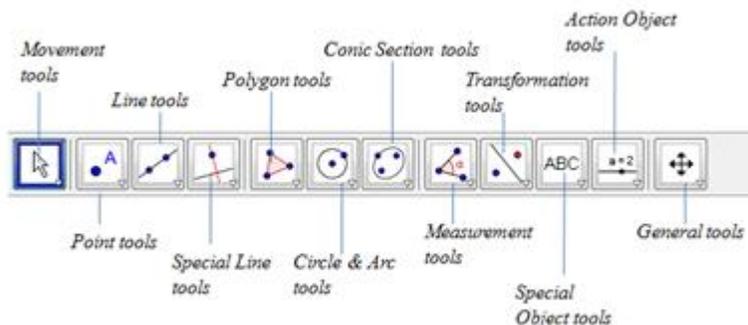


Group Members:**Section 1: Construct Your Own Midsegment Handout**

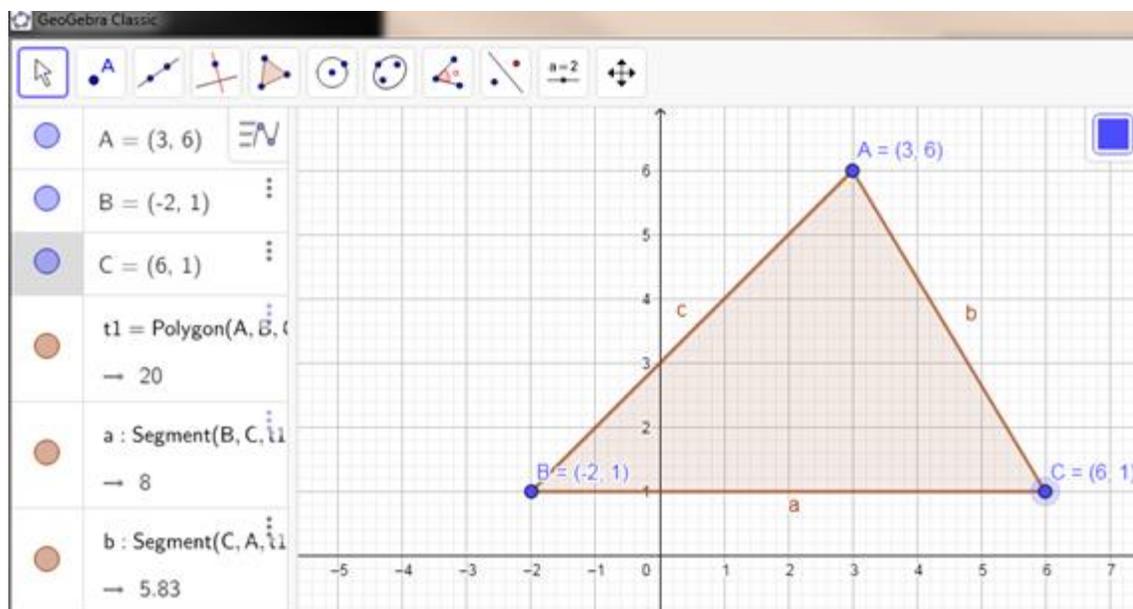
Use this checklist to follow the steps to create your own midsegment using GeoGebra software and answer/discuss questions in your groups.

Initial Design Instructions

- Open the GeoGebra application.
- By default it will open up in the Graphing mode showing the coordinate grid. Let's sketch a triangle now!
- Use the toolbar on top. Select the triangle icon (Polygon).



- Now tap the screen to make three points to create a triangle.
 - Click on the Movement icon, select the points, and drag from the corners to change your triangle into a big size, a nice-looking triangle like the one below.
 - Place your vertices on the same coordinates (A, B, C) you see in the picture in that order.
 - Your triangle should look like the one in the picture.
 - The next item will explain how to show those coordinates on each vertex.



