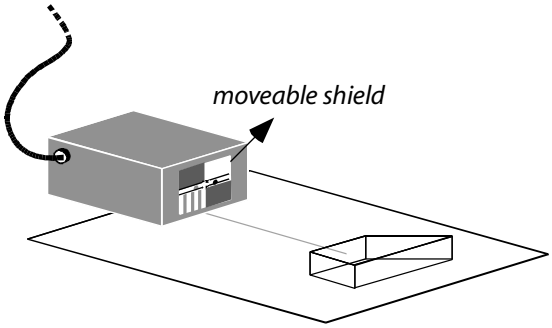
PhyzLab Springboard: A Diversion into Refraction

• Apparatus •
___PASCO Basic Optics System:
__light source (out of bracket)
__power supply (plug)
__trapezoidal prism (in the blue box)
__sheet of paper or white screen
___access to *Physics:Cinema Classics* C-61 (optional)



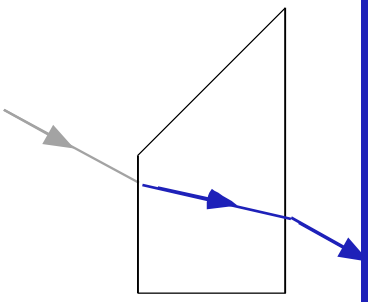
• Set-Up •
1. Attach the power supply to the light source and plug it in.

2. Arrange the light source to be a ray box and adjust the moveable plastic shield so that a single beam is emitted.

3. Place the sheet on the table. Place the ray box on the sheet.

4. Place the trapezoidal prism—**dull side down**—on the paper.

• Procedure: The Initial Mystery •
1. Aim the single beam of light toward the trapezoidal prism as shown to the right.



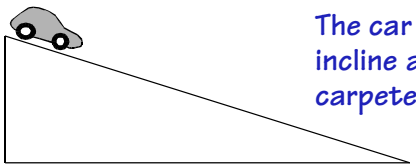
2. When the lights go out, observe the path that the light takes upon passing through the prism. Be sure to observe the situation from **directly** above the prism (looking down). Record your observations in words and pictures.

The beam is bent up when entering the plastic and back down when exiting.

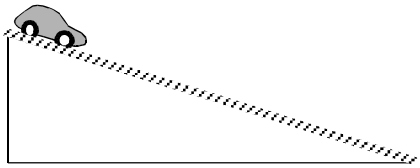
3. Why did this happen? If you don't know, consider the following.

• The Car on the Carpet •
Consider a toy car that can roll down an incline.

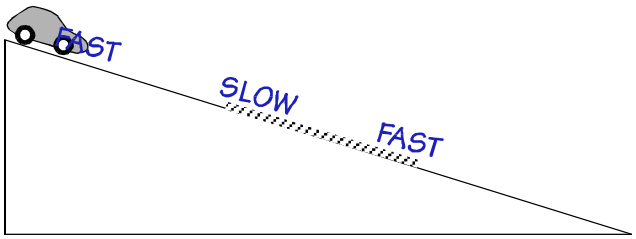
1. One incline has a hard surface, the other has a soft, carpeted surface. Would the car roll any differently on one surface compared to how it rolls on the other? Explain.



The car rolls fast on the hard incline and slow on the carpeted incline.



2. Consider the incline shown to the right. It has a hard surface followed by a carpeted surface followed by a hard surface. Write the words "slow" and "fast," at the appropriate places on the diagram to the right to describe the motion of the car as it rolls down the incline.

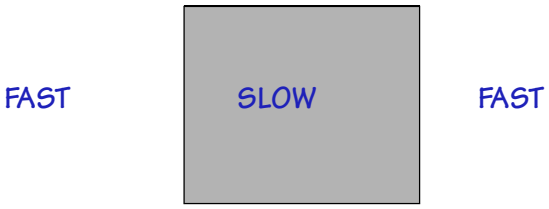


• The Light in the Glass •
Consider a light beam that can propagate through space.

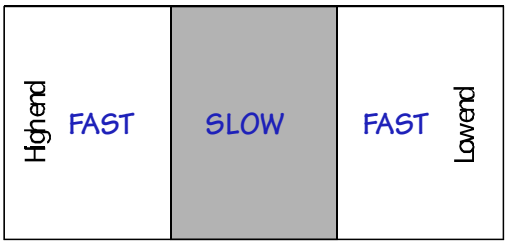
1. One region of space is a vacuum, the other is transparent glass. Would the light beam propagate any differently through one region of space compared to how it propagates through the other? Explain.

The light propagates fast in the vacuum and slow in the glass.

2. Consider the region of space shown to the right. It is a vacuum followed by glass followed by a vacuum. Write the words "slow" and "fast," at the appropriate places on the diagram to the right to describe the speed of the light as it propagates through the region.



• Carpet Car Revisited •
1. Reconsider the car on the incline. Suppose you are viewing it from above. In this new perspective, label the **fast** and **slow** regions.

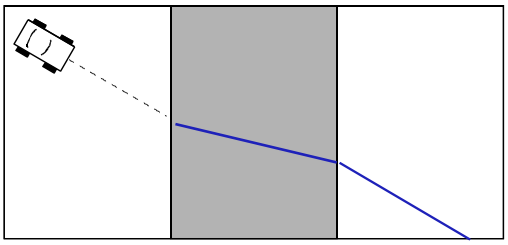


2. What if the car were sent down the incline at an oblique angle as shown to the right?
a. What would happen as the car entered the carpeted region and why?

Its "top" wheel would hit the carpet and be slowed down, turning the car "upward."

b. What would happen as the car emerged from the carpeted region and why?

Its "top" wheel would hit the hard surface and speed up, turning the car "downward."



3. Draw the path the car would take on the diagram to the right.
If possible, view *Physics: Cinema Classics* Disc C, Chapter 61.

• Explain the Mystery •
1. Why does light bend when passing from one transparent material to another?

When a beam passes obliquely across a boundary, one part of the leading edge crosses first. Its change in speed causes a change in the direction of the beam.

2. Is it possible for light to *not bend* when passing from one transparent material to another? Explain.

Yes, when light is incident along the normal and when passing across a boundary between two objects made of substances with equal indices of refraction.

• So What? •
Without an operational understanding of the principle illustrated in this exercise—refraction—the following would not be possible: telescopes, microscopes, cameras, projectors, glasses, or contact lenses, to name only a few.