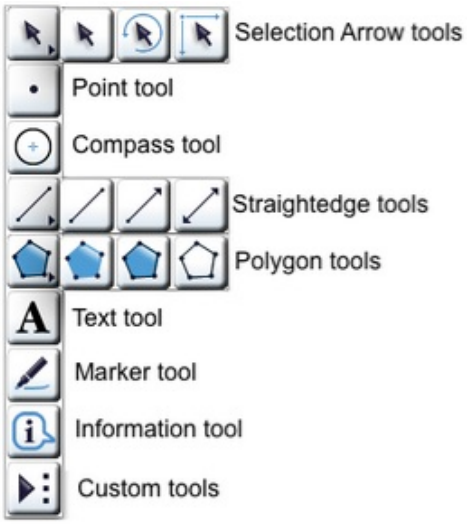
GSP Introduction and 9.1 Constructions

- ✓ Partner work required
- ✓ Lab name: Introduction (name example: Smith_Jones_Introduction.gsp)
- ✓ Save your work frequently. Sometimes the network crashes your application.
- ✓ Use the GSP "text tool" to write your **explanations** clearly in complete sentences near your constructions.
- ✓ The shapes that you create must be "**flexible**," that is, a flexible shape remains that shape no matter how it is rotated, stretched, enlarged, or shrunk. For example, an equilateral triangle must remain an equilateral triangle no matter how the shape is manipulated.

I. Introduction (Tab 1)

• Rename the GSP tab "Intro" – From the top menu go to file -> Document Options -> write in Intro in the page name bar.

1. For this only part, #I.1, there is nothing to write or record. Just drag your mouse over each picture on the toolbar; you'll see what each tool is called. The Toolbox appears on the left of the screen when you start Sketchpad, and includes nine tools. The directions that follow in the next parts will guide you through a brief exploration of these tools.



Selection Arrow tools: Use these tools to select and drag objects in your sketch. The three variations of the tool allow you to drag-translate (move), drag-rotate (turn), and drag-dilate (shrink or grow) objects.
Point tool: Use this tool to construct points.
Compass tool: Use this tool to construct circles.
Straightedge tools: Use these tools to construct straight objects. The three variations of the tool allow you to construct segments, rays, and lines.
Polygon tools: Use these tools to construct polygons. The three variations of the tool allow you to construct a polygon, a polygon and the segments that form its edges, or the edge segments only.
Text tool: Use this tool to create and edit text and labels.
Marker tool: Use this tool to create angle markers and tick marks, and to make freehand drawings and notations.

2. **Point tool**:
   a. Click the *Point Tool*. Move and click the pointer anywhere in the sketch plane to construct one point.
   b. Click several more times in the plane to construct more points.
   c. On your keyboard, hit Ctrl-z to “undo” a few of the points you just constructed (on a MAC this is command-z).

3. **Selection Arrow tool**:
   a. Click and hold on the *Selection Arrow* tool to view all 3 options. In this course we will always use/choose the Selection Arrow’s first option.
   b. Choose the first option and use the Selection Arrow to select two points by clicking on them. Something is selected when it has a thick pink border around it.
   c. Click in a blank space (i.e., “click off the construction”) and notice how this action de-selects everything.
   d. Click, hold and drag a box around the points. Notice they get selected.

4. Connect the points with a segment. You can do this in three ways, try all three!
   a. One is to use the shortcut, which is Ctrl-L (after both points are selected).
   b. You may also try selecting the two points and using “Construct / Segment” from the menu at the top of the page.
   c. ***Straightedge* tool**: The other way is to click and hold the *Straightedge Tool and* choose the Line Segment option. Move the mouse until the pointer “snaps” onto one of the two points. Hold down the mouse button and then drag the mouse to the other point until it “snaps” on and then release.

5. **Compass tool**:
   a. Click on the Compass tool and construct a circle (click, hold and drag).
   b. Construct another circle of a different size.

6. **Polygon tool**:
   a. Click and hold the Polygon tool and choose the polygon with interior option. Make a Triangle (with its interior) – one click for each vertex then double click on last vertex.
   b. Click and hold the Polygon tool and choose the polygon without interior option. Make a quadrilateral (without its interior).
   c. Click and hold the Polygon tool and choose the polygon with only the interior option. Make only the interior of a pentagon.

7. **Marker tool**: Click on the Marker tool.
   a. Mark each of the angles of the triangle you constructed in 6a (move Marker to vertex – click, hold and drag)
   b. On the quadrilateral you constructed in 6b, mark each of the sides with a different number of ticks (move the Marker on a side – click once for 1 tick, twice for 2 ticks, etc.)

