Earth School Outdoors 5E Lesson Plan

Water Quality Education for Austin, TX 5th Grade Students

LESSON OVERVIEW

Lesson Objectives

Students will learn about water flow in a watershed and aquifer, identify pollution threats, and learn about flood safety and actions they can take to help protect water quality. These hands-on experiences build background knowledge and engage students in scientific inquiry relevant to their daily lives and local community. Earth School content is correlated to the state standards and can enrich lessons about landforms, water, and the environment. Lessons may be tailored to highlight an individual campus's eco-features.

Key Concepts

watershed, creek, river, interpreting maps, aquifer, karst, limestone, sedimentary rock, pervious vs. impervious surfaces, erosion, weathering, pollution prevention, water quality, flood safety, native plants, mixtures and solutions, endangered species, endemic species, caves, springs, recharge, discharge, the mission of the City of Austin's Watershed Protection Department

Time

1.5 hours per class (special accommodations can be made for a longer/shorter presentation)

Background

Everyone lives in a watershed, an area of land that drains water into a particular creek, river, or lake, due to the force of gravity. High points and ridges define the boundary of a watershed while water collects at the lowest point. Creeks, rivers, and lakes interconnect to form a large watershed basin that drains to the ocean.

The majority of Austin in located within the Colorado River Watershed, but some northern portions of the city belong to the Brazos River Watershed. The entire watershed basin of the Colorado River exists in Texas, beginning above Colorado City, Texas, and includes all the land that drains water into the Colorado River as it travels down to Matagorda Bay and the Gulf of Mexico. The Austin segment of the Colorado River Watershed Basin is composed of many smaller watersheds that drain to the Colorado River. Most urban and natural areas within Austin city limits drain water to: (1) creeks, (2) the Edwards or Trinity aquifers, and (3) Lake Travis, Lake Austin, or Lady Bird Lake (dammed portions of the Colorado River). Rainwater travels over all the surfaces in a watershed, so water quality in creeks, lakes, and rivers is greatly affected by the condition of the land, streets, buildings, etc. within the boundary of a watershed.

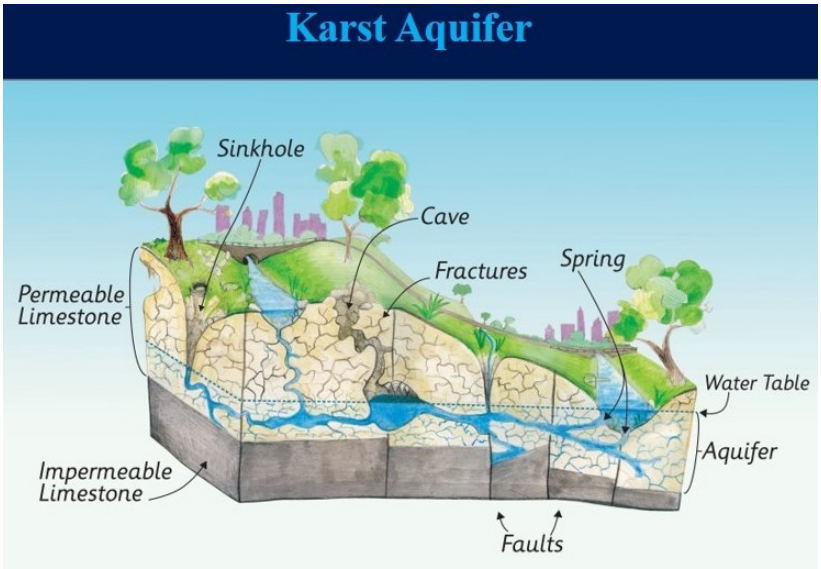
Aquifers are underground rock layers that store groundwater. The most common aquifers are made up of sand, gravel, or limestone. The Edwards Aquifer in Austin is formed from layers of limestone. Some layers of limestone are easily dissolved by water, creating holes, channels, and caves, both at the surface and underground. This karstic landscape allows for the recharge of the aquifer when water enters holes in the rock. Karst aquifers are especially susceptible to pollution because the openings on the surface (sinkholes, caves,

LESSON OVERVIEW

faults, and fractures) can be direct conduits to the aquifer, allowing water (and pollutants) to flow into the aquifer without any filtration through the soil. While the Colorado River is the source of the City of Austin's drinking water, nearby communities get their drinking water from shared aquifers, such as the Edwards or Trinity aquifers. Water from the Edwards Aquifer is usually crystal clear and cold. Water exiting the aquifer is known as discharge, and needs to enter the aquifer clean in order to come out clean at springs. There are many springs across Austin where discharge occurs, including the famous Barton Springs, home to the endangered and endemic Barton Springs and Austin Blind salamanders.

