# SMS-204: Integrative marine sciences II.

## Lab 6, Hearing, vision and a little bit about waves

**Station 1**. Decomposing white light into its components:

a. Use a prism to decompose visible (white) light into its components (use either sunlight or that from a flashlight). For which wavelengths (blue or red) is the index of refraction of the prism higher (the ray's propagation angle is bent the most by the prism)?

b. 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.

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

d. 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.

e. A diffraction grating is another method to break light into its spectral components (it is used in the spectroscope above). Use a diffraction grating and observe how it decomposes the light.

**Station 2**. Pin-hole optics: Use a pin-hole telescope to look at your hand.

a. How does your hand look on the internal screen?

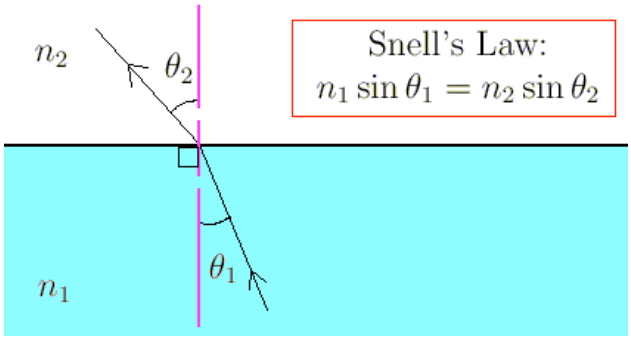
b. Considering the pinhole effect of your eye's pupil, how do you think the image is projected at the back of your eye?

**Station 3**. Lenses — converging and diverging lenses:

a. Shine the laser through each lens onto a white paper (or wall). How is the image size of the laser beam modified when going through the lens?

b. Change the relative position of source and lens and see how the image size is affected.

**Station 4.** Refraction of waves passing through mediums with different transmission properties.




Shine a laser pointer into the center of the side of the water tank. 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. Total internal reflection

Through the sides of the tank, shine the laser towards the air from the water side. 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) .

**Station 5.** Refraction.

Put a ruler in a water tank and observe how the angle of entry appears to change in water relative to that in air. Why does the ruler *appear* to bend in the opposite direction of the light ray in the illustration of Snell's law above?

**Station 6**. Refractometer.

A refractometer is a tool used to measure water salinity based on light refraction. Use it to measure waters of two different salinities. How does it work?

**Station 7**. Sound sensor.

Connect a speaker to a piezo-electric element. Can you hear the noise? Now watch the voltage change on the multi-meter. The word *piezoelectricity* means electricity resulting from pressure. Piezo electric devices generate voltage when deformed and deform when a voltage is applied on them (hence can work as both receiver and sources of sound).

**Station 8**. Sound propagation through air and vacuum.
A buzzer is suspended in a vacuum chamber (make sure it does not touch the walls). Evacuate the chamber and listen to the buzzer sound. Now let the air rush back in (by opening the slit on the top stopper) and listen. Do you hear the difference? Unlike light, sound, a pressure wave, needs a medium to propagate through.

**In the lab you will also see demonstration about waves, resonance and beating, absorption, scattering and fluorescence.**

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