What Can You See from Up There? Determining Visibility from The Top of Tall Structures

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Grade Level	6
Duration	1-2 class periods

National Standards	AZ Standards	Arizona Social Science Standards
GEOGRAPHY **Element 1: The World in Spatial Terms** 1. How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information **Element 2: Places and Regions** 4. The physical and human characteristics of places	**MATHEMATICS** **The Number System** 6.NS.B.3. Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation. **Expressions and Equations** 6.EE.A.2. Write, read, and evaluate expressions in which letters stand for numbers. c. Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). 6.EE.B.6. Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.	**GEOGRAPHY** **The use of geographic representations and tools helps individuals understand their world.** 6.G1.1 Use and construct maps, graphs, and other representations to explain relationships between locations of places and regions.

Overview

Students are often interested in “fun facts” about the highest buildings in various locations. This lesson provides an opportunity to explore some well-known landmarks combining student interest and mathematics.

Purpose

In this lesson, students will learn about well-known cultural landmarks, their locations, and their dimensions. Using the height (which will be referred to as altitude for this lesson) students will calculate the distance they would be able to see from that height under pristine atmospheric conditions. Students will practice working with a mathematical formula, find square roots (or use a square root retrieval), and multiply while also finding locations of some famous world landmarks on a map.

Materials

- World Structure Data Sheet and Answer Key
- Square Root Retrieval
- Atlases
- Resources for information on the landmarks (optional)
- Math Assessment and Answer Key
- World map https://geoalliance.asu.edu/sites/default/files/maps/World-at.pdf

Objectives

The student will be able to:

What Can You See from Up There?

1. Find the square root of a given numeral.
2. Use an algebraic formula.
3. Use informational resources.

Procedures

Note: The formula provided is for places above sea level and to a certain altitude. It has a range of validity. This lesson is meant to introduce students to cultural landmarks and to practice working with a formula. The square root chart is available for those students who have not yet been introduced to determining square roots.

1. Discuss what a landmark is (a human or physical feature that is known by many people). Have the students generate a list of world landmarks. Write these on the board.
2. Distribute the World Structure Data Sheet and a World map. https://geoalliance.asu.edu/sites/default/files/maps/World-at.pdf Have the students compare their class list to the ones on sheet.
3. Instruct students to locate the 7 countries/cities where the landmarks are found on their World map using classroom resources (computers, atlases, etc.). They should create a symbol for each landmark. Put the symbol in the correct location of that landmark. Then create a key to indicate the name of the landmark.
4. When students are done locating the 7 landmarks, discuss the height of the landmarks. Were they as tall as they thought? And how far can one see if you were on top of this landmark?
5. Explain how to use the formula **V=1.22 x √A** (V = Visibility; A = feet above ground) with the height in feet to figure out the distance in miles one would be able to see under pristine conditions. Model a fictional example for the students. "The roller coaster at the fair is 100 feet above ground. How far could you see from the top of the roller coaster?" Visibility would equal 1.22 times the square root of 100, so visibility equals 1.22 times 10, with an answer of 12.2 miles.
6. Give the students time to complete the sheet with visibility statistics.

Assessment

Geography
The World map locations and legend can be graded for completeness and accuracy. Mastery is considered a score of 90% or higher.

Mathematics
The World Structure Data Sheet can be graded for accuracy. Mastery is considered a score of 80% or higher.

The Math Assessment can be graded for accuracy. Mastery is considered a score of 80% or higher.

Extensions

Students may use resource books to find information on other well-known cultural landmarks, mark their location on a map, and determine the visibility from the top of each.

Students could research the height of a tall building in their neighborhood or city, calculate the visibility, then visit the building and check to see if they can actually see that far. The students would identify buildings, parks, etc. that they could see clearly, and then calculate the distance.

The book, *Ben's Dream* by Chris Van Allsburg, mentions several world landmarks and could be used as an introduction to this lesson