Flowing Wells High School

Courses: Pre-Calculus and Pre-AP Algebra

Teacher: Chuck Taylor

Fellow: Amy Veprauskas

G-TEAMS

Goals

- Improve students' understanding of mathematical notation and equations.
- Have students learn how to ***apply*** the skills they learned in class to a real world situation.
- Increase awareness of the applications of mathematics and the broad range of subjects it covers.

FUN with FUNctions

Understanding representations

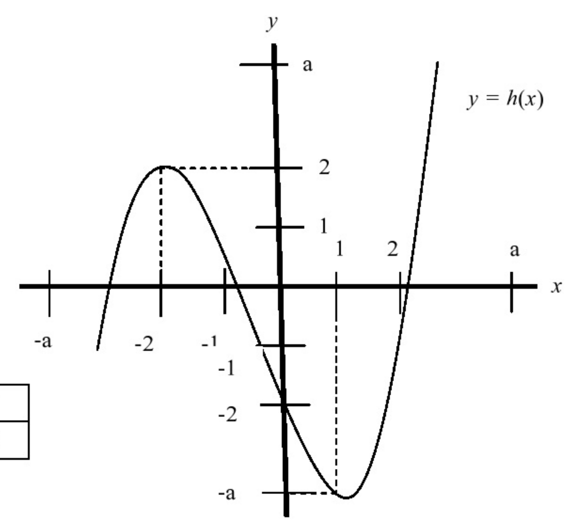
Name ____________________

More Fun with FUNctions

Use the functions given below to answer the following questions. *Note: Some of your answers may contain the constant a.*

$$p(t) = \begin{cases} 3 & \text{for } t<0 \\ t^2+1 & \text{for } t>1 \end{cases}$$

$$f(m) = 2^m$$

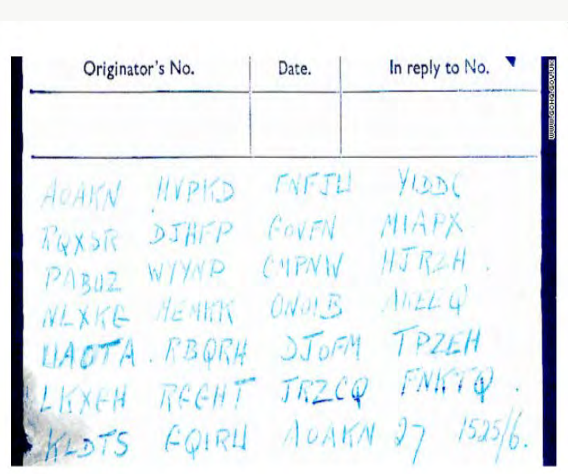


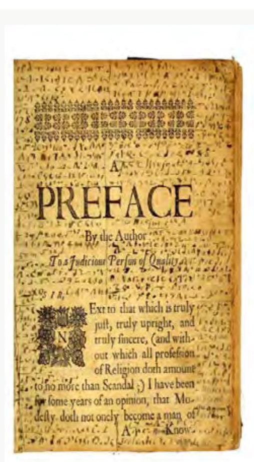
k	-a	-1	0	1	3	7
s(k)	1	0	-a	2	1	a

1. $f(1) + s(3)$
2. $h(f(0))$
3. $s(p(-1)+4)$
4. $s(-a) - p(3)$
5. $7h(-2)$
6. $f(f(2))$
7. If $h(x) = -a$, find x.
8. If $s(k) + f(2) = 6$, find k.

Math in the News

Who's the largest employer of mathematicians in the US?





Problem of the month

This semester we will be implementing problems of the month. These problems will both encourage critical thinking and introduce some interesting areas of mathematics.

Problem of the Month: **February**

Lady or Tiger

Due: **February 25th**

Area of Mathematics: **Logic**

The Problem

The king of a certain land decides to try his prisoners using logic puzzles. Each prisoner is given two or three doors to choose. Behind one of these doors is the lady he wishes to marry and behind each of the other doors is a tiger that might eat the prisoner. The prisoner must use the clues put to each door to determine which door the lady is behind.

The Goal

For each trial, determine which door the prisoner should pick. You must explain why you know for certain that the woman is behind the door you choose, i.e. you must ***prove*** that you are correct. You may choose to do one or both problems.

Example: Here is an example of how you prove your solution is correct

One door is true and the other is false.

I: In this room there is a lady, and in the other room there is a tiger.

II: In one of these rooms there is a lady, and in one of these rooms there is a tiger.

Claim: The lady is behind door II.

Proof: If the first sign is true, then there is a lady in room I and a tiger in room II. But then the second sign must also be true. Therefore, the sign on door I must be false and the sign on door II must be true. Therefore, there must be a lady behind door II.

Trial 1: Either both doors are true or both doors are false

I: At least one of these rooms contains a lady.

II: A tiger is in the other room.

Trial 2: At most one of the three statements is true.

I: A tiger is in this room.

II: A lady is in this room.

III: A tiger is in room II.

Other potential topics: graph theory, knot theory, strategy games

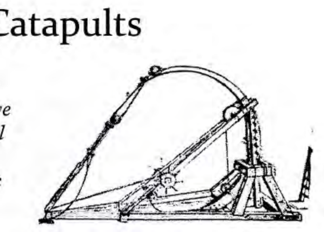
If a ball is on the ground, how high is it?