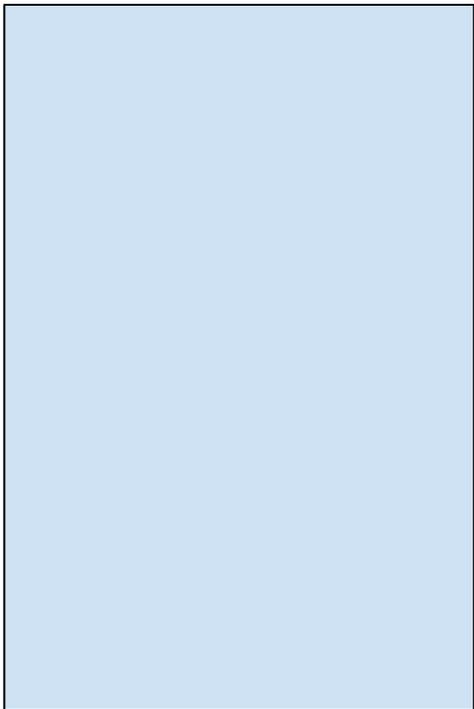
If you don't see the labels and/or the values (coordinates of the points), tap on the  icon then the settings  icon.

- Now go to the main screen and select the point B. Menu options on the right pane will change to Special Settings for this point.
- Check the Show Label option and from the drop-down menu pick option Name & Value.
- Repeat for points A and C. Or you can now simply tap and hold on other points and select Show label from the opening drop down menu right next to each point.
- Now you should be seeing all point labels and their coordinates in (x, y) format. You can close the Settings menu on the right pane at any time by clicking on the X symbol.

Group Leaders:

Put aside your iPad or laptop. Have your group members discuss and work out the following question on paper.

- How can you find/calculate the midpoints on sides AB and AC?
- Also indicate which formula you used.
- Briefly describe your method below and show all work in the box on the right!)



Have your group members estimate the midpoints before you make any calculations. It is OK if they point on the picture. If they point at different spots ask them to justify their answers.

Now make your calculations and provide the coordinates for the midpoints below:

Midpoint AB : (,)

Midpoint AC : (,)

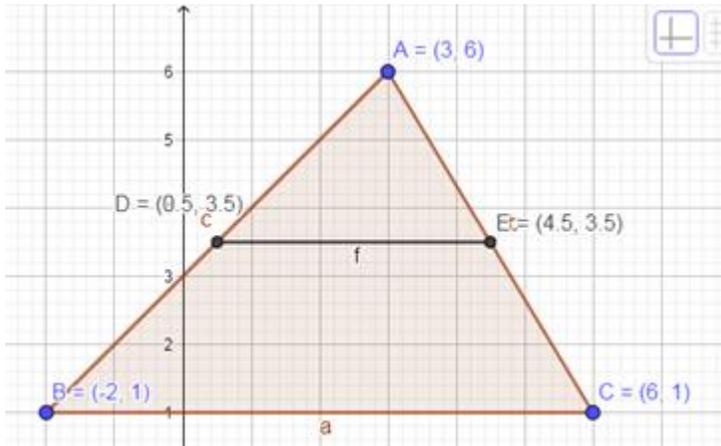
Now go back to Point tools  on your construction. Select  Midpoint or Center

- Go back to your triangle and tap points B and then A. Your midpoint will automatically be created with a black point.
- Repeat by tapping points A and C now. They will be labeled as D and E, respectively.
- Click on the Move tool (white arrow on the toolbar) to make sure you are not creating unwanted points on the grid when you tap on the screen.
- Let's find the coordinates of these new points (midpoints). Click on point D, then settings and then Show Label: Name and Value. These are your midpoints.
- Compare your results with your estimated values and calculations.

Let's create your first midsegment.



- Go to the toolbar and tap the  icon and select segment. Go to your triangle and click on points D and E. Your midsegment is now created.
- Click on the move tool and drag the label for point D out of the way to the left side of the line. Yes, you can move any label on the graph for better view. Your triangle should look like the one below.



□ Group Leaders: Brainstorm/Discuss/Argue the following questions within your groups and jot down notes:

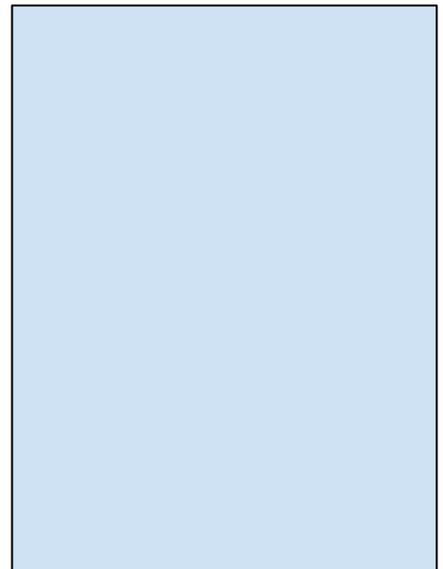
1. Use the following vocabulary and relate them to segments and points you see on your triangle after you created your midsegment between points D and E. Make interpretations, justify your points, or critique others' points if needed. Discuss how the following vocabulary (skills we covered in class before) may apply to your triangle.

