

Middle School Lesson Plan #4

GRADE(S): 6th, 7th, 8th

TOPIC: Water Resources

TITLE: Water - On the Surface and in the Ground

OVERVIEW: The student will understand that water resources include both surface water and ground water. The student will investigate a Texas river basin and an associated aquifer. Maps and graphs will be used by the student to relate the data as part of a written report.

TEXAS ESSENTIAL KNOWLEDGE AND SKILLS:

Science, 6th Grade

(b) Knowledge and Skills

(6.3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:

(C) represent the natural world using models and identify their limitations.

(6.12) Science concepts. The student knows that there is a relationship between organisms and the environment. The student is expected to:

(C) identify components of an ecosystem to which organisms may respond.

(6.14) Science concepts. The student knows the structures and functions of Earth systems. The student is expected to:

(B) identify relationships between groundwater and surface water in a watershed

Mathematics, 6th Grade

(b) Knowledge and Skills

(6.3) Patterns, relationships, and algebraic thinking. The student solves problems involving proportional relationships. The student is expected to:

(A) use ratios to describe proportional situations.

(6.10) Probability and statistics. The student uses statistical relationships to analyze data. The student is expected to:

(C) sketch circle graphs to display data.

(D) solve problems by collecting organizing , displaying, and interpreting data.

(6.11) Understanding processes and mathematical tools. The student applies Grade 6 mathematics to solve problems connected to everyday experiences, investigations in other disciplines and activities in and outside of school. The student is expected to:

(A) identify and apply mathematics to everyday experiences, to activities in and outside of school, with other disciplines, and with other mathematical topics.

(6.12) Understanding processes and mathematical tools. The student communicates about Grade 6 mathematics through informal and mathematical language, representations, and models. The student is expected to:

(A) communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models.

(6.13) Understanding processes and mathematical tools. The student uses logical reasoning to make conjectures and verify conclusions. The student is expected to:

(A) make conjectures from patterns or sets of examples and non examples.

Social Studies, 6th Grade

(b) Knowledge and Skills

(6.6) Geography. The student understands the impact of physical processes on patterns in the environment. The student is expected to:

(B) describe and explain the physical processes that produce renewable and nonrenewable natural resources such as fossil fuels, fertile soils, and timber.

(C) analyze the effects of physical processes and the physical environment on humans.

(6.7) Geography. The student understands the impact of interactions between people and the physical environment on the development of places and regions.

The student is expected to:

(B) identify and analyze ways people have modified the physical environment.

(C) describe ways in which technology influences human capacity to modify the physical environment.

(6.21) Social studies skills. The student applies critical-thinking skills to organize and use information acquired from a variety of sources including electronic technology. The student is expected to:

(B) analyze information by sequencing, categorizing, identifying cause-and-effect relationships, comparing, contrasting, finding the main idea, summarizing, making generalizations and predictions, and drawing inferences and conclusions.

(C) organize and interpret information from outlines, reports, databases, and visuals including graphs, charts, timelines, and maps.

(6.22) Social studies skills. The student communicates in written, oral, and visual forms. The student is expected to:

(A) use social studies terminology correctly.

(B) incorporate main and supporting ideas in verbal and written communication.

(C) express ideas orally based on research and experiences.

(D) create written and visual material such as journal entries, reports, graphic organizers, outlines, and bibliographies.

(E) use standard grammar, spelling, sentence structure, and punctuation.

English Language Arts and Reading, 6th Grade

(b) Knowledge and Skills

(6.13) Reading/inquiry/research. The student inquires and conducts research using a variety of sources. The student is expected to:

(D) interpret and use graphic sources of information such as maps, graphs, timelines, or tables, to address research questions (4-8).

(E) summarize and organize information from multiple sources by taking notes, outlining ideas, and making charts (4-8).

(6.15) Writing/purposes. The student writes for a variety of audiences and purposes and in a variety of forms. The student is expected to:

(A) write to express, discover, record, develop, reflect on ideas, and to problem solve (4-8).

(C) write to inform such as to explain, describe, report, and narrate (4-8).

(6.20) Writing/purposes. The student uses writing as a tool for learning and research. The student is expected to:

(C) take notes from relevant and authoritative sources such as guest speakers, periodicals, and on-line searches (4-8).

