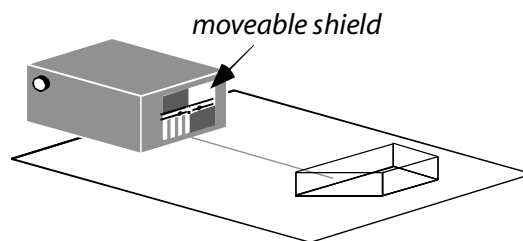


# PHYZLAB SPRINGBOARD: DISPERSION DIVERSION



## • Apparatus •

- \_\_\_ PASCO Basic Optics System:
- \_\_\_ light source (out of bracket)
- \_\_\_ power supply (plug)
- \_\_\_ trapezoidal prism (in the blue box)
- \_\_\_ blank sheet of paper or white metal screen



## • 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: Creating a Spectrum •

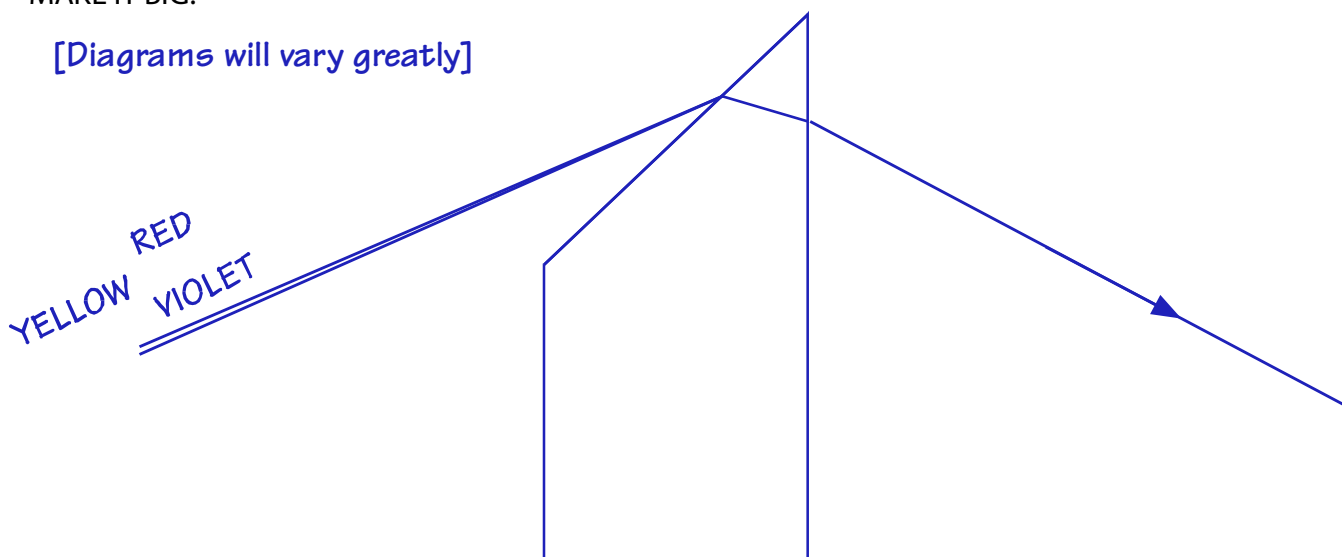
1. Using only the triangular section of the trapezoidal prism, experiment with different arrangements (different angles of incidents on different sides of the prism) until you can produce a spectrum of colors. Your spectrum will not be wide, but you will be able to distinguish colors. Once you have it, turn up a corner of your paper or project the spectrum on the protrusion on the white metal screen to see the spectrum more clearly.



**Use only the triangular section; there should be no light beams in the square section.**

2. In the space below, draw a **magnified** diagram of the configuration (incident ray and any refracted rays, the prism, and the emerging spectrum) as seen from directly above. Do not draw the light source in your diagram. Pay particular attention to the arrangement of the colors in the emerging beam; label yellow, red, and violet in your diagram. Include arrows to indicate the direction of travel of the beams. **MAKE IT BIG!**

[Diagrams will vary greatly]



3. Label the following on your diagram

- incident ray (air to plastic)
- internal ray (in plastic)
- exit ray (with spectrum)
- normals (one at the air to plastic boundary for the first refraction, and one at the plastic to air boundary for the second refraction).

4. Put your head down on the table and arrange the apparatus so that the emerging spectrum goes into your eye directly. Move your head around so that you see different colors one at a time.

• **Questions** •

1. In what direction is the beam refracted as it passes from air to plastic?

or toward the normal      \_\_\_ away from the normal      \_\_\_ not at all

Answers must agree with diagram

2. In what direction is the beam refracted as it passes from plastic back to air?

\_\_\_ toward the normal      \_\_\_ away from the normal      \_\_\_ not at all

3. Which color undergoes the greatest amount of refraction (is bent the most in the process) and which color undergoes the least amount of refraction?

*Violet is bent most; red is bent least.*

4. Which color is slowed most in the plastic and which is slowed least?

*Violet is slowed most; red is slowed least.*

5. Which color travels fastest in the plastic and which color travels slowest?

*Red travels fastest, violet travels slowest.*

6. Does the index of refraction of the plastic depend on the color of the light passing through it? If so, which color gives the highest index of refraction and which gives the lowest?

*Violet has the highest index of refraction; red has the lowest.*

7. Describe and name this phenomenon.

*White light is separated into colors when it refracts into and then out of the plastic prism. The different colors are refracted by different amounts causing them to bend by different amounts. This process is called dispersion.*

8. Why does dispersion occur?

*Shorter wavelengths of light—like violet—interact more frequently with the electrons in the atoms of the transparent material than do the longer wavelengths. Each interaction slows the light because it involves accelerating an electron. And electrons have inertia, so each one resists acceleration. Since the shorter wavelengths interact more, they are slowed to a greater extent.*

*Think of the light as having to interact with an electron in one atom per wave. It would take more waves of violet light than red to span a given thickness of a transparent material. The greater number of waves corresponds to a greater number of interactions.*

