

## PROBEWARE

### (1) Free Probeware Resources

#### (a) Audio analysis: Free # 2

- A computer equipped with a microphone is well designed to study sound. Download one of the audio frequency analyzer freeware program. You may download versions for other operating systems from download.com (search for oscilloscope or audio frequency analyzer). Obtain a picture of a sine wave for two tuning forks with different frequencies. What is the relationship between wavelength and pitch?

#### (b) Vision analysis

- Run the vision tests and answer the following questions? Do the tests indicate any of the following: macular degeneration, protanopia, deuteranopia, red-green color blindness, problems with the pupil or focusing of one or both eyes that cause glare or blur, problems with the detection of the image by the retina or its transmission to the brain through the optic nerve that cause smudges in the field of vision, or problems with the brain in its attempt to combine the images from the two eyes into one image with depth perception?

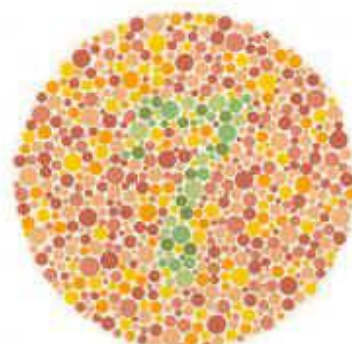
I have run all the vision tests and have not found any problem with my vision.

- Include a screen shot of an optical illusion that you may be able to use in your classroom, and explain how you would use it.

When I will teach a lesson in Optics, I will be able to use the Color Blindness Test with my students as an Introductory Activity to get their attention in the subject.

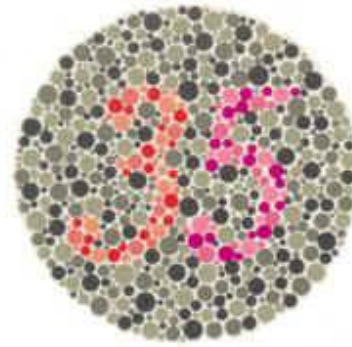
After discussing the test with my students, I will ask them to take the test individually and report the results. Then I will discuss the reasons behind the results and explain the basics of human vision. This will lead my students towards an interesting lesson on Optics.

### Color blindness



VISUAL ACUITY: A person who has sufficient visual acuity should see the number twelve in the circle on the left whether or not they have normal color vision. I

COLOR BLINDNESS: A person with normal color vision sees a number seven in the circle on the left. Those who are color blind usually do not see any number at all.



RED-GREEN COLORBLINDNESS: People with red-green color blindness see either a three or nothing at all. Those with normal color vision see an 8.

PROTANOPIA & DEUTERANOPIA

Those with normal vision see the number thirty-five in the circle above. A person with protanopia sees only the number five. A person with deuteranopia sees the number three. People who are partially color blind will see both numbers but one more distinctly than the other.

(c) Response time & time estimation

- Is your response time faster with audio or visual stimuli?

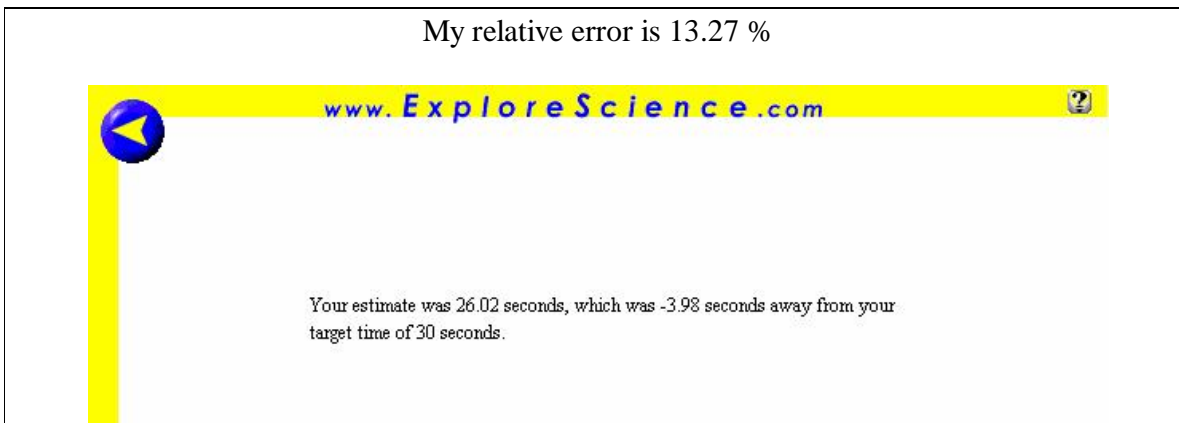
www.ExploreScience.com

Test Again

Average Response Time	Sight: 0.1472 seconds
	Sound: 0.1806 seconds

- How good is your estimate of time? What is your relative error for an estimate of 30 seconds ?  $RE = \frac{(\text{observed} - \text{actual})}{(\text{actual})} \times 100\%$

My relative error is 13.27 %



Your estimate was 26.02 seconds, which was -3.98 seconds away from your target time of 30 seconds.

