks about how we may currently be in an ice age that has been around since the Pleistocene and we may yet see what a hot climate looks like in a few thousand years from now.

Lindsey, R. (2023, May 12). *Climate change: Atmospheric carbon dioxide*. (National Oceanic and Atmospheric Administration) NOAA Climate.gov. https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide

This resource discusses the effects excess carbon dioxide has on our atmosphere and our oceans. Many activities can be created out of exploring this website. While looking through it I found an entire tab on the NOAA website on teaching climate science. The tab offers experiment ideas, activities, and visual aids. NOAA can also be a helpful source for researching sea level rise.

Lindsey, Rebecca, and David Herring. "Hasn't Earth Warmed and Cooled Naturally throughout History?" Climate.gov, October 29, 2020. https://www.climate.gov/news-features/climate-qa/hasnt-earth-warmed-and-cooled-naturally-throughout-history

This article is aimed at a general audience with at least a high school level reading level that talks about the variability of climate that we know of here on earth. One of the important points the authors bring up is the big influence that the amount of carbon dioxide in our atmosphere has to play in the earths climate and temperature.

National Aeronautics and Space Administration (NASA). "Climate Kids: The Story of Fossil Fuels." NASA Website. Accessed November 13th, 2023. https://climatekids.nasa.gov/fossil-fuels-next/

This resource is easy to understand and great for kids it talks about the history of fossil usage, the extraction process, and the drawbacks of using fossil fuels.

National Geographic. 2019. "Causes of Global Warming Explained" National Geographic Website. Accessed November 13th, 2023.

https://www.nationalgeographic.com/environment/article/global-warming-causes

This is a great introduction to climate change; this resource not only discusses the causes of climate change but also why understanding / monitoring these changes matter, and how we can mitigate worst climate change scenarios.

Masterson, Victoria, and Stephen Hall. "Sea Level Rise: Everything You Need to Know." World Economic Forum, September 29, 2022.

https://www.weforum.org/agenda/2022/09/rising-sea-levels-global-threat/.

This is a web article aimed towards at least high school level audience that talks about what sea level rise means for people and how it happens. It talks about how the primary causes of sea level rise is melting ice from the polar regions of our world as well as water expansion due to the same rising temperatures. It also talks about who would be affected by a rising sea level in terms of both the environment and human structures.

Ritchie H., Rosado P., and Roser M. 2020. "Greenhouse Gas Emissions" Our World in Data Website. Accessed November 13th, 2023. https://ourworldindata.org/greenhouse-gas-emissions

This source offers quantitative data, maps, and graphs that can be used as a visual aid to accompany the topic at hand. The link offered is specific to greenhouse gases; it illustrates the rise in green gas emissions and shows which countries release the most.

South Texas Vegetation. n.d. Texas Parks and Wildlife. Accessed November 10, 2023. https://tpwd.texas.gov/landwater/land/habitats/southtx_plain/vegetation/.

This source is useful because it gives a quick overview of how brushlands began replacing the grasslands. It also goes details how human and large cattle involvement quickened this event.

The Nature Conservancy. 2020. "Planting the Seed for Future Generations," January 29, 2020. https://www.nature.org/en-us/about-us/where-we-work/united-states/texas/stories-in-texas/native-seeds-restore-grasslands/.

This source is useful because it details the importance of preserving and cultivating these grasslands as many animals and insects rely on them to maintain a thriving ecosystem. There is also a YouTube video made by the group on the page that details the importance and how they are working with large land owners to bring back these grassy areas.

"Understanding Sea Level." Sea Level Change, February 24, 2022. https://sealevel.nasa.gov/understanding-sea-level/global-sea-level/overview

This is an interactive website of sorts where you can switch pages to a more specific topic within the overview of what the global sea level is and how it is able to change. The specific topics cover water storage in the form of ice, thermal expansion, and ground water removal by humans. This particular page focuses more on current trends but would still be useful to understand each of the functions.

