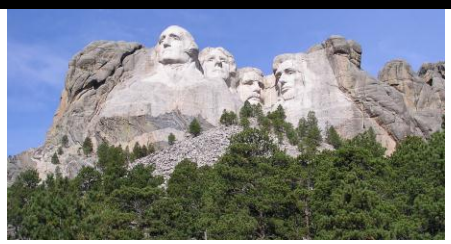

Mount Rushmore Education Program
Planning Worksheet

Instructor Name:_____

Title of Program:
Math at Mount Rushmore

Grade level: 6-8 **Subject area:** Geometry, Algebra, Measurement and Data

Content Standard: Geometry for 6th through 8th grades

-Standards: Common Core Curriculum Standards (http://www.corestandards.org/the-standards/mathematics)

-List Standards:

- 6.G.1. Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.
- 6.G.2. Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas $V = l\ w\ h$ and $V = b\ h$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.
- 6.G.4. Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.
- 7.G.1. Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
- 7.G.3. Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.
- 7.G.4. Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.
- 7.G.6. Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.
- 8.G.1. Verify experimentally the properties of rotations, reflections, and translations:

    a. Lines are taken to lines, and line segments to line segments of the same length.

    b. Angles are taken to angles of the same measure.

    c. Parallel lines are taken to parallel lines.

- 8.G.4. Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.

Lesson objectives: "The learner will be able to . . .

Recognize shapes in Mount Rushmore, whether it's 2D shapes through a series of 2D drawings, or 3D shapes through measurable PDF's of the 3D model of Mount Rushmore. Use geometric formulas to calculate the volumes of these shapes based on scaled representations. Effectively use understanding of scale to translate these calculations to life-size.

Introduction: What is the hook, the attention grabber, the interesting beginning?

Begin with a discussion of what a heritage site is. Introduce students to Mount Rushmore as an American heritage site and discuss how the sculptor, Gutzon Borglum, decided to carve the heads of the four Presidents. Show two pictures of Mount Rushmore: before and after carving. Help the students recognize that the change was brought about through the implementation of a human design and the use of geometry concepts to translate that design into the full-size sculpture. What we have as a result is a monumental sculpture that took a great amount of human and material resources. How do we make sure that we're taking care of an important heritage site like Mount Rushmore when there are forces like deterioration and destruction at play? To illustrate deterioration, use provided sample photos of deteriorating structures. For destructions, use example of Bamiyan Buddhas that were destroyed by the Taliban in 2002. In order to come up with a plan to conserve a site, we would need to have an accurate record of it as our starting point. Use provided introductory videos to learn about digitally documenting heritage sites and the specific process used at Mount Rushmore. For more information, explore the CyArk website.

Content: Body of lesson, sequence of learning activities.
(Keep them busy, keep them active, keep them thinking, keep them involved)

After completing the introduction activity, discuss the history of the carving of the Mountain, including the Hall of Records. One important benefit of having an accurate record of the mountain is knowing the exact shape of it so that you can keep track of whether that shape changes over time. Begin looking closer at the sculpture by using the provided Measurable 3D PDF of the model, or the 3D viewer on the CyArk website. In both the 3D PDF and online 3D Viewer, the teacher can cut sections through the model to better illustrate the presence of geometric shapes.

How do you keep track of changes within the mountain? You can create new 3D models of it over time by laser scanning it again and doing a new volume calculation. Introduce students to geometric formulas to calculate areas and volumes.

-Hands-on activity 1: As a simplified demonstration, use the 2D gridded drawing of the mountain sculpture and have the class split up the faces of the presidents into simpler geometric shapes, calculate their areas, then add all together to arrive at a rough

estimate of the surface area of the presidents' faces. Use a variety of geometric shapes to keep things interesting. Introduce students to the concept of scaled drawings/objects so they can arrive at a real-life size measurement. Use example of the sculptor's scale model of the design versus the real mountain sculpture to reinforce concept of scaled shapes being similar. Mark up lengths, angles, and parallel lines on the 2D drawing or 3D measurable PDF, rotate the drawing/model to see that these characteristics remain the same.

-Hands-on activity 2: Use the provided before-and-after sectional illustration of the Hall of Records to see how partitioning a complex shape can get you a series of simple rectangular shapes, making it much easier to calculate the volume. From this point, use the architectural drawing of the Hall of Records to calculate volume by breaking up the space into a series of smaller, simpler geometric shapes.

Materials needed: (equipment, handouts, graphic organizer, worksheets, props, papers)

-Computer for introduction presentation and any necessary research
-List of area and volume formulas for geometric shapes (to be provided by teacher)
-Photos of Mount Rushmore, before and after carving (provided)
-Illustrative images of deterioration and destruction (provided)
-Mount Rushmore introduction video (provided—if the entire video is too lengthy, the segment between 6:25 and 11:50 provides a sufficient introduction to how the mountain was carved)
-Digital Preservation introduction videos (provided)
-Measurable 3D PDF's of the mountain and scaled model (provided—Teacher should spend some time becoming familiar with this file's use ahead of time)
-Large PDF drawing prints so students can keep track of portions that they've finished calculating the surface area for (teacher to create prints from provided PDF's)
-PDF drawing of Hall of Records (provided)
-PDF illustration of sectioning the Hall of Records (provided)
-Rulers
-Protractors
-Graph paper
-Writing/drawing utensils

Summary and conclusion of lesson: What helps set a course of action or leaves them thinking?

Summarize concepts covered through activities. Discuss the importance of scaled drawings and models as a way to keep accurate records of a structure/sculpture.

Theme statement: (The "big picture", the final result, the "so what?!)

Why is documenting and understanding our heritage so important? For buildings/sculptures that are important to us, we can't take for granted that they'll be around forever. Based on example of Bamiyan Buddhas, show other examples of important heritage sites deteriorating or suffering destruction.

Evaluation method: How will we see the success of your program?
Example: completed worksheets, class discussion, drawings

Evaluate student involvement and results of in-class activities. Possible take-home activity: have students chose a picture of an object then use a grid overlay and graph paper to draw that object at a smaller or larger scale.