High School Lesson Plan #2

COURSE(S): Algebra I; Mathematical Modeling with Applications; Environmental Studies; Aquatic Sciences; Geology, Meteorology, and Oceanography; US History Since Reconstruction; World Geography Studies

TOPIC: Water Availability, Usage and Future Demand in Texas

TITLE: Water in the Texas Coastal Basins

OVERVIEW: The student will study a Texas coastal basin. The student will understand that water resources include surface water and groundwater, even in coastal basins. The student will further understand the importance of maintaining Texas estuaries. The student will map and graph information and write a short report.

TEXAS ESSENTIAL KNOWLEDGE AND SKILLS:

Algebra I

(b) Foundations for functions: knowledge and skill and performance descriptions.

(1) The student understands that a function represents a dependence of one quantity on another and can be described in a variety of ways.

Following are performance descriptions.

(B) The student gathers and records data, or uses data sets, to determine functional (systematic) relationships between quantities.

(D) The student represents relationships among quantities using concrete models, tables, graphs, diagrams, verbal descriptions, equations, and inequalities.

(E) The student interprets and makes inferences from functional relationships.

(c) Linear functions: knowledge and skills and performance descriptions.

(1) The student understands that linear functions can be represented in different ways and translates among their various representatives.

Following are performance descriptions.

(A) The student determines whether or not given situations can be represented by linear functions.

(C) The student translated among and uses algebraic, tabular, graphical, or verbal descriptions of linear functions.

(2) The student understands the meaning of slope and intercepts of linear functions and interprets and describes the effects of changes in parameters of linear functions in real-world and mathematical situations.

Following are performance descriptions.

(A) The student develops the concept of slope as rate of change and determines slopes from graphs, tables, and algebraic representations.

(B) The student interprets the meaning of slope and intercepts in situations using data, symbolic representations, and graphs.

Mathematical Models with Applications

(c) Knowledge and Skills

(1) The student uses a variety of strategies and approaches to solve both routine and non-routine problems. The student is expected to:

(A) compare and analyze various methods for solving a real-life problem.

(B) use multiple approaches (algebraic, graphical, and geometric methods) to solve problems from a variety of disciplines.

(2) The student uses graphical and numerical techniques to study patterns and analyze data. The student is expected to:

(A) interpret information from various graphs, including line graphs, bar graphs, circle graphs, histograms, and scatter plots to draw conclusions from the data.

(B) analyze numerical data using measures of central tendency, variability, and correlation in order to make inferences.

Environmental Studies

(c) Knowledge and Skills

(4) Science concepts. The student knows the relationships of biotic and abiotic factors within habitats, ecosystems, and biomes. The student is expected to:

(E) predict changes that may occur in an ecosystem if biodiversity is increased or reduced.

(5) Science concepts. The student knows the interrelationships among the resources within the local environmental system.

(B) identify source, use, quality, and conservation of water.

(7) Science concepts. The student knows the relationship between carrying capacity and changes in populations and ecosystems. The student is expected to:

(A) relate carrying capacity to population dynamics.

(D) analyze and make predictions about the impact on populations of geographic locales, natural events, diseases, and birth and death rates.

(8) Science concepts. The student knows that environments change. The student is expected to:

(A) analyze and describe the effects on environments of events such as fires, hurricanes, deforestation, mining, population growth, and municipal development.

Aquatic Sciences

(c) Knowledge and Skills

(5) Science concepts. The student knows the relationships within and among the aquatic habitats and ecosystems in an aquatic environment. The student is expected to:

(C) identify the interdependence of organisms in an aquatic environment such as a pond, river, lake, ocean, or aquifer, and the biosphere.

(D) evaluate trends in data to determine the factors that impact aquatic ecosystems.

(8) Science concepts. The student knows that aquatic environments change. The

student is expected to:

(B) analyze the cumulative impact of natural and human influence on an aquatic system.

(C) identify and describe a local or global issue affecting an aquatic system.

(D) analyze and discuss human influences on an aquatic environment including fishing, transportation, and recreation.

(10) Science concepts. The students knows the origin and use of water in a watershed. The student is expected to:

(A) identify sources and determine the amounts of water in a watershed including groundwater and surface water.

(B) research and identify the types of uses and volumes of water used in a water shed.

(C) identify water quantity and quality in a local watershed.

Geology, Meteorology, and Oceanography

(c) Knowledge and Skills

(10) Science concepts. The student knows the interactions that occur in a watershed. The student is expected to:

(A) identify the characteristics of a local watershed such as average annual rainfall, run-off patterns, aquifers, locations of river basins, and surface water reservoirs.

(C) describe the importance and sources of surface and subsurface water.

(11) Science concepts. The student knows characteristics of oceans. The student is expected to:

(A) identify physical characteristics of ocean water including salinity, solubility, heat capacity, colligative properties, and density.

