Trees in the Desert: Using the Principles of Xeriscape
Students will learn how people in Arizona adapt to the desert climate through the use of low-water landscaping techniques.

<table>
<thead>
<tr>
<th>National Geography Standards</th>
<th>Arizona Geography Strand 4</th>
<th>Other Arizona Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ELEMENT FIVE: ENVIRONMENT AND SOCIETY</strong></td>
<td><strong>CONCEPT 5 Environment and Society</strong></td>
<td><strong>Math Common Core Standards Expressions and Equations</strong></td>
</tr>
<tr>
<td>14. How human actions modify the physical environment.</td>
<td>GRADE 6 PO 2 Describe the intended and unintended consequences of human modification on the environment.</td>
<td>6.EE.9. Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.</td>
</tr>
<tr>
<td></td>
<td>GRADE 7 PO 3 Describe how humans modify environments and adapt to the environment.</td>
<td>7.EE.4. Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</td>
</tr>
<tr>
<td></td>
<td>GRADE 8 PO 1 Describe how humans modify ecosystems.</td>
<td>a. Solve word problems leading to equations of the form px+q=r and p(x+q)=r, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Solve real-world and mathematical problems leading to two linear equations in two variables.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Standards for Mathematical Practice</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.MP.1, 7.MP.1, and 8.MP.1 Make sense of problems and persevere in solving them.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>ELA Common Core Standards Writing</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Text Types and Purposes</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6-8.WHST.1 Write arguments focused on discipline-specific content.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.</td>
</tr>
</tbody>
</table>
Overview
Residents of Arizona must adapt to the dry climate by planting native and/or drought tolerant trees and plants. This practice not only saves money for the owner, but also conserves water by using less of it more efficiently.

Purpose
In this lesson students will gain a better understanding of how the principles of xeriscape can help residents of Arizona conserve water in landscaping. They will use T-charts and functions to calculate how much water native trees versus non-native trees use.

Materials
- Handout #1: Xeriscape Program
- Handout #2: Estimated Water Requirements for Tucson
- Handout #3: Estimated Water Requirements for Phoenix
- January Water Use T-Chart: Answer Sheet for Tucson
- January Water Use T-Chart: Answer Sheet for Phoenix
- Handout #4 Water Use T-Charts
- Handout #5: Assessment: Trees for the Parking Lot
- Handout #6: Rubric for Trees for the Parking Lot Paper, pencil
- Sample Response: Trees for Parking Lot June Calculations for Tucson
- Sample Response: Trees for Parking Lot June Calculations for Phoenix
- Calculators (optional)

Objectives
The student will be able to:

1. State the basic principles of xeriscape, and the reasons for using these principles.

2. Name some native trees of southern Arizona.

3. Complete and analyze a T-chart of water usage for different types of trees.

4. Produce a rule (function) that explains the relationship between the number of days of watering and the amount of water used.

5. Explain the reasons for xeriscaping in a formal letter.
**Trees in the Desert: Using the Principles of Xeriscape**

**Procedures**

*Prerequisite Skills: Students should have experience in functions and T-charts.*

**SESSION ONE**

1. Ask students what kinds of trees they typically see in yards around their neighborhoods. Would the trees be the same if you visited a neighborhood in some other part of the country? Why or why not?

2. Introduce the term “xeriscape”. Show or read students the definition of xeriscape and the principles of xeriscape - Handout #1. How do homeowners or businesses of southern Arizona apply the principles of xeriscape to their lawns? Why is it important to minimize water usage in southern Arizona? *(Students should have noticed that many businesses and homeowners cover their yards with gravel interspersed with native plants. Some students may point out that they have seen irrigation systems around the plants. We need to minimize water use because we live in a desert and water is a limited resource.)*

3. Ask students to list some trees that are native to Arizona and some that are not native. How does the water usage vary between the two? Pass out Handout #2 - “Estimated Water Requirements in Tucson” or Handout #3 - “Estimated Water Requirements in Phoenix” to each student. How does this chart show the importance of xeriscape? *(Some native trees of southern Arizona include mesquite, Palo Verde, and sweet acacia. Examples of non-native trees include oak, maple, and mulberry. Students should notice that the fruit and high water trees in the chart tend to need more than twice as much water as the native trees.)*

4. Suppose you were watering a native tree in January, how many gallons of water would you use in a week? In two weeks? *(Tucson: 1.3 gallons for one week, 2.6 gallons for two weeks.)* Phoenix: 1.2 gallons for one week, 2.4 gallons for two weeks.) How does this compare to the amount of water used in a week to water a fruit tree in January? *(A fruit tree needs 2.9 [Tucson] or 2.5 [Phoenix] gallons a week – more than twice the amount needed for the native tree.)*

**SESSION TWO**

1. Ask students to check the numbers on their T-Charts. How did you calculate the amount of water used in 20 days? 30 days? Any number of days? *(Multiply the amount of water used in one day times the number of days)* How could you express this relationship in an algebraic equation? *(Possible answers: [Tucson] W = 1.3D, where W stands for gallons of water and D for number of days. OR y = 1.3x. [Phoenix] W = 1.2D, where W stands for gallons of water and D for number of days. OR y = 1.2x)*

2. Distribute Handout #5 - Trees for the Parking Lot worksheet and Handout #6 - Rubric for Trees for the Parking Lot. Review the problem with students and instruct them to work in small groups to come up with a recommendation to the store.

3. Have students share their recommendations with the class.

**Assessment**

Student work will be assessed on the Trees for the Parking Lot worksheet. The accompanying rubric can be used to evaluate their work. The T-Chart can be graded for mathematics skills and the letter can be graded for geography comprehension. A 3 or higher on the rubric is considered mastery.
Trees in the Desert: Using the Principles of Xeriscape

**Extensions**
The Water Conservation Alliance of Southern Arizona has a page of “Plants for Four Different Types of Desert Landscapes” at the following address:
http://www.watercasa.org/pubs/plantpal.html

The Arizona Municipal Water Users Association has information and links about xeriscape:
http://www.amwua.org/conservation-xeriscape.htm

The Tucson Botanical Gardens has photos of their gardens, including their xeriscape garden at the following site:
http://www.tucsonbotanical.org/html/garden_specialty.html

**Sources**
Definition and Principles of Xeriscape were obtained from the Arizona Municipal Water Users Association website at
http://www.amwua.org/conservation-xeriscape.htm

Data for water use in Tucson and Phoenix was also taken from the Arizona Municipal Water Users Association website in their *Guidelines for Landscape Drip Irrigation Systems*. This guideline can be downloaded from the following page:
http://www.amwua.org/xscp-dripirrigguidelines.htm