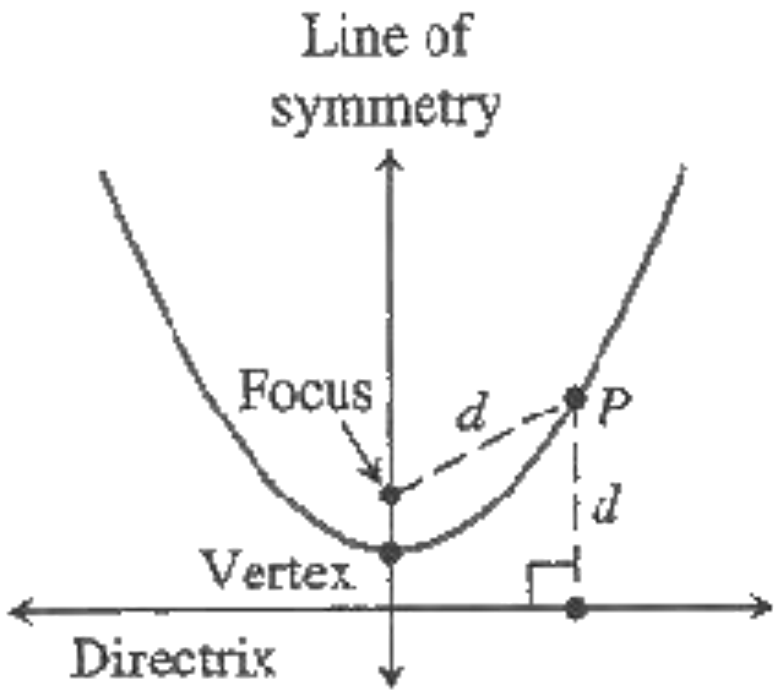
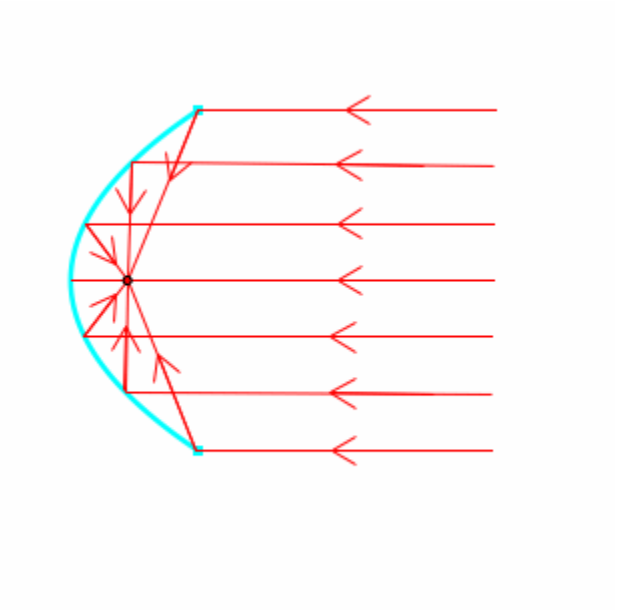
What *really* is a parabola??

A parabola is a locus of points P in a plane, whose distance from a fixed point, *F*, is the same as the distance from a fixed line, l. That is $d_1 = d_2$.

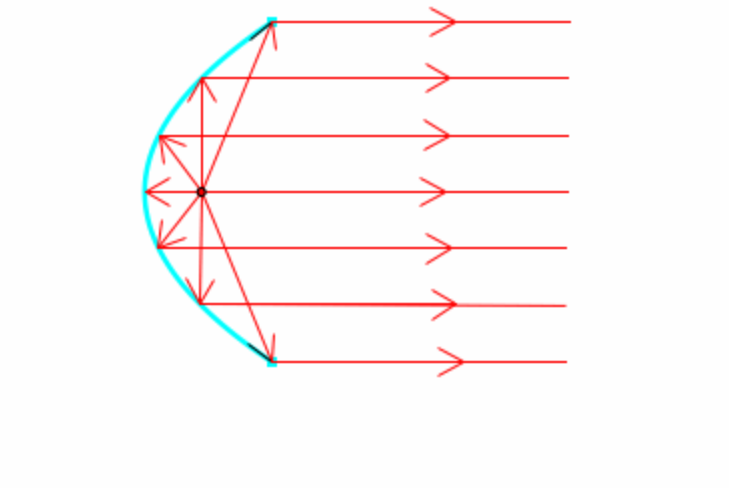


The fixed point, *F*, is called the focus. The line, l, is called the directrix.

A ray that travels parallel to the axis of symmetry will strike the surface of the parabola or paraboloid and reflect toward the focus.



