**“The Power of Fun”**

Math really can be fun if math games and puzzles visually or kinesthetically appealing are aligned to the mathematics standards being studied or reviewed.

“The Power of Fun” is an investigation where three puzzles are used to support several important mathematical concepts. As with any such puzzle, students learn from talking through their experiences, trying to see what sorts of moves lead to dead ends, and why certain forms make it impossible to move further. In each case, the object is to accomplish the task in the ***least*** number of moves.

1. “Sliding Puzzle”

<http://nrich.maths.org/public/>

Please search for “Sliding Puzzle!” This puzzle is an old favorite. The aim of the game is to slide the green square from its starting position, in the top right hand corner, to the bottom left hand corner in the least number of moves. You may only slide squares up, down, left or right and not diagonally.

1. Begin playing using a 2 x 2 grid, increasing complexity throughout the game. Record the number of squares on one side of the grid and the ***least*** number of moves it takes to slide the green square to its final position. Can you find a strategy?

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Side Length of Grid | 2 | 3 | 4 | 5 | 6 |
| Least # of Moves |  |  |  |  |  |

1. Numerically describe the pattern observed between the number of moves and the side length of the grid?
2. Calculate the difference between the dependent variables.
   * What do you realize about the difference in the values?
   * What type of function models a sequence with this characteristic?
3. Write a Now-Next or recursive representation of the pattern described above.
4. Write a function that models the ***least*** number of moves it takes to reach the games objective for an *n x n* grid? Explain your reasoning.
5. How does your Now-Next equation relate to your function model?
6. “Tower of Hanoi”

<http://www.sheppardsoftware.com/braingames/tower/tower.htm>

There is an ancient legend about the great “Tower of Hanoi”. The legend begins with a row of three diamond spindles, representing three towers. On the first spindle there is a stack of 64 gold disks of different sizes, each one smaller than the one below it. Monks in the temple have the task of moving the disks from the first spindle to the last, using the middle spindle when appropriate. They can move only one disk at a time, and can never place a larger disk on top of a smaller one. The legend says that when the task is complete, the temple will disappear in a clap of thunder and the world will end.

1. Using the same directions given to the monks, play the game, “Tower of Hanoi” on a smaller scale. Use the table provided to record the number of disks, and the ***least*** amount of moves it takes to win the game.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| # of Disks | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Least # of Moves |  |  |  |  |  |  |  |

1. Numerically describe the pattern observed between the ***least*** number of moves and the number of disks?
2. Calculate the difference between the dependent variables.
   * What do you realize about the difference in the values?
   * What type of function models a sequence with this characteristic?
3. Write the function that models the ***least*** number of moves necessary to win the game using, *n*, disks. Explain your reasoning.
4. If the monks are very efficient and move these disks in the quickest way possible with each move lasting only one second, how long until the world ends? Show your work and explain your reasoning.

III. “Peg Puzzle”

<http://nlvm.usu.edu/en/nav/category_g_4_t_1.html>

Please search for “Peg Puzzle”! This virtual manipulative is an implementation of the classic logic peg puzzle. The game is played on a line of holes, each of which can hold one peg, excluding the center hole. A number of blue pegs start out in the rightmost holes, and the same number of red pegs start out in the leftmost holes. The object is to switch the pegs on the left with the pegs on the right by moving one peg at a time.

A peg may only be moved to an adjacent empty hole, or you can jump an adjacent peg and move it to the hole on the other side. There are a couple of catches, though. You may not move backwards. The game ends when you win or get stuck. Remember, winning requires the ***least*** number of moves.

1. After determining the ***least*** number of moves to win in a two-peg game, find the ***least*** number of moves it takes to win the four-peg, six-peg, and eight-peg game and complete the table provided.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| # of Pegs | 2 | 4 | 6 | 8 |
| Least # of Moves |  |  |  |  |

1. Calculate the difference between the dependent variables. Calculate the difference of the differences (the second difference)!
   * What pattern exists between the second differences?
   * What type of function models a sequence with this characteristic?
2. Using your calculator, create and sketch a scatterplot of the data from part A.
   * What function type models the pattern observed in the scatterplot?
   * Does it match the function type identified from part B?
3. Find a function that models the ***least*** number of moves it takes to win the game as it relates to the number of, *n*, pegs.