

Differentiated Project Ideas *Low Entry Points and High Ceilings*

Drawing a Picture

- Use Macintosh Grapher, Geometer's Sketchpad, or desmos.com
- Can span from equations of lines to conic sections and parametric and polar representations

Find a line, circle, polynomial function, trigonometric function, or other curve of best fit

- Student solutions may span from guess-and-test to finding solving equations to automating the process with a program

Chaos Theory

- Cobwebbing—from following values on a graph to understanding recursion
- Exploring the Mandelbrot set—from multiplying complex numbers to exploring the impact of parameters on bounds of graphs
- Fractals—from similar figures to exponential and logarithmic relationships

Investments

- Repeated savings models & Mortgage payments—from substituting values into expressions to simplifying geometric series and solving

Logic

- Converse, Inverse, and Contrapositive statements—from constructing truth tables and identifying validity of statements to writing proofs by contradiction

Cryptography

- From following simple substitutions (stressing functions and inverse functions) to applying modular arithmetic

Strategy Games (for logic and probability)

- Guess Who?: Developing strategy based on repeated halving—why is this the best strategy? How many guesses are needed with optimal play? (a logarithmic question)
- Clue: What's the optimal strategy? (Look at things like # of steps to get to certain rooms, and how that increases your likelihood of earning the chance to guess again. Can also formalize logical arguments:
 1. If Austin has Col. Mustard, then Thomas has the Pipe ($C \rightarrow P$)
 2. Thomas does not have the Pipe (not P)
 3. Therefore, Austin does not have Col. Mustard (since not P \rightarrow not C)
- Monopoly: from counting groups of 10 with the dice, counting money, and finding 10% of a value to understanding probability of different rolls and expected value of properties
- Yahtzee: from simple addition or following a table (like Phil Woodward's solution) to computing compound probability with combinations