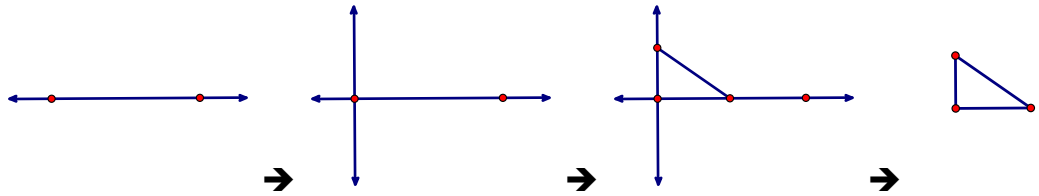
II. Triangles (Tab 2)

- **Add a new page/tab and rename it "Triangles" – From the top menu go to file -> Document Options -> click "Add Page" –> select "Blank Page" -> then write in Triangles in the page name bar.**

1. <u>Acute, Right and Obtuse Triangles</u>
   a. Using the method of your choice; create one triangle.
   b. Label the vertices.
      i. Choose the Selector tool and select the vertices
      ii. From the top menu go to Display – choose Label Points. Type in "A" in the first label box. This will make GSP label the points in the order you clicked on them.
      - If you had selected "Show Label" then GSP would have labeled for you.
      - You can always change a label by double clicking on it.
   c. Make 2 copies of your triangle.
      i. Choose the Selector tool and select every part of the triangle (use the *Selection Arrow*). You can either click on each part individually (the long way!) or you can **highlight the entire triangle by dragging your mouse over it** (like you were selecting text in Word).
      ii. Ctrl-c {copy} and Ctrl-v {paste} and ctrl-v again [for MAC: command-c and command-v]
   d. Label the vertices of the 2nd triangle: A_1, A_2, A_3 (top menu -> Display -> Label Points -> enter in "A[1]")
   e. Label the vertices of the 3rd triangle: 1, 2, 3 (top menu -> Display -> Label Points -> enter in "1").
   f. Move the triangles so they are spaced out along the top of the page (select a whole triangle then use your mouse to move it - click and drag.)
   g. Measure angles using either method below.
      i. Measure angle A:
      <u>Method 1</u> – Select the 3 vertices of the angle in order so that A is in the middle (i.e., select either CAB or BAC). Then from the top menu select Measure -> Angle. Move the measurement below ∆ABC.
      <u>Method 2</u> – Mark the 3 angles. Select one of the angle marks and then from the top menu select Measure -> Angle. Move the measurement below ∆ABC.
      ii. Measure all the angles of each triangle and move the measurements to appropriate locations.
   h. Use the Selector tool to grab and move the vertices of ∆ABC to make it an acute ∆. Then below the ∆ and ∠ measures, use the text tool to write "∆ABC is acute because …" ←**Accurately *finish this sentence*.**
   i. Use the Selector tool to grab and move the vertices of $\Delta A_1A_2A_3$ to make it a right ∆ (get it as close as you can). Then below the ∆ and ∠ measures, use the text tool to write "$\Delta A_1A_2A_3$ to is right because …" ←Accurately *finish this sentence.*
   j. Use the Selector tool to grab and move the vertices of ∆123 to make it an obtuse ∆. Then below the ∆ and ∠ measures, use the text tool to write "∆ABC is obtuse because …" ←**Accurately *finish this sentence*.**

2. <u>Flexible Right Triangle</u>

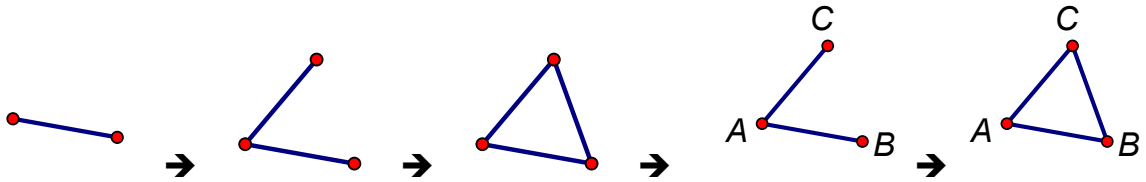
   Below the 3 Δ's you just constructed, you will construct a flexible right Δ.
   Note: There are several ways to construct a flexible right Δ in GSP.
   This is one way.



