Living with the Trinity
Lesson Plan 1: The Natural Water Cycle and the Urban Water Cycle

Learning Objective:
Students will begin to understand the similarities and the differences between the *Natural Water Cycle* and the *North Texas Urban Water Cycle.*

Lesson Activities:
Students will use movement to learn the steps in the natural water cycle. Students will also play a game similar to Musical Chairs or create a collage to better understand the *North Texas Urban Water Cycle.*

Student Performance Objectives:
- The student will identify the parts of and become familiar with the natural water cycle.
- The student will identify the parts of and become familiar with the North Texas Urban Water Cycle.
- The student will recognize the similarities and differences between and among these cycles as well as become familiar with how these cycles interact.

Vocabulary:
Water cycle, precipitation, evaporation, condensation, transpiration, infiltration, runoff, groundwater, urban water cycle, river, dam, drinking water treatment plant, distribution mains, reservoir, household water supply, wastewater, wastewater treatment, wastewater sewers

Materials:
- Pencils/pens
- Copies of the Natural Water Cycle and North Texas Urban Water Cycle diagrams for each student
- Paper
- Transparent tape
- Copies of the ten vocabulary words and their definitions

For the Alternate Activity:
- Newspapers, magazines and/or access to the Internet and a printer
- Scissors
- Markers or crayons
- Glue
- Butcher or poster paper large enough for student collages

Before You Start:
- If you are unfamiliar with the vocabulary terms and concepts, review the sites in the Teacher Web Resources section and read through the Background Information section to help prepare for the lesson.
- Locate an open space for the *Move and Learn* activity and for the *Washed Out* activity. Students will need enough room to stand and move about comfortably.
- Prepare to watch a video from the Internet with your students. If you are unsure how to display a Web site using a projector or other equipment, ask your school computer/technology teacher or librarian for help. Otherwise, you may want to plan to do those portions requiring the group to watch video from the Internet in a computer lab. Be sure to bookmark the sites ahead of time.

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- *Washed Out* Activity Preparation: This game is played very much like Musical Chairs. Print multiple copies of the Washed Out Activity Attachment for each student. Cut the words apart from their definitions. To figure out how many word/definition sets are needed, subtract one from the number of students in your class. Duplicates of some of the words may be needed in order to have enough. Make a large circle by putting down the words with their definition in the order listed on the attachment. For instance, if you have three copies of "river," then all three words with their definition should be in order around the circle, followed by "dam" and its definition, etc. For the first few rounds, leave the definitions near the words. For subsequent rounds, remove the definitions and leave only the vocabulary words.
- If space limitations hinder the performance of the *Washed Out* activity, use the alternate activity provided below to reinforce the vocabulary and concepts learned in the Move and Learn activity.

Background Information:

The surface of our planet is more than seventy percent water. All living things, from the tiniest insect to the largest of mammals, depend on water for survival. Humans, too, are dependent on water for things like drinking, cooking, manufacturing our materials, growing our crops, energy production, recreation, transportation, etc. But the amount of water that is available on Earth is finite and is essentially the same water that has been here since the beginning of time. The water simply moves from one place and/or form to another through a process known as **"the water cycle" (also known as "the natural water cycle" or "the hydrologic cycle").** This process has been in motion for millions if not billions of years, yet we recognize now that the process itself is changing due to the urbanization of human beings. Thus, a new cycle has been conceived. The **urban water cycle** integrates all of the aspects of the natural water cycle while also taking into account the fact that in urban cities, humans make man-made lakes **(reservoirs)** to trap the water and then we pipe the water from the reservoir to a **water treatment plant** where the water is purified and then piped into storage towers so that purified water is continuously available for household uses. It also takes into account the fact that once the water is used within a home or business, etc., that water must be piped to a **wastewater treatment plant** so that it can be cleaned before being released into creeks, streams and rivers, which eventually flow into the lakes and **reservoirs.** It is here that the process can begin again; going around and around in an urban water cycle. Some regions have topographical features, such as mountains or oceans, that play a prominent role in how their water cycles. In North Texas, the Trinity River is the focal point of our **North Texas Urban Water Cycle** and is the main source of water for nearly nine million Texans.