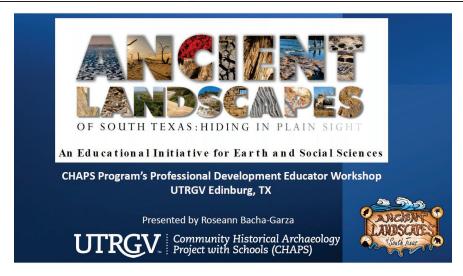
USGS. 2023. The U.S. Wind Turbine Database. https://eerscmap.usgs.gov/uswtdb/viewer/#7.41/26.731/-98.27

This is a link to an interactive map that depicts wind turbines all around the United States of America. Perfect for visualizing how many wind turbines there are in the Rio Grande Valley compared to other places.

United States Geological Survey (USGS). "What are the Types of Coal?" USGS, Science for a Changing World Website. Accessed November 13th, 2023. https://www.usgs.gov/faqs/what-are-types-coal

This resource can be a simple introduction to the types of coal and their uses, as well it briefly discusses the natural process in which coal is made.

Educational tools: Items in Ancient Landscapes of South Texas Traveling Trunk



Project Elements:

Site identification Geoheritage tourism map Website Mobile web

Educational tools

1. Projectile Point AR Poster 2. Lesson Plans

3. K-12 Teacher Workshops 4. Educational Trunks

Geoheritage Photo Book Documentary Film Geoheritage Tourism Book

Ancient Landscapes of South Texas

College of Liberal Arts

Home

Ancient Landscape

Academic
Industry Academic
Recources

As MAYA Call
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As MAYA Call
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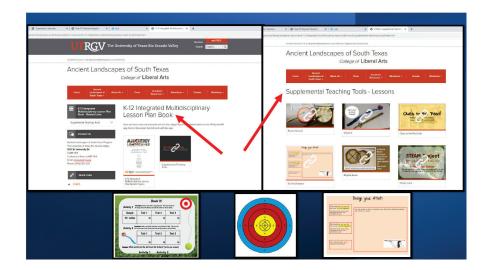
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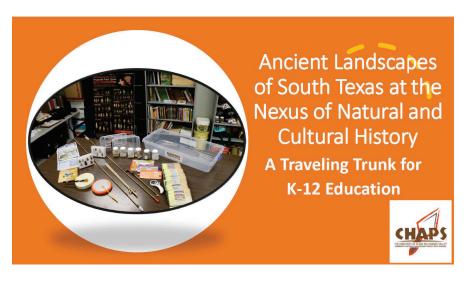
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Items for the Educational Trunk



ANCIENT LANDSCAPES OF SOUTH TEXAS GEOHERITAGE / GEOTOURISM BROCHURE MAP INITIATED BY SARAH FEARNLEY HARDAGE **GEOLOGY-GIS MAPPING SPECIALIST**



Made with Cowhide (can also use deer hide and horse hide)

Authentic Native American Hand-Drum Made by Lipan Apache of Way South Texas

LIPAN APACHE MUSICAL LYRICS Vocable sounds and English Translation

Submitted by Robert Soto – Lipan Apache Tribe of Texas Vice Chairman May 2014

THERE IS A GOOD LAND / Prayer song

Nii gooyí There is a good land

Nizaa'a that is far away

we go off

Hádiiká We are going there (ours)

łi jíí Someday

Ei daagootí That is ours



Atlatl Spear Thrower and Darts



Authentic material atlatl darts are made here with seasoned river cane shafts and fit with chert points. They are fletched with wild turkey feathers and wrapped with genuine deer sinew and natural hide glue. Typical length for darts/spears is between 5-6 feet.



The "Basketmaker" atlatl thrower (above) replicates what was used for hunting -authentic to the region of South Texas. The handle was fit with finger grips made of shell, deer sinew or yucca fibers. The atlatl (below) is one made for modern use – a 'practice thrower' that is simpler and easier to use



 $2^{nd}\,\mbox{Law}$ (F=ma) The application of additional leverage provided by the atlatl gives greater impact of force.

