**EXPERIMENT 1**
**Notes for the Instructor**

## PURPOSE

To measure the wavelength of the light produced by several LEDs of the $GaP_xAs_{1-x}$ series of compound semiconductors and use it to approximate the band gap energy for each LED. To use the experimental results to find a relationship between x and the band gap energy using graphical analysis. To predict the composition of the LED based upon the color ($\lambda$) of the light it produces.

## METHOD

The method here is similar to that of Demonstration 4. It differs in that the focus is on experimentally determining the wavelengths rather than assessing the color qualitatively. A pre-lab discussion should address the following: (1) a definition of metals, semiconductors, and insulators in terms of band gap energies; (2) a definition of the zinc blende structure and AZ stoichiometry (see the background information for this unit); (3) the relationships between band gap energy, size, and electronegativity differences between the atoms in the structure; (4) use of solid solutions to provide many more opportunities for adjusting the band gap energy than the combinations of any two elements with AZ stoichiometry.

## MATERIALS

Four LEDs (see materials for Demonstration 4)

LED plug-in circuit (see procedure for Demonstration 4)

Two meter sticks

One diffraction grating

## ANSWERS TO FOLLOW-UP QUESTIONS

1. What is the relationship between the band gap energy and x in this $GaP_xAs_{1-x}$ ($0 \leq x \leq 1$) series of LEDs?

   **The graph should indicate that as x increases, the band gap energy increases.**

2. The distance between the nuclei is one factor that determines how strongly an electron is held between covalently bonded atoms. As the size of the nuclei increase, the band gap energies decrease. Considering only size, would the LED made of GaP or GaAs be redder in color?

   **Since P has a smaller radius than As, GaP would have the larger band gap energy and shorter associated wavelength of light produced. Therefore, the GaAs LED would be redder.**