(A) Lesson Context

BIG PICTURE of this UNIT:	• mastery with algebraic skills to be used in our work with co-ordinate geometry (midpoint, length, slope) • understanding various geometric properties of quadrilaterals & triangles • how do you really prove that something is "true"?		
CONTEXT of this LESSON:	Where we've been In MS, you have been taught about various types of geometric figures like quadrilaterals & triangles	Where we are Becoming proficient with one analytical tool that we can use in co-ordinate geometry ➔ midpoint	Where we are heading How can I prove various geometric properties of quadrilaterals and triangles?

(B) Lesson Objectives:

a. Exploring the midpoint and length of a line segment through dynamic geometry software (geogebra)
b. Develop proficiency in analytic/algebraic determination of midpoints of line segments and length
c. Apply the use of midpoints/length formulas to problem solving questions

(C) EXPLORATION ASSIGNMENT #1: Dynamic geometry software: Working with Geogebra

1. Show me an axes with a grid	
2. Show me that you can construct a line segment between 2 points and measure its length, slope and find its midpoint	
3. Show me that you can construct a line through two points & determine the slope and equation	
4. Show me that you can construct a triangle and measure the slope of each side and the area	
5. Show me you can reflect a triangle across the x-axis and across the y-axis	
6. Show me that you can translate a triangle 3 units to the left and 6 units down	
7. Show me that you can construct a perpendicular bisector of a side of a triangle	
8. Show me that you can construct an angle bisector of an angle in a triangle	

(D)Line Segment Recap from last class:

A line segment has an endpoint at $A(5,2)$ and midpoint at $M(9,-3)$. Determine the co-ordinates of the other endpoint. Show the algebraic reasoning/work that leads to your conclusion.

On the design plan for a landscaping project, a straight path runs from $(11,29)$ to $(53,9)$. A light is going to be placed halfway along the path.

(A) Draw a diagram that shows the path.
(B) Determine the co-ordinates of the lamp on your diagram
(C) The one lamp is not bright enough to illuminate the pathway. So two more lamps will be placed along the path, such that each lamp is placed a quarter of the distance of the path. Determine the coordinates of the other two lamps.
(D) CHALLENGE: Where would you place the lights, so that there were TWO lights equally spaced between the end points of $(11,29)$ and $(53,9)$

Challenge: A perpendicular bisector of a line segment is a second line that will (i) cut the line segment in half and (ii) be perpendicular to the original line segment . A line segment ends at the points $C(-2,0)$ and $D(4,-4)$. Determine the equation for the perpendicular bisector of line segment CD. Visualize it with Geogebra… then try and complete the problem with algebra.

(E) Length Recap from last class

The formula to find the length of a line segment between two points on a graph is $l = \sqrt{(y_2 - y_1)^2 + (x_2 - x_1)^2}$

- Determine the length of the line segment between $A(1,1)$ and $B(5,9)$

- Determine the length of the line segment between $A(-1,1)$ and $B(5,5)$

A helicopter is travelling from Town A to Town B. A grid is overlaid on the map of this region and Town A is at (-70,770) and Town B is at (220,490) & Town C is the origin.

- Draw a diagram that shows the three towns.
- Approximately how far did the helicopter travel?
- What assumption did you make about the route of the helicopter?

Triangles can be classified according to the lengths of their sides (scalene, isosceles, equilateral). A given triangle has vertices at A(4,5), B(1,2) & C(6,1).

- Determine the lengths of all three sides and then classify the triangle type.
- Construct the triangle on GEOGEBRA.
- Where would you move point C such that you now had an isosceles triangle?

CHALLENGE: A line segment has an endpoint at $A(5,2)$ and has a length of 13 units. Determine the co-ordinate(s) of the other endpoint. Show the algebraic reasoning/work that leads to your conclusion

Application Qs

9. A forest fire is threatening two small towns, Mordon and Bently. On a map, the fire is located at (10, −11), the fire hall in Mordon is located at (26, 77), and the fire hall in Bently is located at (12, −88). Which fire hall is closer to the fire?

