Instructions for the Geometer's Sketchpad files accompanying the "Folding Conics" presentation by Bruce Yoshiwara

There were three Geometer's Sketchpad files demo'd at the presentation: one for the parabola, one for the ellipse and one for the hyperbola. Below are instructions for using the prepared files and also instructions for how you can create the GeoSketchpad files for yourself.

Using the prepared files

1. Unzip the files into a convenient directory on your computer.
2. Open one of the files by double-clicking on it. (You must have a working copy of Geometer's Sketchpad on your computer.)
3. Click on any white space so that no object is selected.
4. Select the blue line (which corresponds to our "crease" and passes through P but not through G) by clicking on it once.
5. Press CTRL+t, that is, press the Control key and the letter "t" simultaneously (or click on Display→Trace Perpendicular Line) so that this line will be "traced."
6. Click on any white space so that the line is de-selected, and then click on the point G to select it. (You can drag the point G to see if the tracing works.)
7. Press ALT+` (or click on Display→Animate Point) to start the animation.
8. If you close the Motion Controller box, click on Display→Stop Animation to stop.
9. Press CTRL+b (or Display→Erase Traces) to erase the traces.
10. You can select and drag the focus and/or directrix to a new position.

You may wish to create the files yourself. Here are directions.

Creating your own files

The parabola
The basic idea is to draw a line for the directrix, put a point F off the directrix to be the focus, put an arbitrary point G on the directrix, and draw the "crease," which is the perpendicular bisector of the segment joining F and G. To see the point P on the parabola that will be the point of tangency between crease and parabola, you need also to find where the perpendicular from G meets the crease. (Animating your drawing in Geometer's Sketchpad works the same as animating my drawing in "focus-directrix.gsp"—the instructions are described above.)

To draw the directrix:
1. Open Geometer's Sketchpad. If it is already open on a file you want to keep, press CTRL-n (or click on File→New Sketch).

2. Set the Straightedge Tool (normally the fourth button from the top on the left edge) to draw lines: click on the small arrow of that button and drag over to the picture of the line with arrows at both ends.
3. Draw a horizontal line to be the directrix.
4. If you want to be fancy, you can right-click on the directrix and play with the options to make the line thick, or modify its color, or add a label. You can also hide the two points that determine the line: Click on the Selection Arrow Tool (the first button), click on white space so that nothing is selected, click on the two points you want to hide, then press CTRL+h (or press Display→Hide Points).

To draw the focus and arbitrary point on the directrix:
1. Click on the Point Tool (the second button), and click on one point off the directrix to be the focus F and another point on the directrix to be our point G.
2. Click on the Text tool (the fifth button) and then label the points. A letter will automatically be assigned when you click on an object, and double-clicking on the label will allow you to give it a new name and to change the style of the font.

To draw the perpendicular bisector:
1. First draw the segment joining F and G: click on the Select Tool (first button) and click on white space so that no object is selected. Click once on both F and on G so that those two points are selected, then click on Construct→Segment to draw a segment joining the two points (or you could have used the Straightedge tool after setting it to draw line segments).
2. Click on Construct→Midpoint to find the midpoint of the segment.
3. Click on the segment so that it is also selected, then click on Construct→ Perpendicular Line.
4. Click on the white space so that no object is selected, then right-click on the perpendicular bisector to change its thickness and/or color if desired. Do the same for the segment.

To draw P:
1. Click on the Select Tool (first button) and click on white space so that no object is selected. Click on G to select it, click on the directrix to select it, and then click on Construct→Perpendicular Line.
2. Click on the "crease" so that it is also selected, then press CTRL+i (or click on Construct→Intersection) to find the point P.
3. Click on the Text tool (the fifth button) and then label P.

I actually hid the perpendicular through G (click on the Select Tool, then on white space, then click on the perpendicular line through G, then press CTRL+h) and drew a ray in its place (change the Straightedge tool to draw a ray, click on first G then P).

The ellipse
You need to draw a circle, a point F off center within the circle to be the other focus, an arbitrary point G on the circle, a segment joining F and G, the perpendicular bisector of that segment, and the point P on the radius to G. (Animating your drawing in

Geometer's Sketchpad works the same as animating my drawing in "PointInCircle.gsp"—the instructions are described above.)

