Optics

Required Equipment:

- Cooking oil (about 400-500 mL)
- Tonic water
- Two beakers (one large and one small)
- Purple (405 nm) laser pointer

Pre-Lab Lecture Key Points:

➔ *Optics* = the science of sight and the behavior of light

➔ Important to mention that optics is a study of light and how it interacts with our eyes and the world around us

➔ Two key concepts in this lesson are fluorescence and index of refraction

➔ *Fluorescence* = an event in which an object absorbs one type of light and releases another type of light (of a lower energy/higher wavelength)

➔ *Index of refraction* = a property that tells light how to bend when it hits an object

➔ Fluorescence and index of refraction are two major concepts in optics (the advantage here is that optics experiments are visually stimulating because they generally involve colored light)

➔ An excellent demonstration of the power of optics can be made if anyone in the classroom is wearing glasses (one student can see perfectly through the lenses but another student can not)

➔ Time permitting, a flashlight can be described as the combination of different-colored (rainbow) light; a laser is basically a powerful isolation of one of these colors

Student Lab Procedure:

*The lab procedure is essentially split into two parts, the first for fluorescence and the second for index of refraction

1. Fill one beaker with tonic water and the other with regular tap water.

2. Place the laser pointer flat on top of a book and position the laser so that it directly faces the wall. Be careful with the laser pointer, it should always remain **flat** and facing the wall!

*Be extra careful with the laser pointer, students will want to point it at other objects but it should always remain **flat** and pointed directly at the wall

*If you don't feel comfortable letting the students touch the laser pointer, you can operate it for them

3. With the laser pointer off, put the beaker with regular tap water between it and the wall. Then turn the laser pointer on and note the color of the light in the water on your worksheet.

4. Repeat step 3 for the tonic water.

*Stop here to explain to students that there are chemicals in the water that absorb the purple light from the laser pointer and then emit blue light; alternatively, you can ask students to come up with an explanation for why the colors are different

*The second part of the lab procedure starts here

5. Empty the water from both beakers.

6. Fill approximately half of the large beaker with cooking oil.

7. Now slowly dip the small beaker into the cooking oil until it is completely submerged. Note what happens to the small beaker on your worksheet!

*Stop here to ask students why they think the small beaker disappeared in the cooking oil; then explain to them that since the indices of refraction for the oil and the beaker are the same, light goes through the small beaker such that we can not see it

8. If there is time remaining, try shining the purple laser through the oil and see what happens!

*Like the tonic water, the oil contains other chemicals that absorb purple light and emit a different color

<u>Wrap-Up</u>:

➔ One last time, ask students to define and/or describe the concepts of fluorescence and index of refraction

- ➔ An excellent application of fluorescence is fluorescent lighting (or glow sticks/necklaces)

- ➔ Time permitting or if anyone is interested, you can begin to talk about the physics of lasers, in which a crystal is pumped/excited by high-frequency light, causing emission of a very coherent wavelength