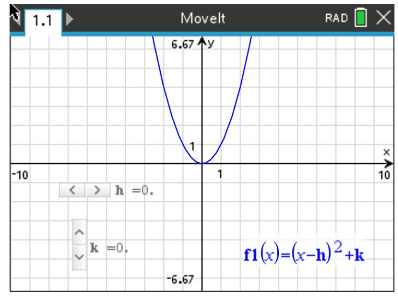
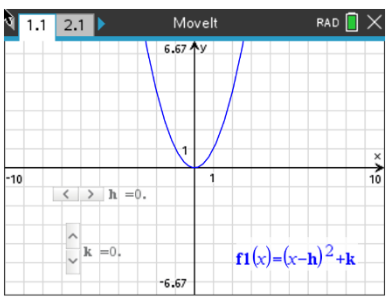
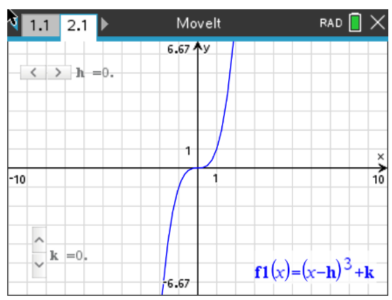
Name ________________
Class ________________

The goal of this activity is to help you understand how the graph of a function can be translated vertically (up or down) and horizontally (left or right) by adding to or subtracting from the output or the input.



In this activity, the movements of the parent functions $f(x) = x^2$ and $f(x) = x^3$ will be explored. You will be using the program ***MoveIt.tns***, downloaded on or sent to your handheld by your teacher. On page 1.1 you will see the graph of the parent function $f(x) = x^2$ and on page 2.1 you will see the graph of the parent function $f(x) = x^3$. For each problem in this activity, you will use the sliders on each page to translate both types of functions. Simply press the slider to shift your function according to each problem.





Problem 1 – $\boldsymbol{f(x) \rightarrow f(x-h)}$

Use the horizontal slider to change the value of **h only**. Leave k = 0. You will need to first determine the value of h in each question.

Let's see what you remember about transforming $\boldsymbol{f(x) \rightarrow f(x-h)}$:
In questions **1** and **2**, describe the transformation for each graph as compared to the graph of the parent function $f(x)$, use your handheld to verify your answer.

1. $f(x-2)$ ____

2. $f(x+5)$ ____

3. In general, describe the transformation of $\boldsymbol{f(x) \rightarrow f(x-h)}$ and explain your reasoning.

   ____

   ____

Problem 2 – $\boldsymbol{f(x) \rightarrow f(x) + k}$

Use the vertical slider to change the value of **k only**. Leave h = 0.

Let's see what you remember about transforming $\boldsymbol{f(x) \rightarrow f(x) + k}$**:**
In questions **4** and **5**, describe the transformation for each graph as compared to the graph of the parent function $f(x)$, use your handheld to verify your answer.

4. The graph of $f(x) + 4$ ____

5. The graph of $f(x) - 3$ ____

6. In general, describe the transformation of $\boldsymbol{f(x) \rightarrow f(x) + k}$ and explain your reasoning.

   ____

   ____

Problem 3 – $\boldsymbol{f(x) = (x-h)^2 + k}$

7. Describe the transformations of $f(x-7) + 6$ as compared to the parent function $f(x)$.

   ____

   ____

8. In general, describe the transformations of $\boldsymbol{f(x) = (x-b)^2 + c}$ when:

   b and *c* are both positive ____

   b and *c* are both negative ____ *b* is positive and *c* is negative ____

b is negative and *c* is positive ____

Problem 4 – $f(x) \to af(x)$

In order to transform your function through the multiplication of *a,* go to pages 3.1 and 4.1. Press the sliders to explore how *a* transforms the graph.

9. Describe the transformation of $0.5f(x)$ as compared to the parent function $f(x)$.

   ____

With a classmate, create a table of values comparing the y-values for given x-values for the functions $f(x) = x^2$ and $f(x) = 0.5x^2$. For example, when *x* = 2, the corresponding values for the functions are 4 and 2 respectively. In other words, the y-values are "pushed lower" as a result of multiplying by 0.5. This is known as a ______________________________________.

