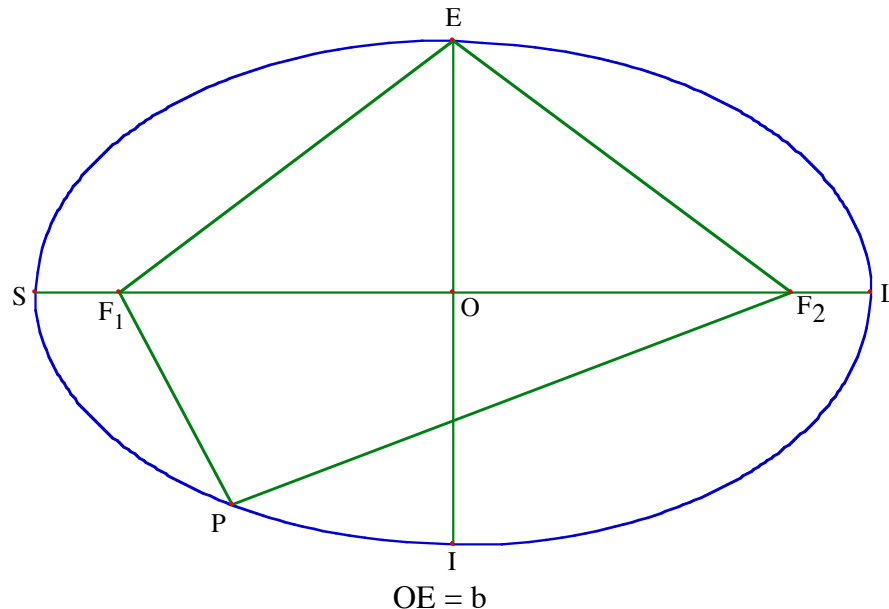


## Geometry of the Ellipse



$$OE = b$$

$$OF_1 = OF_2 = f$$

*For all points P on this ellipse,  $PF_1 + PF_2 = 2a$*

### Getting to an Equation

1. Write  $a$ ,  $b$ , and  $f$  next to the appropriate segments on the figure. (**Hint:** use what you know about  $EF_1 + EF_2$ .)
2. How are  $a$ ,  $b$ , and  $f$  related?
3. Find the length  $OS$  in terms of  $a$ ,  $b$ , and/or  $f$ . (**Hint:** use what you know about  $SF_1 + SF_2$ .)
4. How are  $EF_1$  and  $OS$  related?
5. Write an equation for the ellipse, assuming
  - a.  $O$  is at the origin.
  - b.  $O$  has coordinates  $(h, v)$ .

**Definitions:**  $SL$  is the *major axis*.  $EI$  is the *minor axis*.  $2f$  is the *focal distance*.  $PF_1$  and  $PF_2$  are the *focal radii*.  $OS$  and  $OL$  are the *x-radii*.  $OE$  and  $OI$  are the *y-radii*.

6. What are the  $x$ -radius and the  $y$ -radius in terms of  $a$ ,  $b$ , and/or  $f$ ?

### Turning It Around

7. Sketch an ellipse centered at the origin, but with the foci on the  $y$ -axis. Mark  $a$ ,  $b$ , and  $f$  wherever they show up on your sketch. (**Hint:** In this case, the major axis is vertical, and the minor axis is horizontal. The minor axis is still equal to  $2b$ , and the focal distance is still equal to  $2f$ .)
8. Write an equation for the ellipse, assuming
  - a.  $O$  is at the origin.
  - b.  $O$  has coordinates  $(h, v)$ .
 (**Hint:** the answers are different from #5.)

### Equation Challenges

9. Find the equation of an ellipse centered at the origin, with:
  - a. major axis 6, focal distance 8, foci on the  $x$ -axis
  - b. one focus at  $(0, 6)$ , sum of the focal radii 16.
10. Where are the foci if the center is at  $(2, 3)$ , the  $x$ -radius is 4, and the  $y$ -radius is 5.