

## Middle School Lesson Plan #5

**GRADE(S):** 6<sup>th</sup>, 7<sup>th</sup>, 8<sup>th</sup>

**TOPIC:** Water Resources

**TITLE:** Water - Planning for the Future

**OVERVIEW:** The student will understand that water resources include both surface water and ground water. The student will investigate the increases (or decreases) for water user groups - irrigation, municipal, manufacturing, steam electric power generation cooling, livestock, and mining. The student will use percentage change during the investigation. Graphs will be used by the student to relate the data as part of a written report.

### TEXAS ESSENTIAL KNOWLEDGE AND SKILLS:

#### Science, 6<sup>th</sup> 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.

#### Mathematics, 6<sup>th</sup> Grade

##### (b) Knowledge and Skills

(6.2) Number, operation, and quantitative reasoning. The student adds, subtracts, multiplies, and divides to solve problems and justify solutions. The student is expected to:

(C) use multiplication and division of whole numbers to solve problems including situations involving equivalent ratios and rates.

(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:

(A) draw and compare different graphical representations of the same data.

(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, 6<sup>th</sup> 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, 6<sup>th</sup> 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, 7<sup>th</sup> 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, 7<sup>th</sup> Grade**

### **(b) Knowledge and Skills**

(7.1) Number, operation, and quantitative reasoning. The student represents and uses number in a variety of equivalent forms. The student is expected to:

(A) compare and order integers and positive rational numbers.

(B) convert between fractions, decimals, whole numbers, and percents mentally, on paper, or with a calculator.

(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, 7<sup>th</sup> Grade**

### **(b) Knowledge and Skills**

(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.

(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.

(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, 7<sup>th</sup> 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, 8<sup>th</sup> 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, 8<sup>th</sup> Grade**

### **(b) Knowledge and Skills**

(8.1) Number, operation, and quantitative reasoning. The student understands that different forms of numbers are appropriate for different situations. The student is expected to:

(A) compare and order rational numbers in various forms including integers, percents, and positive and negative fractions and decimals.

(B) select and use appropriate forms of rational numbers to solve real-life problems including those involving proportional relationships.

(8.2) Number, operation, and quantitative reasoning. The student selects and uses appropriate operations to solve problems and justify solutions. The student is expected to:

(A) select and use appropriate operations to solve problems and justify selections.

(B) add, subtract, multiply, and divide rational numbers in problem situations.

(C) evaluate a solution for reasonableness.

(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, 8<sup>th</sup> 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, 8<sup>th</sup> 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, 6<sup>th</sup> 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, 7<sup>th</sup> 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 (including those of Native Americans), the types of agriculture, and other human activities were and are linked with available water - either as surface water or as groundwater.

One acre-foot of water equals 325,851 gallons of water and is enough water to cover one acre one foot deep.

The Texas Water Development Board has developed a State Water Plan for Texas. This plan includes statewide water management strategies as well as descriptions of the water resources historically available in Texas and the projected water resources that should be available in the year 2050. These water resources cover the surface water available in the 15 major river basins and the groundwater located in aquifers.

Management strategies break the users of water into six groups.

1. municipal
2. manufacturing
3. electrical steam generation cooling
4. mining
5. livestock
6. irrigation



The water management strategies projected to be used include:

1. the current water infrastructure (physical items needed for water - pipes, pumping stations, distribution systems, etc.),
2. expanded infrastructure to local supplies,
3. reuse/return flows,
4. reallocation of reservoir storage,
5. water marketing,
6. new groundwater development,
7. new transfer of existing supplies between river basins, and
8. new reservoir development.

The development of conventional new water resources is limited because Texas has already developed 75-80% of its conventional (fresh ground and surface) water resources.

Current projections are that approximately 17,600,000 acre-feet of water will be used in Texas per year by 2050.

Projections for irrigation water needed in Texas in the year 2050 do not identify affordable water supplies due to the declining availability of water resources (primarily groundwater) and the relatively high cost of replacement water supplies. While water supplies could be available the question becomes one of economics of using water resources for irrigation in lieu of using those same water resources for another use.

### **LEARNING EXPERIENCE:**

**GENERAL TIME FRAME:** 2-3 hours depending student responses.

**Description:** Students will research and describe water management strategies from the 1990's to the year 2050. Students will also map recommended major water supply and conveyance projects in Texas. Graphs will be prepared comparing planned water management strategies and also of the projected costs associated with construction/development of water infrastructure projects. Students will write a short report comparing planned Texas water management strategies. This report will include maps and graphs of the gathered data.

**Time Frame:** 3 to 4 - 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. Find the percentage change in projected water need from 1990 to 2050 for the following user groups: irrigation, municipal, manufacturing, steam electric power generation cooling, livestock, and mining.
2. Make bar graphs showing the actual and projected needs for these same six groups in 1994 and 2050.
3. Make bar graphs showing the actual and projected needs for these same six groups for surface water in 1994 and 2050.
4. Make a pie graph showing management strategies to meet 2050 water needs.
5. Make a line graph showing the projected capital cost of water related infrastructure activities for the period of 1996 to 2050. Break the over all time period into three groups: 1996-2000, 2001- 2020, 2021-2050. Find the percentage change in the total cost of water related infrastructure activities from 1996 to 2050.
6. Make a line graph showing urban and agricultural water use from 1990 to 2050.
7. Write a short report discussing water availability versus need up to the year 2050. The report is to include the graphs.

**Teacher Talk:**

The need on water resources in Texas will continue to increase onto the future. To meet this increasing demand for water the Texas Water Development Board has developed long term water management strategies meet the need projected for the year 2050. Water conservation has been included as one of the management strategies. Current estimates are that approximately 2,600,000 area feet or 12.4% of the total water demand in Texas in 2050 can be meet through water conservation.

Teacher Questions	Possible Replies
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Teacher Questions	Possible Replies
1. What might happen if the current estimate of water availability in the year 2050 due to conservation are not met?	1. Student answers will vary. Replies may include: less water for each user group, some user groups may have to do with much less water than planned, the cost of water will be greatly than expected, more money will have to be spend on water related infrastructure activities.
2. How will the projected urban and agricultural uses of water change between now and the year 2050?	2. By the year 2050, urban uses of water will be greater than the agricultural uses. Currently the reverse is true.
3. Why are conservation measures a very cost effective method for extending existing water resources?	3. Student answers will vary. Examples of possible answers: a. Many conservation measures are very inexpensive to put in place and by lowering water usage they can actually save the consumer money. b. Everyone can conserve water.
4. Which water user groups have a percentage increase in need above 90.0% from 1990 to 2050? Which one actually has a decline?	4. The municipal, steam electric power generation cooling, and mining user groups all have percentage increases above 90.0% from 1990 to 2050. Only irrigation shows a decrease from 1990 to 2050.

**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](mailto: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

**EXTENSION:**

Invite a representative from the local water utility to speak to the students about the costs associated with plans to meet the increased demand for water in the local area.