10. Describe the transformation of $2f(x)$ as compared to the parent function $f(x)$.

    ____

11. In general, describe the transformation when $0 < |a| < 1$ for the graph of $af(x)$ as compared to the parent function $f(x)$.

    ____

12. In general, describe the transformation when $|a| > 1$ for the graph of $af(x)$ as compared to the parent function $f(x)$.

    ____

13. Change the coefficient of the quadratic and cubic functions to -0.5 and then to -2. Describe the graph of $af(x)$ when *a* is negative as compared to when *a* is positive.

    ____

Problem 5 – $f(x) \rightarrow f(ax)$

In order to transform your function through the multiplication of *a,* go to pages 5.1 and 6.1. Press the sliders to explore how *a* transforms the graph.

14. Describe the transformation of $f(2x)$ as compared to the parent function $f(x)$.

    ____

With a classmate, create a table of values comparing the y-values for given x-values for the functions $f(x) = x^2$ and $f(x) = (2x)^2$. For example, when *x* = 2, the corresponding values for the functions are 4 and 16 respectively. In other words, instead of it taking x = 4 to get y = 16, it took x = 2 to get y = 16, therefore x-values are "pushed lower" as a result of multiplying the x-value by 2 or the x-value was halved. This is known as a ____________________________________.

15. Describe the transformation of $f(0.5x)$ as compared to the parent function $f(x)$.

    ____

16. In general, describe the transformation when $0 < |a| < 1$ for the graph of $f(ax)$ as compared to the parent function $f(x)$.

    ____

17. In general, describe the transformation when $|a| > 1$ for the graph of $f(ax)$ as compared to the parent function $f(x)$.

    ____

18. Change the sign of the value being multiplied by *x* for the quadratic and cubic functions to -0.5 and then to -2. Describe the graph of $af(x)$ when *a* is negative as compared to when *a* is positive.

    ____

    ____

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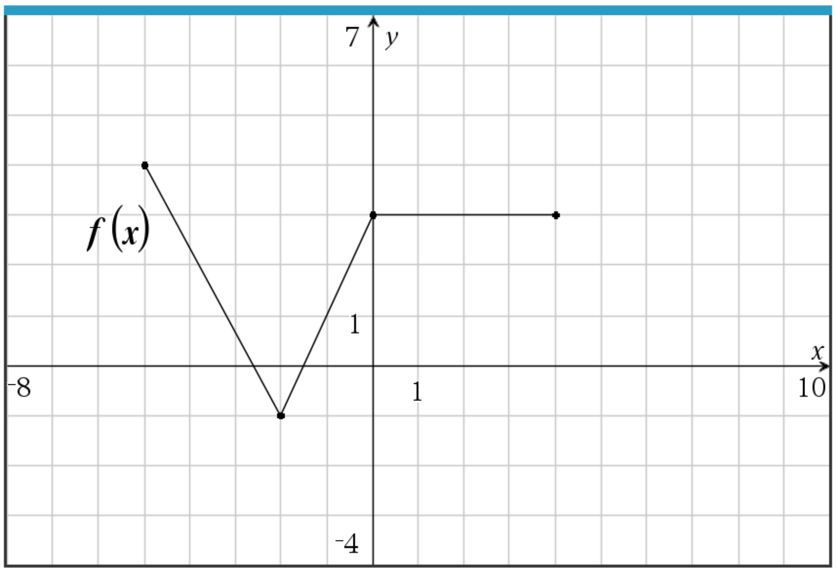
Further IB Applications

The following diagram shows the graph of the function $y = f(x)$, for $-5 \leq x \leq 4$. The points (-5, 4) and (0, 3) both lie on the graph of f. There is a minimum at point (-2, -1).



Let $g(x) = -f(x-3) + 2$.

(a) Write down the domain of f. ______________________________

(b) Write down the range of g. ______________________________

(c) On the graph above, sketch the graph of g.

Let $h(x) = f(-3x)$.

(d) Describe the transformations of $h(x)$ as compared to $f(x)$.

____

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