(B) evaluate the effects of tides, tidal bores, and tsunamis.

United States History Studies Since Reconstruction

(c) Knowledge and Skills

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

(B) pose and answer questions about geographic distributions and patterns shown on maps, graphs, charts, models, and databases.

(11) Geography. The student understands the relationship between population growth and modernization on the physical environment. The student is expected to:

(A) identify the effects of population growth and distribution and predict future effects on the physical environment.

(24) 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:

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

(25) 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.

World Geography Studies

(c) Knowledge and Skills

(8) Geography. The student understands how people, places, and environments are connected and interdependent. The student is expect to:

(A) explain the interrelationships among physical and human processes that shape the geographic characteristics of places such as connections among economic development, urbanization, population growth, and environmental change.

(B) compare ways that humans depend on, adapt to, and modify the physical environment using local, state, national, and international human activities in a variety of cultural and technological contexts.

(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 and evaluate the validity and utility of multiple sources of geographic information such as primary and secondary sources, aerial photographs, and maps.

(C) construct and interpret maps to answer geographic questions, infer geographic relationships, and analyze geographic change.

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

(A) design and draw appropriate maps and other graphics such as sketch maps, diagrams, tables, and graphs to present geographic information including geographic features, geographic distributions, and geographic relationships.

(B) apply appropriate vocabulary, geographic models, generalizations, theories, and skills to present geographic information.

RELATED ESSENTIAL KNOWLEDGE AND SKILL:

Environmental Studies

(c) Knowledge and Skills

(5) Science concepts. The student knows the interrelationships among the resources within the local environmental system. The student is expected to:

(F) evaluate the impact of human activity and technology on land fertility and aquatic viability.

(7) Science concepts. The student knows the relationship between carrying capacity and changes in populations and ecosystems. The student is expected to:

(D) analyze and make predictions about the impact on populations of geographic locales, natural events, diseases, and birth and death rates.

English I

(b) Knowledge and Skills

(3) Writing/grammar/usage/conventions/spelling. The student relies increasingly on the conventions and mechanics of written English, including the rules of grammar and usage to write clearly and effectively. The student is expected to:

(A) produce legible work that shows accurate spelling and correct use of the conventions of punctuation and capitalization such as italics and ellipses.

(D) produce error-free writing in the final draft.

(4) Writing/inquiry/research. The student uses writing as a tool for learning. The student is expected to:

(D) represent information in a variety of ways such as graphics, conceptual maps, and learning logs.

(F) compile written ideas and representations into reports, summaries, or other formats and draw conclusions.

English II

(b) Knowledge and Skills

(3) Writing/grammar/usage/conventions/spelling. The student relies increasingly on the conventions and mechanics of written English, including the rules of grammar and usage to write clearly and effectively. The student is expected to:

(A) produce legible work that shows accurate spelling and correct use of the conventions of punctuation and capitalization such as italics and ellipses.

(D) produce error-free writing in the final draft.

(4) Writing/inquiry/research. The student uses writing as a tool for learning. The student is expected to:

(D) represent information in a variety of ways such as graphics, conceptual maps, and learning logs.

(F) compile written ideas and representations into reports, summaries, or other formats and draw conclusions.

English III

(b) Knowledge and Skills

(3) Writing/grammar/usage/conventions/spelling. The student relies increasingly on the conventions and mechanics of written English, including the rules of grammar and usage to write clearly and effectively. The student is expected to:

(A) produce legible work that shows accurate spelling and correct use of the conventions of punctuation and capitalization such as italics and ellipses.

(D) produce error-free writing in the final draft.

(4) Writing/inquiry/research. The student uses writing as a tool for learning. The student is expected to:

(D) represent information in a variety of ways such as graphics,

conceptual maps, and learning logs.
(F) compile written ideas and representations into reports, summaries, or other formats and draw conclusions.

English IV

(b) Knowledge and Skills

(3) Writing/grammar/usage/conventions/spelling. The student relies increasingly on the conventions and mechanics of written English, including the rules of grammar and usage to write clearly and effectively. The student is expected to:

(A) produce legible work that shows accurate spelling and correct use of the conventions of punctuation and capitalization such as italics and ellipses.

(D) produce error-free writing in the final draft.

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

(E) organize notes from multiple sources in useful and informing ways such as graphics, conceptual maps, and learning logs.

(G) compile written ideas and representations into reports, summaries, or other formats and draw conclusions.

DID YOU KNOW?

The State of Texas has eight Coastal Basins.

Here are some interesting facts about Texas coastal basins.

