

Introduction to GeoGebra for Grades 3 – 5 Teachers

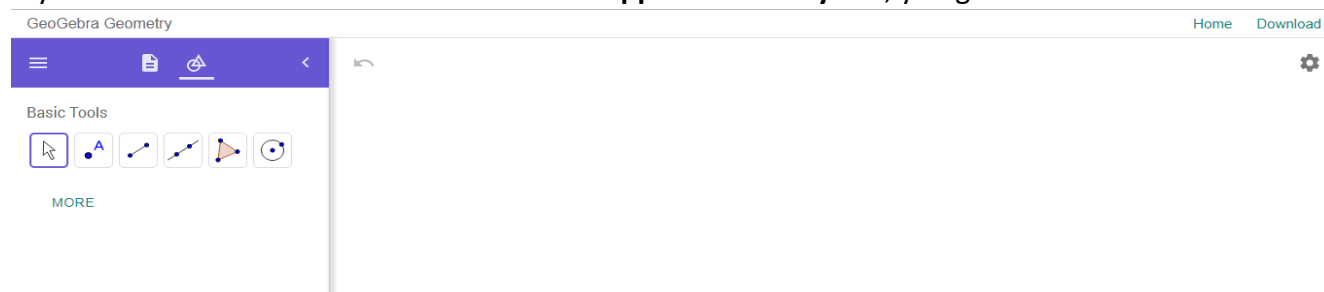
AIR practice tests and released test items at all grade levels from Grade 3 to High School contain questions where students must interact with a grid. Students must understand how to activate a variety of tools to draw items and how to delete items they draw that aren't correct.


GeoGebra is a dynamic open source software that unites **Geometry** and **Algebra**. It includes a spreadsheet utility and a Computer Algebra System (CAS) as well as other tools useful for Geometry, Measurement, Probability, Statistics, and Calculus.

A FREE download of this software, an online version, a mobile or iPad App, and a large variety of free classroom materials are available at www.geogebra.org. There is also an online Manual, online Tutorials, and an option to Search for help and information under the Help link. Most of the icons pictured in this document were copied from materials at this site. Go to this site now.



The Online GeoGebra “New” Math App


If you select the online GeoGebra **New Math Apps – Geometry** link, you get the screen below.






Select Settings  on the top right, and **Show Grid** with **Major Gridlines**. The Basic Tools are shown in a menu on the left, and you can select **MORE** to see more tools.

Highlighting indicates what tool is currently active. Selecting a tool will bring up a small screen on the bottom left that gives you information about the tool or brief instructions for using it.

Select the **Point** Tool  or the **Segment** Tool  and then click or click and drag on your screen to create points or segments.

 The **Move Tool** is used to select or drag objects. Objects that are selected are indicated by highlighting. You can select multiple objects using a right click and dragging a selection box around the objects. Try selecting and moving a point or segment.

You get a blank Geometry canvas by selecting **File**  and then + **New** (which replaces the current window, so you will be asked whether you wish to save your current work).

There is an Undo arrow  at the top left of the drawing canvas and a Delete tool. 

Example 1 – Lines, Rays, Segments, and Vectors


On a blank canvas, draw a line, a ray, a segment, a segment with length 3 cm, and a vector. You first need to drag the Basic Tools scrollbar down to see the Lines toolbox that has these options. Select the **Move** tool and observe what happens as you try to move each item or point. When you select an object, you can use the **Style bar** to experiment with different colors, styles or thicknesses, or labels for the points, segments, and lines in your sketch. Select **File – Print Preview** to see how the items would look if the page were printed.

Example 2 – Area and Perimeter

On a blank canvas, hide the axes and show the grid. Then use the **Polygon** tool to draw a polygon (click and release, click in another spot, ... , click on the first vertex to finish). In the **Measure** Toolbox select the **Area** tool, and click on the polygon to compute its area. Use the **Distance or Length** tool in this toolbox to compute the polygon's perimeter. These computations will appear without any units. You can use the Text tool (below) to add units as desired. The grid is a centimeter grid, so when the grid is shown, *centimeters* is an appropriate unit for perimeter and *square centimeters* is an appropriate unit for area.

Example 3 – Adding Text and Exporting Drawings to Word

You can use the **Text** tool to add text (or labels) to a drawing. If you hide the grid and label the sides of a figure with your own labels, be sure that the labels you choose are visually accurate. For example, don't draw two segments that are the same length, and label them with different lengths.

