

## Unit 2: Families of Functions

**Standard Focus:** Patterns, Algebra & Functions

**Time Range :** 1-3 Days

### Topics of Focus :

- Families of Functions
- Piecewise Functions
- Modeling
- Transformations
- Odd & Even Functions

Seeing Structure in Expressions	A-SSE	1b. Interpret complicated expressions by viewing one or more of their parts as a single entity.
Interpreting Functions	F-IF	2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
Interpreting Functions	F-IF	7. Graph functions expressed symbolically and show key features of the graph, by hand and using technology for more complicated cases. ★
Interpreting Functions	F-IF	7b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
Interpreting Functions	F-IF	8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
Interpreting Functions	F-IF	9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
Building Functions	F-BF	3. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$ , $k f(x)$ , $f(kx)$ , and $f(x + k)$ for specific values of $k$ ; find the value of $k$ given the graphs.

### Procedures:

- A.) Student will be given the letter from Chief Harris, the possible suspects, and crime scene puzzles.
- B.) Students will work in pairs or individually to solve the crime.
- C.) Students will determine which suspect should be arrested.
- D.) Students will create a portfolio of evidence proving that they have arrested the right person and will demonstrate their understanding of their mathematical content present in the problem.
- \*E.) Students can present their evidence to the class as an oral presentation.

\*Extensions

# CSI Algebra 2 & Pre-Calc: Families of Functions



Detectives,

Check your Twitter because the international evil genius terrorist group the Mathemagicians are causing havoc on yet another world region. It seems they are making progress in their plans to build a world conquering device despite our best efforts to apprehend their cronies. West Africa is the victim of the latest string of heists at the hands of a henchman (or henchwoman), Megatransform. One thing is sure, Megatransform is definitely some kind of henchperson.

As has become the calling card of the Mathemagicians they have left behind a trail of notes with a cryptic text message. The text message when substituted correctly will calculate to Megatransform's favorite number. So far there are six suspects that police have questioned. It is hoped that someone with a relatively strong number sense and spatial reasoning can crack some codes that have puzzled the detectives on the case so far.



Your job is to bring Megatransform to justice and save the planet. You need to be prepared to state your case and demonstrate your understanding of the following skills that Megatransform is known to use in the notes.

- Families of Functions
- Piecewise Functions
- Modeling
- Transformations
- Odd & Even Functions

Be sure to include:

- Other examples of the concepts
- Definitions
- Any other relevant information.

This is not a time to be sloppy. The slightest miscalculation or illegible footnote could result in a not guilty verdict. Oh, did I mention that use of a calculator might prematurely set off his world conquering device? Good luck to you, gumshoe.

Chief Harris

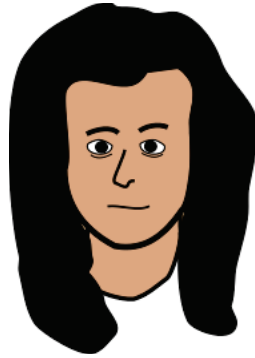
# Who is Megatransform?



Name: Maribel

Occupation: Elementary  
School Teacher

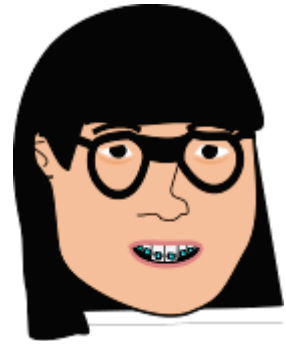
Favorite Number: 0



Name: Rebecca

Occupation:  
Screenwriter

Favorite Number: 792



Name: Russo

Occupation: Hedge-Fund  
Manager

Favorite Number: 81



Name: Arnold

Occupation: Principal

Favorite Number: -555



Name: Safiya

Occupation: Restaurant  
Owner

Favorite Number: 7



Name: Kofi

Occupation: Musician

Favorite Number: -230








Scene #1 The Grand Mosque -- Djenne, Mali



Considered one of the greatest architectural achievements, Megatransform apparently took samples of the adobe of the Grand Mosque which may be used in the World Conquering Device. Later, investigators found this note carved into the floor.

Megatransform is here to introduce you to his family of mathematical pain. Welcome to the African Math Olympiad. Every country brought their favorite function in hopes of winning. They wait on pins and needles until... the requirements are revealed to advance to the finals...

$f(8) \geq 10$  AND  $f(-1) < -3$ ... Both must be true

 <p><b>Côte d'Ivoire</b> <math>f(x) = 2^{x-1}</math></p>	 <p><b>Ghana</b> <math>f(x) = 7x - 3</math></p>	 <p><b>Mauritania</b> <math>f(x) = \sqrt{7x - 7}</math></p>
 <p><b>Senegal</b> <math>f(x) = \frac{60}{x - 3}</math></p>	 <p><b>Sierra Leone</b> <math>f(x) = (12 - x)^2</math></p>	<p>How many countries meet both requirements to advance?</p> <p><b>1</b> → <b>f = 1</b></p> <hr/> <p><b>2</b> → <b>i = 2</b></p> <hr/> <p><b>3</b> → <b>w = 3</b></p>

Scene #2 Loango National Park -- Western Gabon

A relatively new eco-tourist destination, Megatransform crossed over wildlife preserves and chimpanzee-napped an entire family of chimps.


