

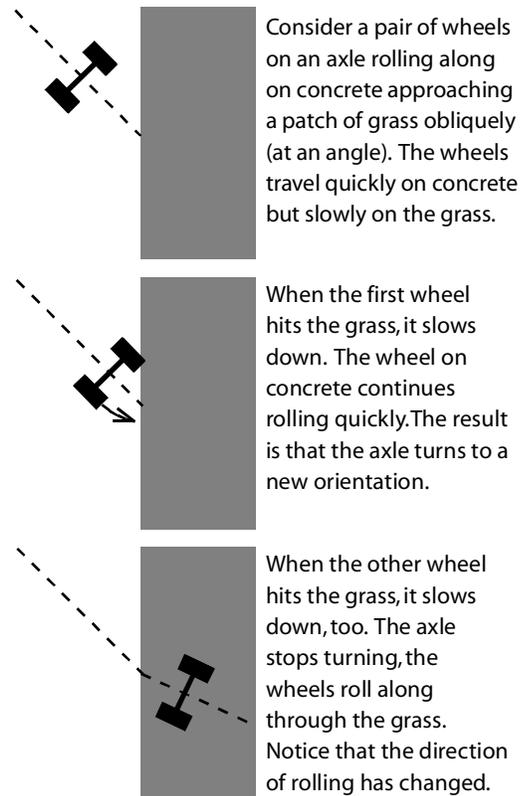
PhyzGuide: Refraction Analogies

A pair of wheels rolls faster on concrete than on grass. If the pair were to roll straight from concrete to grass, it would simply slow down. But consider the situation shown to the right. A pair of wheels rolls from concrete to grass at an angle, and the path of the wheels is bent.

Or consider the situation shown below. How can the lifeguard reach the swimmer in danger in the least time? As you can see, the path of *shortest distance* is not necessarily the path of *least time*!

When light passes through a vacuum, the oscillating electric and magnetic fields experience no “resistance” to their propagation. When light passes through a transparent solid, however, its propagation is slowed. This is because the incident fields must force the electrons in the solid to oscillate. If the electrons in the solid don’t oscillate, the wave doesn’t continue. The speed of the wave is slowed because the electrons in the solid have inertia, and resist being forced into oscillation.

Light passing obliquely from a light medium to a dense medium boundary will undergo a change in direction in addition to being slowed down, just like the wheels. In getting from point A to point B, light follows the shortest path in *time*, not in distance. This is known as **the principle of least time**.



*How can the lifeguard get to the drowning victim in the least amount of time?
S/he can run on sand faster than he/she can swim through the water.*

