NATIONAL MUSEUM OF THE UNITED STATES AIR FORCE

MOSAIC MURAL MATHEMATICS

Students will learn about an amazing example of mosaic/ceramic tile artwork, as well as to learn about basic mathematics and how they may be applied to the design of this gigantic mural. The mural depicts the Wright brothers' historic first flight!

LESSON PLAN

Learning Objectives

The students will

- Learn about the incredible 'first flight' mural, and how it was designed and built
- Learn about basic mathematics (namely, fractions, decimals, percentages, ratios and areas of simple geometric shapes) and how they may be applied to this ceramic tile masterpiece
- Learn about the Wright brothers and their first powered, controlled, heavier-than-air flight

Introduction/Background

Wilbur Wright was born in Indiana in 1867, just two years after the Civil War had ended. The Wrights moved to their home in Dayton, Ohio in 1871, and Orville was born that same year (in their family home). Katherine, their younger sister, was also born at the Dayton homestead, and the Wright children grew up in an America filled with many new innovations and inventions, including the telegraph, the steamship, the transcontinental railroad, the automobile, the electric light and the telephone! In 1900, the brothers traveled by train to Kitty Hawk, North Carolina to conduct glider experiments with a much larger glider than their earlier, five-foot-wingspan Wright kite. The technology of the day featured cloth stretched over wooden spars. The Wright brothers chose Kitty Hawk because it had steady, consistent winds, and the sand dunes provided a soft landing surface. They also performed glider experiments with an even larger glider in the fall of 1901, but the glider that was truly successful was the one they built and flew in 1902. This was the first time all three axes of motion had been controlled in the air by man (roll, pitch and yaw). The Wright brothers developed a small, 12-horsepower engine to power their aircraft, and they also designed the two large propellers that would be required. The propellers were counter-rotating and they actually 'pushed' the airplane through the air! On December 17, 1903, Orville flew the aircraft 120 feet in 12 seconds—12 seconds that changed the world forever. Wilbur piloted their fourth flight that day and it lasted for 59 seconds—the distance covered was 852 feet!

Grade Level: 4—5

National Standards for Mathematics:
Representation, Measurement, Connections, Geometry and Number and Operations

National Science Education Standards:
Science and Technology, History and Nature of Science and Science in Personal and Social Perspectives

National Standards for History:
Chronological Thinking, Historical Comprehension and Historical Analysis and Interpretation

Materials Required:

- Magic board and markers
- Overhead/digital projector
- Demo items and materials for students as listed within lesson plan

Resources:

- *The Bishop's Boys* by Tom Crouch; New York: W. W. Norton & Co.; 1989
- *First To Fly* by Peter Busby; New York: Crown Publishers; 2002
- *Friend's Journal;* Volume 26, No. 3; Fall 2003 (article by Reuben Wolk)
- *Young Orville and Wilbur Wright* by Andrew Woods; Mahwah, NJ: Troll Associates; 1992

- General Information:
http://www.nationalmuseum.af.mil/factsheet_print.asp?fsID=15134&page=1 and http://wings.avkids.com/Book/Wright and http://www.first-to-fly.com

The first flight mural, depicting the Wright brothers' first powered, controlled, heavier-than-air flight, is located in Kettering Hall at the National Museum of the United States Air Force. This mosaic/ceramic tile masterpiece is the creation of Read Viemeister of Yellow Springs, Ohio, and it is 61 feet long and 17 feet high! Viemeister used existing computer technology to assist with the design in 1970. The amazing mural consists of 163, 296 ceramic tiles, and each one is only .91 inch square. There are 20 different designs on the tiles themselves, and the artistry includes a likeness of Orville, one of Wilbur, the date of the first flight, a side silhouette of the 'Flyer,' a wind tunnel, seagulls, an in-flight view of the aircraft, a plan view of the airplane, Icarus, etc. The original photograph used to design the mural was provided by Mrs. Ivonette Wright Miller, a niece of the Wright brothers. The print was made from the original glass negative taken at Kitty Hawk, N.C. on December 17, 1903!

Procedures:

NOTE: Teachers may use as much of the information contained within the "Intro/Background" section as they deem appropriate for their students; similarly, teachers may wish to pick and choose items within this "Procedures" section.