10. In a video game, three animated characters are programmed to run out of a building at $F(1, -1)$ and head in three different directions. After 2 s, Animal is at $A(22, 18)$, Beast is at $B(-3, 35)$, and Creature is at $C(7, -29)$. Which character ran farthest?

14. A coordinate grid is superimposed on the plan of a new housing development. A fibre-optic cable is being laid to link points $A(-18, 12)$, $B(-8, 1)$, $C(3, 4)$, and $D(15, 7)$ in a run beginning at A and ending at D. If one unit on the grid represents 2.5 m, how much cable is required?

15. A leash-free area for dogs is going to be created in a field behind a recreation centre. The area will be in the shape of an irregular pentagon, with vertices at (2, 0), (1, 6), (8, 9), (10, 7), and (6, 0). If one unit on the plan represents 10 m, what length of fencing will be required?

Geometry Qs

7. A triangle has vertices at $A(2, -2)$, $B(-4, -4)$, and $C(0, 4)$.
- **a)** Draw the triangle, and determine the coordinates of the midpoints of its sides.
- **b)** Draw the median from vertex A, and determine its equation.

9. A quadrilateral has vertices at $P(1, 3)$, $Q(6, 5)$, $R(8, 0)$, and $S(3, -2)$. Determine whether the diagonals have the same midpoint.

11. A triangle has vertices at $P(7, 7)$, $Q(-3, -5)$, and $R(5, -3)$.
- **a)** Determine the coordinates of the midpoints of the three sides of $\triangle PQR$.
- **b)** Calculate the slopes of the **midsegments** of $\triangle PQR$.
- **c)** Calculate the slopes of the three sides of $\triangle PQR$.
- **d)** Compare your answers for parts b) and c). What do you notice?

12. Determine the equations of the medians of a triangle with vertices at $K(2, 5)$, $L(4, -1)$, and $M(-2, -5)$.

Black Level/HL Extension Questions:

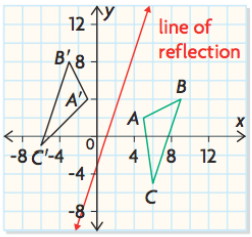
12. Calculate the distance between each line and the point. Round your answer to one decimal place.
- **a)** $y = 4x - 2, (-3, 3)$
- **b)** $y = -x + 5, (-1, -2)$
- **c)** $2x + 3y = 6, (7, 6)$
- **d)** $5x - 2y = 10, (2, 4.5)$

13. A new amusement park is going to be built near two major highways. On a coordinate grid of the area, with the scale 1 unit represents 1 km, the park is located at $P(3, 4)$. Highway 2 is represented by the equation $y = 2x + 5$, and Highway 10 is represented by the equation $y = -0.5x + 2$. Determine the coordinates of the exits that must be built on each highway to result in the shortest road to the park.

17. $\triangle ABC$ has vertices at $A(1, 2)$, $B(4, 8)$, and $C(8, 4)$.
- **a)** $\triangle ABC$ is translated so that vertex A' is on the x-axis and vertex B' is on the y-axis. Determine the coordinates of the translated triangle, $\triangle A'B'C'$.
- **b)** $\triangle DEF$ has vertices at $D(-1, 1)$, $E(-2, 6)$, and $F(-8, 3)$. Is $\triangle DEF$ congruent to $\triangle ABC$? Justify your answer.

15. A triangle has vertices at $D(8, 7)$, $E(-4, 1)$, and $F(8, 1)$. Determine the coordinates of the point of intersection of the medians.

16. In the diagram, $\triangle A'B'C'$ is a reflection of $\triangle ABC$. The coordinates of all vertices are integers.



- **a)** Determine the equation of the line of reflection.
- **b)** Determine the equations of the perpendicular bisectors of AA', BB', and CC'.
- **c)** Compare your answers for parts a) and b). What do you notice?

17. A quadrilateral has vertices at $W(-7, -4)$, $X(-3, 1)$, $Y(4, 2)$, and $Z(-2, -7)$. Two lines are drawn to join the midpoints of the non-adjacent sides in the quadrilateral. Determine the coordinates of the point of intersection of these lines.