Demonstrating UV Fluorescence

Instructors teaching college-level classes tell some strange stories about students who pay good money to take a class or attend a seminar on forensic lighting only to show up with a smart phone. In the unlikely event that someone wants to pay me good money to teach a forensic lighting seminar, I wouldn't waste my time if the students are not equipped to work at a fairly advanced level. My requirements, or the functional equivalent, include a:

- DLSR camera with Live View and an Info button
- Macro lens, a close-focusing normal prime, or a
- Close focusing zoom from moderate wide angle to moderate telephoto
- Tiffen #15 barrier filter to fit the lens or lenses
- Tripod with an articulated center column
- Light stand with a Manfrotto Super Clamp, or a
- Monopod with tripod legs and a Manfrotto Super Clamp
- Low power headlamp such as the focusing Coast HL7
- Battery-powered 450 nanometer UV light source
- Orange contrast-enhancing viewing glasses

Reflected UV fluorescence can only be demonstrated in subdued light if not near-total darkness. Shutter speeds are likely to run ten seconds or longer at a small aperture such as f/16 to capture the required depth of field. You'll need a solid support for your camera. You'll probably want a solid support for your light source.

I use a long-discontinued Giottos MM 5580 monopod with a Manfrotto 035 Super Clamp to hold both my forensic lights and a 1,075 lumen Coast HP550 focusing flashlight that I use for both white light search and to focus on subjects beyond the range of the camera's built-in focusing aid. ***Today's closest equivalent is the Manfrotto MMXPROASBUS with a Manfrotto 234RC head.***

When mounted on a light stand or tripod, the Manfrotto 035 Super Clamp can be adjusted to position a flashlight, including a forensic flashlight, to any desired angle and hold it steady while you take your picture.

Try hand-holding your forensic light if you have to photograph a fingerprint developed with UV powder on the bottom of a door knob or high on a bathroom mirror.

If you're time is worth more than 10¢ an hour and your patience is worn thin from too many years in the trenches, closeup work requires a tripod with an articulated center column. I'm using an older Giottos. The current version is the Giottos YTL 9314 or the Manfrotto MT 055XPRO3, either with a Manfrotto 054 ball head. If I had it to do over, I might opt for a Manfrotto XPRO geared head to position the camera with greater precision. I also carry a Manfrotto 454 macro focusing rail.

A Joby Gorillapod with a small ball head is another handy gadget to have in your truck when closeup work is in the offing.

Why waste two full pages talking about closeup gear in an article devoted to demonstrating ultraviolet fluorescence? Because the subjects likely to be photographed using ultraviolet fluorescence at a typical crime scene are largely closeup subjects that cannot be photographed using ambient light or flash. The subjects that come readily to mind include:

- Dried blood, urine, saliva, semen and vaginal stains.
- Latent blood stains developed with Luminol and Hemascein
- Latent prints developed with fluorescent powders.

These are closeup subjects by any reasonable standard. Thus, you need to be prepared to take closeup photographs in subdued light or near-total darkness with a forensic light source using slow shutter speeds and small apertures.

I once sat through a class in which the instructor demonstrated ultraviolet fluorescence by loaning his students cheap 450 nm lights of the type commonly sold to fluorescent mineral hobbyists and cheap point and shoot cameras affixed to cheap table top tripods. The target was a white hanky with a few drops of dried urine encased in a Ziplok bag. The students were asked to hold a flat orange filter in front of the lens and hold a similar filter in front of their eyes in lieu of a proper photographic-quality filter and contrast-enhancing viewing glasses.

This very likely sufficed for the purpose of a one hour presentation conducted as part of a one week seminar on blunt trauma and clinical forensics which cost the paying students $1,000. I got a free ride because I was one of the presenters, on another subject I hasten to add.

Assuming that the students and their instructor are prepared to work in subdued light if not total darkness, the next step is acquiring a 450 - 455 nanometer forensic light source. My light is a long-discontinued 450 nm Inova. At $135.00 postpaid, the XeLED-Cr1BL-R3-455 from Xenopus Electronix is the ideal replacement. Unlike other dealers, Xenopus sells both the lights themselves and replacement parts such as tail cap switches. They have forensic lights priced from forty to five thousand dollars, which should cover most eventualities.

The pictured kit includes a 455 nanometer flashlight, a pair of orange contrast-enhancing barrier glasses, two CR123A disposable lithium batteries and a well-padded plastic case. There is an empty slot for two additional CR123A batteries. I use Surefire CR123A batteries available at Walmart in both my Inova 455 nm flashlight and my Streamlight Polytac tactical flashlight.