You can create multiple copies of an object within a GeoGebra sketch by using **Edit – Copy** and **Edit – Paste** under the main menu .

To export a drawing to a Word document or to another program, use the **Snipping** tool on your computer.

Example 4 – Parallel and Perpendicular Lines

The **Construct Toolbox** allows you to construct (not just draw) midpoints or centers, perpendicular lines and perpendicular bisectors, parallel lines, angle bisectors, and tangents.

The Spreadsheet View

Go back to the main GeoGebra website and open a **Classic Apps - Spreadsheet**. If you are familiar with Excel, the spreadsheet in GeoGebra works somewhat similarly. One big difference is that the Graphics view illustrates points, functions, and expressions entered into the spreadsheet. Also, functions and expressions do not have to be entered in the $y =$ format.


Example 5 – Plotting Points, Functions, and Relations

Type (1,2) in cell A1 and (2,4) in cell A2. The points appear in the Graphics View.

Type $y = x^2$ in cell B1. The function will appear in the Graphics View.

Type $x^2 + y^2 = 4$ in cell C1. The circle will appear in the Graphics View.

Example 6 – Sequences

Get a new Spreadsheet canvas by selecting **File**  (which in Classic mode is at the top right) and then + **New** (which replaces the current window, so you will be asked whether you wish to save your current work).

- (a) Type 1 in cell A1 and 4 in cell A2. Addition patterns (arithmetic sequences) can be continued by selecting both cells (click and drag so that the two cells are highlighted) and then pointing at the bottom right corner and clicking and dragging downward. Another option is to type 1 in cell B1 and type $=B1+3$ in cell B2, select and copy the formula in cell B2, highlight the cells below B2, and paste (or highlight the formula in B2, point at the bottom right corner, and drag downward).
- (b) Click and drag doesn't work to extend multiplication patterns. Use a formula in column C to replicate the pattern (geometric sequence) 3, 6, 12,
- (c) Use a formula in column D to reproduce some terms of the Fibonacci Sequence: 1, 1, 2, 3, 5, 8,

Example 7 – The Summation Tool



There is a difference between how the summation tool Σ works in GeoGebra and in Microsoft Excel. In Excel, when you select the cell below a column (or beside a row) of numerical values and then select Σ , the sum of the values will appear in the selected cell. In GeoGebra, you must select all of the values for which you wish to find the sum, then select Σ .

The Online Graphing Calculator

Open a **New Math Apps - Graphing Calculator** Canvas from www.geogebra.org.

Example 8 – Lines

Type $y = 2x + 3$ into the Input Bar and hit Enter.

Select **Tools**  and **More** (at the bottom of the tool column) to see more tools. Use the **Measurement** toolbox **slope** tool  to display the slope of the line.

Use the **Construction** toolbox to construct a perpendicular line and a parallel line, then use the slope tool to display the slopes of these lines.

In Algebra View  you can select the  menu to the right of a function to create a table of values for the function.

Example 9 – Materials – Saving and Searching

If you create a FREE account at www.geogebra.org, you can save your materials and worksheets. You can save materials in three forms: private, shared, or public. You can share materials using a link or by email.

You can search the online materials for free activities created by others.

Example – searching the phrase **partial products** leads to the recommended activities below:

Duane Habecker – Partial Products of 1-digit by 3-digit, and Partial Products to Multiply Whole Numbers.

Click on a person's name to see other activities that they have created. You will find over a million free classroom resources at this site.

Handouts to Introduce Students to GeoGebra

The pages that follow give 2-page handouts that could be used at the 3rd, 4th, and 5th grade levels to introduce students to GeoGebra. These can be used with students with no previous knowledge or experience (i.e. the 4th & 5th grade handouts do not assume students have used the prior handouts).


Reference:

Tool icons were copied from the GeoGebra Classic Manual (online).

<https://wiki.geogebra.org/en/Manual>


Introduction to GeoGebra – Grade 3 (Using the New Math Geometry App)


(1) (a) At www.geogebra.org select **New Math Apps - Geometry**.

(b) Select Settings  on the top right, and **Show Grid** with **Major Gridlines**.

(c) The Basic Tools are shown in a menu on the left; select **MORE** to see more tools.

(d) If you mess up, you can use the Undo tool  at the top left of the screen or click on the

Delete tool  and click on the object(s) you want to delete.

(2) (a) Select the point tool  and click on the grid to plot two points that are 4 units apart *horizontally* (across, sideways).


(b) Click on the grid to plot a point that is 3 units away *vertically* (up and down) from one of your points.