(D) summarize and organize ideas gained from multiple sources in useful ways such as outlines, conceptual maps, learning logs, and timelines (4-8).

Science, 7th Grade

(b) Knowledge and Skills

(7.3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:

(C) represent the natural world using models and identify their limitations.

(7.12) Science concepts. The student knows that there is a relationship between organisms and the environment. The student is expected to:

(A) identify components of an ecosystem.

(7.14) Science Concepts. The student knows that natural events and human activity can alter Earth systems. The student is expected to:

(C) make inferences and draw conclusions about effects of human activity on Earth's renewable, nonrenewable, and inexhaustible resources.

Mathematics, 7th Grade

(b) Knowledge and Skills

(7.4) Patterns, relationships, and algebraic thinking. The student represents a relationship in numerical, geometric, verbal, and symbolic form. The student is expected to:

(C) describe the relationship between the terms in a sequence and their positions in the sequence.

(7.13) Understanding processes and mathematical tools. The student applies Grade 7 mathematics to solve problems connected to everyday experiences, investigations in other disciplines and activities in and outside of school. The student is expected to:

(A) identify and apply mathematics to everyday experiences, to activities in and outside of school, with other disciplines, and with other

mathematical topics.

(7.14) Understanding processes and mathematical tools. The student communicates about Grade 7 mathematics through informal and mathematical language, representations, and models. The student is expected to:

(A) communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models.

Social Studies, 7th Grade

(b) Knowledge and Skills

(7.8) Geography. The student uses geographic tools to collect, analyze, and interpret data. The student is expected to:

(A) create thematic maps, graphs, charts, models, and databases representing various aspects of Texas during the 19th and 20th centuries.

(B) pose and answer questions about geographic distributions and patterns in Texas during the 19th and 20th centuries.

(7.9) Geography. The student understands the locations and characteristics of places and regions of Texas. The student is expected to:

(C) analyze the effects of physical and human factors such as climate, weather, land forms, irrigation, transportation, and communication on major events in Texas.

(7.10) Geography. The student understands the effects of the interaction between humans and the environment in Texas during the 19th and 20th centuries. The student is expected to:

(A) identify ways in which Texans have adapted to and modified the environment and analyze the consequences of the modifications.

(7.21) Social studies skills. The student applies critical-thinking skills to organize and use information acquired from a variety of sources including electronic technology. The student is expected to:

(A) differentiate between, locate, and use primary and secondary sources such as computer software, databases, media and news services, biographies, interviews, and artifacts to acquire information about Texas.

(C) organize and interpret information from outlines, reports, databases and visuals including graphs, charts, timelines, and maps.

(H) use appropriate mathematical skills to interpret social studies information such as maps and graphs.

(7.22) Social studies skills. The student communicates in written, oral, and visual forms. The student is expected to:

(B) use standard grammar, spelling, sentence structure, and punctuation.

(C) transfer information from one medium to another, including written to visual and statistical to written or visual, using computer software as appropriate.

(D) create written, oral, and visual presentations of social studies information.

English Language Arts and Reading, 7th Grade

(b) Knowledge and Skills

(7.13) Reading/inquiry/research. the student inquires and conducts research using a variety of sources. The student is expected to:

(D) interpret and use graphic sources of information such as maps, graphs, timelines, or tables, to address research questions (4-8).

(E) summarize and organize information from multiple sources by taking notes, outlining ideas, and making charts (4-8).

(7.15) Writing/purposes. The student writes for a variety of audiences and purposes and in a variety of forms. The student is expected to:

(A) write to express , discover, record, develop, reflect on ideas, and to problem solve (4-8).

(C) write to inform such as to explain, describe, report, and narrate (4-8).

(7.20) Writing/purposes. The student uses writing as a tool for learning and research. The student is expected to:

(C) take notes from relevant and authoritative sources such as guest speakers, periodicals, and on-line searches (4-8).

(D) summarize and organize ideas gained from multiple sources in useful ways such as outlines, conceptual maps, learning logs, and timelines (4-8).

Science, 8th Grade

(b) Knowledge and Skills

(8.3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:

(C) represent the natural world using models and identify their limitations.

(8.14) Science concepts. The student knows that natural events and human activity can alter Earth systems. The student is expected to:

(C) describe how human activities have modified soil, water, and air quality.

