Name: Mendi White

Grade Level/Subject: Trigonometry

Topic: The Unit Circle

Objectives (P.A.S.S.):

Introduction: The game helps students discover the unit circle. It enables them to see if "lifesize" and to create it themselves. They also begin to see the connections between the corresponding radian measures and the corresponding degree measure. Movement around the unit circle helps them to understand the positive and negative degree/radian measures.

Instructional process: (See Attached Teacher Instruction Page) Be sure to have all components of this game ready ahead of time. Students need to have already been introduced to the unit circle and all of the aspects of the trigonometric functions.

Closure: At the end of this game, the instructor should be sure to emphasize each of the main ideas of the different games used in part 2. Be sure students visually see the relationships of the different angles.

Assessment: Assessment on this project can be completition of the worksheet or a test on the components of the unit circle.

Modifications/Accommodations: This game could be modified to be used in two days.

Reflection: Upon reflection, I would make sure that there was enough time in class to complete this project. Or I would figure out a way to do the project in two days.

"The Trig unit circle"
Teacher instructions

Materials:

1. Streamers – 4 colors, cut into two equal lengths for each color
   2 pieces of the same color for the x & y axis
   2 pieces of the same color for the 60º lines
   2 pieces of the same color for the 45º lines
   2 pieces of the same color for the 30º lines
2. Construction paper (6 colors) to make the game pieces (I suggest laminating these after they are made so that they can be reused.)

Preparation before playing the game: (Each different element of the trig circle should be put on a different color to be easily separated.)

Make ½ page rectangles in one color with all of the radian measures (17 including 0 and 2Π); in a different color with all of the degree measures (17 including 0º and 360º); in a different color with all of the coordinating points (16 of them); a star to be the origin; in a different color to be the four quadrants; and in a different color to do the signs in each of the four quadrants.

Prior Knowledge: Students should have a basic knowledge of the unit circle used in trigonometry, including degree measures, radian measures, coordinates, and the six trigonometric functions' values.

PLAYING THE GAME

1. Have students pair up. Each pair (up to 4 pairs) takes two strands of the same color streamer. The first pair lays down their streamers representing the x- and the y-axes. Give one of the students the star representing the origin and have them place it on the origin. Pass out the quadrant numbers and signs and have the students place them in the correct positions. Next have another pair take their two strands and have them lay them down on the floor representing the 45º, 135º, 225º, and 315º lines. Have another pair lay down their two strands representing the 30º angles, and the last pair lay down their two strands representing the 60º angles. (See picture.)
2. Next, hand out the cards representing the degree measures and have the students lay the cards on the floor in the correct positions. The teacher should then check the positions of the cards to make sure everything is correct. Discuss the positions. This is a good time to discuss reference angles.
3. Hand out the cards representing the radian measures and have the students lay out those cards on the floor in the correct positions. Check for accuracy. This is a good time to discuss corresponding positions and radian measures. Actually move around the circle while explaining.
4. Now hand out the cards with the coordinate points and have the students place them in the appropriate positions. Check for accuracy. Discuss the relationship between each of the coordinates and the radian/degree measures.

Part 2:

The second part of the trig circle is strictly up to the level of your students and how much time you have.

Preparation before playing the game: Each different set of game cards should be put on a different color of paper. Make each card about the size of a 3X5 index card.

MOVE IT! Cards: Create cards with degree and radian measures in different increments, some positive and some negative.

BASICS! Cards: Create cards with different trig values on them, such as sin 60º. Use all six trig functions and use radian and degree measures.

FLIP IT! Cards: Create cards similar to the BASICS! cards but use the reciprocal functions.

SDRAWKCAB! Cards: Create cards with "unknown" trig values on them, such as $\sin \theta = \frac{1}{2}$.

(See sample list on next page.)

THE RULES:

MOVE IT! – The instructions for these cards are to have the student move counterclockwise, starting at 0 until they land on the given measure. If the card contains a negative value, the student will move clockwise. It is great if these cards have values larger than 360º or 2Π. This is a chance for the student to move around the big circle that they have just created.

