18. Fluorescent Minerals

In Unit 17, we learned about all sorts of special effects. In this unit, we'll explore one special effect more deeply. To earn your Fluorescent Minerals badge, you should be able to define "fluorescence" and explain why some minerals fluoresce and then name some common fluorescent minerals. You might also learn about famous localities for fluorescent minerals, collect examples and create a fluorescent display case, and learn about safety when it comes to working with ultraviolet lamps.

Activity 18.1: *What is "fluorescence" and why do some minerals fluoresce?*
Note: *This activity is required to earn this badge.*
Define "fluorescence" and explain why some minerals fluoresce.

Activity 18.2: Famous fluorescent mineral localities.
Some fluorescent mineral localities have become world famous. Name at least three localities and some of the fluorescent minerals to be found at each.

Activity 18.3: Collecting fluorescent minerals.
Build a collection of 6 to 10 fluorescent minerals and make a list or table telling what color they are under normal lighting, short-wave ultraviolet lighting, and long-wave ultraviolet lighting. Be sure to follow the basics of good curation in building your collection: label each specimen and keep a catalog with key information about what it is and where it came from. (See Badge 5: Collecting.)

Activity 18.4: Creating a fluorescent display case and exhibiting your collection.
Building a fluorescent case requires more effort and parts than a normal mineral display case. Build or buy your own and exhibit your collection at a gem show, county fair, school science fair, in class at school, or elsewhere. (See Badge 6: Showmanship.)

Activity 18.5: *Safety with fluorescent lamps.*
Note: *This activity is required to earn this badge.*
Fluorescent lamps, particularly those emitting shortwave ultraviolet light, can "sunburn" skin and eyes. Don't look directly into a fluorescent lamp when it's turned on, and limit the time you spend working under ultraviolet lighting. Learn what other precautions you should take when working with fluorescent lamps.

Activity 18.6: Special effects of some fluorescent minerals.
In addition to changing color and glowing, some minerals show other special effects under fluorescent lighting. Name at least two other special effects and the minerals that produce them.

Activity 18.7: Making fluorescent minerals with glow-in-the-dark paints.
Make your own simulated fluorescent minerals using ordinary non-fluorescent rocks and dabbing them with paints that glow under a black light. Name actual fluorescent minerals that glow the same colors as your simulated minerals.

18. Fluorescent Minerals

□ 18.1 *What is "fluorescence" and why do some minerals fluoresce?* (required to earn this badge)

□ 18.2 Famous fluorescent mineral localities

□ 18.3 Collecting fluorescent minerals

□ 18.4 Creating a fluorescent display case and exhibiting your collection

□ 18.5 *Safety with fluorescent lamps* (required to earn this badge)

□ 18.6 Special effects of some fluorescent minerals

□ 18.7 Making fluorescent minerals with glow-in-the-dark paints.

To earn your Fluorescent Minerals badge, you need to complete at least 3 of the 6 activities. (Please note that successfully completing Activities 18.1 and 18.5 are required to earn this badge.) Check off all the activities you've completed. When you have earned your badge, sign below and have your FRA leader sign and forward this sheet to the AFMS Juniors Program chair.

_____
Date completed

_____ _____
My signature Youth leader's signature

_____
Name of my club

Leader's preferred mailing address for receiving badge:

_____

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Back-up page 18.1: What is "fluorescence" and why do some minerals fluoresce?

Light moves in waves and comes in different forms depending on the wavelength. Some of these forms are **infrared**, **visible**, and **ultraviolet (UV)**. We humans are most familiar with visible light. UV light moves in waves too short for human eyes to detect, but we can see the effects with certain minerals. What appears to be a gray rock in visible light may glow orange or green under UV light. Or a mineral of one bright color under visible light may appear a different color under UV; for instance, purple fluorite may turn green or blue. Still other minerals may stay the same color but appear more vivid, as with red ruby. In all these cases, under UV light the minerals seem to glow from within.

