FLUORESCENCE

Materials:

- White paper
- Blacklight flashlight that switches between blacklight and white light modes
- Transparent films of different colors (For example, red, blue, green)
- Fluorescent markers
- Non-fluorescent markers of colors similar to the fluorescent colors
- Different objects (coral, green leaf, white T-shirts, laundry detergent, teeth, Vaseline, olive oil, and many others of your choosing)
- Black and white paper
- Ear swabs to paint vaseline

Instructions:

1. This experiment needs to be performed in a dark room.
2. Note what happens when you view different objects under a white light and when you expose it under a blacklight.
3. Make a list of those objects that glow under the blacklight.
4. When you turn off the blacklight, what happens to the glow? If it turns off immediately, then that is fluorescence. If it continues to glow after the light is switched off, then that is phosphorescence. (There is also a phosphorescence experiment, #6, that you can participate in.)
5. Draw some designs on a white piece of paper with the fluorescent markers. You can be creative, but it will be easier to compare the inks if you make the drawings the same for each color marker, such as a short straight line. Draw another figure with the same color but of a non-fluorescing marker next to the fluorescing ones of the same color. Shine the blacklight onto the drawings using fluorescent markers and compare the fluorescing images to those drawn with non-fluorescing inks.
6. Place a different filter between the white light flashlight and the fluorescent drawings. Compare the colors and brightness of the images of fluorescing and non-fluorescing inks with the different filters.

Which colored filters provide the brightest fluorescence and which the least?
____

Write the filters in order of providing the brightest fluorescence to lowest fluorescence? ________________> ________________ > ________________

Do any filters provide the similar fluorescence intensity as the white light alone? Which one? _______________________

Do any of the filters with the white light produce fluorescence of similar intensity as the blacklight alone? Which one?

Use the attached transmission spectra of different colored filters to understand better which colors affect and block phosphorescence.

7. Take a look at the Jablonski diagram (next page). It shows some possible energy levels to which electrons in a molecule can be excited to and how that energy can be lost. The farther apart the energy levels for the transition, the larger the energy it takes to do that.

You can't get more energy out than the amount of energy that goes in. If high energy light (like ultraviolet or violet or blue) is absorbed by molecules, their electrons are excited to higher potential energy levels. If low energy light like orange or red light is absorbed, electrons can only be excited to lower potential energy levels.

That energy absorbed by the molecule can then be lost in many ways as shown in the diagram. Some are nonradiative pathways like vibrational relaxation and external conversion. Other pathways are radiative, when energy is emitted as light. ***This emitted light must be equal to or lower than the energy of light absorbed.***

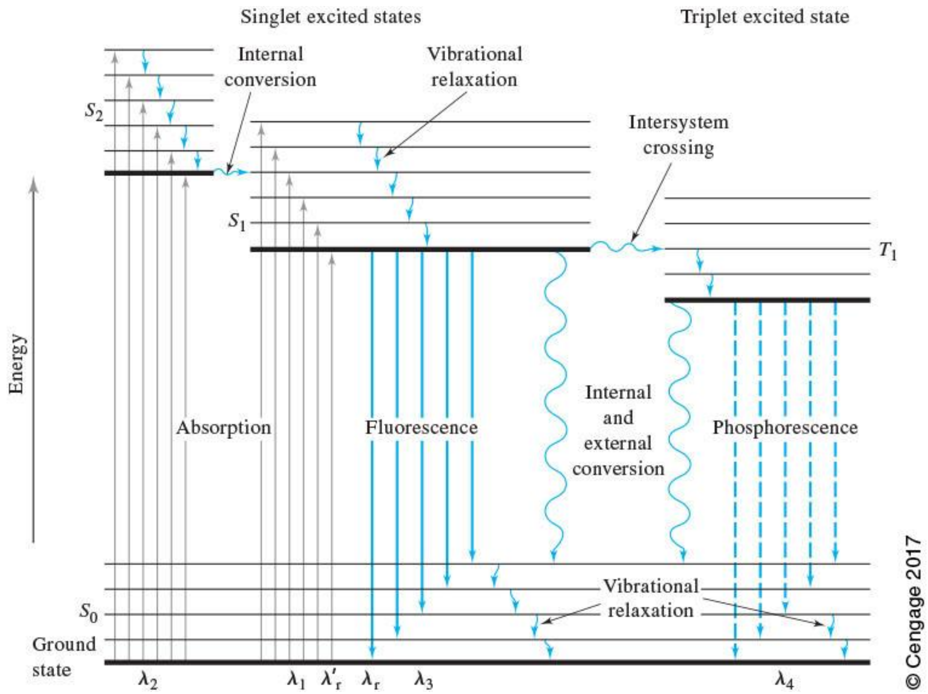
One of those radiative pathways is fluorescence. This has a short duration. So, when you turn off the excitation light, the fluorescence disappears right away.

Another radiative pathway is phosphorescence. An electron's spin flips (during intersystem crossing), and thus stays longer in the excited state before relaxing back to the ground state. This phenomenon allows you to turn off the excitation light and see an object continue to phosphoresce for minutes to hours. It can "glow" in the dark.

8. Explain why there is fluorescence with some color filters between the exciting light and the object and why there is little to no fluorescence with other color filters. Use the transmission spectra that accompany the color filters and the Jablonski diagram to explain the results.

9. Place increasing thicknesses of Vaseline onto black paper. Place a series in a row. How does the intensity of the fluorescence change with amount of Vaseline? Why do you think this is the case?

Theory—The Jablonski Diagram



Douglas A. Skoog, F. James Holler, S. R. Crouch, "Principles of Instrumental Analysis", Seventh Edition, Boston, MA: Cengage Learning, 2018.