# BALTIMORE COUNTY PUBLIC SCHOOLS

## OFFICE OF MATHEMATICS

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# PASCAL'S TRIANGLE

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# PASCAL'S TRIANGLE

Pascal's triangle is a figure named after Blaise Pascal. Pascal was a French thinker, mathematician and scientist. He created the first arithmetic machine which later became known as the calculator. It was this contribution that earned him the title "Father of the computer age." Today, one of our most valuable computer languages, Pascal, is named after him.

In addition to the first calculator, Blaise Pascal also developed theories about the cycloid. (The cycloid is the curve traced by a point on a circle as the circle rolls along a straight line.) Together with Pierre de Fermat, they formed the basis of probability theory. This branch of mathematics predicts the chance that something will occur.

Pascal is also credited with developing the first one-wheeled wheelbarrow and with designing a bus. In addition, his research on atmospheric pressure and the vacuum established principles crucial to the study of physics. However, it is his work on Pascal's Triangle that he is most famous for. Although the triangle has been around since the fourteenth century when Chinese mathematician Zhu Shijie discovered it, Blaise discovered new patterns in it and found several other uses for the triangle. To see some of these patterns, we will create Pascal's Triangle.

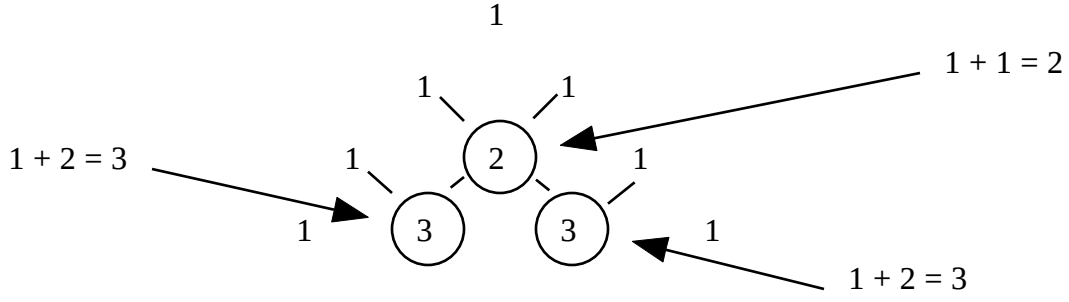
To construct Pascal's Triangle, complete the following steps:

1. Using the handout, begin at the top and number each row. Begin your numbering with zero and continue until you reach the bottom of the triangle. (The last row should be number 31.)

2. The triangle is divided into many small six-sided figures. These figures are called hexagons. In each hexagon going down the left side of the triangle, write the number 1.

3. Repeat step two going down the right side of the triangle.

4. Row zero has a one in it and row one has two ones in it. We will use row one to fill in the hexagon in row two. In row two, you have one empty hexagon. To fill it in, add the two numbers in the adjoining hexagons directly above the empty hexagon (in row one). We repeat this process to fill in row three. In row three, there are two empty hexagons. To fill them in, look at row two. Add the numbers in the adjoining hexagons directly above the empty hexagons (row two). So far, you should have the following numbers filled in:



5. Complete this process until you get to row nine.

6. Within the hexagons, the numbers are getting larger and larger. To fill in the remainder of the triangle, we will use the concepts of odd and even numbers. Beginning in row ten, rather than writing the number in the hexagon, write either O for odd or E for even.

   Use the following rules:

   odd + odd = even
   even + even = even
   even + odd = odd

   For example, the tenth row of Pascal's Triangle looks like this:

   1 10 45 120 210 252 210 120 45 10 1

   Rather than doing the arithmetic, let's replace the row with Os and Es. Row ten should look like this:

   O E O E E E E E O E O

   O O O O E .... ◄—— The beginning of row eleven is shown here. We used the rules from above to complete it.

7. Color all of the odd numbers within the triangle.

Notice the pattern. This pattern is a famous fractal called the Sierpinski Triangle. The triangle was named after the turn of the century mathematician Waclaw Sierpinski.

Roughly sketch the Sierpinski Triangle on another sheet of paper. How many different sized triangles are there?

If you made the triangle larger, what might it look like? Draw it.

Now, write a paragraph describing the pattern within the Sierpinski Triangle.