Mathematics, 8th Grade

(b) Knowledge and Skills

(8.4) Patterns, relationships, and algebraic thinking. The student makes connections among various representations of a numerical relationship. The student is expected to generate a different representation of data such as a table, graph, equation, or verbal description.

(8.14) Understanding processes and mathematical tools. The student applies Grade 8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines and activities in and outside of school. The student is expected to:

(A) identify and apply mathematics to everyday experiences, to activities in and outside of school, with other disciplines, and with other mathematical topics.

(8.15) Understanding processes and mathematical tools. The student communicates about Grade 8 mathematics through informal and language, representations, and models. The student is expected to:

(A) communicate mathematical ideas using language, efficient tools, appropriate units, physical, or algebraic mathematical models.

Social Studies, 8th Grade

(b) Knowledge and Skills

(8.30) Social studies skills. The student applies critical-thinking skills to organize and use information acquired from a variety of sources including electronic technology. The student is expected to:

(B) analyze information by sequencing, categorizing, identifying cause-and-effect relationships, comparing, contrasting, finding the main idea, summarizing, making generalizations and predictions, and drawing inferences and conclusions.

(C) organize and interpret information from outlines, reports, databases, and visuals including graphs, charts, timelines, and maps.

(H) use appropriate mathematical skills to interpret social studies information such as maps and graphs.

(8.31) Social studies skills. The student communicates in written, oral, and visual forms. The student is expected to:

(B) use standard grammar, spelling, sentence structure, and punctuation.

(C) transfer information from one medium to another, including written to visual and statistical to written or visual, using computer software as appropriate.

(D) create written, oral, and visual presentations of social studies information.

English Language Arts and Reading, 8th Grade

(b) Knowledge and Skills

(8.13) Reading/inquiry/research. The student inquires and conducts research using a variety of sources. The student is expected to:

(D) interpret and use graphic sources of information such as maps, graphs, timelines, or tables, to address research questions (4-8).

(E) summarize and organize information from multiple sources by taking notes, outlining ideas, and making charts (4-8).

(8.15) Writing/purposes. The student writes for a variety of audiences and purposes and in a variety of forms. The student is expected to:

(A) write to express , discover, record, develop, reflect on ideas, and to problem solve (4-8).

(C) write to inform such as to explain, describe, report, and narrate (4-8).

(8.20) Writing/purposes. The student uses writing as a tool for learning and research. The student is expected to:

(C) take notes from relevant and authoritative sources such as guest speakers, periodicals, and on-line searches (4-8).

(D) summarize and organize ideas gained from multiple sources in useful ways such as outlines, conceptual maps, learning logs, and timelines (4-8).

RELATED ESSENTIAL KNOWLEDGE AND SKILL:

Social Studies, 6th Grade

(b) Knowledge and Skills

(6.4) Geography. The student understands the characteristics and relative locations of major historical and contemporary societies. The student is expected to:

(B) identify and explain the geographic factors responsible for patterns of population in places and regions.

Social Studies, 7th Grade

(b) Knowledge and Skills

(7.11) Geography. The student understands the characteristics, distribution, and migration of population in Texas in the 19th and 20th centuries. The student is expected to:

(C) analyze the effects of the changing population distribution in Texas during the 20th century.

DID YOU KNOW?

Water has always played an important role in Texas. The location of settlements, the types of agriculture, and other human activities were and are linked with available water - either as surface water or as groundwater.

Here are some interesting water facts about Texas

1. Not counting the Great Lakes, Texas ranks first in the nation for number of square miles of fresh, inland surface water (4,950 sq. mi.).
2. Caddo Lake is the only natural lake in Texas.
3. Texas has over 6,700 lakes with at least 10 surface acres. There are only 205 major reservoirs in Texas and 74 of these contain over 98% of the state's storage capacity.
4. Texas has already developed 75-80% of its conventional (fresh ground and surface) water resources.
5. Texas has 15 major rivers.
6. There are approximately 80,000 miles of rivers and streams in Texas.
7. Major and minor aquifers underlie approximately 81% of Texas.

Definitions that are helpful when studying river basins and aquifers include:

river basin - watershed or drainage area for a river and all tributaries

in-basin uses - need for water within a river basin

aquifer - large amounts of water located under the surface (groundwater)

groundwater - water located under the below the surface of the land

recharge - the addition of water to an aquifer

recharge zone - area on the land surface where water will move down to the aquifer

acre-foot - amount of water needed to cover one acre of land one foot deep in water. This amount of water equals 325,851 gallons.