   a. Use the Straight Edge tool to construct a line (not line segment and not ray).
   b. Click off the construction to de-select everything. Then select only 1 point and the line.
   c. From the top menu select Construct -> Perpendicular Line
   d. Use the straight Edge tool (Line Segment) to construct a segment with one endpoint on each ⊥ line (Do NOT use the 2nd point already on the line).
   e. Hide both ⊥ lines and 2nd point. (Select objects and then from the top menu select Display –> Hide Objects)
   f. Use the straight Edge tool (Line Segment) to construct the remaining sides of your right Δ.
   g. Use the Angle Marker tool to mark the right angle.
   h. Use the Selector tool to grab each vertex individually and drag it around and observe what happens to the triangle.
   i. Below the Δ, use the text tool to write "To construct this flexible right Δ, we used the property that perpendicular lines …"←**Accurately *finish this sentence*.**

3. <u>Flexible Equilateral Triangle</u>

   Below the flexible right Δ you just constructed, you will construct a flexible equilateral Δ. Note: There are several ways to construct a flexible equilateral Δ in GSP. This is one way.

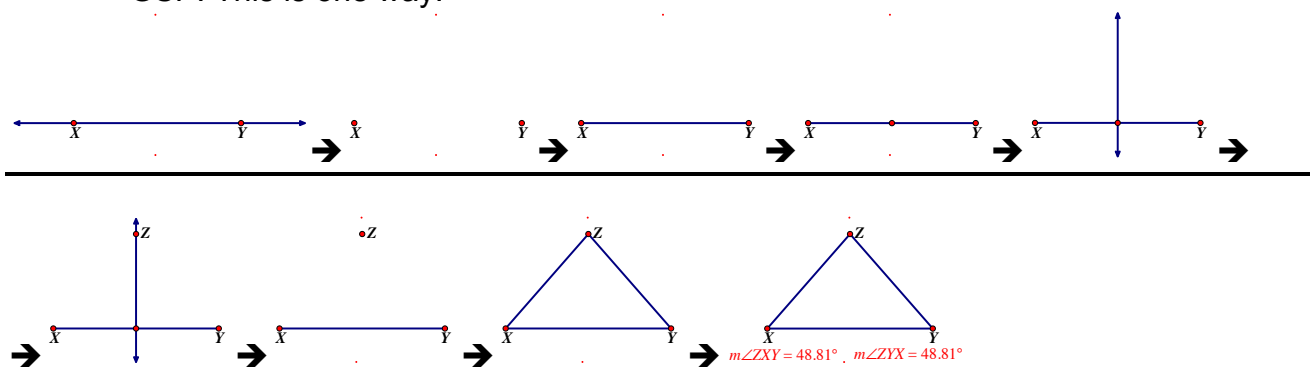


   a. Use the Straight Edge tool to construct a line segment.
   b. Use the Selector tool to "Mark" the left endpoint by double clicking on it. You will see it briefly expand. This marks that point as the center of a rotation.
   c. Select only the segment and the right endpoint (not the left endpoint).
   d. From the top menu select Transform -> Rotate -> enter 60 into the Angle box.
   e. Label the vertices A, B, and C as shown below.
   f. Mark vertex B as the new center of rotation. Then rotate the segment between A and B (but not A and B) negative 60˚.

g. Measure each side of ΔABC: To measure side AB, select vertices A and B, then from the top menu select Measure -> Distance. Move the measurement below ΔABC. Repeat for sides BC and side CA.
h. Grab each vertex individually and drag it around and observe what happens to the triangle.
i. Below the Δ and measurements, use the text tool to write "To construct this flexible equilateral Δ, we used the property that equilateral Δ's have …" ← **Accurately *finish this sentence*.**

4. <u>Flexible Isosceles Triangle</u>

Below the flexible equilateral Δ you just constructed, you will construct a flexible isosceles Δ. Note: There are several ways to construct a flexible isosceles Δ in GSP. This is one way.