Navigating between representations and their physical interpretations

Team Members

Catapult # 2

Applications of Quadratics: Catapults



When we model the height of a projectile shot from a catapult as a function of the horizontal distance it has traveled we get a quadratic function. In this activity we use the catapults to shoot a penny into the air. We will measure the time the penny spends in the air and the horizontal distance it travels to determine a quadratic equation for its motion.

For each test run, you will need one person to do each of the following:

a. Launch the catapult.
b. Watch the penny and mark the spot where it FIRST hits the ground. Mark this spot with a piece of tape. Record the horizontal distance the penny went in **centimeters**.
c. Time each run. Record how long it took the penny to reach the ground after it was shot by the catapult in **seconds**.

PART I

1. Place the catapult on the ground and try a few practice shots. Make sure your catapult does not move. Pull the catapult all the way down each time.
2. Once you start to get consistent times and distances, record three of these runs. (*Do not count runs that are not consistent with the others.*) The times and distances for the three runs you chose are:

Time	Distance
1 sec 34ms	145cm
1 sec 21ms	147cm
1 sec 26ms	150cm

3. Calculate the average time and distance for these three runs. You will use these average values for the future calculations.

Average Time	Average Distance
1sec 27ms	147.3 cm

4. *Fill in the blanks*: At time $t = 0$ sec, the height of the penny is $h = 0$ cm. At time $t =$ 1.27 the height of the penny is also $h = 0$ cm. In all, the penny spent 1.27 seconds in the air. Since half of this time the penny was rising and half the time the penny was falling, the penny spent .635 seconds falling.

$d = \frac{1}{2}(1.27)$

5. The vertical distance traveled d of an object in freefall is given by $d = \frac{1}{2}gt^2$ where g is gravity $g = 9.8\text{m/sec}^2 =$ 980 cm/sec^2 and t is the falling time. Use this equation to determine the highest point the penny reaches.

$d =$ 311.15

6. We wish to find a function $h(x)$ representing the height of the penny as a function of its horizontal distance. From the calculation in #5, we know that the y-coordinate of the vertex is 311.15. The x-coordinate of the vertex, will be half of the total horizontal distance traveled. Therefore the x-coordinate of the vertex is 73.665.

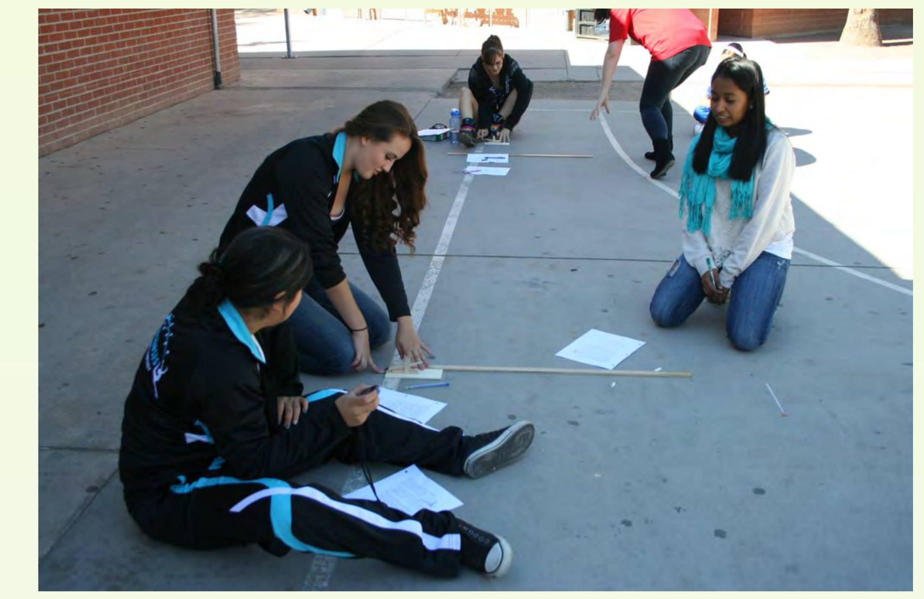
7. All together, the vertex of $h(x)$ is (311.15, 73.665). You also know at least two other points that lie on the graph of $h(x)$. The point (147.3, 0) lies on the graph of $h(x)$.

8. a. Use your answers from #7 to determine the function $h(x)$. Recall that the standard form of a quadratic is given by $h(x) = a(x-h)^2 + k$.

$h(x) = a(147.3 - 73.665)^2 + 311.15$

$h(x) = -.057(x - 73.665)^2 + 311.15$

$a = -.057$



Student Responses

This activity was easy & simple. I liked it because we actualy had to do hands on stuff to review. :)

Though this excercise was very fun and incorporating it is a bit confusing to work with. It seems there are too many constants to work with, d, distance, a, & distance. Our group was lost for we knew not how to work on each step. It may also be my lack of understanding but the exercise was a bit more than challenging. Still, it was a fun and great excercise since we all got to participate on this.

When students cover quadratic functions, they are often asked to answer questions related to projectiles.

Given the equation for the trajectory of a projectile, they often have difficulties giving the physical interpretation of the model.

The aim of this exercise was to improve this understanding by having them create their own models.