Middle School Lesson Plan #3

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

TOPIC: Water Resources

TITLE: Water Usage and Conservation

OVERVIEW: The student will investigate water usage at school and at home. Graphs and tables will be used by the student to evaluate water usage and describe possible water conservation measures. Graphs and tables will be used to relate data as part of a written report.

TEXAS ESSENTIAL KNOWLEDGE AND SKILLS:

Science, 6th Grade

(b) Knowledge and Skills

(6.2) Scientific processes. The student scientific inquiry methods during field and laboratory investigations. The student is expected to:

(C) analyze and interpret information to construct reasonable explanations form direct and indirect evidence.

(D) communicate valid conclusions.

(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data.

(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.

Mathematics, 6th Grade

(b) Knowledge and Skills

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

(C) use integers to represent real-life situations.

(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:

(B) use addition and subtraction to solve problems involving fractions and decimals.

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

(6.8) Measurement. The student solves application problems involving estimation and measurement of length, area, time, temperature, capacity, weight, and angles. The student is expected to:

(B) select and use appropriate units, tools, or formulas to measure and to solve problems involving length (including perimeter and circumference, area, time, temperature, capacity, and weight).

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

(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:

(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:

(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:

(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

(7.1) Scientific processes. The student conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.

(7.2) Scientific processes. The student will use scientific inquiry methods during field and laboratory investigations. The student is expected to:

(C) organize, analyze, make inferences, and predict trends from direct and indirect evidence;

(D) communicate valid conclusions.

(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data.

(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.

(7.14) 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

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

(A) represent multiplication and division situations involving fractions and decimals with concrete models, pictures, words, and numbers.

(B) use addition, subtraction, multiplication and division to solve problems including situations involving fractions and decimals.

(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.

(C) select or develop an appropriate problem-solving strategy from a variety of different types, including drawing a picture, systematic guessing, and checking, acting it out, making a table, working a simpler problem, or working backwards to solve a problem.

(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

(7.10) 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

(8.2) Scientific processes. The student will use scientific inquiry methods during field and laboratory investigations. The student is expected to:

(C) organize, analyze, evaluate, make inferences, and predict trends from direct and indirect evidence;
(D) communicate valid conclusions.
(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data.

(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.

Mathematics, 8th Grade

(b) Knowledge and Skills

(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 the 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.

(8.12) Probability and statistics. The student uses statistical procedures to describe data. The student is expected to:

(C) construct circle graphs, bar graphs, and histograms, with and without technology.

(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.

(C) select or develop an appropriate problem solving strategy from a variety of different types, including drawing a picture, looking for a pattern, systematic guessing and checking, acting it out, making a table, working a simpler problem, or working backwards to solve a problem.

(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:

(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:

Science, 6th Grade

(b) Knowledge and Skills

(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.

Science, 7th Grade

(b) Knowledge and Skills

(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.

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.

Science, 8th Grade

(b) Knowledge and Skills

(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.

DID YOU KNOW?

Water has played an important role in the settlement of Texas. The location of settlements (including those of native Americans), the types of agriculture, and other human activities have historically been linked with available water. As the population of Texas grows and the multiple uses of water increases, the question of whether or not there are and will be enough water resources to meet the need of all users becomes even more important.

One option to extend available water resources that any one can participate in is conservation and reduction of actual water used in many daily activities.

Water can be conserved by students and their parents in their homes in many ways. Those ways included:

1. changing to conserving shower heads;
2. either replacing existing toilets with conserving models or retrofitting toilets to use less water;
3. installing conserving aerators on kitchen and bathroom faucets;
4. fixing water leaks; and
5. if there is a yard or landscaping, using native or adapted plants and drip or soaker watering methods.

Faucet drips waste a lot of water. The following table indicates how much water is wasted for a single leaking faucet:

Type of Leak	**Water Wasted**
Slow, steady leak (~100 drops per minute)	350 gallons per month
Fast drip	600 gallons per month
Small stream	2000-2700 gallons per month
Large stream	4600 gallons per month

The flow rate for a shower head can be measured by timing how long it takes the water from the shower head to fill a one-gallon container. For example, if it takes 20 sec. to fill the container then the flow rate is a least 3.0 gallons per minute - a high flow rate.

LEARNING EXPERIENCE:

GENERAL TIME FRAME: 4-6 hours depending on student responses

Description: The student will investigate water usage at school and at home. Graphs and tables will be used by the student to evaluate meter readings and other data as part of a written report.

Time Frame: 6 to 8 - 45 minute periods

Advanced Preparation:

1. Request monthly water usage information for the previous twelve months for the school and the home address of each student from the local water utility. (If the student's home uses a private well, ask the parents for this information.)
2. Discuss with students the different uses of water around the school and in/around their homes.

