SATELLITE DISH

EXPLORING PARABOLAS: THE SHAPE OF A SATELLITE DISH

littleBits
EXPANSION ACTIVITY

A very beautiful property of parabolas is that at a point called the ***focus***, all of the lines entering the parabola parallel to its axis are 'reflected' from the ***parabolic curve*** and intersect the focus. This property is used by astronomers to design telescopes, and by radio engineers to design satellite dishes.

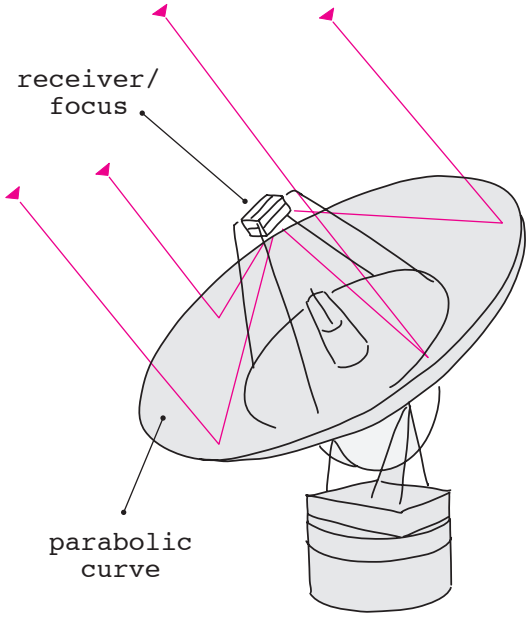

FIGURE A

FIGURE A shows a satellite dish with a radio receiver located at the focus of the parabola. The radio rays are reflected from the parabolic surface and concentrated at the focus. This focusing and amplification property of parabolic reflectors is also used for solar heating and generating solar electricity.

FIGURE B defines the distance, f, of the focus from the bottom of the dish, and the diameter, D, of the dish.

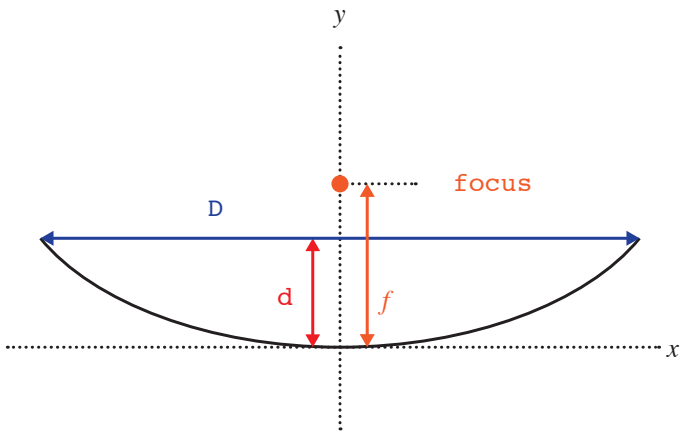

FIGURE B

Suppose you wanted to design a parabolic dish with a depth, d, of 1 meter and a radius of 5 meters. Where would the focus be located?

The basic equation of a parabola is $y = ax^2$
The location of the focus will be at $f = 1/(4a)$

Since we know that the point (5,1) is on the curve of the parabola, that means that we can begin solving for a for this particular dish.

$1 = a(5)^2$ therefore $a = 1/25$

We can now put the value for a in our formula for the location of the focus.

$f = 1/(4a)$
$f = 1/(4/25)$
$f = 25/4$
$f = 6\ 1/4$

Therefore our focus is at 6 1/4 meters above the bottom of the dish and this is where we should place our receiver. Let's design a few parabolic reflectors that we can use to reflect and concentrate sound waves, or sunlight!

Try This!

PROBLEM

A bird watcher wants to record bird songs from a distance. He goes to the cooking store and finds a parabola-shaped bowl that is lightweight. It has a diameter of 12 inches and a depth of 5 inches. How far below the edge of the bowel does he have to mount the microphone to use this as a sound amplifier?

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ANSWER

The radius of the bowl is x = 6 inches, and at this location y = 5 inches. The equation is $y = ax^2$, and we know that the point (6, 5) is on this curve, so $5 = a(6)^2$ so a = 0.139. The focus distance is then f = 1/(4x0.139) = 1.8 inches from the bottom of the bowl, or 5 – 1.8 = 3.2 inches from the top edge of the bowl.