3.4: Reflection, Too

Suppose you look at a point of light reflected in a mirror. Imagine the point sending out rays in all directions, as it does. The ray that enters your eye from the mirror goes along the shortest bouncing-off-the-mirror path. You can prove that this is equivalent to angle of incidence equals angle of reflection by considering the path difference for a nearby path.

Of course, for a curved mirror there may be more than one shortest path. To take an extreme case, consider the two-dimensional scenario of a perfectly reflecting ellipse with a point light source inside. If the source is at one focus of the ellipse, all the light will be reflected to the other focus. And, all the paths will have the same length! (Recall an ellipse can be constructed with a piece of string, the ends nailed down at the foci, the string stretched taut.) A parabolic mirror is the limiting case of an ellipse with the other focus sent to infinity, so parallel rays coming in along the axis from a distant star will all go to the focus in phase with each other.