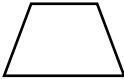
(c) Click on the grid to plot a point so that the four points are vertices of a rectangle.

(3) (a) Click on the **Segment** tool .

(b) Click and release on your first point, drag to your second point, and click to create the segment between your points.

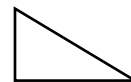
(c) Use the segment tool and draw the rectangle that has your four points as its vertices.

(4) (a) Use the segment tool. Draw a figure that looks like . This figure is a *rhombus*; it has four equal sides.

(b) Use the segment tool. Draw a figure that looks like . This is a *trapezoid*; it has a pair of parallel sides.



(c) Use the segment tool. Draw a square.


(5) (a) Use segments to draw a triangle that has a right angle (square corner). This is called a *right triangle*.



(b) Use segments to draw a triangle that is not a right triangle (that does not have a square corner).


(6) To get a clean drawing canvas:

(a) Select the Main menu  on the top left of the screen. Select  New and Don't Save.

(b) Select Settings  on the top right, and **Show Grid** with **Major Gridlines**.

(c) If you don't see all the tools on the left; select **MORE** to see more tools.

(d) If you mess up, you can use the Undo tool  at the top left of the screen or click on the

Delete tool  and click on the object(s) you want to delete.

(e) Practice using the delete tool. Draw an object, and then delete it.

(7) (a) Use segments to draw a rectangle that shows the multiplication number sentence
 $2 \times 6 = 12$.

(b) Use segments to draw a rectangle that shows the multiplication number sentence
 $6 \times 2 = 12$.

(c) The *area* of a figure is the number of square units inside the figure. The two rectangles above each have an area of 12 square units. How many other rectangles can you draw that have an area of 12 square units?

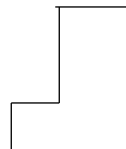
(8) The *perimeter* of a figure is the distance around the figure.

(a) What is the perimeter of the 2 x 6 rectangle that you drew above? Do all of your rectangles that have area 12 have same perimeter? Why or Why not?

(b) Draw a rectangle that has a perimeter of 20 units, and a length of 6 units. What is the width of the rectangle?

(9) Draw an irregular figure that has area 12 square units.


Example of an irregular figure:



(10) Draw any figure or picture that you want to draw.


Introduction to GeoGebra – Grade 4 (Using the New Math Geometry App)


(1) (a) At www.geogebra.org select **New Math Apps - Geometry**.

(b) Select Settings  on the top right, and **Show Grid** with **Major Gridlines**.

(c) The Basic Tools are shown in a menu on the left; select **MORE** to see more tools.


(d) If you mess up, you can use the Undo tool  at the top left of the screen or click on the


Delete tool  and click on the object(s) you want to delete.

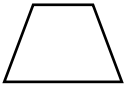
(2) (a) Select the point tool  and click on the grid to plot two points that are 4 units apart *horizontally* (across, sideways).

(b) Click on the grid to plot a point that is 3 units away *vertically* (up and down) from one of your points.

(c) Click on the grid to plot a point so that the four points are vertices of a rectangle.

(d) Click on the **Segment** tool . Click and release on your first point, drag to your second point, and click to create the segment between your points. Use the segment tool and draw the rectangle that has your four points as its vertices.

(3) (a) Use the segment tool. Draw a figure that looks like . This figure is a *rhombus*; it has four equal sides.

(b) Use the segment tool. Draw a figure that looks like . This is a *trapezoid*; it has a pair of parallel sides.

(c) Use the segment tool. Draw a square that has area 9 square centimeters (each square on the grid is 1 square centimeter).

(d) Draw a rectangle that has area 9 square centimeters, but is not a square.





(e) Find the perimeter of the square and the rectangle. The *perimeter* of a figure is the distance around the figure.


The square has perimeter _____ centimeters.


The rectangle has perimeter _____ centimeters.


(f) Draw a rectangle that has a perimeter of 20 units, and a length of 6 units. What is the width of the rectangle?

(4) To get a clean drawing canvas:

- (a) Select the Main menu  on the top left of the screen. Select  New and Don't Save.
- (b) For the examples below, we need a blank canvas, not the grid. If you don't see all the tools on the left; select **MORE** to see more tools.
- (c) If you mess up, you can use the Undo tool  at the top left of the screen or click on the Delete tool  and click on the object(s) you want to delete. Practice using the delete tool. Draw an object, and then delete it.

