ENHANCING NIGHT HIKES WITH TECHNOLOGY

UV, Lasers, bat detectors oh my!

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ULTRAVIOLET LIGHT
SCIENTIFIC JARGON:

- Ultraviolet (UV) is electromagnetic radiation with a wavelength from 10 nm to 400 nm, shorter than that of visible light but longer than X-rays. UV radiation is present in sunlight constituting about 10% of the total light output of the Sun. It is also produced by electric arcs and specialized lights, such as mercury-vapor lamps, tanning lamps, and black lights. Although long-wavelength ultraviolet is not considered an ionizing radiation because its photons lack the energy to ionize atoms, it can cause chemical reactions which causes many substances to glow or fluoresce. Consequently, the chemical and biological effects of UV are greater than simple heating effects, and many practical applications of UV radiation derive from its interactions with organic molecules.

- Electromagnetic radiation which causes many substances to glow or fluoresce

Short wave length: <300 nm

Long wave length: 320-400 nm
MOST COMMON UV USE BY HUMANS

• Blacklights – posters, parties, decorations (since the 60’s or 70’s)
• Disinfection – restaurants, water treatment, hospitals
• Pest control and detection – Bed bugs, scorpions bug zappers (more on insects in a moment)
• Bodily fluid detection – Crime scenes, pet waste, rodent detection
• Counterfeit and forgery detection – Money, stamps, driver’s licenses, passports, other documents, paintings, etc.
• Animal rearing – reptiles need UV to replenish vitamins and nutrients
• Curing – inks, adhesives, coatings, glues (Dentistry)
• Skin Tanning
WHY UV PREVENTIONS/PROTECTIONS ARE TAKEN BY HUMANS

10% of light from the sun made up of UV-A, UV-B and UV-C

UV-A and a little UV-B makes it through the atmosphere; UV-C is harmful and is generally reflected by the ozone layer

Organisms on earth have evolved to adapt to UV-A radiation and some UV-B; we also use protection

• Sun screen
• Sunglasses/Protective glasses
• UV protective clothing
ANIMALS USE UV

• