Detecting ‘Invisible’ Light Lab Activity
due April 30th, 2003

In recent years, with the continued development of digital cameras and digital video cameras, a unique opportunity exists to "show" your students that invisible light exists. To complete this lab may require a little bit of hunting or borrowing, but the outcome is definitely worth it.

Introduction:

Have you ever wondered how your TV remote control (RC) works? You press buttons and your TV magically responds, but what's going on? How does your TV know you are pressing buttons on the RC? The setup below will allow you to "see" what your TV sees!

Materials:

1) A digital camera with a preview screen or a digital video camera
2) A remote control device for a television set or other electronic device with FRESH BATTERIES
3) Accessories you may need to answer the lab questions below

Lab Set-up:

1) Acquire a digital camera with a preview screen or a digital video camera (again with a preview screen). Turn on the camera and set it so that it shows you a "live" image.

2) Point your remote control (RC) at the camera. The end of the RC facing the camera should be the same end that you normally point the RC towards your television set.

3) Press any of the buttons on your remote. If all is well, you should be able to see flashes of near-infrared light coming from the remote control.

Troubleshooting:

1) If you have trouble with the above procedure (i.e. you are not seeing any light coming from the RC), try the following:

* Are you using the camera preview screen or are you trying to look through the viewfinder? Commonly the viewfinder does not show you what the CCD is seeing, just where you are pointing the camera. Try using the preview screen.

* Is the RC working? If the RC is still working to control your TV, this it is probably okay. But make sure you are pointing the RC the right direction.

* Try your setup in a room that is fairly dark and see if the IR from the RC is easier to detect?

2) If you have a digital camera but it does not have a preview function, you can still try taking a picture of the remote control as it flashes, and then download the picture and see if you can see the light coming from the RC. If you can manually set the exposure on the camera, try setting it for 2 seconds so that you will be sure to capture the IR from the RC.

3) If your video camera does not have a preview screen, try connecting the video camera directly to a television set, or videotape your experiments and watch the videotape.

4) If you absolutely cannot get access to a digital camera, please let your instructor know so you can conduct this lab in school.
Lab Activity:

The light used by your RC is very close in frequency to visible light but is slightly lower energy - just beyond the red - and called near infrared. The CCD (Charge Coupled Device) in your camera is sensitive to visible light but it is also sensitive into the near infrared. Therefore, even though we cannot detect with our eyes the IR light coming from the RC, the CCD in the camera can - just like the infrared detector on the front console of your television set can!

Now that you have the experimental setup, answer the following questions.

Your lab write-up (1-2 pages) should include:

a. Brief introduction to the lab
b. Brief description of the general procedure
c. Data & Analysis section which includes your answers to the below questions (1-4) and a description of how you determined the answers
d. Brief Conclusion & Reflection section (question 5)

Please discover the answers to the following questions:

1) **How sensitive is your experimental setup?**

Optimize and report on the maximum distance you can separate your camera and your RC and still detect a signal with the camera. **How does this compare with the sensitivity of your TV infrared detector? Does the amount of ambient light matter?**

2) **What do you notice about the pattern of the light if you press different buttons on the RC? Why do you think the remote is designed this way?**

3) **Design an experiment** to show whether near-infrared light reflects off of a mirror in the same way that visible light does. Describe the design and results of your experiment.

4) A filter is an object that blocks light. Most our experience with filters involves visible filters - red filters stop the transmission of all light except for red light, green filters block all the colors except for green light, a trash bag blocks all of the colors and no light gets through. Try placing each of the following between your RC and your camera.

   **Which of the following blocks infrared light? Which of the following blocks visible light?** Report your results as "completely blocks", "does not block at all", and "partially blocks".
   
   - plain white paper
   - plastic baggie
   - black garbage bag
   - tissue paper
   - eyeglasses
   - 2 additional things that you decide to try on your own

5) In the Conclusion & Reflection section of your lab write-up include some brief reflections on this lab. **Was this the first time that you have "seen" invisible light? Were you really seeing it? How could you use this setup in your class? What difficulties did you encounter?**

Credits

Inspiration for this lab activity came from Alan Gould and Steve Pompea who have been developing a new Lawrence Hall of Science GEMS guide on "Invisible Light." This curricula is currently being field tested and will be available for purchase later this year. Adrienne Gauthier created this for use in the Invisible Universe Online in the spring of 2003.