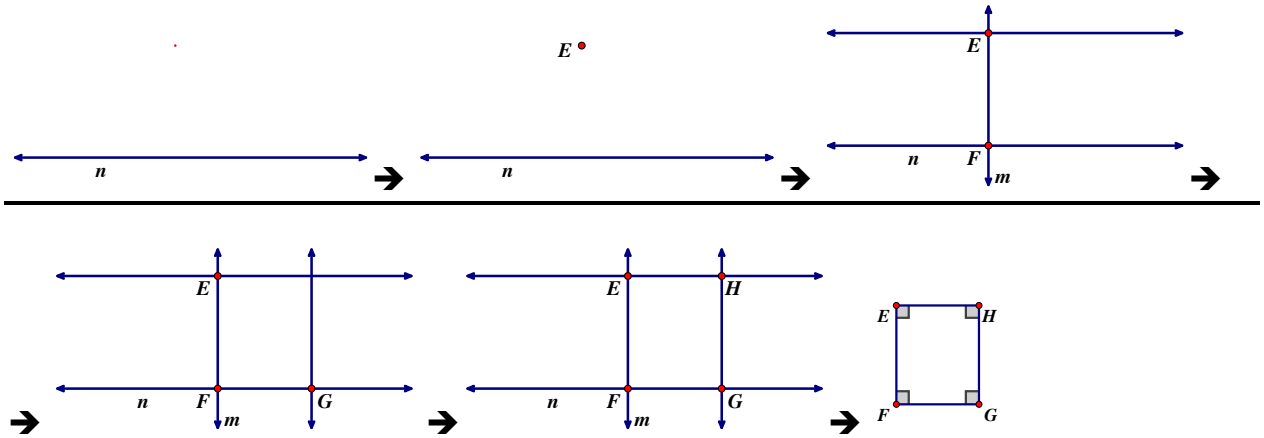
a. Use the Straight Edge tool to construct a line (not line segment and not ray). Label the 2 points Y and X.
b. Hide the line but not points Y and X (select only the line then Ctrl-h).
c. Use the Straight Edge tool to construct a line segment between Y and X.
d. Select only the segment and construct its midpoint (from the top menu select Construct -> Midpoint)
e. Construct a perpendicular line through the midpoint (select only the segment and its midpoint, then from the top menu select Construct -> Perpendicular Line).
f. Use the point tool to snap a point onto the ⊥ line. Label the point Z.
g. Hide the ⊥ line.
h. Construct a line segments between X and Z and between Y and Z.
i. Measure the base angles of the isosceles Δ (∠ZXY and ∠ZYX)
j. Grab each vertex individually and drag it around and observe what happens to the triangle and the base angles.
k. Below the Δ and measurements, use the text tool to write, "Isosceles Δs, have base ∠s that are…" ← **Accurately *finish this sentence*.**

III. Quadrilaterals (Tab 3)

- **Add a new page/tab and rename it "Quadrilaterals" – From the top menu go to file -> Document Options -> click "Add Page" –> select "Blank Page" -> then write in Quads in the page name bar.**

1. <u>Flexible Square</u>
   Review the construction of the flexible equilateral Δ and use similar techniques to construct a flexible square.

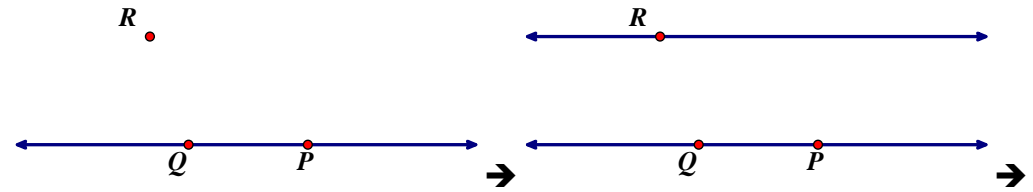
2. <u>Flexible Rectangle</u>
   Below the flexible square you just constructed, you will construct a flexible rectangle. Note: There are several ways to construct a flexible rectangle in GSP. This is one way.

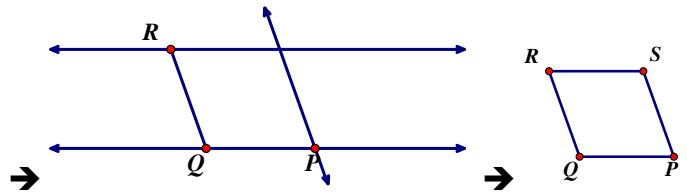


   a. Construct a line (not line segment and not ray). Hide the 2 points, then label the line n.
   b. Use the Point tool to construct a point not on line n. Label the point E.
   c. Construct a perpendicular line to line n through the point E (select only the line and the point, then from the top menu select Construct -> Perpendicular Line). Then use the Selection Arrow tool to mark the intersection point and label it F.
   d. Construct a parallel line to line n through the point E (select only the line and the point, then from the top menu select Construct -> Parallel Line). Label the line m.
   e. Construct another point on line n and label it G.
   f. Construct a line parallel to line m through point G.
   g. Use the Selection Arrow tool to construct the last intersection point (**click on the intersection and point will "appear"**) and label it H.
   h. Hide the lines (but not the points) then construct segments between the points to make the square. Mark the angles.
   i. Grab each vertex individually and drag it around and observe what happens to the rectangle.
   j. Below the rectangle, use the text tool to list at least 2 of the properties of rectangles used to make the construction.

