Ellipse > Locating the foci, finding the normal and the tangent

Learning outcomes:
• I can locate the foci and construct tangents and normals to an ellipse.

By the end of the lesson I will be able to:
• Locate the foci of an ellipse
• Construct normals to an ellipse
• Construct tangents to an ellipse
• Reflect the tangent to a new in-line point on the ellipse

Before studying this lesson I need to make sure that I know how to:
• Construct an ellipse using any method
• Bisect an angle
• Draw a perpendicular bisector

Self Assessment
(to be done after the lesson)

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<th>Well Achieved</th>
<th>Achieved</th>
<th>Almost There</th>
<th>Need more Effort</th>
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<tr>
<td>I can construct an ellipse</td>
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<td>I can construct the normal to an ellipse</td>
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<td>I can construct the tangent to an ellipse</td>
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<td>I can apply the tangent of an ellipse to new designs and situations</td>
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The Foci of an ellipse
The foci of an **Ellipse** can be found by drawing an arc from the minor axis onto the major axis. This radius must be equal to **half the major axis**. The following video illustrates the whole process of this tutorial: https://youtu.be/PWfNtZUtoUA

Using the following labeled parts on the ellipse,

We can locate the foci of an ellipse using the radius as shown.
Constructing a normal to an ellipse

A normal to an Ellipse can be constructed by bisecting the angle between the two foci and the point of the normal. It is important to note that a normal is always at right angle to an ellipse or a circle.

Let us take point P on the ellipse as the point where we need to construct the normal, and F1 & F2 as the foci;

Step 1: Join F1 & F2 to point P.
**Step 2:** Bisect the angle at point P. The following video illustrates the bisection of an angle: [https://youtu.be/g7RjgzrEyLA](https://youtu.be/g7RjgzrEyLA)

**Step 4:** The line bisecting the angle is the **Normal**.
Constructing a tangent to an ellipse
A tangent to an **Ellipse** can be constructed by erecting a perpendicular to the normal.

Let us take point **P** and the following normal on the ellipse to construct the tangent;

**Step 1:** Draw two equal arcs on the normal.
Step 2: Erect a perpendicular from point P using the two arcs. The following video illustrates how to erect a perpendicular:
https://youtu.be/4TcJuM3X0L1

Step 3: Extend the Tangent. If point Q is in line to point P, you can also reflect it and create some interesting designs.

Note: You can use this method to draw a tangent on any point on the ellipse.