TEKS (Texas Essential Knowledge and Skills) for:

3rd Grade:

Science: 3.3C; 3.5A, B; 3.10A, B; 3.11A
Language Arts: 3.2A, B; 3.15B
Social Studies: 3.1A; 3.4A, B, C, D; 3.5C, D; 3.9B; 3.11A, B, C; 3.16E; 3.17B

4th Grade:

Science: 4.11C
Language Arts: 4.13A, B; 4.27A, B
Social Studies: 4.6A, B; 4.8, A, B, C, D; 4.9 A, B, C;

5th Grade:

Science: 5.5A, B; 5.6B
Language Arts: 5.11D; 5.13A, B; 5.14A, B, C; 5.22Aii, Bi
Social Studies: 5.5A; 5.6A, B;

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2010-2011 *School Year Science TEKS*

3rd Grade: 3.8B
4th Grade: 4.8B
5th Grade: 5.8B

Time Needed:

Two 45-Minute Sessions (The teacher may choose to repeat the Move and Learn and Washed Out activities below over a few weeks' time to reinforce vocabulary.)

Session 1

How to Start:

Say: *So, what do you think that dinosaurs drank when they were thirsty millions of years ago?* (Probable answer: water) We also drink water when we're thirsty. *How many of you think that we're drinking the same water that the dinosaurs drank way back then?* How many of you think that's impossible? (Look around the room to acknowledge the students' hands. Ask for volunteers to explain their theories if time permits). Hand out the Natural Water Cycle Diagram to each student. Say: *As you are watching this video, listen to see if your guess or hypothesis is correct.* ***Also,*** *every time you hear a word listed on your diagram, draw a box around it.*

Steps

1. **Introductory Video:** Watch The Water Cycle video on the Living with the Trinity Web site (http://www.trinityrivertexas.org/trinity_fla/watershed/index.html). Replay the video a second time, pausing and resuming if you feel like the students need more information or deeper explanation in order to understand any of the concepts. At the end of the video, ask for a student volunteer (or volunteers) to come to the board.
2. Say: *Let's brainstorm what we think the circled words on our diagrams mean. Let's start with the first word "precipitation." From what you already know, or what you learned from the video, what are some of the words that we use to explain "precipitation?"* Repeat this process for the words "evaporation," "condensation" and "transpiration." As the students are brainstorming, if they need the help, provide parts of the definitions provided below in order to facilitate the discussion.
   precipitation- rain, sleet, snow or hail that falls from the clouds when they become too heavy with moisture
   evaporation- when the sun heats up water and it becomes a vapor or steam
   condensation- when water vapor or steam gets cold and changes back to its liquid form, forming clouds.
   transpiration- the process by which plants lose water from their leaves.
   infiltration- when water/precipitation soaks into the ground
   groundwater- water within the earth that supplies wells and springs.
3. Say: *Do you now think that we are drinking the same water that dinosaurs drank?* (Answer: yes). Ask students to discuss how their previous answers compared to what they learned during the video.
4. ***Move and Learn Activity:***
   After students finish taking notes, ask them to stand up and spread out. Say: *We are now going to learn a dance to help us remember the main steps of the natural water cycle.*

- For "precipitation," show the students how you want them to reach up to the sky on their tiptoes with their hands held high. Then, fan their fingers down from above their heads all the way down to the ground and squat.

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- For "evaporation," start off bent down, pretending to touch their hands to water on the ground and rise up slowly, palms lifting towards the sky.
- For "transpiration," start off bent down, pretending to touch their hands to plants on the ground and rise up slowly, palms lifting towards the sky.
- For "condensation," ask the students to come together as closely as possible and link arms to form a "cloud."

Begin the activity saying each vocabulary word, always starting with "precipitation" and going in the order above. Then, to demonstrate the continuing circular process of the water cycle, place the students in a circle and assign each student one of the components of the water cycle. So Student One would be "precipitation," Student Two would be" evaporation," Student Three would be" transpiration," Student Four would be "condensation," Student Five would be "precipitation," Student Six would be "evaporation," Student Seven would be" transpiration," Student Eight would be "condensation," etc., all the way around the circle. Have the students say their part and do their motion one at a time all the way around the circle. Challenge the students to see how fast or how slow the process can go.

Another challenge may be to have the students start the water cycle at a different step and continue from there (ex., start by saying "condensation," then "precipitation," then "evaporation.") You may also want to add your own (or have the students create their own) rhythm or additional steps to the dance. Occasionally stop and randomly ask a student the definitions of the words to check for understanding. As an adaptation, modify the moves to be done while seated if space is limited or if you need an extension activity.