- Write (on board) the things that will be covered/discussed/reviewed in class, including: background on Orville and Wilbur Wright, events leading up to man's first, successful airplane flight, the 'first flight' mural, the amazing design of the mosaic/ceramic tile masterpiece and finally, Mosaic Mural Mathematics fun!
- Hook: tell the students to imagine a photograph they have taken or a piece of artwork they have created. Then have them think about that photo or art 'super-sized!' Ask the class how they would feel/what they would think if their favorite photograph or piece of art were 61 feet long and 17 feet high! Take them to a designated spot outside or in the school gymnasium and show them how large 61 feet by 17 feet really is (ideally, you have already measured the 61 feet and marked it off). If you are doing this demo in your gym, you should be able to show the class a wall height of approximately 17 feet as well. Have the students return to their classroom and show them a picture of the 'first flight' mural by passing a few copies around, or by showing it on an overhead projector ('Teacher Addendum' on page 4).
- Draw a rectangle on the board and mark the length as 61 feet and the height as 17 feet. Ask students how they would determine the area of the rectangle.
- For younger students, simply show that 61 (length) times 17 (width) equals 1,037, and tell them that the area would be expressed in square feet. Show them a piece of cardboard that is one foot by one foot, and tell them that it would take 1,037 of these squares to cover the surface of the huge rectangle!
- For older students, ask them what the formula is for calculating the area of a rectangle. If they need a review, tell them it is base times height OR length times width (showing them where those dimensions are on your drawing). Allow them to use their calculators to compute the answer. Tell them that, if you have a dance floor that needs new tiles (and the tiles happen to be one square foot each) you know that you need 1,037 tiles!
- Draw a square on the board that is one foot by one foot, and ask students how many square inches there are on the surface of your drawing. Show them that each side of the square is 12 inches long, and if you apply the formula for the area of a rectangle or square, base (12") times height (12") equals 144 square inches!
- Ask the students how many square inches there would be on the surface of the gigantic 61' by 17' rectangle, or on the mosaic/ceramic tile 'first flight' mural. Tell them that the answer is 149,328 square inches, but ask them to explain how you arrived at the answer (there are 144 square inches in a square foot, and the mural's surface is 1,037 square feet. 144 times 1,037 equals 149,328 square inches)!
- Tell the class that each tiny ceramic tile of the 'first flight' mural is LESS THAN ONE SQUARE INCH (.91 square inch, or 91 percent of one square inch). Ask the class if they think there would be more (or less) ceramic tiles than square inches on the surface of the mural. Answer: since .91 square inch is smaller than a square inch, there are more .91 square inch tiles on the mural's surface than square inches.
- The actual number of tiny tiles that compose the mural is 163,296. For this grade range, you may wish to round that number off to 163,000, and you may also wish to round off all the numbers contained within the chart on page 4 (17,746 could be rounded off to 17,700; 17,889 could be expressed as 17,900; etc.).
- Pass out copies of the ceramic tile 'symbols' chart on page 4. You may wish to round the numbers off before making copies for students (to save some time during the actual lesson/presentation).
- Ask the students (or teams, if you think they would work better in a cooperative learning scenario) what the percent-to-total mural tiles the Orville Wright ceramic tiles represent.
- Ask students how they would arrive at a solution to this first mathematics problem.

Procedures (continued)

- Use the board and work through the first problem with the students: one method to get the percent-to-total is to divide the Orville tile number (17,700) by the total number of tiles in the mural (163,000) and the quotient is 10.85 (10.85 is the percentage of all the mural tiles that the Orville tiles represent).
- Tell students that another way to find the answer is to use the ratio method: 163,000 is to 100 percent as 17,700 is to 'x' (where the value for 'x' is the Orville tile percentage).

$$\frac{163{,}000}{100} \cdot \frac{17{,}700}{x}$$

Cross multiply 17,700 times 100 and that yields 1,770,000. Divide that number by 163,000 and the value for 'x' (the percent-to-total for Orville's tiles) is 10.85%.

- Ask students what the decimal equivalent is for the Orville tile percentage (just have them move the decimal point two places to the left and the answer is .1085).
- Ask students what the fractional equivalent is for the Orville percentage (it would be between 1/10 and 1/11, but actually much closer to 1/11).
- Ask students how they could represent the Orville tile fraction by using the drawing of a fruit pie. Using the board, show them that, by using a center point as a reference, a circle can be sectioned off, and this can be used to illustrate the slices of a fruit pie, a pizza or a cheesecake!
- If you draw perpendicular lines through the center point, the result is four slices that represent one-fourth (1/4) of the pie. If you divide those slices again, the resultant slices represent one-eighth (1/8) of the pie. Those slices are getting fairly close to how small the pie pieces would have to be to represent the Orville tile fraction of 1/10 or 1/11. Make sure students recognize that the pieces would have to be somewhat smaller than 1/8.
- Tell the class that the decimal equivalent of one-eighth (1/8) is .125, and that 8 times .125 equals 1 (one pie)! Similarly, the decimal equivalent of one-tenth (1/10) is .1, and it takes ten of those slices to make a whole pie!
- Ask students to look at the chart on page 4, and have them look for the symbol and ceramic tile number that is closest to 1/10 of the mural. Answer: since the total number of tiles is exactly 163,296, one-tenth of that number would be exactly 16,329; the 'Orville Dressed For Flight' ceramic tile number is 16,371!
- Have students work on several other examples using other ceramic tile numbers from the chart on page 4. Make sure they express their 'percent-to-total of all mural tiles' as a regular percentage (using whatever method they choose), as a decimal and as a fraction.
- Walk around the classroom and assist only when absolutely necessary.
- The smallest exemplar from the chart is the Wright Wind Tunnel; the rounded number of tiles is 4,600; the percent-to-total is 2.82; the decimal equivalent is .0282; the fractional equivalent is between 1/35 and 1/36. The pie pieces, then, would be extremely tiny!
- When the students have completed all assigned tasks, congratulate them on becoming successful aerospace mathematicians!