455 nanometers is not ultraviolet. It is right smack dab in the middle of the visible spectrum. However, many subjects that will fluoresce under a true 365 nm forensic light source will also fluoresce under a 455 nm light source. UV light can

be hazardous. Thus, in a classroom or crime scene setting with bystanders in the area, the 455 nm light source is the safer choice.

Contrast-enhancing glasses specific to the wavelength that you're working with are a necessity, as are a contrast-enhancing barrier filter for your camera.

Your light puts out a relatively bright excitation wavelength centered on a specific frequency, 455 nm in this instance. Think of the light output as a bell curve, ranging from perhaps 390 nm on the low end to 520 nm on the high end.

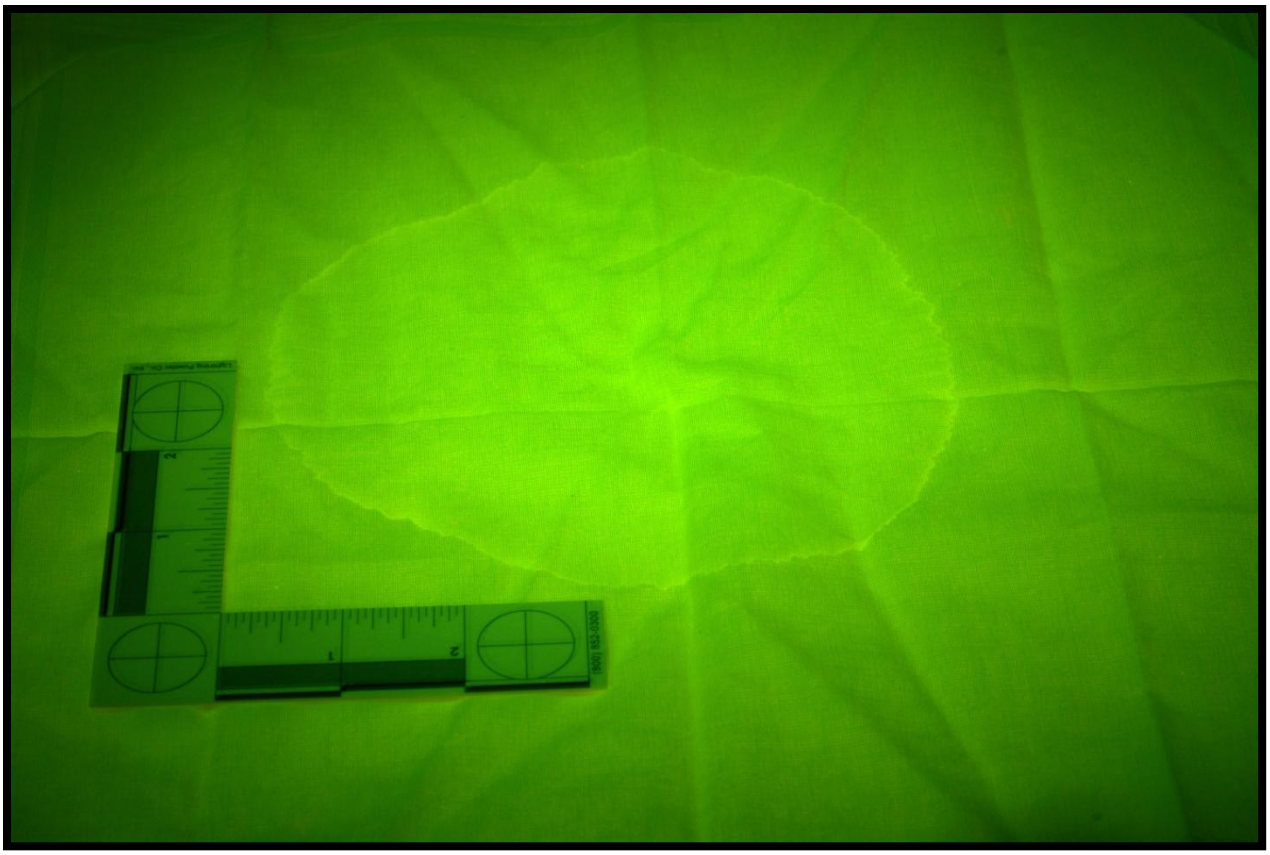
The fluorescence emitted by the target in the visible portion of the spectrum is relatively weak. Contrast-enhancing glasses and barrier filters (in this case a Tiffen #15) suppress the excitation wavelength so you can see more of the fluorescence that you're interested in.