5. Ask students to sit down. Say: *Now, we can see how the same water that the dinosaurs drank is still the same water we use today, thanks to the water cycle. But, think for a minute about the times we live in. What are some things that we have that didn't exist when the dinosaurs ruled the earth?* (Possible answers: cars, cell phones, houses, schools) *Since these things weren't around during dinosaur times, they also didn't have most of the things we have that cause our water to get dirty. What are some of the ways that water gets dirty today? (Possible answers: when we brush our teeth, or wash our clothes, etc.) How do you think that water gets clean again so that we can re-use it?*

Allow students to discuss with a partner what they think happens to water between the time it goes down the drain and the time we use it again. Let them draw pictures to illustrate and share if time permits. Say: *Next we will learn how the water cycle works in the world we live in today – in a process known as the urban water cycle.*

Session 2

Steps

1. Review the natural water cycle by asking students to do the *Move and Learn* activity described above. Remind them that times have changed, however, and that the natural water cycle, though it still works the same, has been changed or modified to work in urban or city areas. This changed or modified process is known as the urban water cycle.

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2. Pass out the *North Texas Urban Water Cycle* diagram to each student. Ask the students to draw boxes around the vocabulary words as you talk through all of the words that are listed on their sheet. Students can write the definitions as you roll over each word on the interactive, or you can give them a separate sheet with the definitions listed. Ask the students to look at both cycles to see if there are any words that are on both diagrams (Answer: "precipitation," "evaporation," "transpiration" and "condensation").
3. Point out that the two water cycles connect and interact but in the meantime, water is often sidetracked into pipes which lead from our reservoirs or manmade lakes, into the water treatment plant where it is cleaned for drinking, then into storage towers, then into our homes. And, from our homes, the water is used and then sent again through pipes to a wastewater treatment plant where it is cleaned before it is released into a creek, stream or river. Once the water reaches the river, the cycle begins again with water evaporating from the river and forming clouds through condensation, etc.

   Below are the vocabulary words from the handout with their definitions that will be needed for this activity:
   PRECIPITATION- rain, sleet, snow or hail that falls from the clouds when they become too heavy with moisture.
   RESERVOIR- a lake built by people where water is stored until it is used.
   DRINKING WATER TREAMENT PLANT- a facility that uses chemicals and natural processes to remove pollutants from water taken from rivers and lakes.
   DISTRIBUTION MAINS- pipes that carry water from drinking water treatment plants to water towers for storage and then out to homes, schools and businesses.
   HOUSEHOLD WATER SUPPLY- water that has been cleaned and is ready for use in our homes, schools and businesses.
   WASTEWATER SEWER- a system of pipes used to move human waste.
   WASTEWATER TREAMENT PLANT- a facility that uses chemicals and natural processes to remove pollutants from wastewater.
   RIVER- body of water that usually flows toward a lake, ocean, sea or another river.
   EVAPORATION- when the sun heats water and it becomes a vapor or steam.
   CONDENSATION- when water vapor or steam gets cold and changes back to its liquid form, forming clouds

Washed Out Activity:

a. Lead students over to the area where you have prepared the large circle with the words and definitions from the urban and natural water cycles as described in the Before You Start section of the lesson. Instruct the students to each stand by a word/definition set. The game is played like Musical Chairs.
b. Tell the students to walk around the circle near the word/definition sets as you play a water related song (see the Music section of the Curriculum Extension activities below for song ideas). When the music stops, the students should scurry to stand by a word/definition set. The student who does not find a set is automatically "washed out" and must leave the circle.
c. Next, randomly ask students what their word is and what the definition is. If the student cannot tell you the definition, they, too, are "washed out". Remove two of the word/definition sets from the circle and repeat until you only have one winning student remaining.
d. For the advanced round, remove the definitions.
i. When the music stops, students must scurry to stand next to a word. The student who does not find a word to stand by is automatically "washed out" and must leave the circle.

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ii. Randomly select students to tell you what their word means. If they cannot give you the definition, then they are "washed out" as well.
iii. In that case, randomly choose a student who is already "out" to give the definition. If they state it correctly, they can return to the game. Remove two more words, turn on the music and repeat until one winning student remains.