Newton's 2nd and 3rd Laws of Motion: A Visual Aid

The late Dennis Stanford of the Smithsonian Institution physics demonstration at Colorado College (c. 1988)



3rd Law: When the dart hits the target – the shaft is forced backwards as an equal and opposite reaction. Therefore, can reload multiple times.



Projectile Point Artifact Poster in Augmented Reality APP

RGVpointsAR





Projectile Point Artifacts

Cast Replicas



Geological Materials for use with foldscopes

1.Mineral Salt
2.Petrified Wood
3.Roma Sandstone
4.Bituminous Coal
5.Catahoula
Volcanic Ash
6.South Texas
Sand Sheet Sand

Foldscopes – for use with Geological Materials







Traveling Museum
Exhibit
Debut Nov 1, 2023
Student Installation
Docents & Stewards
See CHAPS website for
schedule of venues

Awardwinning
UTRGV CHAPS
YouTube
Channel

https://youtu.be/398URwHw8VU





For further information about the CHAPS Program, contact us at chaps@utrgv.edu



If you would like a copy of our Geoheritage photo book, scan the QR code or go to <u>www.lulu.com</u>



www.utrgv.edu/ancient-landscapes-southtexa: www.utrgv.edu/chaps Like us on facebook UTRGV CHAPS



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Dr. Russell K. Skowronek Director CHAPS Program and Professor of Anthropology & History (Emeritus)

Dr. Christopher L. Miller Associate Director CHAPS Program Professor of History (Emeritus) Roseann Bacha-Garza, MA CHAPS Program Project Director Associate Professor of Practice Anthropology / Public Heritage & Community Engagement

Sarah Fearnley Hardage, MS CHAPS Team Member Lecturer III of Geology - School of Earth, Environmental & Marine Sciences

CHAPS Development Team



Thank you for your time and attention!

Note: download the Ancient Landscapes of South Texas Hiding in Plain Sight: A Multidisciplinary Integrated Place-Based Lesson Plan book for free at:

https://www.utrgv.edu/ancient-landscapes-southtexas/_files/documents/ancient-landscapes-multidisciplinary-lesson-plan-book.pdf

Or, purchase it at Lulu.com at: www.lulu.com

About the CHAPS Program and the Ancient Landscapes of South Texas Project

Roseann Bacha-Garza, Juan L. González, Christopher L. Miller, and Russell K. Skowronek

The Big Picture

Given the prevalence of the historical sciences (History, Anthropology, Archaeology, Biology, Geology, Geography, among others) in traditional academic pursuits, it is hard to imagine any major portion of the occupied world in the 21st century as a *tabula rasa* when it comes to fundamental knowledge about its past. Yet to a large degree that was the condition of local knowledge about the Lower Rio Grande Valley (LRGV) until quite recently. This region, encompassing the 5 southernmost counties in Texas and occupied by approximately 1.3 million people, is far from unknown, however. Even those who give only the most cursory attention to national media know the names of the major towns and cities, but the only associations they have with them is that they are characterized by poverty, narcotrafficking, and illegal border crossings. The people who live in the region know better, of course, but even they know very little about the natural and cultural foundations of their society. In 2009 what was then the University of Texas—Pan American undertook the creation of a program designed to address the problem.

The Community Historical Archaeology Project with Schools (CHAPS) Program was founded as a self-consciously multidisciplinary endeavor, drawing eventually on disciplines as disparate as anthropology, biology, business, communication, geology, history, library special collections, educational psychology, and public administration with the common purpose of providing local citizens and school children with foundational background about the natural and cultural history of their region as well as to counter negative stereotypes being cultivated in mass media. Now, more than a decade later, it has embarked upon its most ambitious and allencompassing initiative yet: *The Ancient Landscapes of South Texas*—At the Nexus of Natural and Cultural History. This book represents a major step forward in accomplishing those goals and lies at the core of the initiative's educational calling.