Assessment/Evaluation

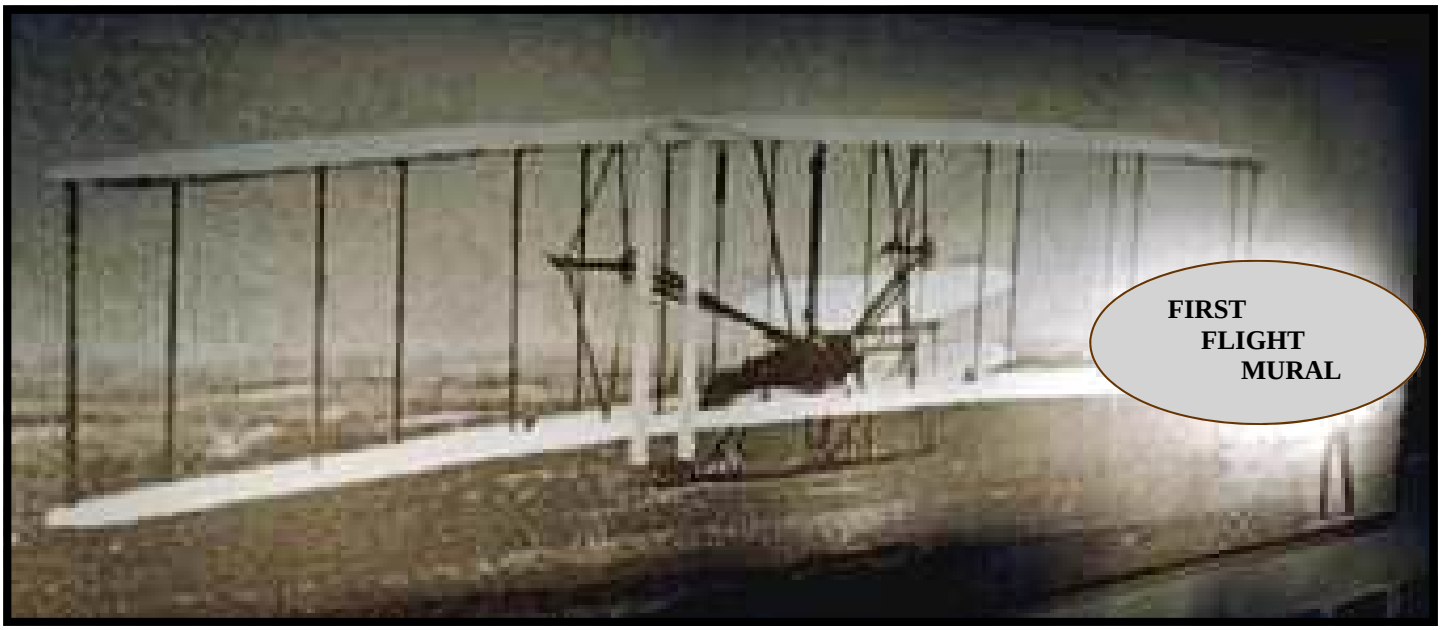
The students should be evaluated on their class participation, listening skills and ability to follow instructions.

Extension

Have the class imagine what some of the individual mosaic/ceramic tiles look like, and ask them to sketch a few of them on cardstock (use the symbol descriptions on page 4). One 8.5" by 11" piece of paper could be divided into four, equal ceramic tile representations!

TEACHER ADDENDUM / PAGE 4

ON DECEMBER 17, 1903, THE WRIGHT BROTHERS MADE MAN'S FIRST SUCCESSFUL, POWERED, CONTROLLED, HEAVIER-THAN-AIR FLIGHT AT KITTY HAWK, NORTH CAROLINA

(THE FOLLOWING CHART DOES NOT INCLUDE EVERY TILE SYMBOL CONTAINED IN THE MURAL)

'SYMBOLS' ON CERAMIC TILES	# OF TILES
ORVILLE WRIGHT	17,746
WILBUR WRIGHT	17,889
ORVILLE DRESSED FOR FLIGHT	16,371
ICARUS	13,474
DATE OF FIRST FLIGHT	12,610
HAND TOOL USED	11,218
SEAGULLS	10,896
IN-FLIGHT VIEW OF FIRST AIRPLANE	9,873
PLAN VIEW OF FIRST AIRPLANE	8,745
YEAR OF FIRST FLIGHT	6,898
BICYCLE AND EARLY WRIGHT PROPELLER	6,331
SOLID COLOR TILE (LIGHT)	6,058
WRIGHT WIND TUNNEL	4,579