Alternate Activity:

If space limitations do not allow for the Washed Out activity (or as an extension to the activity), have the students use newspapers, magazines, and/or the Internet to create a collage showing pictures that represent the ten vocabulary words that are most often used to characterize the urban water cycle. This activity can be done as an individual activity, small group activity or large group activity.

a. Hold up the diagram of the *Natural Water Cycle* in one hand and the North Texas Urban Water Cycle in the other.
b. Ask: *What are the differences you see between the* Natural Water Cycle *and the* North Texas Urban Water Cycle? (Students will name things like the drinking water treatment plant, sewers, river, wastewater treatment plant, etc.)
c. Tell the students that they will be creating their own representation of the *North Texas Urban Water Cycle.* Instead of a drawing, they will use pictures cut from newspapers or magazines or pictures printed from the Internet to create a collage which "defines" or provides examples of ten points of the urban Water Cycle.
d. Provide students with scissors, tape, markers/crayons, newspapers, magazines and/or access to the Internet and printer.
e. Provide each student (or group of students if done as a group activity) with a copy of the ten vocabulary words.
f. Remind the students to begin with "precipitation" just like they did in the *Move and Learn Natural Water Cycle Activity.*
g. Remind the students that the urban water cycle, just like the natural water cycle, forms a circle and thus their collages should represent the continuous nature of the process.
h. Instruct the students to find pictures that demonstrate the definition of each word. For example, for "precipitation," they would find pictures of rain, sleet, snow or hail, etc. Students also may draw some of the elements and mix in the clippings to create their illustration.
i. Have the students cut out and tape the vocabulary words and their pictures in the correct sequence onto the butcher or poster paper
j. When the students, or student groups, are finished, have them hang their collages in the hallway leading to the classroom.
k. Each collage should be hung end to end, from one to the next, again reinforcing the circular nature of both the natural water cycle and the urban water cycle.

Wrap Up:

Ask for volunteers to share one new thing they learned about water. Encourage students to try to stump their parents with their newfound information about how the water cycle allows us to drink the same water that dinosaurs drank millions of years ago.

Assessment:

Ask students to fill in the blanks on the *Natural Water Cycle* and *North Texas Urban Water Cycle* diagrams using their notes or without any help at all. Use the Water Cycle Assessment questions as a quiz, class work or homework to reinforce new learning.

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Name _____ Date _____

Water Cycle Assessment

1. What is water that falls from the sky as rain, sleet, snow or hail called?

2. What happens to that water once it falls to Earth?

3. What would happen to the water cycle if there was no precipitation?

4. What would happen to the water cycle if there was no evaporation?

5. What would happen to the water cycle if there was no condensation?

6. Where does the water that goes down your drain or shower go?

7. Where does water from your local car wash end up?

8. Describe how the water in your backyard creek could end up being water that falls from the sky as rain.

9. Describe how water from the Trinity River could end up being your bath water.

10. Describe how your toilet water could end up in the Trinity River.

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Water Cycle Assessment

[POSSIBLE STUDENT ANSWERS]

1. What is water that falls from the sky as rain, sleet, snow or hail called?
   Precipitation

2. What happens to that water once it falls to earth?
   Answers will vary. It falls on the ground and joins a river or stream, waters our ground, falls into a catchment and flows to a water treatment plant, etc.

3. What would happen to the water cycle if there was no precipitation?
   Answers will vary. The clouds would get bigger and bigger. Or, the earth would dry up and the plants and animal would die, etc.

4. What would happen to the water cycle if there was no evaporation?
   Answers will vary. All of the water would stay on the earth and we would have a flood.

5. What would happen to the water cycle if there was no condensation?
   Answers will vary. There would be no clouds and no precipitation.

6. Where does the water that goes down your drain or shower go?
   Answers will vary. It goes down the drain, to a waste water treatment plant, then back to a river.

7. Where does water from your local car wash end up?
   Answers will vary. It goes down the drain, to a wastewater treatment plant, then back to a river.

8. Describe how the water in your backyard creek could end up being the water that rains from the sky.
   Answers will vary. It will be evaporated by the sun, then condensation will make it become a cloud. When the cloud gets full, it will rain.

9. Describe how water from the Trinity River could end up being your bath water.
   Answers will vary. Water from the Trinity River will be evaporated by the sun, then condensation will make it become a cloud. When the cloud gets full, it will rain. The rain could fall into a reservoir, flow to a water treatment plant, then flow to our house through the distribution mains.

10. Describe how your toilet water could end up in the Trinity River.
    Answers will vary. Once you flush the water, it goes through pipes to the sewer. Then it flows to a wastewater treatment plant where it is cleaned. Then, it is released back into the river.

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Curriculum Extensions:

Math

After a rain, have the students form teams and measure (in cm) a rain puddle(s). The teams need to create a hypothesis concerning how long they think it will take for the puddle to evaporate. Students will create a chart to place their data; measure the puddle at least three different times; and record how long it takes the puddle(s) to evaporate.