The first person to describe this phenomenon was English scientist Sir George Stokes in 1852. He worked with fluorite, so he called the effect **fluorescence**. Some minerals containing impurities called **activators** will absorb UV light, then emit longer, visible light waves which we see as colors. At the atomic level, UV light causes electrons in some molecules from the "activators" to jump to a higher energy level. In falling back to their normal level, they give off the extra energy in the form of visible light. UV light is usually divided into **short wave (SW)** and **long wave (LW)**. Most fluorescent minerals are sensitive to SW. Some will change color as you switch from SW to LW. Fluorescent lamps, especially SW, are very expensive, but you can use a less expensive alternative for LW with a black-light tube readily available at hardware stores—the kind of light tubes gardeners use as grow-lamps for plants and that teenagers use to make posters of their favorite rock stars glow.

What I've provided above is an extremely brief and simplistic explanation of fluorescence. Some great books for teaching kids more about fluorescence and fluorescent minerals are:

- Stuart Schneider, *Collecting Fluorescent Minerals*, 2004. Not only does this book have great opening chapters about fluorescent minerals in general and collecting them, it also serves up a feast for the eyes with a colorful photographic atlas of fluorescent minerals from around the world filling most of the pages.
- Stuart Schneider, *The World of Fluorescent Minerals*, 2006. Schneider picked up from his earlier book with even more colorful photos in this follow-up volume.
- Manuel Robbins, *Fluorescence: Gems & Minerals under Ultraviolet Light*, 1994. Robbins describes fluorescence, overviews significant localities, and provides full chapters devoted to individual minerals, as well as a chapter on the activators that cause fluorescence of different colors. While not as colorful as the Schneider books (it contains a small color insert), it's still chock full of good information.
- Harry Wain, *The Story of Fluorescence*, 1965. This little paperback has been around for decades. The Raytech company manufactures fluorescent lamps and packages a copy with each lamp they sell.

Finally, you can also get great information from the web site of the Fluorescent Mineral Society, www.uvminerals.org.

Back-up page 18.2: Famous fluorescent mineral localities.

The Schneider and Robbins books listed on Back-up page 18.1 provide information about fluorescent mineral localities around the world. For this activity, I encourage you to point kids toward those books or the web. Here are just a few famous spots:

The Franklin & Sterling Hill zinc mines of northern New Jersey are probably the most famous localities in the U.S. with brilliant yellow-green willemite, calcite in shades of pink and orange-red, pectolite that glows purple, and many more minerals and vivid colors. Most fluorescent mineral collectors started with minerals from these areas.

St. Lawrence County in north-central New York once hosted major mines, many now closed with the land being reclaimed, but you can occasionally still go on club-organized trips to mine dumps for sphalerite, calcite, diopside, fluorapatite, norbergite, and more.

Arizona has more mines than can be succinctly listed that have been prime producers of fluorescent minerals of all sorts.

The Terlingua area of Texas is home to mercury mines famous for "Terlingua calcite," which glows blue in SW and pink in LW UV, with a high degree of phosphorescence.

Sweetwater County, Wyoming, yields gray Sweetwater agates speckled with black dots. While drab in regular lighting, they glow vivid apple-green under UV.

Mont Saint-Hilaire in the province of Quebec, Canada, is an important mining and mineral locality where over 270 minerals have been collected. One authority has catalogued over 60 fluorescent minerals from this region.

The Bancroft District of Ontario is another important Canadian mineral area, featuring a mineral museum, an annual mineral show, and dig sites yielding such fluorescents as feldspar, scapolite, calcite, zircon, sodalite, hackmanite, fluorite, scheelite, apatite, etc.

Mexican mines have produced some great fluorescent minerals from such places as Mapimi in Durango County and Cerro del Mercado.

Durham, England, has mines with some of the most spectacularly fluorescent fluorite.