The Ancient Landscapes of South Texas (ASLT)

Like all of its initiatives, this one was born out of initially casual conversations and shared interests among the CHAPS team's core members—archaeologist Russ Skowronek, geologist Juan González, anthropologist Roseann Bacha-Garza, and historian Chris Miller. Skowronek and González were the first to notice and respond to the informational abyss concerning deep cultural and geographical currents in the region. González, for example, discovered that a geological formation long thought to be naturally occurring sandstone in the area of Rio Grande City was actually something quite different. He identified the composition as being volcanic ash deposited over 20 million years ago at what was once the coastline some 60 miles inland from where the current gulf shore is located. This opened up a whole series of new discoveries and suggested numerous biological, geographical, and cultural implications that no one had thought of before. And with that, ALST took flight.

Initially the project focused on turning out scholarly papers focusing on the new discoveries, opening up the academic world to previously unsuspected aspects of American prehistory and natural physical development. But the CHAPS vision called for much more. Following previous initiatives such as the Rio Grande Valley Civil War Trail, a similarly groundbreaking and stereotype-shattering project that has won both national and international attention and awards, ALST was conceived on a number of levels with multiple audiences and purposes.

Consistent with one of its missions, the CHAPS team envisioned a broad-based effort to enlighten the public about the LRGV's unique cultural and natural features and to foster sustainable economic development for the region by encouraging cultural and geo-tourism. In pursuit of these ends they first created a "coffee table" book featuring breathtaking photographs of many of the region's unique sites (*Ancient Landscapes of South Texas—Hiding in Plain Sight*). They followed this up with a map/brochure suitable for mass distribution through tourist centers, chambers of commerce, and other outlets. Tied to the map was a website carrying further information about what was pictured on it and in the book, as well as a mobile web feature that would allow any interested tourist to access supporting material through any telephone. This was joined by a 45-minute documentary film, debuted at a special session of the Texas State Historical Association meeting in 2023 to rave reviews. Following this is a traveling museum exhibit featuring again images from the book and information to enhance broad audience awareness of the region's uniqueness. Like previous such exhibits designed and distributed by the CHAPS Program it is expected that this will visit a wide variety of venues and bring yet more attention to opportunities for public enjoyment and sustainable development.

But as the word "schools" in the organization's name suggests, ALST would not stop there. Fundamental to its mission, the CHAPS Program is deeply concerned with local school curriculum. Conscious of the fact that educational researchers have noted that an individual's ability to learn and understand new concepts is dependent on that person's ability to make connections to their existing knowledge, including cultural and locally relevant experiences, the CHAPS Program has consistently focused upon place- and community-based learning models, hopefully enabling students from the region to connect learning to recognizable materials and create memorable lessons that in turn build a sense of community. The bottom line being that as the research and our experience has demonstrated, when children can physically connect with the material they are learning they remember what they learned when the all-important tests assess their levels of achievement.

Also consistent with the CHAPS Program vision, the resulting curriculum had to be made deeply multidisciplinary. Middle and high school students in Texas are exposed to "integrated science" courses that include earth or environmental sciences, but cross-disciplinary integration is rare. In isolation, students learn about Native Peoples and the geography of Texas, and broader US history. The CHAPS Program sought to rectify this shortcoming by promoting a STEAM approach, bringing a more nuanced appreciation of how landscape shapes human experience and how throughout the ages of human habitation in the region, people have, in turn, shaped the landscape. The human experience cannot function separate from the natural environment and humans, by their nature, cannot help but affect that environment through their interactions with it. As students pass from grade to grade, from one science class to another or from a science to a social science class, they will take important integrating information with them, fitting together the jigsaw puzzle pieces into coherent natural and cultural pictures.

Moving Forward we envision the students in Region One ESC will benefit from this integrative approach and gain from it a better understanding of and appreciation for the special nature of their home. They in due time will be the decision makers who will be able to consider issues surrounding "livability" and "sustainability" on our precious landscape. This approach has the potential to be expandable across Texas for those with the vision to do so.

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