Pre-AP Algebra 2
Explore/Explain Transformations

(Use two different colors of pencils for sketching \(y_1\) and \(y_2\) on the graphs provided)

I. Explore Vertical Translations
1. Enter \(y_i = |x|\)
2. Now, one at a time, enter the following 4 functions into \(y_2\) and compare to the parent function \(y_i = |x|\). Record your observations below the graph.
   a. \(y_2 = |x| + 2\)
   b. \(y_2 = |x| - 3\)
   c. \(y_2 = |x| + 1\)
   d. \(y_2 = |x| - 1\)

3. Generalize: What happens to the graph of a function when you add or subtract a constant to the function rule?

   \[\text{up} \quad \text{down}\]

II. Explore Horizontal Shifts
1. Enter \(y_i = |x|\)
2. Now, one at a time, enter the following 4 functions into \(y_2\) and compare to the parent function \(y_i = |x|\). Record your observations below the graph.
   a. \(y_2 = |x - 2|\)
   b. \(y_2 = |x + 1|\)
   c. \(y_2 = |x - 3|\)
   d. \(y_2 = |x + 2|\)

3. Generalize: What happens to the graph of a function when you add or subtract a number inside parenthesis with \(x\)?

   \[\text{right} \quad \text{left}\]
III. Explore Vertical Stretches and Compressions
1. Enter $y_1 = |x|$
2. Now, one at a time, enter the following 4 functions into $y_2$ and compare to the parent function $y_1 = |x|$. Record your observations below the graph.
   a. $y_2 = 5|x|$
   b. $y_2 = 25|x|$
   a. $y_2 = \frac{1}{10}|x|$
   b. $y_2 = 0.3|x|$

3. Generalize: What happens to the graph of a function when you multiply the function by a number not in parenthesis?
   
   $a > 1$  Skinny V. Stretch
   $0 < a < 1$  Wider V. Compression

IV. Explore Horizontal Stretches and Compressions
1. Enter $y_1 = |x|$
2. Now, one at a time, enter the following 4 functions into $y_2$ and compare to the parent function $y_1 = |x|$. Record your observations below the graph.
   a. $y_2 = 5x$
   b. $y_2 = 25x$
   a. $y_2 = \frac{1}{10}x$
   b. $y_2 = 0.3x$

3. Generalize: What happens to the graph of a function when you multiply $x$ by a number inside the parenthesis?
   
   $b > 1$  Skinny H. Comp
   $0 < b < 1$  Wider H. Stretch
V. Explore Reflections
1. Enter the following into $y_1$ and $y_2$
   a. $y_1 = |x|$ and $y_2 = -|x|$
   b. $y_1 = |x|$ and $y_2 = -|x|$

![Graphs showing reflections](image)

2. Generalize: What happens to the graph of a function when you multiply the function by a negative outside of the function?
   Flips over $x$-axis

3. Generalize: What happens to the graph of a function when you multiply $x$ by a negative inside of the function with $x$?
   "no change" Flips over $y$-axis

VI. Multiple transformations
1. Enter the following into $y_1$ and $y_2$
   a. $y_1 = |x|$ and $y_2 = -(x-3)$
   b. $y_1 = |x|$ and $y_2 = -|x| - 3$
   c. $y_1 = |x|$ and $y_2 = -|x + 3|$ 

![Graphs showing transformations](image)

2. Generalize: What happens to the graph of a function when you multiply by a negative inside parenthesis and also subtract 3 inside the parenthesis? Which do you do first?
   You must graph the reflection first.
Given the equation $y = |x|$ write the new equation, in $y =$ form, after the following transformations. Also describe the transformation in words.

1. $f(x+2)$
   Equation: $y = |x+2|$
   Words: Left 2

2. $f(x)+2$
   Equation: $y = |x|+2$
   Words: Up 2

3. $-f(x+1)$
   Equation: $y = -|x+1|$
   Words: V. Flip, Left 1
   Over x-axis

4. $f(-x)+5$
   Equation: $y = |x|+5$
   Words: H. Reflection over y-axis, Up 5

5. $f(-(x+2))+1$
   Equation: $y = |-(x+2)|+1$
   Words: H. Reflection over y-axis
   Left 2, Up 1

6. $2f(x)-3$
   Equation: $y = 2|1x| - 3$
   Words: V. Stretch down 3

7. $f\left(\frac{1}{2}x\right)$
   Equation: $y = \frac{1}{2}|x|$
   Words: H. Stretch

8. $f(3x)+4$
   Equation: $y = |3x|+4$
   Words: H. Compression up 4

9. $\frac{1}{2}f(x)$
   Equation: $y = \frac{1}{2}|x|$
   Words: V. Compression