3. <u>Flexible Parallelogram</u>

Below the flexible rectangle you just constructed, you will construct a flexible parallelogram. Note: There are several ways to construct a flexible parallelogram in GSP. This is one way.

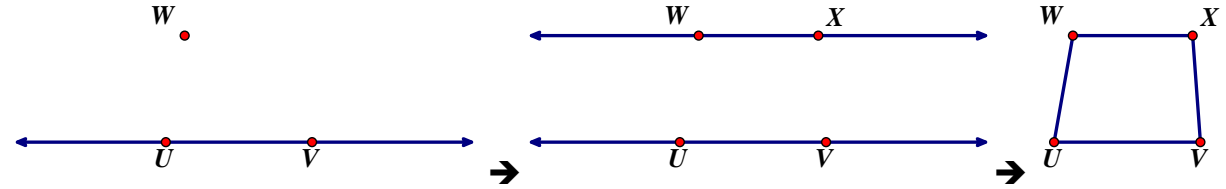




a. Construct a line (not line segment and not ray). Hide the 2 points then use the Point tool to construct two points on the line (label them P & Q) and a point not on line (label it R).
b. Construct a parallel line to line PQ through the point R.
c. Construct segment RQ then construct a line parallel to line RQ through point P.
d. Use the Selection Arrow tool to construct the last intersection point (**click on the intersection and point will "appear"**) and label it S. Then hide the lines (but not the points) then construct segments between the points to make the parallelogram.
e. Measure each side of PQRS and measure each angle. Move the measurements below PQRS.
f. Grab each vertex individually and drag it around and observe what happens to the parallelogram.
g. Below the parallelogram and measurements, use the text tool to list a relationship between the sides and a relationship between the angles.

4. <u>Flexible Trapezoid</u>

Below the flexible parallelogram you just constructed, you will construct a flexible trapezoid. Note: There are several ways to construct a flexible trapezoid in GSP. This is one way.



a. Construct a line (not line segment and not ray). Hide the 2 points then use the Point tool to construct two points on the line (label them U & V) and a point not on line (label it W).

b. Construct a parallel line to line UV through the point W. Construct a point on that line and label it X.
c. Hide the lines (but not the points) then construct segments between the points to make the trapezoid.
d. Measure each angle. Move the measurements below the trapezoid.
e. Grab each vertex individually and drag it around and observe what happens to the parallelogram.
f. If we use the definition of a trapezoid that is a quadrilateral with at least one pair of parallel sides then what shapes can you make with your trapezoid construction that would be considered trapezoids but not what we typically think of as trapezoids?

[Note: In this course we normally will use the trapezoid definition that is a quadrilateral with exactly one pair of parallel sides – see text p. 582.]

IV. Circles (Tab 4)

• Add a new page/tab and rename it "Circle"

1. <u>Radius of a circle</u>
   a. Use the Compass toll to construct a circle.
   b. Use the straightedge tool to snap a segment on the circle's center and onto the circle's edge. This segment is the circle's radius.
   c. Grab the end of the radius and rotate it around the circle.

2. <u>Diameter of a circle</u>
   a. Construct another Circle and label the center O.
   b. Construct another point on the circle and label it P.
   c. Use the Straight edge tool to construct ray PO (select the Ray option then click on P then on O).
   d. Construct the intersection of ray PO with the circle and label it R.
   e. Hide ray PO then construct segment PR. (Segment PR is the diameter of circle O.)
   d. Grab each end of the diameter and rotate it around the circle.

3. <u>Tangent to a Circle</u>
   a. Construct another Circle (label center Q) and its radius with endpoints Q & S.
   b. Construct another point on circle Q and label it T.
   c. Construct line ST (not line segment and not ray). (Line ST is called a *Secant* and segment ST is called a *Cord*.)
   d. Measure ∠QST. Move T around the circle and describe what happens to ∠QST ← **Answer this in a text box.**
   e. Construct a ⊥ line to radius QS through point S. This line is the *Tangent line* to circle Q at point S.
   f. Again, move T around the circle. When T gets closer to S (and right on top of S) how do the secant line and tangent line compare? ← **Answer this in a text box.**
   g. What does your answer to part f imply about the maximum degree measure of ∠QST and when does that maximum measure happen? ← **Answer this in a text box.**