## **(2) DATA ACQUISITION WITH PROBES FREE # 3**

### **Investigation: Inverse Square Law**

Illustrate the inverse square law for illuminance using light probes, or the inverse square law for magnetic interaction using the magnetic sensor probes. Remember that ambient light and magnetic fields will influence your results.

**Illuminance:** (I=luminous intensity, cd; E=illuminance; I= intensity of source)

$$E = \frac{I}{D^2}$$

Include a table and graph of your data and briefly discuss your results.

## **(3) SIMULTANEOUS PLOTS OF PROBEWARE OUTPUTS: FREE # 4**

### **Investigation: The influence of solutes upon the heating/boiling characteristics of water**

Study the effect of solutes upon the heating and boiling characteristics of water. Fill one beaker with water, and another with a salt solution. Place temperature probes in each of the two beakers, and place both beakers on the same hot plate that has been pre-heated to maximum temperature.

- (a) Include labeled printouts showing the heating curves of both beakers as a function of time.
- (b) What, if any, influence do the dissolved salt have upon the heating and boiling characteristics of water? Explain using your data.

## **(4) DATA ANALYSIS OF PROBEWARE OUTPUT: FREE # 5**

### **Investigation: Energy & Power**

Construct a graph that shows net energy consumption (calories) as a function of time. A calorie is defined as the amount of energy required to raise one gram of water one degree Celsius. Thus, if you know the mass of water heated (since the density of water is 1 g/mL, the volume in mL has

the same numeric value as the mass in grams) , and the temperature change (the data collected in part 2), you can create a graph showing net calorie consumption. (a) Include a plot of total energy consumption as a function of time. (b) At what time was the energy consumption per unit time (power consumption) greatest? Include a screen shot showing the tangent at the point with the steepest slope.

#### **(5) DATA ACQUISITION WITH INDEPENDENT VARIABLES OTHER THAN TIME**

##### **Investigation: Boyle's Law:**

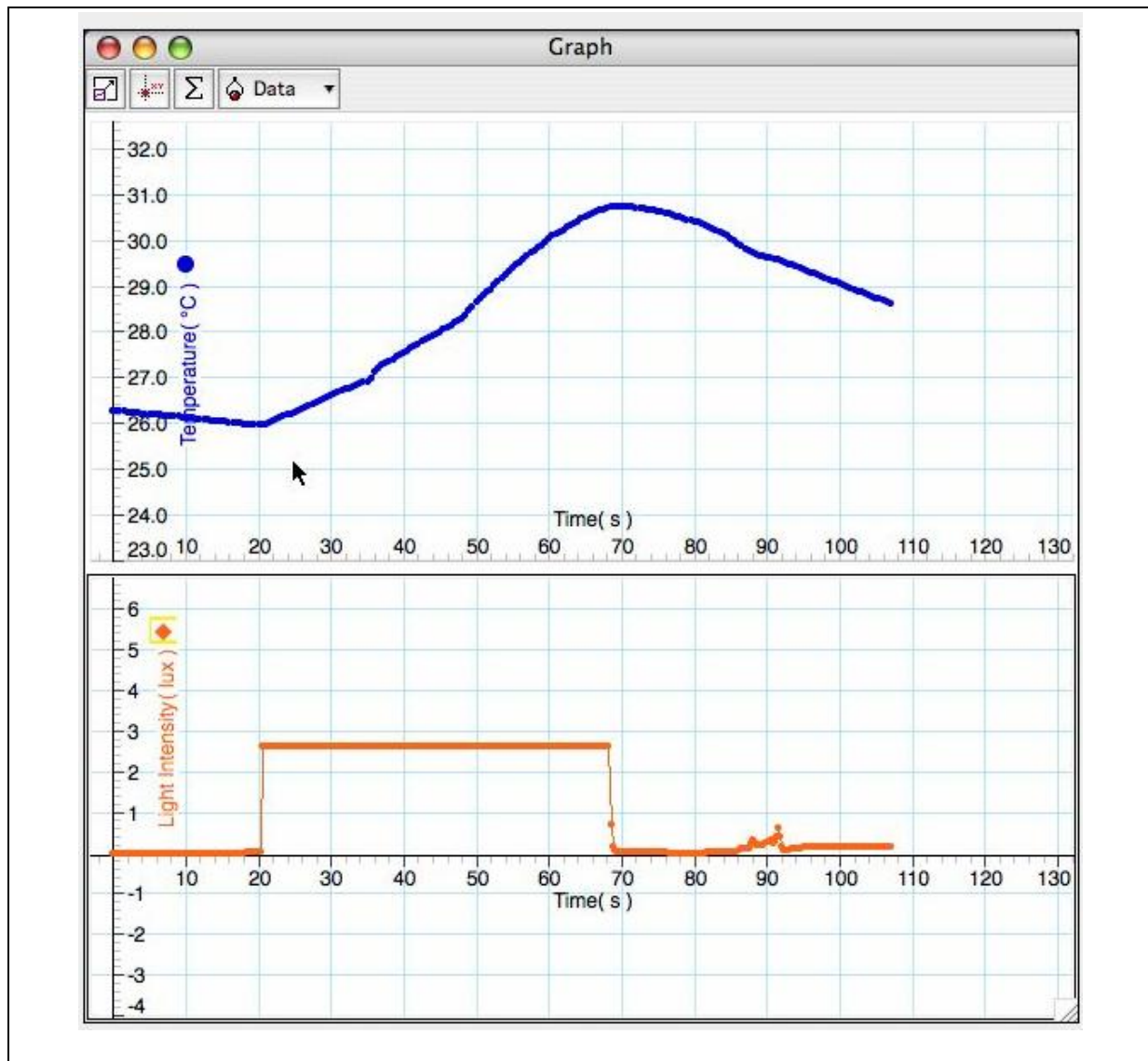
Although most probeware continuously records data as a function of time, it is possible to change the independent variable to another measure. In this activity we shall investigate Boyle's Law ( $P_1V_1=P_2V_2$ ) by plotting the pressure of a sealed container as a function of its volume. Include a printout of the results and a brief discussion of their meaning.