3. Prior to presenting the report to an administrator, discuss the project and

student findings with the administrator. Inform the administrator that the students are to be able to answer questions asked about the report.

Procedure:

1. Divide students into teams. Each team will investigate water usage in a different section of the school (different wings, different floors, different halls, athletic department, grounds maintenance, office area, cafeteria, etc.) The investigation should include the number of plumbing fixtures in the assigned section and notes on how water is being used.

2. Construct a line graph showing water usage by the school for the previous twelve months.

3. Construct a line graph showing water usage for each student's home for the previous twelve months. Have each student list ways their family could conserve water. (If the family has installed any water saving devices, have the student estimate how much water is saved each month.)

4. Have each team of students write a letter to the district planning or maintenance department asking what measures the district currently uses or is planning to use to conserve water.

5. Have each team investigate water recycling possibilities at their school. Each team should answer the following questions.
   a. Does the school do any recycling of water?
   b. If so, for what activities?
   c. If not, where might the school be able to recycle water?

6. Each team is to write a report about water usage in their assigned section of the school and possible water conservation measures including recycling of water. The report is to incorporate the graph of pervious water usage and an explanation about why water usage varies from month to month.

7. Have the class compile their reports into a single report on water usage at their school. Invite an administrator to the class to receive the report. Students should be able to answer questions from the administrator about the report.

Teacher Talk:

One of the challenges faced by all Texans today is to plan for the increasing need for water. One of the quickest and least costly options to extend existing water supplies is to promote conservation.

Conservation of water also can result in savings from lower water bills at home and for the students' school. Cost savings result from as simple a thing as fixing a leaking faucet thereby not wasting as much as 4600 gallons of water every month. By replacing toilets with models that use 1.6 gallons per flush or less and replacing shower heads with ones with a flow rate of 2.75 gallons per minute or less in every home in a community can rapidly result in a significant decrease in the amount of water needed for residential use and extend available water resources.

Even in the landscaping chosen for a single family residence, an apartment complex, or a school can lead to using less water than landscaping used in the past. Choosing native plants or plants that have been adapted to the area not only can be appealing to the eye, but also means that less water will be needed for upkeep. Water systems that use a either a drip or a soaker system get the water to the plants root systems where it is needed. As simple a plan as watering during the early morning hours results in using less water while actually discouraging certain plant diseases.

Teacher Questions	Possible Replies
1. What different places in the assigned area of the school did the students find where water could be conserved by fixing a leak or replacing a water using device?	1. Student answers will vary depending on their assigned area. Locations should include rest rooms, faucets in the kitchen area of the cafeteria, showers in the gym locker rooms (if present), and possibly the water fountains.
2. What places did students find in their homes where water could be conserved?	2. Student answers will vary.
3. How can recycling of water reduce water usage?	3. Student answers will vary. However, students should include in the answer that recycling of water permits the water to be used more that one time either for the same use or for different uses. An example of water recycling the students may be familiar with is an automatic car wash where water is collected, filtered and then reused to wash other vehicles.
4. Why are conservation measures a very effective method for extending existing water resources?	4. Student answers will vary. Possible answers include that everyone can conserve water and that many conservation measures can be as simple as turning off faucets, fixing leaks, and using water saving devices.
5. Given the surface area of the roof, find how much water could have been collected the last time it rained from just the roof? How much water could be collected from the roof in a year with average precipitation?	5. Student answers will be calculated based on the surface area of the roof (from the maintenance department) multiplied by the rainfall measured either by a rain gauge at the school or by rainfall data from the National Weather Service.
6. If rain water/snow melt was collected from the roof, what are some ways the water could be used that do not include using it as drinking water?	6. Student answers will vary. Suitable answers include irrigation of athletic fields, watering of landscaping, mopping floors, and general cleaning of the school. The water collected can not be used for drinking or cooking purposes.

RESOURCES:

Literature on water conservation by the Texas Water Development Board, and other water conservation materials such as bags to measure shower flow, toilet leak detection tablets, and drip gauges. View and order currently available materials at http://www.twdb.state.tx.us/assistance/conservation/pubs.htm, contact Patsy Waters at patsy.waters@twdb.state.tx.us, fax an order 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**

Contact the water utility serving the area for additional local water conservation information.

The local Council of Governments for the particular region of Texas may be able to supply region wide water conservation information.

EXTENSIONS:

1. Invite a representative from the local water utility to speak to the students about how the conservation measures undertaken by the water utility.

2. Arrange for students to present their findings to a representative of the school board.

3. Have student investigate how manufacturing plants or large institutions such as hospitals conserve water.