There are three major zones in an aquifer:

1) The contributing zone: portions of watersheds upstream of a recharge zone whose creeks and rivers flow downstream to the recharge zone
2) The recharge zone: land with caves, sinkholes, faults, and fractures that rainwater and streamflow drain through to an aquifer
3) The confined zone: area of land where the aquifer is capped by an impermeable or impervious layer, such as clay or shale, so the groundwater is under pressure



A watershed map prepared by the City of Austin will be used to locate the school's watershed and to discover which zone of the aquifer the school is located within. It is useful for students to define the boundary of the smaller watershed where they live and go to school. The condition of the body of water in their watershed will be an indicator of the environmental problems facing their neighborhood and the city at large. Students can relate to the effect of their own behavior and choices, and focus efforts on cleaning up pollution sources close to home. What students and other citizens do in their neighborhood affects their local creek and the Colorado River. Those effects continue to travel downstream to the Gulf of Mexico.

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	What will it look like?	Materials
ENGAGE	***Prior to Earth School, the classroom teacher will introduce concepts by playing the Earth School video available on the City of Austin's Earth School website.*** Earth School educators will check for students' prior knowledge by asking questions and discussing: • What is a watershed? Introduce watershed hand model and watershed chant. • Where does the water falling on your school grounds flow to? (nearby creek -> Colorado River -> Gulf of Mexico) • Where does our drinking water come from? • What is the difference between pervious and impervious surfaces? Play Soak-In/Run-Off jumping game. • What is a recharge zone? Aquifer? Use watershed hand model. Show karst limestone sample.	• ***Earth School video (classroom teacher shows class before lesson)*** • Watershed hand model • Austin watershed map • Colorado River map • Karst limestone sample
EXPLORE	**Explore:** Campus Eco-Features • Class will travel to and learn about various kinds of eco-features on their school campus that affect water quality and capture stormwater runoff such as: stormwater infrastructure (storm drains, stormwater ponds, rain cisterns, rain gardens, etc.), landscaping (native plant beds, and/or edible garden beds), and/or natural areas (forests, wildflower meadows, and/or creeks). **Investigate:** How does pollution on land affect water quality in our creeks, rivers, and ocean? • Class will use the watershed models to investigate the path of water and pollution as it moves across the watershed. **Investigate:** How does pollution on land affect water quality in our aquifer and springs? • Class will view how water carries pollutants through the Edwards Aquifer, underground, and back up through springs.	• Instructional photos • Native plant field guides (optional) • Watershed models • Aquifer model • Dog waste model and "Scoop the Poop" bag • Litter samples
EXPLAIN	• Educators will guide students through the photos and examples of different kinds of pollution, including litter, oil/gas, lawn chemicals, and dog waste. • Educators will connect students' prior exploration to the formal learning.	• Instructional photos and props

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ELABORATE	• Dive deeper into the main types of pollution found on land/in a watershed and how they can affect our water quality using visuals and sample materials where appropriate. • Students will brainstorm their own solutions and alternatives to pollution problems. • (Play optional Watershed Pollution & Solutions Game) • Extend students' understanding of aquifers and deepen their knowledge of the effects of pollution on living creatures, such as the Barton Springs Salamander.	• (optional) Watershed Pollution & Solutions Game • Aquifer model • Salamander figurines • *Grow Green: Native & Adapted Landscape Plant Guide* • Recycled and upcycled items • Beneficial insect models
EVALUATE	Students will demonstrate comprehension by sharing one new way they have learned how to protect our area's water quality and the source of our drinking water. Each student will receive the following items to help deepen and extend their knowledge after the program: • Watershed map for their school's local creek • "Aquifer Pollution Search" activity sheet • "Go With The Flow" activity sheet • "Clean Creek Champion Challenge" sheet • Earth School sticker After the program, the classroom teacher will evaluate their student's knowledge and commitment to implementing pollution solutions by keeping track of their class's progress via the Clean Creek Challenge game board. All classes that earn 50 bubble points and submit completed game boards back to the Earth School team will receive a special prize!	• Watershed Map for participating school (one per student) • "Aquifer Pollution Search" activity sheet (one per student) • "Go With the Flow" activity sheet (one per student) • "Clean Creek Champion Challenge" sheet (one per student) • "Clean Creek Champion" teacher game board (one per class) • Earth School stickers • Special Prize!

CURRICULUM CONNECTIONS

Science TEKS

Hands on Watershed Models & Aquifer Model Demonstration

5.1 Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following home and school safety procedures and environmentally appropriate and ethical practices. The student is expected to:

(A) demonstrate safe practices and the use of safety equipment as outlined in Texas Education Agency-approved safety standards during classroom and outdoor investigations using safety equipment, including safety goggles or chemical splash goggles, as appropriate, and gloves, as appropriate

(B) make informed choices in the conservation, disposal, and recycling of materials.