Greenland may be a bit out of the way for most of us but is making a name for itself as a source of fluorescent minerals from what's known as the Ilimaussaq Complex.

Afghanistan, particularly the Sar-e-Sang district along the Kokcha River in Badakhshan Province, is well known for tenebrescent sodalite known as hackmanite, which shows up at a lot of gem shows. It also has fluorescent fluorapatite, calcite, scapolite, etc.

Pakistan, particularly northern Pakistan, is a great source of fluorescent minerals, along with a wonderful variety of gemstone minerals.

Back-up page 18.3: Collecting fluorescent minerals.

Most minerals do not fluoresce. In fact, according to one report, only about 500 out of some 3,600 named minerals fluoresce, and not even all of them fluoresce all the time. It depends on whether they contain the necessary activators. Some are truly exotic minerals that are difficult to collect because of their scarcity or the few places they may be found. But others are fairly common, either if you are personally collecting in the field or if you are buying from a mineral dealer. Here are some that kids might consider as they build their own fluorescent collections. These are sure to please! Keep in mind that colors may vary from what's presented in this chart, depending on the locality.

Mineral	Natural Color	SW UV Color	LW UV Color
Agate (esp. Sweet-water agates)	varies: clear, white, gray, blue, etc.	green, yellow-green	faint green
Albite	White	velvet red, purple-red	purple
Aragonite	white or yellow	white, yellow, green	cream
Barite	varies: many colors	Creamy white	bright creamy white
Calcite	varies: clear, white, pink, yellow, etc.	varies: white, red, orange, etc.	varies: white, red
Chalcedony geodes from Mexico	White	bright green	faint green
Celestite	colorless, blue, yellow	faint blue	faint blue
Corundum, var. Ruby	red, purple-red		bright cherry red
Fluorite	varies: purple, yellow, blue, pink, clear, etc.	blue-green	violet blue, purple
Halite	varies: white, pink, blue, etc.	pink, bright orange	
Hardystonite	white, gray, tan	purple-blue	weak purple-blue
Hyrdozincite	White	bright blue-white	dark blue
Opal (common)	White	bright green	
Pectolite	Clear	weak pink, purple	orange-pink, lavender
Scapolite, var. Wernerite	yellow or greenish-yellow	dull yellow	intense yellow
Scheelite	creamy white, yellow	blue-white	cream yellow
Selenite	golden-yellow	pale blue	
Sodalite	Blue	orange, red	bright orange
Sphalerite	black, brown, yellow, reddish	yellow-orange, blue	yellow-orange, blue
Willemite	varies: white, gray, red, yellow, brown	Green	green, brown-yellow
Wollastonite	gray or white	Bright orange, yellow	weakly yellow
Zircon	often dark brown	yellow-orange	brown-yellow

Help kids build a collection with some of these minerals that glow with dramatic brilliance. Kids who become especially fascinated by fluorescent minerals might be encouraged to join the Fluorescent Mineral Society, www.uvminerals.org.

Note: *Kids can use this activity to satisfy requirements toward earning the Collecting badge simultaneously (Activity 5.1).*

Back-up page 18.4: Creating a fluorescent display case and exhibiting your collection.

Building a fluorescent case requires more effort, parts, and expense than a normal display case. Suggestions for crafting a fluorescent display are included on the Fluorescent Mineral Society (FMS) website: http://uvminerals.org/fms/display-techniques. If you plan to work with your juniors to build a case, I recommend contacting members of FMS. Here are some basic suggestions and tips:

- Fluorescent displays require darkness: a darkened room, or a display case within a drape or a black tent, or an enclosed display case with a small "viewing port."

- I've been frustrated trying to find blueprints for a basic UV display case, and I've ended up using my regular display case with a modified top that has extra openings: one for regular lamps and one for my fluorescent lamp. I have separate plugs for each lamp, with on/off switches. (If you're into electrical wiring, you can figure a way to put these on timers so that viewers don't have to flip switches themselves to switch from white light to UV light.) Then, I created a frame with a curtain to drape over my case, creating a darkened booth.

