Title: Game Show Math	**Grade:** 8th **Author(s)**: Hope Phillips	**BIG Idea:** Probability

Real-World Connection:

On the game show, *The Price is Right*, Plinko is a favorite! According to www.thepriceisright.com the "game is played on a tall rod-studded surface that is almost upright, and it is played with discs that are dropped one at a time from a position above the multi-rodded surface. Each disc falls, (by gravity) and bounces off the rods in its path until it reaches the bottom and drops into one of nine receptacles. The nine receptacles are worth dollar values ranging from $100 up to $5000. The numbers across the bottom are as follows: $100, $500, $1000, $0, $10,000, $0, $1000, $500, $100. The contestant is awarded one disc upon starting the game and then can win up to four (4) more in a pricing game (editor's note -- that precedes the use of the Plinko game board). It is theoretically possible for a contestant to win $50,000 in this game."

How Students will Experience the Connection: highlight in yellow all that apply

*Video Clip Photo Podcast
Print Media (article, ad, etc.) Vodcast Other

*select from clips available at http://www.priceisright.com/show/games/plinko

GPS Standards:

M8D2: Students will determine the number of outcomes related to a given event.

M8D3: Students will use basic laws of probability.

M8P2: Students will reason and evaluate mathematical arguments.

M8P3: Students will communicate mathematically.

M8P4: Students will make connections among mathematical ideas and to other disciplines.

Objectives:

1. Students will chart the paths a Plinko chip may take on a modified Plinko game board.
2. Students will determine the likelihood of a Plinko chip landing in each position on a modified Plinko game board.
3. Using Pascal's Triangle, students will determine the likelihood of a Plinko player winning predetermined amounts of cash playing on an actual Plinko game board.

Materials:

Created as part of *Making Real-World Connections in Mathematics*, a project of the Columbus Regional Mathematics Collaborative at Columbus State University through IMPROVING TEACHER QUALITY Higher Education funds administered by the University of Georgia.

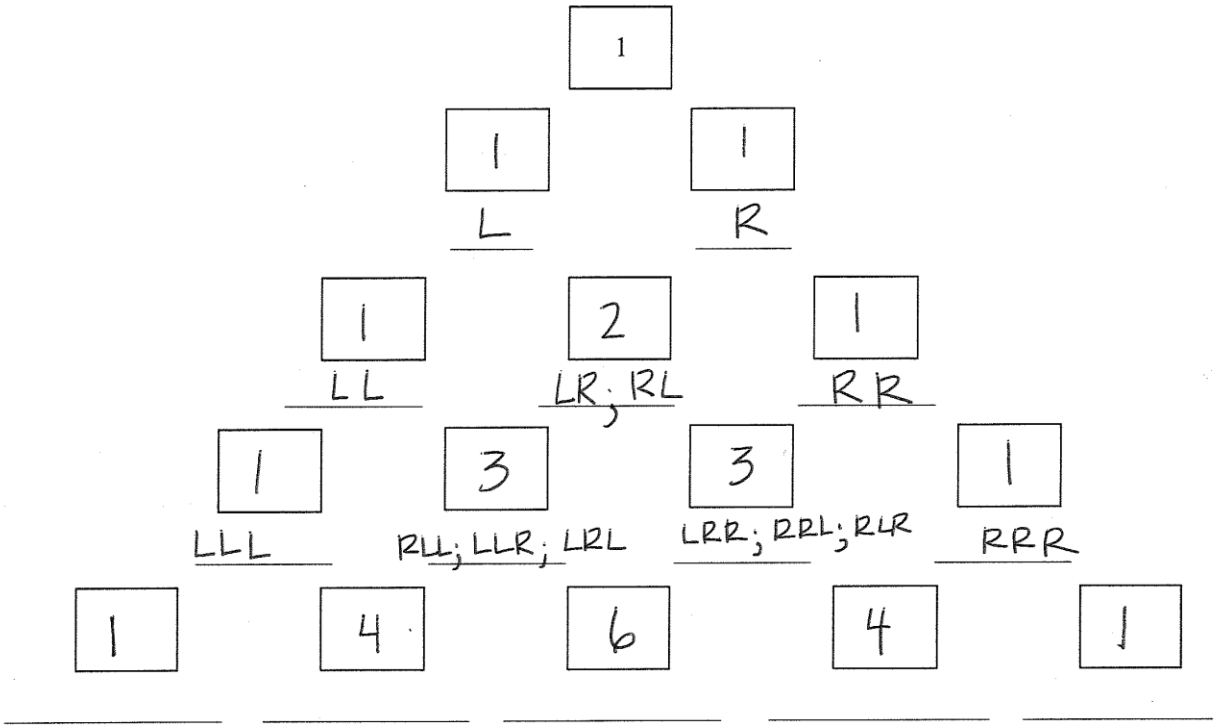
Plinko handout – one per student; one for teacher
Pascal's Triangle handout –one per student
Pascal's Triangle handout – one for teacher
Interactive whiteboard – teacher
Calculators – per student/student pair; optional; for calculating Pascal's Triangle values
Computer and digital projector – teacher
Video clip from http://www.priceisright.com/show/games/plinko

