BIG PICTURE of this UNIT:	• How do we WORK WITH & EXTEND the concept of "functions" • Why are linear equations written in different forms? • How do we EXTEND our knowledge of LINEAR functions, beyond the basics of IM2?

This lesson will be based upon a STUDENT DIRECTED DISCUSSION model ….. in your groups, you should be having DISCUSSIONS about how to think and work through and then present the solutions to the following questions. The questions will involve basic ideas from IM2 Linear Relations UNIT including (i) functions, (ii) linear functions, (iii) GEOGEBRA and Co-ordinate Geometry. EVERY LESSON this semester will involve **spiralling through** these 4 major concepts as you will be given the opportunity to deepen and extend your conceptual knowledge & skill set on these 4 major themes as you see them multiple times in our lessons.

So, in your group, discuss & prepare solutions to the following questions. Record the key ideas of your discussions/solutions in your notebook. Then, once you have had your discussions, present your solutions on the board. Solutions do NOT necessarily NEED to be correct – they simply form the basis for DISCUSSIONS !!!! If your group has (i) multiple solutions that lead to the same answers OR (ii) same/different solutions that lead to different answers, present them ANYWAY!!

1. Use DESMOS to graph the absolute value function $g(x) = |x|$. You will now investigate the concept of transformations of this parent function. {11,13}

   a. Graph the second function $f(x) = -|x-2| + 3$ and explain how the new graph compares to the parent function, $g(x) = |x|$.
   b. Graph the second function $f(x) = 2|x+5|$ and explain how the new graph compares to the parent function, $g(x) = |x|$.
   c. Graph the second function $f(x) = -\frac{1}{2}|x| - 4$ and explain how the new graph compares to the parent function, $g(x) = |x|$.
   d. Make a general statement about the appearance of the graph of $f(x) = A\,|x - C| + D$.

2. Use algebra to solve the system defined by $\begin{matrix} f(x) = (x-1)^2 - 4 \\ g(x) = 2x - 7 \end{matrix}$. Use DESMOS on this system of equations in order to verify where they seem to intersect. {2,6,18}

3. A piecewise linear function is defined as $p(x) = \begin{cases} 2x+5 & \text{if } x < -2 \\ ax - 3 & \text{if } x \ge -2 \end{cases}$. Determine the value of *a* such that the function is **continuous** at x = -2. {13}

4. A linear system can be described as having no solutions, one unique solutions or infinite solutions. {6}

   a. Use on-line resources to explain/describe/understand each term and write your definitions (include diagrams) into your notes.

   b. Given the linear system $\begin{matrix} 2x + 3y = 11 \\ kx + 4y = -3 \end{matrix}$, determine a value for k such that:

      i. The system has NO solutions,

      ii. The system has a unique solution

5. Now working with the linear system $\begin{matrix} 2x + 3y = 11 \\ kx + 4y = m \end{matrix}$, determine values for k and m such that the system has INFINITE solutions.

6. Jose travelled 95 km from Oakville to Oshawa by car and by train. The car averaged a speed of 60 km/hr and the train averaged 90 km/hr. The whole trip took 1.5 hours of travel time. {6}

DEFINE YOUR VARIABLES, then complete the tables

Data Table (distance):

x						
y						

Data Table (time):

x						
y						

(a) Write an equation for the time traveled.

(b) What do the x- and y-intercepts represent?

(c) Write an equation for the distance traveled.

(d) What do the x- and y-intercepts represent?

(e) Use algebra to write and solve a single equation that can be used to determine how much time was spent traveling by car.

7. I have been observing the motion of a bug that is crawling on my graph paper. When I started watching, it was at the point (1, 2). Ten seconds later it was at (3, 5). Another ten seconds later it was at (5, 8). After another ten seconds it was at (7, 11). {16}

   a. Draw a picture that illustrates what is happening.
   b. Write a description of any pattern that you notice. What assumptions are you making?
   c. Where was the bug 25 seconds after I started watching it?
   d. Where was the bug 26 seconds after I started watching it?

Higher Level Questions for More Complex Concepts OR an EXTENSION of basic concepts involved with linear relations and functions in general.

1. You now extend your working knowledge of absolute value. {13}

   a. Explain what the Absolute Value "function" does to an input, for example the numbers -3 and +5
   b. Evaluate $|-2+5+7-13\times 2|$ and evaluate $(-2+5+7-13\times 2)$ and explain WHY the answers are different.
   c. The function $f(x)=|2x+5|$ can be understood as a piecewise function. What are the two "pieces" and in which restricted domain does each piece apply?
   d. Solve $|2x+5|=4$ GRAPHICALLY on DESMOS and explain WHY there are two solutions.
   e. Explain HOW to solve the equation $|2x+5|=4$ ALGEBRAICALLY.
   f. Solve $|2x+5|=x+4$ GRAPHICALLY and explain WHY there are two solutions.
   g. Explain HOW to solve the equation $|2x+5|=x+4$ ALGEBRAICALLY.

2. Given the functions $f(x) = \frac{1}{x}$ and $g(x) = 2x - 6$, {3,9,15,19}
   a. Use your TI-84 to graph $y = f \circ g(x)$ and label the asymptotes. Write the equation for $f \circ g(x)$.
   b. Give one reason why Mr S prefers $g(x) = 2x - 6$ to be written as $g(x) = 2(x - 3)$
   c. Determine the average rate of change of $y = f \circ g(x)$ between the x-values of x = 4 and x = 5.
   d. Determine the average rate of change of $y = f \circ g(x)$ between the x-values of x = 4 and x = 4.1.
   e. Determine the average rate of change of $y = f \circ g(x)$ between the x-values of x = 4 and x = 4.001.
   f. PREDICT the INSTANTANEOUS rate of change of $y = f \circ g(x)$ at x= 4.
   g. Use the TI-84 to draw the tangent line at x = 4 to verify your prediction.