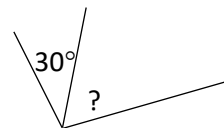
(5) (a) Use segments  to draw an angle that you think has measure about 60° .

- (b) Select the angle measure tool  then select the three points of your angle to find its measure. If it measures the exterior (outside) angle instead of the interior (inside) angle, delete the measure and select the three points in the other order.

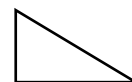
- (c) If your angle was not a 60° angle, select the move tool  and then drag one of the points until the measure of the angle is 60° .

(d) Repeat steps (a) – (c) to create an angle that has measure 100° .



- (e) Once you have a 100° angle, draw a segment that makes a 30° angle inside of your 100° angle as shown. What is the measure of the other interior angle? Use the angle measure tool (see step (b) above) to check.



(6) (a) Use segments to draw a triangle that has a right angle (square corner). This is called a *right triangle*.





- (b) Use segments to draw a triangle that is not a right triangle (that does not have a square corner).
- (c) Use segments to draw a triangle that has an obtuse angle (an *obtuse angle* is an angle that has measure greater than 90°).
- (d) Can you draw a triangle that has two obtuse angles? Why or why not?
- (e) Draw a triangle that you think has three equal sides.

- (f) Use the measure tool  to measure the sides of your triangle. Use the move tool  to move one or more vertices until the triangle has three equal sides.



(7) Draw any picture that you want to draw.


Introduction to GeoGebra – Grade 5 (Using the New Math Geometry App)


(1) (a) At www.geogebra.org select **New Math Apps - Geometry**.

(b) Select Settings  on the top right and **Show Axes** and then select Settings  again and **Show Grid** with **Major Gridlines**. We will only need the first quadrant. Click on the screen and drag down and to the left until the only negative numbers you see are the -1s.

(c) The Basic Tools are shown in a menu on the left; select **MORE** to see more tools.

(d) If you mess up, you can use the Undo tool  at the top left of the screen or click on the Delete tool  and click on the object(s) you want to delete.

(2) (a) Select the point tool  and click on the grid to plot the points (1, 2), (2, 4), and (6, 4). Then plot one more point so that the four points are vertices of a *parallelogram* (a quadrilateral with two pairs of parallel sides).

(b) Click on the **Segment** tool . Click and release on your first point, drag to your second point, and click to create the segment between your points. Use the segment tool and draw the parallelogram that has your four points as its vertices.

(c) Use the segment tool. Draw a square such that two of the vertices of the square are the points (2, 6) and (4, 8). There is more than one way to do this.

(i) Give one solution for the two other vertices: _____ and _____.

(ii) Give a different solution for the two other vertices: _____ and _____.

(d) Use the segment tool. Draw a *rhombus* (a quadrilateral with four equal sides). Write the coordinates of the vertices of your rhombus below.


(e) Use the segment tool. Draw a *trapezoid* (a quadrilateral with a pair of parallel sides). Write the coordinates of the vertices of your trapezoid below.

(f) Use the segment tool. Draw a trapezoid that has at least one right angle. Write the coordinates of the vertices of this trapezoid below.


(3) To get a clean drawing canvas select the Main menu  on the top left of the screen.

Select  New and Don't Save. Select Settings  and **Show Grid** with **Major Gridlines** (for this example, you do **not** need to Show the Axes).

- (a) Use segments to draw a *right triangle* (a triangle that has a right angle) that is also an *isosceles triangle* (a triangle that has two equal sides). Write below what you think the measures of the three angles of the triangle are.



- (b) Select the angle measure tool  then select the three points of your triangle to find the measure of one of its angles. Repeat to find the measures of the other two angles.

- (c) Use segments to draw a right triangle that is not isosceles. Write below what you think the measures of the three angles of the triangle are.

- (d) Select the angle measure tool  then select the three points of your triangle to find the measure of one of its angles. Repeat to find the measures of the other two angles.


- (e) Use segments to draw an *obtuse triangle* (a triangle that has an obtuse angle). Can you draw a triangle that has two obtuse angles? Why or why not? Write the measures of the three angles of your triangle below.

- (f) Draw a triangle that you think is *equilateral* (has three equal sides).

- (g) Use the measure tool  to measure the sides of your triangle. Use the move tool  to move one or more vertices until the triangle has three equal sides.

- (h) Measure the angles of your triangle, and write the angle measures below.

(4) To get a clean drawing canvas, select the Main menu  on the top left of the screen.

Select  New and Don't Save. Draw any picture that you want to draw.