To draw the circle:
1. Open Geometer's Sketchpad. If it is already open on a file you want to keep, press CTRL-n (or click on File→New Sketch).
2. Select the Circle Tool (normally the third button from the top on the left edge) and drag from where you want the center to a point where you want the circumference.
3. You can right-click on the circle and play with the options to make the curve thick, or modify its color, or add a label. You can also hide the point on the circumference: Click on the Select Tool (first button), click on white space so that nothing is selected, click on the point you want to hide, then press CTRL+h (or press Display→Hide Points).

To draw the focus and arbitrary point on the circle:
1. Click on the Point Tool (the second button), and click on one point within the circle but off center to be the focus F and another point on the circle to be our point G.
2. Click on the Text tool (the fifth button) and then label the points. A letter will automatically be assigned when you click on an object, and double-clicking on the label will allow you to give it a new name and to change the style of the font.

To draw the perpendicular bisector:
1. Click on the Select Tool (first button) and click on white space so that no object is selected. Click once on both F and on G so that those two points are selected, then click on Construct→Segment to draw a segment joining the two points (or you could have used the Straightedge tool after setting it to draw line segments).
2. Click on Construct→Midpoint to find the midpoint of the segment.
3. Click on the segment so that it is also selected, then click on Construct→ Perpendicular Line.
4. Click on the white space so that no object is selected, then right-click on the perpendicular bisector to change its thickness and/or color if desired. Do the same for the segment.

To draw P:
1. Click on the Select Tool (first button) and click on white space so that no object is selected. Click once on both the center C and on G so that those two points are selected, then click on Construct→Segment to draw a segment joining the two points (or you could have used the Straightedge tool after setting it to draw line segments).
4. Click on the perpendicular bisector to select it also, then press CTRL+i (or click on Construct→Intersection).
5. Click on the Text tool (the fifth button) and then label P.

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The hyperbola
     You need to draw a (small) circle, a point F outside the circle to be the other focus, an arbitrary point G on the circle, a segment joining F and G, the perpendicular bisector of that segment, and the point P that will be the point of tangency between the hyperbola and the perpendicular bisector. (Animating your drawing in Geometer's Sketchpad works the same as animating my drawing in "PointOutsideCircle.gsp"—the instructions are described above.)

To draw the circle:
1. Open Geometer's Sketchpad.
2. Select the Circle Tool (normally the third button from the top on the left edge) and drag from where you want the center to a point where you want the circumference.
3. If you want to be fancy, you can right-click on the circle and play with the options to make the line thick, or modify its color, or add a label. You can also hide the point on the circumference: Click on the Select Tool (first button), click on white space so that nothing is selected, click on the point you want to hide, then press CTRL+H (or press Display→Hide Points).

To draw the focus and arbitrary point on the circle:
1. Click on the Point Tool (the second button), and click on one point outside the circle to be the focus F and another point on the circle to be our point G.
2. Click on the Text tool (the fifth button) and then label the points. A letter will automatically be assigned when you click on an object, and double-clicking on the label will allow you to give it a new name and to change the style of the font.

To draw the perpendicular bisector:
1. Click on the Select Tool (first button) and click on white space so that no object is selected. Click once on both F and on G so that those two points are selected, then click on Construct→Segment to draw a segment joining the two points (or you could have used the Straightedge tool after setting it to draw line segments).
2. Click on Construct→Midpoint to find the midpoint of the segment.
3. Click on the segment so that it is also selected, then click on Construct→ Perpendicular Line.
4. Click on the white space so that no object is selected, then right-click on the perpendicular bisector to change its thickness and/or color if desired. Do the same for the segment.

To draw P:
1. Click on the Select Tool (first button) and click on white space so that no object is selected. Click once on both the center C and on G so that those two points are selected, then click on Construct→Line to draw a line through the two points (or you could have used the Straightedge tool after setting it to draw lines).
2. Click on the perpendicular bisector to select it also, then press CTRL+i (or click on Construct→Intersection).
3. Click on the Text tool (the fifth button) and then label P.

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