Related Task:

Discuss the Plinko game with students using a clip from the website of *The Price is Right*. Ask questions such as the following: Do you think it is more or less likely that a player would win, say, $100 versus $10,000? Would producers of The *Price is Right* want players to win a little money or a lot of money? Would you continue watching a show where players rarely won large sums of money? Who likely designs the Plinko game board for *The Price is Right*?

Show a video clip of a contestant playing Plinko. Tell students to concentrate on how the game is played and the number and type of monetary slots along the last row of the game board. Tell students they will discover the likelihood of a player winning different denominations of money from playing the game.

Open Plinko handout on interactive whiteboard. Tell students they will be recording the paths the chip can take and the total number of paths.



Created as part of *Making Real-World Connections in Mathematics*, a project of the Columbus Regional Mathematics Collaborative at Columbus State University through IMPROVING TEACHER QUALITY Higher Education funds administered by the University of Georgia.

The chip is dropped in the slot/box labeled "1," called "Row Zero." On the graphic above, the paths, and the number of ways to arrive at each slot, are identified. Help students see the numerical patterns, as well as the path patterns. For example, on Row Three, notice that the three paths in slot two, RLL; LLR; and LRL, are reversed from the three paths in slot three. Numerically, the left- and rightmost positions are always "1" because there is only one way for the chip to land in these spots. The "interior" values are the sums of the two values on the previous rows, to the left and right of the value in question. For example, on Row Four, the "6" is the sum of the "3" and "3" on the previous row and are to the left and right of the "6."

By the time students reach Row Four, they will likely have determined a pattern and be able to fill in "1, 4, 6, 4, 1." There is no need to determine the complicated paths; reliance upon the numerical pattern is sufficient at this point. Pascal's Triangle can be used to determine the number of outcomes for a given event. The sum of each of the triangle's rows corresponds to the number of paths the Plinko chip can take to land in that row. Each value per row corresponds to the number of ways a chip can land in that particular space.

Discuss with students another pattern helpful in determining total outcomes – beginning with Row Two, the sum of each row is a power of two. For example, Row 1 – sum of 2; Row 2 – sum of 4; Row 3 – sum of 8; Row 4 – sum of 16. Use this fact to initiate a discussion on the likelihood of a chip landing in each of the slots ("boxes" on game board). To the left of each slot/box, ask students to write the probability of a chip landing in each spot on each row. Link the probabilities to the total number of paths a chip can take per row.

$$1$$

$$\frac{1}{2} \qquad \frac{1}{2}$$

$$\frac{1}{4} \qquad \frac{2}{4} \qquad \frac{1}{4}$$

$$\frac{1}{8} \qquad \frac{3}{8} \qquad \frac{3}{8} \qquad \frac{1}{8}$$

$$\frac{1}{16} \qquad \frac{4}{16} \qquad \frac{6}{16} \qquad \frac{4}{16} \qquad \frac{1}{16}$$

The chance of a chip landing in the first slot on Row Zero is 100% because it is the only entry point to the game board. In Row One, there is an equal chance of the chip landing in either slot because there are only two slots available. Remind students this is like flipping a coin and having "heads" or "tails" as the only possible outcomes. On Row Three, there is a greater likelihood that the chip will land in the center slot; twice as often as landing on either of the edge positions. Continue the conversation in this manner. Remind students that these probabilities are *theoretical*; if the game were played only a few times, an individual's outcomes may not yield these results. Now is a good time to discuss the difference between *theoretical* and *experimental* probability.

Created as part of *Making Real-World Connections in Mathematics*, a project of the Columbus Regional Mathematics Collaborative at Columbus State University through IMPROVING TEACHER QUALITY Higher Education funds administered by the University of Georgia.

Using their partially-filled in Pascal's Triangle handout, students should complete the triangle through Row Eight. Have students transfer these results to their *Plinko* handout.