1. Texas coastal basins include diverse and important ecological areas such as river deltas, estuaries, bays, and marshlands.
2. The productivity of Texas' estuaries greatly depends on the inflow of fresh water.
3. Commercial, sport fishing and other recreational activities along the Texas coast including Texas' bays and estuaries contribute nearly $3 billion every year to the Texas economy.
4. Texas bays, estuaries, and wetlands provide protected habitats (like the Aransas National Wildlife Refuge) for endangered species such as the whooping crane.
5. Rice and other important food crops are grown in Texas coastal basin areas.
6. Texas estuaries are located between the Texas coast and the Texas barrier islands.
7. The Laguna Madre is one of only four hypersaline marine lagoons in the world.
8. Desalination is an option for increasing water resources in Texas coastal basin areas.

Definitions that are helpful when studying coastal basins include:

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

estuary - aquatic region where freshwater mixes with saltwater forming a salinity gradient
in-basin uses - demand for water within a given coastal basin
groundwater - water located under the below the surface of the land
desalination - the removal of salts from brackish water
hypersaline - higher salts concentration than seawater
brackish water - water with a higher salt and mineral content than normal for fresh water
acre-foot - amount needed to cover one acre of land one foot deep. This amount of water equals 325,851 gallons.
hydrogeology - study of water bearing geological formations

LEARNING EXPERIENCE:

GENERAL TIME FRAME: 6-8 hours depending on student responses.

Description: Students will research and describe a Texas coastal basin. The description will include water resources available for development, the importance of continued influx of fresh water, and the water usage and availability now and in the future. A written report will be prepared that includes graphs showing in-basin water usage and maps showing bays and estuaries.

Time Frame: 8 to 10 – 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 the selected coastal basin.

2. Contact the Texas Water Development Board and the Texas Natural Resource Conservation Commission for information on Texas coastal areas including bays and estuaries. (see Resources)

Procedure:

1. Select a coastal basin to study from the eight Coastal Basins.
2. Indicate by color or other means the selected coastal basin area on a map of Texas. Include on the map the river(s) flowing into the coastal basin area.
3. List the river(s) and any major streams located in the coastal basin.
4. List the major crop(s) grown in the coastal basin and determine the water resource(s) used for the crop(s).
5. List commercially important aquatic life forms found in the bay(s) and estuary(ies) in the coastal basin area.
6. Describe how fresh water and seawater mix in an estuary.
7. Make a map of the coastal basin area showing major cities (or towns), bays,

and estuaries.
8. Determine the total groundwater storage capacity, including both fresh water and brackish water, in the coastal basin area.
9. Discuss the importance of brackish water as an available water resource.
10. Using a bar graph, show in-basin water demands by demand segment for the years 2000 and 2050.
11. Compare in-basin water demands versus in-basin water supplies for the years 2000 and 2050 using line graphs.
12. Using the information researched, write a report covering water usage and availability in the coastal basin area. The report is to include discussions of the use of brackish water as a water resource, a description of fresh water and seawater mixing, the graphs showing in-basin water usage and maps showing the location of bays and estuaries.

Teacher Talk:

The demand on water resources, both surface water and groundwater, in Texas will continue to increase for the foreseeable future. For coastal basin areas the issue of sufficient fresh water reaching the coastal basin whether or not in-basin water supplies will meet the in-basin water demands. 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. Excess removal of water can lead to subsidence among other problems.

Teacher Questions	Possible Replies
1. What would be an expected result if insufficient fresh water reaches the Texas coastal basin areas?	1. Student answers will vary. However all answers should address the increased salinity of the surface water in the coastal region, including estuaries.
2. How can desalination contribute to water resources in a coastal basin area?	2. Desalination allows the use of brackish ground water as a water resource. Otherwise the brackish water would not be useable.
3. Why are estuaries important?	3. Student answers will vary. Examples are: (a) as a breeding habitat for commercially valuable aquatic species and (b) as a habitat for human food sources.
4. What are examples of ways to help ensure sufficient fresh water reaches the Texas coastal areas?	4. Student answers will vary. Examples of ways to minimize the amount of water lost to upstream uses include: (a) recycling of water, (b) conservation of water used for agricultural purposes, (c) treatment of used water prior to reintroduction to the river or stream, and (d) use of appliances and processes requiring less water than those currently in use.

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

Information about pollution prevention and the handling of problems such as oil spills is available from the Texas Commission on Environmental Quality http://www.tceq.state.tx.us or by mail at:

Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087
(512) 239-4594

Information on detailed maps of Texas coastal basin areas and further water resources data is available from the United States Geological Survey (USGS) http://www.usgs.gov, calling 1-800-HELP-MAP, or by mail at:

USGS Information Services
Box 25286
Denver Federal Center
Denver, CO 80225

Fundamentals of Aquatic Ecosystems by R.K. Barnes and K.H. Mann; Blackwell Scientific Publications; Boston, MA; 1980; 229 p.

EXTENSIONS:

1. Instead of having each student work independently, divide students into groups with 3-4 members each. Assign each group a different coastal basin to research. Have each group give an oral presentation of their findings.

2. Have students work in teams to research and then construct a model showing how desalination works.