2.2 PART I — HIDDEN MESSAGES

Name_____ Date_____ Period_____

White light, like the light from the Sun or a light bulb, is made up of many different colors. In this activity, you will explore light and color.

MATERIALS: Red and blue crayons, sheets of white, red, and black construction paper, and red and blue "gels" (a gel is simply a sheet of transparent colored plastic).

A. Predict what color, if any, you will see when you look at a blank white, red, and black sheet through the red gel and through the blue gel.

		blank white sheet	blank red sheet	blank black sheet
red gel	Predicted			
	Observed			
blue gel	Predicted			
	Observed			

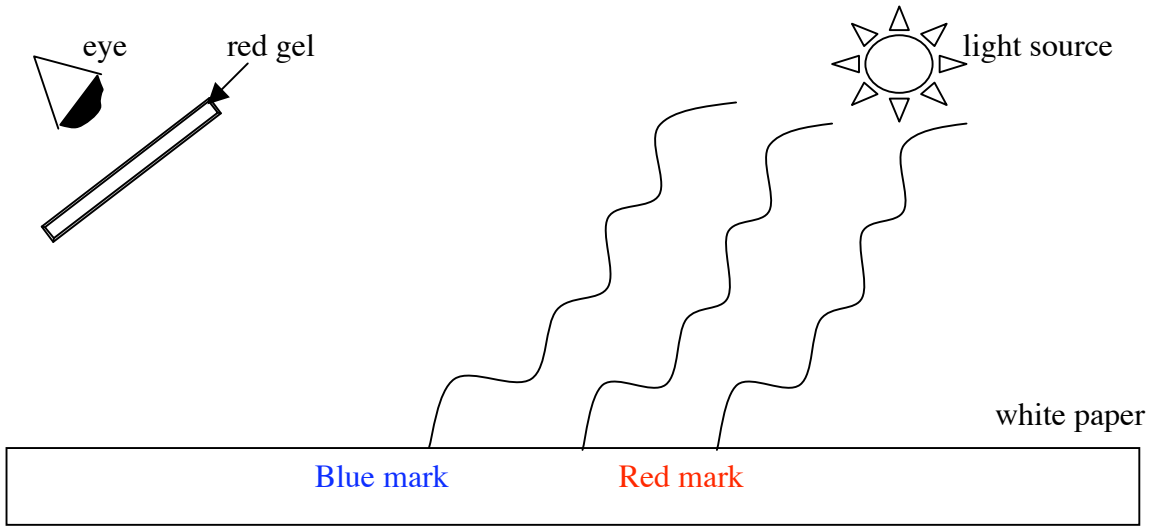
Explain your reasoning for the predictions you just made.

B. Isaac Newton, a 17th century scientist, discovered that white light is comprised of all colors. You might have seen this if you've ever directed white light (such as a flashlight, a slide projector beam, or sunlight) through a prism. Another example is a rainbow in the sky, which is created when water droplets in the atmosphere act like a prism and separate sunlight into its colors.

1. According to Newton's theory, what colors of light are bouncing off the white sheet and entering your eye (when no gel is present)?

2. Now, look at the blank sheet of white paper through the red gel. Write the color you see, if any, in the appropriate column of the table above. Did this match your earlier prediction?

C. Use the red and blue crayons to complete the diagram below, showing the path that each color of light travels after it is reflected from the blue and red mark on the white paper through the red gel to your eye.



D. Predict what you will see if you look at a blank sheet of RED paper through the BLUE gel. (Hold the construction paper overhead, with room lights behind, to avoid a glare) Explain your reasoning using a sketch if necessary. Then test your prediction and write what you see in the table in Part A.

E. Look at a blank sheet of black paper through the red gel.

1. Write down what you see in the table in Part A. Did this match your prediction? Repeat with the blue gel.

2. Consider the following statements from two students:

   Student #1: I've heard that black is a combination of all colors. So, when we look at something that appears black, we're seeing all the colors mixed together.

   Student #2: I've heard that black is the absence of all colors. So, when we look at something that appears black, we're not seeing any reflected light.

State whether you agree or disagree with EACH student and use your observations in explaining your choices.

3. With one crayon, write the same message on both the white and the black blank sheets of paper. With the other crayon, on each sheet, write a second message directly on top of the first, so that the first message is partly covered by the second. It is okay if, when you are done, you are not able to clearly read the two messages.