BASICS! – The instructions for these cards are to have the students move to the radian or degree measure shown on the card and then give the indicated trig value. For example, if the card reads sin 30º the student would read the card and then respond with "one-half". Advanced students could do this without the degree and radian measures being shown in order to help them memorize those positions.

FLIP IT! – The instructions for these cards are to have students move to the radian or degree measure on the circle and the give the indicated trig value's reciprocal value.

SDRAWKCAB! – That is "Backwards" backwards. The instructions for these cards are to have the students move to the radian or degree measure on the circle where the answer to the equation is located. Two answers to most cards are possible. If two answers are possible, it is usually easy to see on the big circle and students should find both solutions.

OPTIONAL: Unit Circle Worksheet

Thanks to Kitty Morgan for introducing this game!

Unit Circle

1. What is the radius of the unit circle?

2. The unit circle is divided into special degree increments. What are they?

3. The unit circle is divided into special radian increments (the Π measurements).What are they?

4. The unit circle is a circle with a special radius (found in #1) that was placed n a coordinate plane. The coordinates that lie on the circle represent the x and y distances from the origin to that point on the circle. Because this is a circle, do you see any similarities among the points on the circle? Because of the coordinate plane with signed numbers that represent direction, do you see any differences among the point on the circle?

5. The degree or radian measurements that divide the circle into quarters are called quadrants. List the radian and degree measures along with the x and y coordinates of the quadrants.

6. Look at all of the places on the unit circle that have a radian measure with a denominator of 6. List the x and y coordinates of the one in the first quadrant. What kind of triangle does the radius make with the x –axis? Do all of the Π/6's have the same triangle? If so, do they have the same coordinates? If not, why?

7. Look at all of the places on the unit circle that have a radian measure with a denominator of 4. List the x and y coordinates of the one in the first quadrant. What kind of triangle does the radius make with the x –axis? Do all of the Π/4s have the same triangle? If so, do they have the same coordinates? If not, why?

8. Look at all of the places on the unit circle that have a radian measure with a denominator of 3. List the x and y coordinates of the one in the first quadrant. What kind of triangle does the radius make with the x –axis? Do all of the Π/3's have the same triangle? If so, do they have the same coordinates? If not, why?

9. Can you find any patterns with the numerators as you move counterclockwise? Write down your pattern. If you do not see a pattern, look and see how the numerator of the radian measure compares with the denominator in each quadrant.

10. In Trig, we learn the relationship of trig functions to right triangles and their sides. If the cosine function is the ratio of the adjacent side to the hypotenuse and the hypotenuse of all triangles in the unit circle is the radius of the unit circle, then we can just say that in the unit circle the cosine of the angle is _____. Because the adjacent side of the triangle is always the x-coordinate of the point, we can further say that the cosine of the angle is _____.

11. In Trig, we learn the relationship of trig functions to right triangles and their sides. If the sine function is the ratio of the opposite side to the hypotenuse and the hypotenuse of all triangles in the unit circle is the radius of the unit circle, then we can just say that in the unit circle the sine of the angle is _____. Because the opposite side of the triangle is always the y-coordinate of the point, we can further say that the sine of the angle is _____.

12. We also know that the tangent function is the ratio of the opposite side to the adjacent side of all triangles, and that the opposite side corresponds to the y-coordinate and the adjacent side corresponds to the x-coordinate. Can you determine the tangent for the angle? How?

Samples for Cards:

MOVE IT!

$\frac{5\Pi}{3}$ $\frac{-7\Pi}{6}$ $\frac{\Pi}{2}$ $\frac{-9\Pi}{4}$

BASIC!

$\sin 0$ $\cos \frac{1}{2}$ ` $\tan \frac{-5\Pi}{2}$

FLIP IT!

$\cot \frac{2\Pi}{3}$ $\sec \Pi$

BACKWARDS!

$\tan \theta = -1$ $\sin \theta = ½$