Name: ___________________________

Geometry Investigation 6

Date: ___________________________

Geometric Probability

Period: _________________________

Recall that the probability of an event happening is equal to the number of outcomes in which that event happens divided by the total number of possible outcomes.

$$P(event) = \frac{Number\ of\ desired\ outcomes}{Number\ of\ possible\ outcomes}$$

Experimental probability is a process where trials are conducted to test the probability of an event and the results are recorded. Experimental probability is determined by dividing the number of trials where the desired event occurred by the total number of trials that were conducted.

Geometric probability is a form of probability that is defined as a ratio of geometric measures such as lengths, areas, or volumes.

For example, a spinner that is divided into two congruent sections shaded red and blue has a 50% chance of landing on red. This is known because the red section makes up 50% of the spinner's area. If the red section comprised just 25% of the spinner's area, the chance that it would land on red would be 25%.

In groups, assemble a spinner and conduct a probability experiment. With a crayon or colored pencil, shade sectors 1-5 red. Shade sectors 6-7 blue. Shade sectors 8-10 yellow. Cut a strip of paper or cardstock into the shape of an arrow, and fasten the arrow to the spinner base with a brad.

1. Use a protractor to measure the central angle of each of the three colored sectors of your spinner. What are the measures of the red, blue, and yellow central angles, respectively?

2. What percent of the time would you expect the spinner to land on red? Why?

The probability of landing on red can be determined because it covers half the spinner. To determine the probability of landing on blue or yellow, write a proportion. For example, blue measures 72° out of 360° in the entire circle.

$$\frac{Degrees\ in\ sector}{Total\ Degrees\ in\ Circle} = \frac{72}{360} = \frac{1}{5}$$

As a percentage, this is 20%, so you would expect the spinner to land on blue about 20% of the time.

Now conduct a probability experiment with the spinner. Each row records 10 spins in addition to the previous tallies brought down from the row above.

	Results Experimental			Probability		
Spins	Blue	Yellow	Red	P(Blue)	P(Yellow)	P(Red)
10						
20						
30						
40						
50						
60						
70						
80						
90						
100						

To fill out the first row of the table, spin the spinner 10 times and record a tally mark in the corresponding column for each time it lands on a color.

Then, find the experimental probability of landing on each color by dividing the number of times the spinner landed on the color by the total number of spins. Fill out the last three columns.

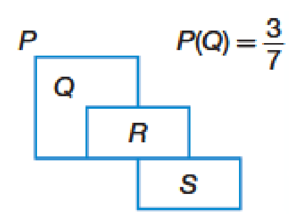
Spin the spinner 10 more times and update the tallies for the next row of the table. Continue finding the experimental probability for each row until 100 spins have been tallied.

3.What are the theoretical probabilities of getting blue, yellow, and red?

4. How close are the experimental probabilities in the first row of the table to the theoretical probabilities? How close are they in the fifth row of the table?

5.What trend occurs in the difference between the experimental probabilities and the theoretical probabilities in the table as the number of spins increases?

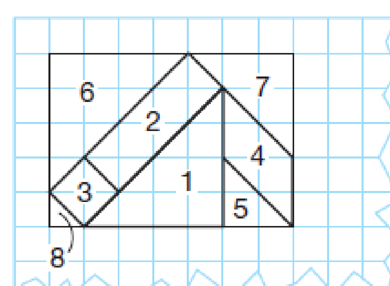
Suppose a plane figure *P* can be separated into nonoverlapping regions *Q*, *R*, and *S*. The theoretical probability for one of the smaller regions, say *Q*, is the ratio of the area of *Q* to the area of *P*.



$$P(Q) = \frac{A_Q}{A_P}$$

As long as an event that could happen in any region of *P* is random, the experimental probability in a set of repeated trials should approach the theoretical probability.

Using graph paper, draw the shapes as shown in the art at right. Color each shape a different color.



Cut each of the parallelograms and triangles created by the gridlines. Place all of the triangles in a bag. With all of the remaining parallelograms, cut each along a diagonal to make congruent triangles, and place these triangles in the bag with the others.

Draw a table like the one shown. Then randomly pull triangles from the bag and record the results in the table.
Shape Number of Triangles Theoretical Probability

Shape	Number of Triangles	Theoretical Probability
1		
2		
3		
4		
5		
6		
7		
8		

Complete the first column by listing the 8 shapes that made up the original figure. Make sure to note the color of each shape. In the second column, record the number of triangles that comprised each shape. In the third column, calculate the theoretical probability of drawing a part of each shape from the bag.
Begin taking shapes from the bag. Make a table to tally the results, as in the spinner experiment. Do as many trials as time allows. When finished, find the experimental probability of drawing a triangle from each of the colored shapes.

6.Compare the experimental probability to the theoretical probability. Are the trends the same as in the spinner experiment?

7. What is the theoretical probability that a triangle will be drawn that is part of Shape 1 or Shape 2?

8. Based on observations from both activities, what can be concluded about the experimental and theoretical probabilities as more and more trials are conducted?

Investigation Practice
a. Design and make a spinner so that $P(Red) = \frac{1}{2}$, $(Blue) = \frac{1}{4}$, and $(Green) = \frac{1}{4}$.

b. Conduct a probability experiment with the spinner from part a.
Comment on the results.

c. Use square grid paper to design a simple set of shapes that comprise a rectangle. Use only the grid lines as edges. Make a table like the one used in the second experiment of this investigation for the set of shapes.

d. Write a problem about the theoretical probabilities for the experiment conducted in part c. Exchange the probability problem with another student. Solve each other's problems.

e.Compare your experiment in part c with the experiment in the second part of the investigation. In each activity, was the probability proportional to the number of triangles or squares in the shape, the area, or both? What key ideas about probability did you observe in both activities?