**CCD Module**

**Student Worksheet**

**Exploration 1: Instruments**

In this exploration you will learn which instruments contain CCDs.

Write on below, which instruments use CCD.

**Exploration 2: Film or CCD**

In this activity, you will use the movie to explore the differences between film and CCD cameras.

Compare and contrast each pair of photographs and decide which was taken with a film or a CCD camera.

**Slide 1:**

**Slide 2:**

**Slide 3:**

**Slide 4:**
Exploration 3: Materials

In this exploration you will learn how electrons of different types of metals are excited by light of different wavelengths.

1) Select one metal from the list in the bottom left corner. Write the name of the metal below.

2) Identify the minimum wavelength that excites the electron from the valence band to the conduction band. Report your answer below.

3) Calculate the energy of the photon corresponding to the light with that minimum wavelength. Report your answer below.

4) Repeat these steps for another metal.

Metal:

Wavelength: Energy:
5) Identify the metal that requires a photon of light with the minimum energy. Report the name of the metal, the wavelength and the energy.

Metal: 

Wavelength: 

Energy: 

**Exploration 4: Excited Electrons**

In this exploration you will learn how CCDs use the excitation of electrons to create an image.

Select one of three objects on the top left corner and take a picture of it. Use the movie to count the number of electrons in each pixel to form the digital picture. Repeat with at least one more object.

Record all your observations below.

**Application**

1) Which of the following object does not use CCD?
   
   a. Television  
   b. Scanner  
   c. X-ray machine

2) The energetic gap between the valence band and conduction band for silicon is $1.79 \times 10^{-19}$ J. What is the wavelength of light that will provide this amount of energy?
   
   a. $1.11 \times 10^{-6}$ m  
   b. $1.23 \times 10^{-23}$ m  
   c. $3.70 \times 10^{-15}$ m

3) What is the energy of a photon from a blue light (wavelength = 450 nm)?
   
   a. $4.42 \times 10^{19}$ J  
   b. $4.42 \times 10^{28}$ J  
   c. $1.47 \times 10^{27}$ J