Vocabulary to use: corresponding angles, parallel lines, congruent angles, distance (the distance formula), slope, equation of a line (or segment in our case),

- Discuss if there are any parallel lines. If so, name them and explain your reasoning and your proof.
- How would you prove that those two lines are parallel? Show your work/proof below. Mention slope(s) in your description.

List all corresponding angles.

- Are they congruent angles? What (evidence) makes you think that? Show your work.



2. How do you think you can calculate the distance (length) of each side of the triangle? Find each side length. Show your work.

Do you see any relationships/patterns?
Discuss your findings.

AD =

DB =

AE =

EC =

DE =

BC =

Findings:

3. Write the equations for the lines (segments) DE, BC, AB, and AC. Show your work below.

Proof Using GeoGebra

Now your group will use GeoGebra to help with those calculations. Compare your results/findings after each step and discuss within your groups.



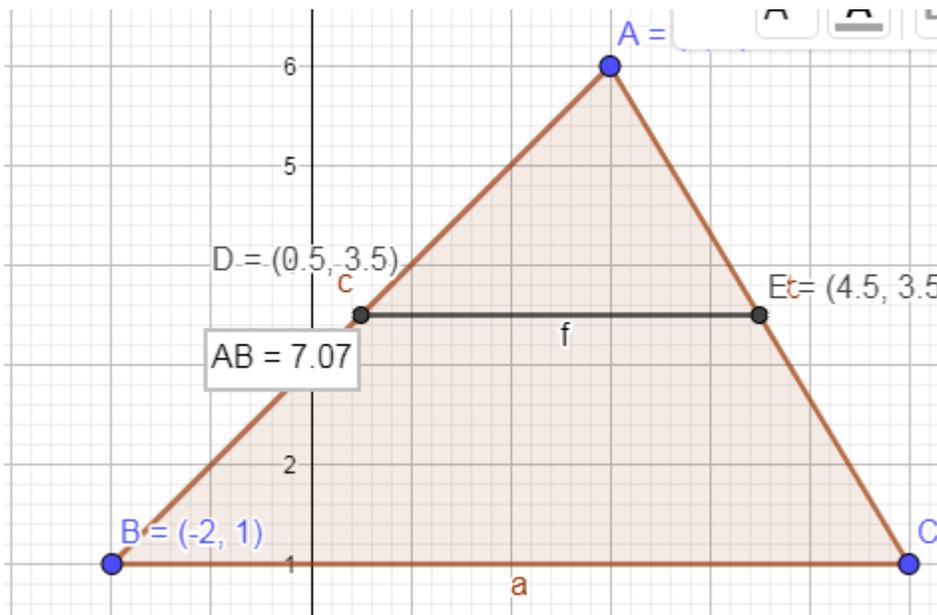
Go to toolbar and select the  icon then select Slope.

- Go to your triangle and click on segment DE. Your slope will be shown in m= format.
- Repeat for segment BC. Compare with your findings and discuss the relationship between the two segments and why?
- Why this is important? What conclusion you can make?

Now let's calculate each side length (distances).