1, 8, 28, 56, 70, 56, 28, 8, 1 (number of paths to each slot)

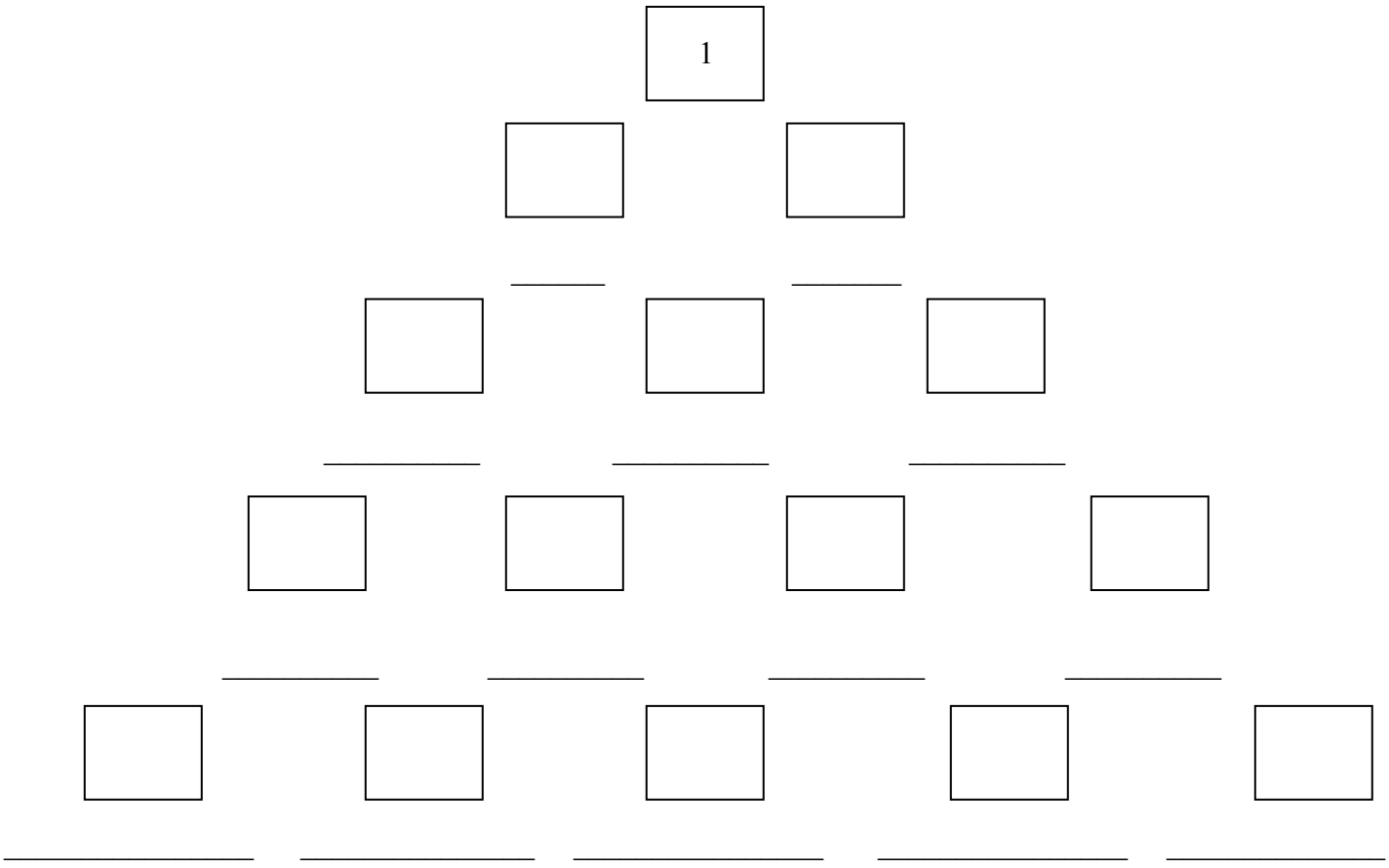
$\frac{1}{256}$ $\frac{8}{256}$ $\frac{28}{256}$ $\frac{56}{256}$ $\frac{70}{256}$ $\frac{56}{256}$ $\frac{28}{256}$ $\frac{8}{256}$ $\frac{1}{256}$ (probability of landing on slot)

$100; $500; $1000; $0; $10,000; $0; $1000; $500; $100 (*Plinko* monetary values)

Discuss with students why *The Prices Right Plinko* strategist would assign the monetary in this way. Ask questions like the following: Are you surprised by any of the monetary placements? If you ran the show, would you change the values and/or their positions? Why assign $10,000 to the largest probability? Why assign $100 to the lowest probabilities?

