

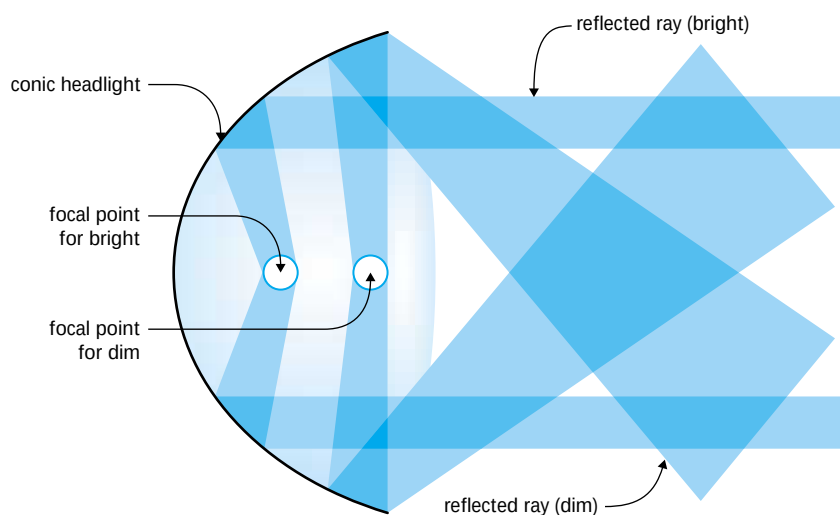
This chapter has referred to satellites, conical reflectors in flashlights and headlights, and other reflection devices. Why are these items designed as conics? You will need to examine the reflective properties of conics to understand their significance.

You can easily create a model of a parabolic reflector. Sketch the graph of $x^2 = 8y$ on a large sheet of graph paper and mark the focus. (You could choose any other parabolic equation, but make sure the graph will fit on the paper.) Bend a thin strip of cardboard and place it accurately and securely along the parabola. Carefully roll a marble toward the curve making sure to roll the marble in a direction that is parallel to the y-axis. Roll the marble several times, starting from different points, but always roll the marble in a direction that is parallel to the y-axis.

Think, Do, Discuss

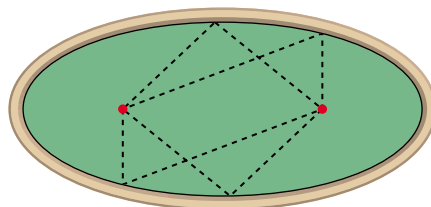
1. Does the marble's path cross the focus? Explain.
2. Draw a diagram of this model. Using the diagram, demonstrate why the marble's path crosses the focus.
3. The reflective properties of the parabola appear in the design of flashlights, car headlights, and satellite dishes. Can you find other instances of parabolic reflectors?

When you flick car headlights from bright to dim, think about conics. The bright beam is created by the light source at the focal point; its rays are parallel to the parabola's axis of symmetry. When you dim the headlights, the light source changes location and the rays point down and up. The rays pointing up are shielded—only the rays pointing down are reflected out.



4. Try to create a model of an ellipse that is similar to the model of the parabolic reflector. This time, start with one marble at one focal point and “shoot” it toward any point on the ellipse. Shoot the marble from this focal point at several different points along the ellipse. What do you notice?
5. Draw a diagram of this model. Discuss why you think that, if you were to roll a marble from one focal point to a point on the ellipse, the marble would roll back through the other focal point.

Imagine an elliptical pool table with only one pocket located at one of the foci. If you place a ball at the other focus and roll it toward the cushion of the pool table, the ball will always be reflected to the pocket.



If a tangent is drawn to the curve at the point where the ball strikes the cushion, the angle at which the ball strikes the cushion is equal to the angle at which it rebounds from the cushion. In this way, the ball will always roll toward the pocket.

6. If you wanted to build an elliptical pool table with a length of 2 m and a width of 1.8 m, then where would you place the “pocket”?

Did You Know?

A “whispering gallery” is another instance of the reflective properties of an ellipse. A whispering gallery is a large room where the walls of the gallery, or the dome above it, are in the shape of an ellipse. If a person stands at one focal point of the ellipse and whispers, then someone standing at the other focal point can hear the whisper. There are many whispering galleries in the world. The ceiling in St. Paul’s Cathedral in London, England is a great dome, 34 m in diameter. The dome’s shape is an ellipse. If someone, facing the wall of the cathedral’s whispering gallery, whispers, then the whisper is clearly audible on the opposite side of the cathedral.



One room in the National Statuary Hall in Washington, D.C., was unintentionally constructed as a whispering gallery in the nineteenth century. However, the room was unsuitable for meetings because of the echoes and was reconstructed.

The room where the city council meets in Coquitlam, British Columbia, has an elliptical dome ceiling. This room was constructed so that it would not be a whispering gallery.