Science

- Conduct the Trinity River Watershed Lesson with the students.
- Offer opportunities for students to perform simple experiments at home with water, such as creating their own working water cycle model. Use this lesson from Planet H2O as a guide: http://www.thirteen.org/h2o/educators_lesson2b.html .
- Encourage students to use newspapers or magazines to create a collage showing pictures of things that pollute our water versus things that we can do to keep our water clean.

Art

Allow the class to "paint" on the sidewalk using water only. Have the students observe and record how long it takes for the "paintings" to evaporate.

Language Arts

Ask each student to write an adventure story entitled: "If I Were a Raindrop." Allow the students to draw pictures to enhance their stories. Hang some or all of the stories in the hallway to teach others about the water cycle. Combine all of the stories in a class book, which can be kept and shown to students in the following years.

Music

- Create a CD with songs about water: "Water" by Lauryn Hill, "Waterfalls" by TLC, "Blame it On the Rain" by Milli Vanilli, "Rain, Rain Go Away," "Itsy Bitsy Spider," "Wipeout," "Under the Sea" from Disney's "The Little Mermaid" or "Sailing" by Christopher Cross. Or assign students to work with their parents for homework to brainstorm songs about water.
- Show students the "Water Cycle Jump" video from Bill Nye the Science Guy (http://www.youtube.com/watch?v=BayExatv8lE&feature=related). Let students create their own song or rap about water.

Social Studies

- Encourage students to use newspapers or magazines to create a collage showing pictures of things that pollute our water versus things that we can do to keep our water clean.
- Create a school-wide campaign to encourage students and families to take better care of our creeks and rivers, such as adopting a nearby stream and organizing monthly clean-ups. The City of Dallas also has volunteer opportunities available: http://www.wheredoesitgo.com/about-volunteer.html

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Student Web Activities for Centers or Small Groups:

Trinity River Educational Interactives from the Center for Global Environmental Education
http://www.trinityrivertexas.org/education/interactives

Environmental Education for Kids from the Wisconsin Department of Natural Resources
http://dnr.wi.gov/eek/

Floods from FEMA for Kids
http://www.fema.gov/kids/floods.htm

Teacher Web Resources:

Water teaching resources from the Environmental Protection Agency
http://epa.gov/teachers/water.htm

Trinity River Audubon Center
http://www.trinityriveraudubon.org/site/PageServer?pagename=Home

ActewAGL Education Website with interactive natural and urban water cycles, comprehensive activities and other links.
http://www.actewagl.com.au/education/water/UrbanWaterCycle/default.aspx

Water Cycle Game from the National Oceanic and Atmospheric Administration

http://response.restoration.noaa.gov/topic_subtopic_entry.php?RECORD_KEY(entry_subtopic_topic)=entry_id,subtopic_id,topic_id&entry_id(entry_subtopic_topic)=447&subtopic_id(entry_subtopic_topic)=27&topic_id(entry_subtopic_topic)=3

Classroom resources from the United States Geological Survey including a detailed diagram of the natural water cycle in different languages and a printable water cycle placemat.
http://ga.water.usgs.gov/edu/watercycle.html

Downloadable urban water cycle graphic from the United Nations Environment Programme
http://maps.grida.no/go/graphic/urban_water_cycle

Diagram from the Pacific Islands Geoscience Commision depicting how wastewater, stormwater and freshwater behave within the urban water cycle
http://www.pacificwater.org/userfiles/image/Water%20Demand%20Management/waterflow.jpg

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PRECIPITATION

rain, sleet, snow or hail that falls from the clouds when they become too heavy with moisture.

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RESERVOIR

a lake built by people where water is stored until it is used.

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DRINKING WATER TREAMENT PLANT

a facility that uses chemicals and natural processes to remove pollutants from water taken from rivers and lakes.

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DISTRIBUTION MAINS
pipes that carry water from drinking water treatment plants to water towers for storage and then out to homes, schools and businesses.

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HOUSEHOLD WATER SUPPLY

water that has been cleaned and is ready for use in our homes, schools and businesses.

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WASTEWATER SEWER
a system of pipes used to move human waste.

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WASTEWATER TREAMENT PLANT

a facility that uses chemicals and natural processes to remove pollutants from wastewater.

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RIVER

a body of water that usually flows toward a lake, ocean, sea or another river.

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EVAPORATION

when the sun heats water and it becomes a vapor or steam

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CONDENSATION

when water vapor or steam gets cold and changes back to its liquid form, forming clouds

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