- Protect the eyes of viewer from shortwave UV light. Position the lamp so that people won't look directly into it. (I hang my lamp at an angle, facing away from the viewer.) Ordinary types of glass will stop shortwave UV light almost completely, so place a glass front between the specimens and viewer.

- Be careful in your choice of liners, risers, or stands. Many fabrics and papers and some woods fluoresce. Same thing with many plastics, so avoid using plastic stands or risers that might show beneath your mineral specimens. Best choices for liners are dull black fabric, paper, or cardstock, or wood painted dull black. (Test a dab of the paint first to make sure it doesn't fluoresce.)

- For labels, use "reverse printing" with your computer to bring white letters against a black background; otherwise, your labels will glow brighter than many of your specimens and will detract attention from the specimens.

- If using black fabric liners and/or risers, clean the liners and risers with tape or a lint roller before placing specimens into the case. Otherwise, small flecks of lint and dust will show up like stars when the fluorescent lights are turned on.

Help kids build their own fluorescent mineral collections and encourage them to exhibit on their own or in a group case at a show, county fair, school, etc. Raytech sells the "Raytech View Box" that you can also use for looking at individual specimens or a small collection, and they sell a variety of fluorescent lamps: www.raytech-ind.com.

Note: *Kids who publicly exhibit a fluorescent collection can use this activity to satisfy requirements toward earning the Showmanship badge simultaneously (Activity 6.4).*

Back-up page 18.5: Safety with fluorescent lamps.

Note: ***This activity is required for kids to earn the Fluorescent Minerals badge.***

No one should look directly into a fluorescent lamp when it's turned on. While long-wave ultraviolet light (LW UV) is relatively harmless, short-wave ultraviolet light (SW UV) can "sunburn" skin and eyes and cause irritation, especially for people with sensitive skin. Although protective glasses can shield eyes from harm, kids should be advised to limit time spent with UV light of any sort.

Teach kids to be safe, not sorry! They should learn to observe the following precautions in working with fluorescent lighting:

- To prevent "sunburn" on skin, limit exposure by limiting the time spent with fluorescent lighting, particularly SW UV, and limit the amount of exposed skin by wearing long-sleeved shirts, museum gloves, etc.

- Never look directly into an ultraviolet lamp when it's turned on, just as you should never stare directly into any light source. Eye irritation and damage can result. Always keep the light aimed away from your face.

- Be aware that even if the lamp is pointed away from you, if it's aimed at a reflective surface, UV light can still be reflected back at you.

- To further help prevent eye irritation when working with fluorescent lamps, wear protective eyeglasses, such as regular laboratory-style safety glasses, goggles, or even regular eyeglasses, and—again—limit time spent working with a fluorescent lamp turned on. The best sorts of glasses to use are those offering 99.9% UV protection.

- If building a fluorescent mineral display case, tuck or angle fluorescent lamps where people can't look directly into them.

- Have a glass front between the lamp and the viewer in a fluorescent mineral display case. Ordinary types of glass are usually effective at blocking some, but not all, SW UV light.

Back-up page 18.6: Special effects of some fluorescent minerals.

In addition to changing color and glowing as if lit from within, some fluorescent minerals exhibit still more special effects. These include *phosphorescence* and *tenebrescence*.

Phosphorescence.

Kids today might not have experienced this, but folks from my generation will recall turning off the television in a darkened room late at night and watching the screen slowly fade to black. Some fluorescent minerals do the same thing, momentarily holding a faint glow after a fluorescent lamp has been switched off, in a phenomenon known as phosphorescence. It's especially noticeable in pink calcite rhombohedrals from Nuevo Leon, Mexico, often sold at gem and mineral shows. A large chunk makes a great addition to Activity 17.8, The Amazing Mineral Magic Show. It is truly neat to watch as the calcite continues glowing in the dark after fluorescent lights are switched off, with the glow gradually fading away. Phosphorescence, or "afterglow," is also observed in scapolite, some celestine and barite, gypsum, hydrozincite, Terlingua calcite from Texas, and other minerals.

