Decomposing white light into its components:

a. Look through a spectroscope at a white light from within the lab (if possible a fluorescent bulb output as well as a regular incandescent bulb) and the natural light outside (through the slit). Describe any difference in color composition you see.

b. Predict what you will see if you looked through a container of water with food coloring.

c. Test your prediction by putting a test tube of water with food coloring in front of the small slit of the spectroscope. Describe the change in the color spectrum seen.

d. Look at different sources of light (fluorescent bulb, vs. incandescent bulb). Explain what you observe.

e. Shine a red and a blue laser through a diffraction grating. How do the positions of positive/negative interference compare? What does it tell you about the relation between the blue and red wavelengths?

Refraction of waves passing through mediums with different transmission properties.

Shine a laser source into the center of the side of the water tank. Shining the laser from air to water observe the angle change due to refraction.

a. At which angle does the light beam change direction the most?

b. Which angle gives the least effect?

c. What is the maximum angle for the light beam in the water?

d. Now shine the light from water to air. You will observe that at some angles the light completely internally reflects. This angle, called the critical angle, defines a circle for an observer looking at the oceans surface from below beyond which (that is at higher angles of observation) all the light comes from below the surface (see picture below).

Index of refraction matching.

a. Put a dry glass rod in water. Can you see it?
b. Now, wipe the rod and put it in a glass with mineral oil. What happened to the rod?

By matching the index of refraction of the rod and fluid, light is not scattered and we cannot see it.

Shine a light through a glass with swelled carbohydrate beads or crystals. Can you see them? The material they are made of is quite refractive but because so much water is added to them when they swell their effective index of refraction matches that of water (phytoplankton have a low index of refraction relative to water due to their high water content compared to that of their constituent materials).

Light absorption and scattering

What controls the color of water?

A. Absorption.

You have in front of you 3 little water baths each of a different color (blue, green and red). Which will attenuate (that is remove energy by absorbing photons) the most blue, green and red light? Try it using the 3 LED light sources you have.

B. Scattering.

Take a laser and look at its light on a wall (BE CAREFUL NEVER TO TARGET A PERSON'S EYE). Can you see the beam in the air? Now shine the beam through water with milk/malox in it. Can you see the beam?

Ocean color

Use a beaker which is lined with dark tape to investigate how scattering and absorption compete to provide you with the color you see. Add a few drop of green food coloring – what color is the water from the surface?

Now, add drops of milk. How is the color changing? What does it tell you about the effects of absorption and scattering on the color of water?

Fluorescence.

Fluorescence occurs in a fluid when material within it absorbs light and then emits light (usually) at a longer wavelength.

Shine a purple laser on a chlorophyll extract from the side and observe it at 90degrees. What color do you see? The red is due to chlorophyll fluorescence and is in the heart of using fluorometer and satellites to observe chlorophyll fluorescence.

Polarization

Use a linear polarizer to look at different light source. Do you see it change as you rotate the polarizer around its center (perpendicular to your eye)? If there is none, it means that these are sources of light that is not linearly polarized.

Shine a laser across the polarizer. Rotate the laser around its axis. Is there a change? Lasers are linearly polarized sources.

Observe a laser beam in water with scatterers from 90degrees and rotate the beam. Do you see an effect on the scattered light? What if the beam was not polarized and you rotate the polarizer?

No look at sky light and or light reflected from surfaces. Is there a change of intensity as you rotate the polarizer? If there is, it is an indication that upon reflection the light gets linearly polarized. Does it change as you look closer or further away from the sun (that is changing the angle of scattering)?

Shine a laser pointer (a source of linearly polarized light) through a tank with scattering material and observed the beam from ~90 degrees.
Rotate the laser on its axis. Is there a change in the intensity of the light observed?
Do the same for the beam coming from the end of the tank. How does the intensity as you rotate compared to the 90 degree?

Using a linear polarizer block a beam of light from a laser pointer from reaching a wall. Now insert another polarizer between the pointer and the first polarizer. How does it affect the light passing through? Can you explain your observations?

Repeat the above, this time, instead of the second polarizer have the beam bounce from a table before you try to block it with the polarizer. Can you block the beam? Can you explain your observations?

If available, look at clouds at about 90 degree scattering angle from the sun with polarizers and rotate them. Can you explain your observations?