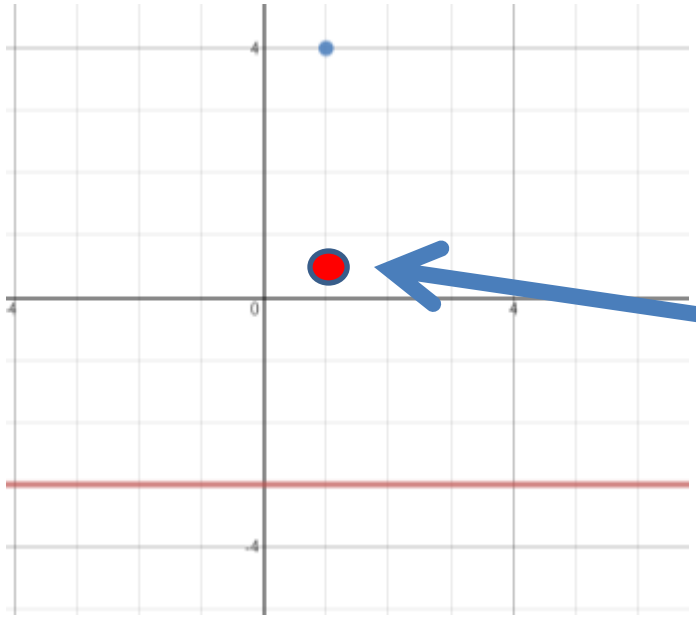
Likewise, when a ray from the focus strikes the curve, it will reflect in a ray that is parallel to the axis of symmetry.



Where is this property seen in our everyday life?

Satellite dishes, car headlights, flashlights, etc

1) Find the vertex if the focus is located at (1, 4) and directrix is $y = -3$.



Vertex is half the distance from the focus to the directrix. So the vertex will be at (1, ½)

2) If the vertex is (-2, 2), and the focus is (-2, -4), what is the equation of the directrix?

The distance from the vertex to the focus is 6 units. The parabola is concave down. So the directrix is 6 units above the vertex and its equation is $y = 8$

3) If the directrix is $y = 3$, and the vertex is (6,2), where is the focus?

The distance from the directrix to the vertex is one unit. The parabola is concave down. Therefore the focus is located at (6, 1)

How to determine scale factor:

The distance from the vertex to the focus is equal to $\frac{1}{4a}$.

4. Write the equation of the parabola with focus (1,3) and directrix $y = -1$

Answer: $y = \frac{1}{8}(x-1)^2 + 1$

$$\frac{1}{4a} = 2$$
$$8a = 1$$
$$a = \frac{1}{8}$$

5. Find all important information for the parabola with an equation:

$$y = \frac{-1}{4}(x+4)^2 - 4$$

Answers:

Vertex: (-4, -4)

Focus (-4, -5)

Directrix $y = -3$

6. A parabola has a directrix at $y = 6$ and a focus at (-6,0).
What is the equation of the parabola?

Answer:

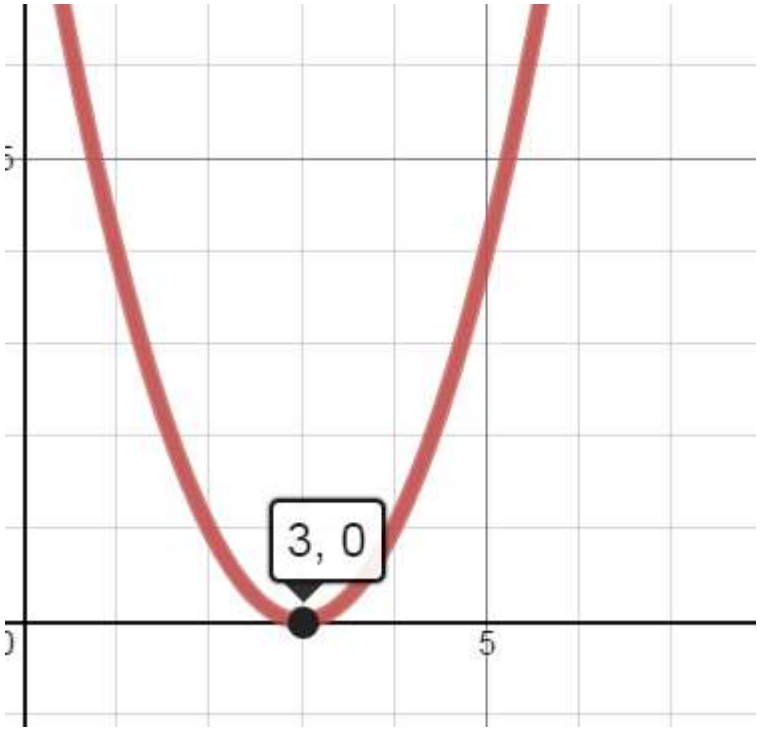
$$\boldsymbol{y = -\frac{1}{12}(x+6)^2 + 3}$$

Sheila is designing a parabolic dish to use for cooking on a camping trip. She plans to make the dish 40cm wide and 20 cm deep. Where should she locate the cooking grill so that all the light that enters the parabolic dish will be reflected toward the food?

Answer: Five centimeters above the vertex along the line of symmetry.

Double Roots!

$$y = a(x-3)^2$$



$$y = a(x-5)^2$$