Created as part of *Making Real-World Connections in Mathematics*, a project of the Columbus Regional Mathematics Collaborative at Columbus State University through IMPROVING TEACHER QUALITY Higher Education funds administered by the University of Georgia.

In the line below each box, write each path that the PLINKO chip can make to reach the box. For example, LLL means the chip went left at the first box, then left, then left again to arrive at the first box on the third row. Inside each box write the total number of paths (all the ways a PLINKO chip could land in that box).

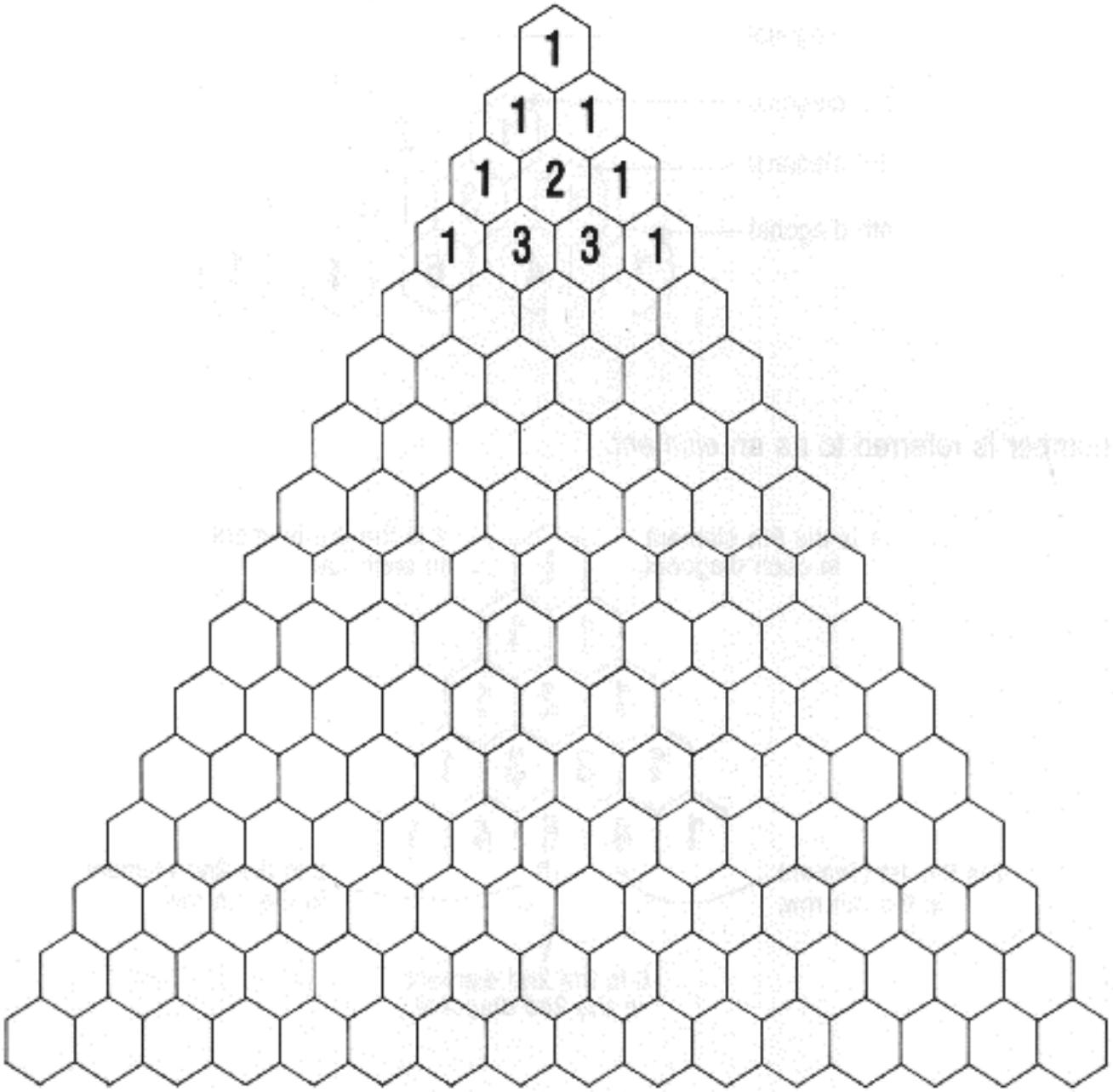


Look for patterns. How could you fill in a row by looking at the previous row?

What would the fifth row look like? Fill in the blanks below.

_____ _____ _____ _____ _____ _____

Fill out Pascal's Triangle through the ninth (9^{th}) row.



Pascal's Triangle