LEARNING EXPERIENCE:

GENERAL TIME FRAME: 3-5 hours depending student responses.

Description: Students will research and describe a river basin located in their local Water Planning Region and an associated aquifer. Students will then write a short report that will include graphs showing in-basin water usage and maps showing the river basin and aquifer in relation to the rest of Texas.

Time Frame: 3 to 6 - 45 minute periods

Advanced Preparation:

1. If Internet access is available to students at the school, arrange for students to spend a minimum of one period doing research on water resources and use in the local Water Planning Region.
2. Use TWDB's website to obtain information on water availability, historical/projected water usage, and water demand data for the period from the 1990's to 2050 (<http://www.twdb.state.tx.us/data/data.htm>).

Procedure:

1. Select a river basin in the local Water Planning Region.
2. Color a map of river basins in Texas and show the selected river basin.
3. List the existing reservoirs/lakes in the river basin.
4. List planned and recommended reservoir projects in the river basin.
5. Find the major aquifer in the river basin.
6. Find how much groundwater the aquifer will hold.
7. Using a bar graph, show in-basin water need by use group (for example: mining) for the years 2000 and 2050.
8. Compare in-basin water needs versus in-basin water supplies for the years 2000 and 2050 using line graphs.
9. Using the river basin and aquifer data as a basis, write a short report discussing water availability needed to meet future demand. The report is to include the map and graphs in addition to the information found out about the river basin and aquifer.

Teacher Talk:

The need for water in Texas will continue to increase for the foreseeable future. Water resources used to meet this need will, as in the past, include both water on the surface and water in an aquifer as groundwater. For river basins the primary question is whether or

not in-basin water supplies will meet the in-basin water needs or if water will need to be imported from another part of Texas that has a surplus. For aquifers the primary question is whether or not recharge rates can meet or exceed the rate at which water is and will be removed from the aquifer. Excess removal of water can lead to many problems including the water no longer being available.

Teacher Questions	Possible Replies
1. What is expected to cause a total water use increase or decline by the year 2050 in the selected river basin?	1. Student answers will vary depending on the selected river basin. For example, in many Texas river basins, the amount of water used in agriculture is expected to decline by 2050.
2. What are the dangers of overusing the available water in an aquifer?	2. Overuse of groundwater in an aquifer can in water no longer being available. Overuse of water can also result in the surface of the land dropping from the original elevation. (subsidence).
3. What are ways that an aquifer can be maintained as a water resource?	3. Student answers will vary. Examples of possible answers are (a) limit the amount of water withdrawn from the aquifer to the recharge amount and (b) maintain the watershed(s) in the recharge zones.

RESOURCES:

Literature on water conservation by the Texas Water Development Board. View and order currently available brochures at <http://www.twdb.state.tx.us/assistance/conservation/pubs.htm>, contact Patsy Waters at patsy.waters@twdb.state.tx.us, fax the form to (512) 936-0812, call (512) 463-7955, or write to:

Conservation
 Texas Water Development Board
 P.O. Box 13231
 Austin, Texas 78711-3231

Maps of Texas River Basins, Aquifers, and Regional Reservoir Basin Maps are available on TWDB's website at <http://www.twdb.state.tx.us/mapping/index.htm>

State of Texas Water Quality Inventory by the Texas Commission on Environmental Quality:
<http://www.tnrcc.state.tx.us/water/quality/>

Lesson plans and literature on water quality is also available from the Texas Commission on Environmental Quality at <http://www.tnrcc.state.tx.us/admin/topdoc/index.html>. Search for the following publications by number on TCEQ's website.

Lesson Plans and Resources for Teaching Environmental Sciences- GI 268

Water Education Team (WET) Instruction Handbook- GI 026

Land Use and the Water Cycle poster- GI 194

For additional information, call (512) 239-1000, or write to:

Texas Commission on Environmental Quality

P.O. Box 13087

Austin, Texas 78711-3087

EXTENSIONS:

1. Instead of having each student work independently, divide students into groups with 3-4 members each. Assign each group a different Texas river basin or aquifer to research. Have each group give an oral presentation of their findings.
2. Invite a representative of the US Army Corps of Engineers to speak to the students about the federal program to build and maintain reservoirs.