Chimpanzee tracking would take on a whole new level if conservationists used math functions to denote families. Let's plays...

**Are you my mother?**

1. My mother is continuous
2. My mother increases and decreases
3. My mother is an even function
4. My mother's range is  $[0, \infty)$

The name of the correct function equals 20.

\_\_\_\_\_ = **20**

$a(x) =  x $	$c(x) = x^3$	$r(x) = \sqrt{x}$
$w(x) = 2^x$		$i(x) = [x]$
$c(x) = x$	$r(x) = \frac{1}{x}$	$c(x) = \cos(x)$

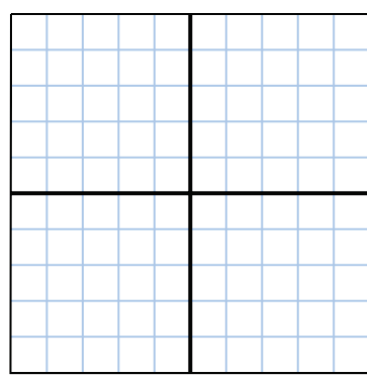


A security guard reported a break-in this morning at a museum devoted to the history of the Atlantic Slave Trade. Museum curators were startled to find that maps of the Atlantic Ocean were stolen.

Miraculous reunions are highlighted in Maison des Esclaves. Match the table of points on the left to the correct family on the left... but which family is left out? **This will lead to your next clue...**

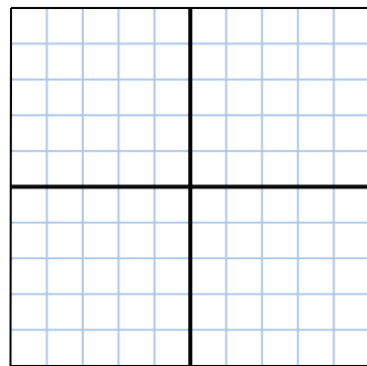
1.

x	y
-1	-2.5
0	-2
1	-1
2	1
3	5



2.

x	y
-1	-0.5
0	-1
1	Und
2	1
3	0.5

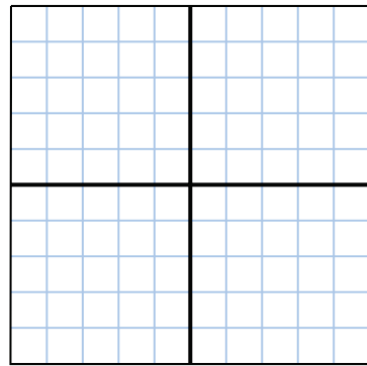


WHICH FAMILY IS NOT INCLUDED?

CUBIC	➔	$c = -1$
EXPONENTIAL	➔	$a = -1$
RATIONAL	➔	$r = -1$
QUADRATIC	➔	$w = -1$
SQUARE ROOT	➔	$i = -1$

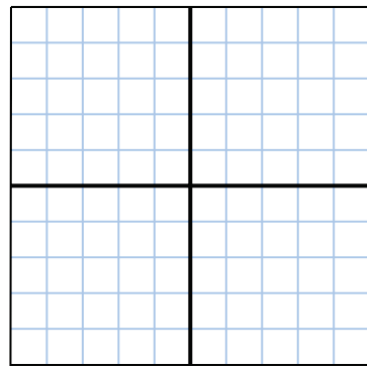
3.

x	y
-1	4
0	-1
1	-4
2	-5
3	-4



4.

x	y
-1	0
0	1
1	1.4
2	1.7
3	2



\_\_\_\_\_ = \_\_\_\_\_

Scene #4 Abuja Stadium -- Abuja, Nigeria



A note was left in the home team locker room of the new state of the art sports complex. Megatransform apparently has stolen the cleats of the Nigeria National Soccer Team.

I decided to have some fun sorting out soccer teams with mathematical functions. There are three teams, but one team needed to add more players than the others. **Which team got more players?**



$f(x) =  x  - 3$	$f(x) = (x - 5)^2$	$f(x) = - x - 2 $	$f(x) = -\frac{1}{x}$
$f(x) = x^3 - 5$	$f(x) = 2x$	$f(x) = -x^2 + 4$	$f(x) = \frac{1}{x} + 8$

TEAM ODD	TEAM EVEN	TEAM NEITHER
<b>WHICH TEAM NEEDED MORE PLAYERS?</b>		
<b>Odd -&gt; a = 71</b>	<b>Even -&gt; f = 72</b>	<b>Neither -&gt; w = 0</b>

Scene #5 Mount Cameroon -- Cameroon

A park ranger believes she witnessed an individual repelling into the volcano (also the highest peak in West Africa) and left with five bags full of magma.

I gave the best piece-wise directions to get from the oasis to the jungle. I forgot to check to see if they work. Are my directions continuous?

$$f(x) = \begin{cases} \frac{1}{2}x - 3, & -10 \leq x \leq -8 \\ |x + 6| - 9, & -8 < x < -2 \\ -(x^2) - 1, & -2 \leq x < 2 \\ -5, & 2 \leq x \leq 5 \\ \frac{1}{5}x + 2, & x > 5 \end{cases}$$

**Is it a continuous path that reaches the destination?**

<b>YES</b>	<b>R = 10</b>
<b>NO</b>	<b>F = 10</b>