If you're working with a group, order extra orange glasses at $18.00 each for every student in the group. Xenopus orange glasses are designed to work with their 455 nm lights. If your school or your agency is too cheap to provide each student with appropriate barrier glasses, instruct the students to purchase their own at $23.45 postpaid before showing up for a demonstration.

Xenopus is not the only game in town. Every forensic supply house and gem and mineral dealer catering to fluorescent mineral collectors will have lights covering all wavelengths from 254 nm (UV-C, hazardous without protective clothing and eyeware) to 1,000 nm (right on the edge of the microwave spectrum).

Having four or five D-cell LED Maglites floating around the house, I'd be interested in trying the BMF100 replacement lens for a D-call Maglite. At $65.95 plus postage from Sirchie, the BMF100 will pass excitation light from 390 to 520 nm centered on 450 nm. Maglites are relatively inexpensive and practically indestructable.

With a suitable camera system and light source decided upon, what can we use for a class-room safe demonstration material? Robert Cheeseman suggests a dilute solution of Tide powdered detergent applied to a new, once-laundered handkerchief. Tide is high in optical brighteners so you won't need an extremely bright light source to generate fluorescence that you can see and photograph without jumping through hoops.



I used a scant teaspoon of Tide in one cup of warm water. Stir well. Pour a little on your hanky to simulate blood, semen, saliva or vaginal fluid. Sprinkle a few drops on a second hanky to simulate high velocity blood spatter. Let dry overnight. You now have two biologically safe targets that can be used in a classroom setting without health concerns.

Several forensic supply houses sell simulated blood for training purposes. One variety has fluid characteristics similar to wet blood. Another variety has chemical characteristics similar to wet blood. I queried the dealer, who told me that they have not tested their product under UV light. The second variety was designed to work in conjunction with Luminol and Hemascein, which would presumably be covered in an advanced class on blood pattern analysis.

My first Tide test target photographed in 2009 using a Nikon D70 camera, a Nikon 60 mm AF-D macro lens and a 52 mm Tiffen #15 filter. Twenty seconds at f/16, ISO 200, using an Inova 455 nm flashlight. I had to handhold the flashlight, which prompted the purchase of a $35.00 Manfrotto Super Clamp.

I lay the hanky stained with a weak solution of dried Tide on the flatbed scanner in my office, set up my tripod, focused in room light, turned off the ceiling light, took a TTL spot meter reading and used the self-timer to trip the shutter without moving the camera. The first shot turned out so I quit while I was ahead.

A night housekeeping patrol is a challenging exercise for folks who can take their gear home at night. After lights out, photograph everything that you can find exhibiting UV fluorescence. Don't overlook the toilet, the bedding, the dirty clothes hamper, the closets, the pantry and the bookcases.

You'll find that many books, labels and paper products fluoresce because optical brighteners are incorporated in the ink and the paper itself. Urine stains around the toilet are almost inevitable if there are men in the house. You may have trouble photographing urine stains around the toilet without a Gorillapod for the camera and a monopod with a tripod base and a Super Clamp for your light.

I purchased a 52 mm Tiffen #15 filter because it worked with my 60 mm AF-D macro and my 24, 35 and 50 mm AF-D primes. For demonstration purposes, I be inclined to purchase a larger filter to go on my zoom lens, letting me go wide for urine stains around the base of the toilet and long for a dust jacket on the top shelf. Tiffen #15 filters are relatively inexpensive, typically fifteen or twenty dollars plus postage if you shop online.

For serious crime scene work, I'd want one for my macro to work with fluorescent fingerprint powders and the smallest stains, and one for my zoom for wide angle to telephoto coverage.

For more information, see:

- Reflected UV Imaging - Dr. Austin Richards
- http://www.ultravioletcameras.com/pdf/NEARUV%202008.pdf
- http://www.crime-scene-investigator.net/uvchildphoto.html
- http://www.crime-scene-investigator.net/alternatelightsources.html
- http://www.crime-scene-investigator.net/fluoresceinmethod.html
- http://www.crime-scene-investigator.net/dv-photo.html

And, if your interests extend to IR photography:

http://www.crime-scene-investigator.net/Infrared_Photography_research_paper.pdf