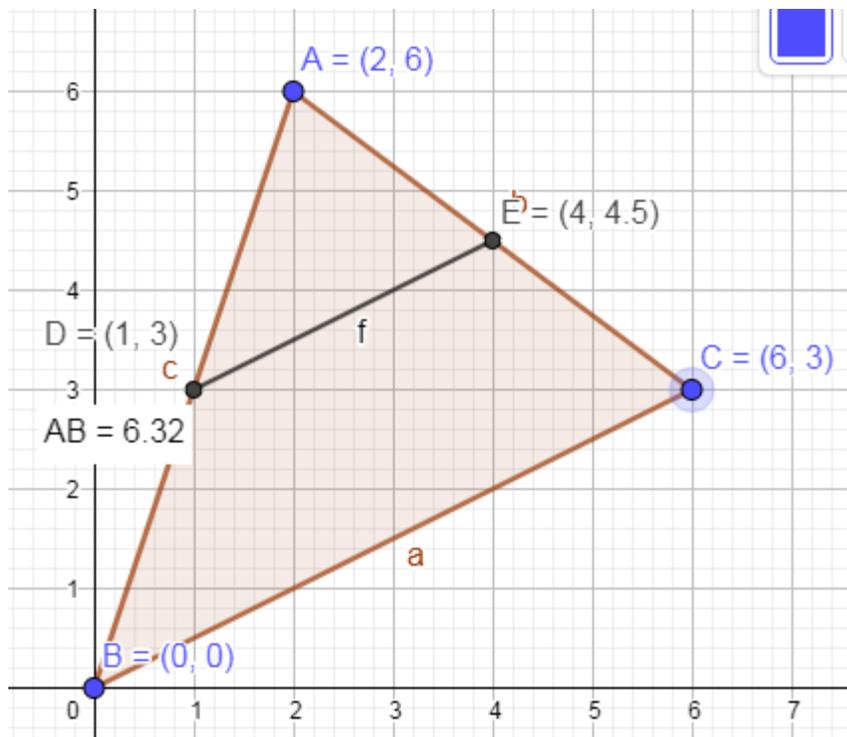


- Under the same icon now select  and then go to your triangle and select each pair of points you would like to measure the distance between them, say, AB...
- Repeat for each side you did in the previous question. See below for side AB as an example. Drag and move the label to an appropriate spot if necessary as I did.



Let's Add Some Challenge

Drag your triangle from the corners and move the vertices to new coordinates as you see below.



□ Calculate the slopes for segments DE and BC. Make a conjecture about the slopes of both segments. Compare and discuss in your groups. What is (are) your conclusion(s)? Why? Write a final statement here:

□ You may now try to find slopes using the measure tool in GeoGebra. Did you find the same results compared to your calculations. Use the distance and length tool now to measure all segments like you did before:

AD =

DB =

AE =

EC =

DE =

BC =

Findings:

- Make conjectures regarding the relationship between angles D & B and also angles C & E. Now

calculate these angles using the angle measure tool



- Interpret your findings. Does it support your conjectures? Why or why not? What are your conclusions?

Inside Triangle:

- Now drag and move point C to point (7, 0).
- Using the tools, mark the midpoint of segment BC. The program will automatically label it as point F.
 - Go to settings and show label and value for the point. Now, create new segments between points D and F and then E and F.
 - Select the move tool and freely drag point A to see how this new inside triangle you just created and the big triangle are changing.
 - What is happening to segments DF and BF or FC?
 - Now drag point B around and observe what is happening to segments EF and AD or DB.
 - What relationship do you observe between these pairs of segments? Discuss your observations in your groups. What is happening?

Make a conjecture regarding the lengths of segments DE and BF and then DE and FC:

What are your final conclusions? Did your finding support your conjecture(s) or did you find out/learn something new? Discuss and write a final statement below.

- Make a conjecture regarding the perimeters of the small triangle (DEF) and the big triangle (ABC). Find and compare their perimeters. What did you conclude?

□ Make a conjecture regarding the areas of the small triangle (DEF) and the big triangle (ABC). Find and compare their areas using hand calculation ($\text{Area} = \text{Base} \times \text{height} / 2$). What did you conclude?

Section 2: Real-life Problem Solving Using GeoGebra and Google Earth

In this activity, your group will help solve a real-life problem for our school using what you have learned in the previous section regarding the properties of triangle midsegments.

Here is your task:

The local elementary school wants to use the high school's parking lot for their carnival, and many children will be disappointed if we can't use the space. They will need a parking lot that is at least 500 feet long due to a county regulation and that can accompany certain number of visitors to their event. Is our parking lot big enough? Also know that the school's blueprints are missing the length of the parking lot and you are supposed to find a way, using GeoGebra, Google Earth, and scientific methods to accurately calculate that distance as correctly as possible. You must find a geometrical calculation method to do just that.

Recommended steps:

- Go to Google Maps, enter our school name or address to locate the school's map. Switch to earth mode to see the buildings. Zoom in to make sure school's map is in focus.
- Crop the image and paste into GeoGebra app. Using the construction tools in GeoGebra, identify points, segments, triangles, midsegments, etc. that are going to help you solve the task.
- Your group should keep in mind that since you are allowed to actually visit any space inside the building to take measurements, this might help you make calculations using some features of triangles (such as midsegments, similarity, etc.) and estimate the length of the parking lot based off of that information.
- You will not be given any measurement tool. So, your group members could use steps, collect some data, take averages if necessary, make calculations and convert them into feet. You can search to find out how to convert the number of walking steps into feet unit. The use of iPhone apps and pedometers are also allowed as long as your group converts results into feet.

Sample Google Earth model of the school: (You should look larger for better modeling)