#### **(6) DESIGN YOUR OWN EXPERIMENT WITH PROBEWARE**

Perform an experiment using one or more of the following probeware modules. Describe the experiment and its results, and include pictures of your data. (Direct-connect temperature probe, Standard Temperature probe, Quick-Response Temperature Probe, pH Amplifier, pH electrode, pressure sensor, colorimeter, thermocouple, light sensor, magnetic field sensor, barometer, relative humidity sensor, heart rate monitor, student force sensor, voltage measurement leads, ultrasonic motion detector, force probe, radiation monitor.)

We conducted an experiment using Light Probe and Temperature Probe to determine the relation between the change in the Temperature (in Degree) and the Light Intensity (in Lux) of a candle. We placed the Light Probe and the Temperature Probe approximately two centimeters away from the candle, and we collected data for about 55 seconds.

Below is the simultaneous graph that shows the reading from the two Probes. The graph shows that the Light Intensity remained constant through out the experiment with a value of 2.7 Lux, but the temperature increased slowly.



The image displays two screenshots of a software window titled 'Table'. The top screenshot shows a table with the following data:

Time (s)	Temperature (°C)
42.0000	27.7
42.5000	27.8
43.0000	27.8
43.5000	27.9
44.0000	27.9
44.5000	28.0
45.0000	28.0
45.5000	28.0
46.0000	28.1
46.5000	28.1
47.0000	28.2
47.5000	28.2
48.0000	28.3
48.5000	28.4
49.0000	28.5
49.5000	28.5
50.0000	28.6
50.5000	28.7
51.0000	28.8
51.5000	28.9
52.0000	28.9
52.5000	29.0
53.0000	29.1
53.5000	29.2
54.0000	29.2
54.5000	29.3
55.0000	29.4
55.5000	29.5
56.0000	29.5
56.5000	29.6

The bottom screenshot shows a table with the following data:

Time (s)	Light Intensity (lux)
16.0000	5.4932e-4
16.2000	5.1880e-4
16.4000	1.0681e-4
16.6000	3.0518e-5
16.8000	0.00
17.0000	3.0518e-5
17.2000	1.9836e-4
17.4000	6.4087e-4
17.6000	0.00
17.8000	9.6130e-4
18.0000	0.00
18.2000	6.4087e-4
18.4000	0.00
18.6000	0.00
18.8000	0.01
19.0000	0.01
19.2000	0.00
19.4000	0.00
19.6000	0.00
19.8000	0.00
20.0000	0.00
20.2000	0.00
20.4000	0.00
20.6000	2.62
20.8000	2.62
21.0000	2.62
21.2000	2.62
21.4000	2.62
21.6000	2.62

**(7) USING PROBEWARE TO TEST UNDERSTANDING OF CONCEPTS****DONE IN CLASS...****Investigation: Motion (distance, velocity, acceleration)**

Examine each of the graphs below. Picture in your mind the motion that is being described, and then walk in such a way that the position, velocity, or acceleration of your body is reflected in the graph. Use the ultrasonic motion detector to analyze your movement and perform a screen capture of each activity.