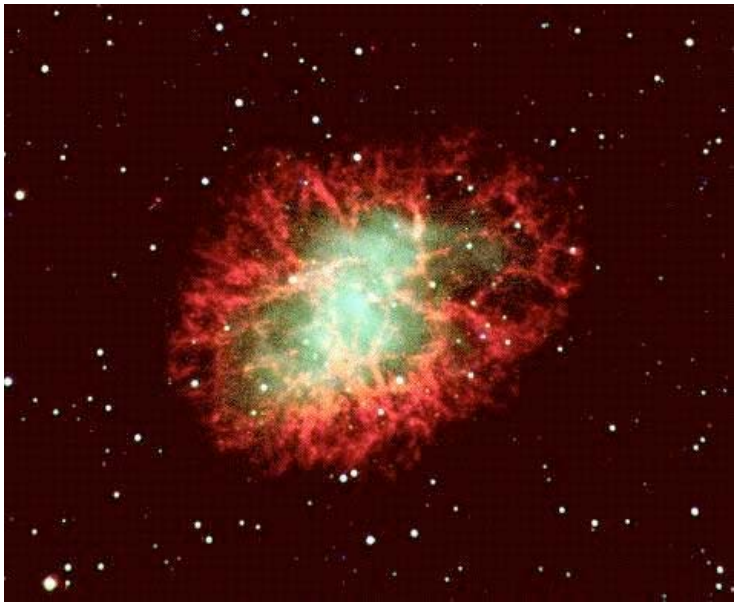
Predict which message you will be able to read, if any, when you look at the white sheet and the black sheet through the red gel, and then through the blue gel.

		which message you will see on white paper	which message you will see on black paper
red gel	Predicted		
	Observed		
blue gel	Predicted		
	Observed		

H. Test your predictions by looking at the messages with each of the gels. Explain why the red gel reveals the message that it does for each sheet of paper.

I. When you looked at the messages on the white and black paper through a gel, you could read one of the two messages, without it being obscured by the other message. Astronomers use gels, which they call "filters", in a similar manner when they look at the sky. Sometimes when an astronomer wants to look at a particular star or nebula, he or she will use a filter to select part of the light from that star or nebula to study to highlight specific features of visible in that one color.

Go to the following web site:
http://www.sofia.usra.edu/Edu/materials/activeAstronomy/crabnebula.html
(This image is also included in the "Images File" on the CD-ROM)



1. If you only wanted to look at the center of the nebula, and didn't want to be distracted by the light coming from the outer edges of the nebula, which gel do you think you should use, red or blue? Explain your reasoning.

2. Look at the picture on the computer screen through the gel. Was your prediction correct?

PART II — HIDDEN STARS

Name_____ Date_____ Period_____

In PART I — HIDDEN MESSAGES, you placed gels between your eyes and the objects at which you were looking. This blocked some of the colors of visible light from reaching your eyes. Sometimes, however, things exist between us and the objects we wish to observe that block all the visible light from reaching our eyes.

A. Look at the picture entitled "Visible Light View of a Hot Toaster." It shows a toaster covered in a plastic bag. As you can see, the plastic bag blocks all the visible light bouncing off the toaster. Does this mean that the plastic bag will block all wavelengths of the electromagnetic spectrum?

B. Now look at the picture entitled "Infrared Light View of a Hot Toaster." It shows the same toaster, but this picture was taken with a camera that detects infrared light.

1. Draw a sketch of the toaster with the bag in front of it, showing what is happening in both the visible light and infrared light ranges of the electromagnetic spectrum.

2. With your group, think of any differences or similarities between what happened when you looked through the gels in Part I of this activity and what happened with the plastic bag in these pictures. Draw a Venn diagram for the gels and the plastic bag using your red and blue crayons and a black pen or pencil.

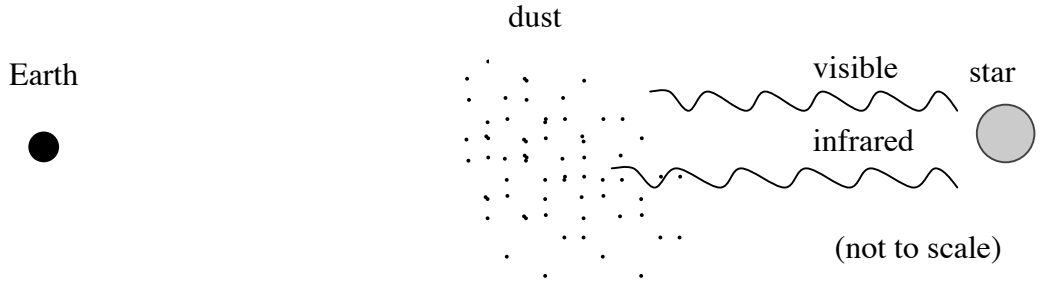
C. Plastic bags aren't the only things that are opaque to visible light, but allow infrared light to pass through. The URL: http://www.sofia.usra.edu/Edu/materials/activeAstronomy/multiband-logo.html (this image is also included in the CD-ROM) shows two pictures of the same thing, one taken with a standard video camera and one with a camera that detects infrared light.

Explain why can't you see the SOFIA logo in the photo taken with visible light.

D. Recall that infrared light is not visible to the naked eye, and that it corresponds to the energy given off by thermal radiation or heat. Write down as many actual uses of infrared light and cameras that register infrared light that you can think of.

E. In space, there are small particles of dust called interstellar dust, because the dust particles float in the nearly empty spaces between the stars. This dust behaves like the plastic bag and the striped cloth in the pictures. It is opaque to visible light, but allows other parts of the electromagnetic spectrum to pass through, most notably infrared light.

1. Complete the sketch below showing the effect of interstellar dust on the light from a star. Show the path that visible light takes once it leaves the star, and the path that infrared light takes.



2. Explain why an astronomer would use an infrared telescope to look at the star.