Tenebrescence.

I learned about tenebrescence at one of those gem shows that take place in the rooms of a big hotel. My wife and I entered Room 204, whereupon an elderly man from Afghanistan waved a pale purple crystal in our faces and urged us to join him in the bathroom. Our hesitation when he closed the door turned to alarm when he switched off the lights to total darkness. Then, with a "click," we saw his bright smile illuminated by a fluorescent lamp and the crystal glowing bright apricot orange. I was ready to buy it then and there, but the show wasn't over. When we emerged back into the light of the hotel room, I saw that the formerly pale crystal was now a vivid raspberry color! The man's smile grew even larger as I reached for my wallet. Later at home, we saw that the color of our wonderful new acquisition had reverted back to pale purple when we left it exposed to daylight. Thus, my first-hand lesson about tenebrescence, a property by which a mineral can change color when exposed to UV light (particularly SW UV), then fade under daylight, only to regain its brighter colors with a little more UV exposure. This color reversal can be repeated indefinitely. The property of reversing color with changes in light radiation has been called *reversible photosensitivity* or *reversible photochromism*, or more commonly, *tenebrescence*. Hackmanite (a variety of sodalite) is the mineral perhaps most well known for exhibiting this special effect. You can show the same effect with "photosensitive eyeglasses" that self-darken into sunglasses on exposure to strong sunlight and then turn clear again indoors. Other minerals that can exhibit tenebrescence include tugtupite, spodumene, "chameleon diamonds," and some barites.

Back-up page 18.7: Making fluorescent minerals with glow-in-the-dark paints.

This activity, sent in by Karen Nathan (Florida), teaches about fluorescence in a fun, hands-on way. To begin with, she scheduled the fluorescence unit to coincide with Halloween. Rocks that glow in the dark—just like those glow-in-the-dark skeleton costumes! What could be more appropriate and attention-grabbing for kids? After a brief talk to educate everyone about fluorescence, a display with sample specimens under a fluorescent lamp, and a video from the Sterling Hill Museum website in New Jersey at http://sterlinghillminingmuseum.org/visitor/mineralcollect.php, Karen concluded with an activity that is quick and simple: painting simulated fluorescent minerals with glow-paints then tagging the colors to minerals that cause fluorescence in those colors.

You'll need the following materials:

- non-fluorescent rock samples (preferably dark)
- glow-paints from a craft store (yellow, green, orange, pink, blue)
- paper plates
- sponges cut into small square pieces
- recycled applesauce containers (for display and transport home)
- an ultraviolet light

Place a small dab of each glow-paint on a paper plate for a palette. Have kids gently dab sponge squares into the different paints then onto their rocks. Turn out the lights and use a UV flashlight or a black light to see the newly created fluorescent rocks glow! (Remember SAFETY when viewing with a UV lamp and tell kids not to look directly into the light.) Have kids identify the minerals from a key provided, such as the following:

A KEY TO FLUORESCENT MINERAL COLORS	
Color	**Likely Fluorescent Mineral/s**
Green	Willemite
Orange-Red to Red	Calcite, Sodalite
Bright Cherry Red	Corundum variety Ruby
Pink	Calcite
Blue	Hydrozincite, Diopside
Powder-Blue	Microcline
Yellow	Norbergite
Pale Yellow to Blue	Scheelite, Powellite
Violet to Purple	Hardystonite
Orange, Yellow, & Blue	Sphalerite

Remind kids that this is a general guide and that colors and minerals may vary. In fact, you might give an assignment for them to augment and add to the table. Then encourage them to explore and learn more on websites, in books, at museum displays, and elsewhere.