5.2 Scientific investigation and reasoning. The student uses scientific practices during laboratory and outdoor investigations. The student is expected to:

(A) describe, plan, and implement simple experimental investigations testing one variable

(B) ask well defined questions, formulate testable hypotheses, and select and use appropriate equipment and technology

(C) collect and record information using detailed observations and accurate measuring (WHEN DATA COLLECTION IS REQUESTED and/or TIME IS ALLOTTED)

(D) analyze and interpret information to construct reasonable explanations from direct (observable) and indirect (inferred) evidence

(E) demonstrate that repeated investigations may increase the reliability of results

(F) communicate valid conclusions in both written and verbal forms

5.3 Scientific investigation and reasoning. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:

(A) analyze, evaluate, and critique scientific explanations by using evidence, logical reasoning, and experimental and observational testing

(B) draw or develop a model that represents how something that cannot be seen such as the Sun, Earth, and Moon system and formation of sedimentary rock works or looks

(C) connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists. (WHEN ECO-HEROES CONTENT IS REQUESTED and/or TIME IS ALLOTTED)

Science TEKS

Solubility of Lawn Chemicals	**5.5 Matter and Energy: The student knows that matter has measurable physical properties and those properties determine how matter is classified, changed, and used.** (C) identify changes that can occur in the physical properties of the ingredients of solutions such as dissolving salt in water or adding lemon juice to water
Formation of Limestone/Sedimentary Rocks after Cretaceous Period & Uplift Along Balcones Fault	**5.7 Earth and Space. The student knows the Earth's surface is constantly changing and consists of useful resources. The student is expected to:** (A) Explore the processes that led to the formation of sedimentary rocks and fossil fuels **4.7 Earth and space. The students know that Earth consists of useful resources and its surface is constantly changing.** (A) Examine properties of soils, including color and texture, capacity to retain water, and ability to support the growth of plants (C) Identify and classify Earth's renewable resources, including air, plants, water, and animals, and nonrenewable resources, including coal, oil, and natural gas, and the importance of conservation **3.7 Earth and space. The student knows that Earth consists of natural resources and its surface is constantly changing** (B) investigate rapid changes in Earth's surface such as volcanic eruptions, earthquakes, and landslides
Lawn Chemicals, Dog Poop, Eutrophication & Endangered Species	**5.9 Organisms and environments. The student knows that there are relationships, systems, and cycles within environments** (A) observe the way organisms live and survive in their ecosystem by interacting with the living and nonliving components (B) describe the flow of energy within a food web, including the roles of the Sun, producers, consumers, and decomposers (C) predict the effects of changes in ecosystems caused by living organisms, including humans, such as the overpopulation of grazers or the building of highways (D) identify fossils as evidence of past living organisms and the nature of the environments at the time using models

	3.9 Organisms and environments. The student knows and can describe patterns, cycles, systems, and relationships within the environments. (A) observe and describe the physical characteristics of environments and how they support populations and communities of plants and animals within an ecosystem
Effects of Pollution on Aquatic Species	**5.10 Organisms and environments. The student knows that organisms have structures and behaviors that help them survive within their environments** (A) compare the structures and functions of different species that help them live and survive in a specific environment such as hooves on prairie animals or webbed feet in aquatic animals
Native Plants Adaptations & Beneficial Insect Life Cycle	**3.10 Organisms and environments. The student knows that organisms undergo similar life processes and have structures that help them survive within their environments** (B) investigate and compare how animals and plants undergo a series of orderly changes in their diverse life cycles such as tomato plants, frogs, and lady beetles

Social Studies TEKS

Green Stormwater Infrastructure, Aquifer Recharge Zone, & Climate Resilience	**6) Geography. The student understands places and regions in the United States. The student is expected to:** (A) describe political and economic regions in the United States that result from patterns of human activity (B) describe regions in the United States based on physical characteristics such as landform, climate, and vegetation **7) Geography. The student understands the location and patterns of settlement and the geographic factors that influence where people live. The student is expected to:** (A) identify and describe the patterns of settlement such as rural, urban, and suburban (B) explain the geographic factors that influence patterns of settlement and the distribution of population in the United States

Social Studies TEKS

Green Stormwater Infrastructure, Aquifer Recharge Zone, & Climate Resilience

(8) Geography. The student understands how people adapt to and modify their environment. The student is expected to:

(A) describe how and why people have adapted to and modified their environment in the United States such as the use of human resources to meet basic needs; and

(B) analyze the positive and negative consequences of human modification of the environment in the United States

(C) identify different points of view about an issue, topic, historical event, or current event

(D) identify the historical context of an event

(24) Social studies skills. The student uses geographic tools to collect, analyze, and interpret data. The student is expected to:

(A) apply mapping elements, including grid systems, legends, symbols, scales, and compass roses, to create and interpret maps

(B) interpret geographic data, population distribution, and natural resources into a variety of formats such as graphs and maps

Austin ISD Science Vocabulary

Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6
solubility	direction	oil	earth	adaptation	adaptation
dissolve	force	organic matter	surface	carnivore	habitat
mixture	gravity	sedimentary rock	fresh water	decomposer	niche
solution	movement	deposition	ocean	ecosystem	predator
		erosion	precipitation	herbivore	prey
		landform	runoff	omnivore	species
		valley	climate	environment	growth
		weathering	data	impact	life cycle
			temperature	decay	stage
			weather	model	
				sediment	
				weathering	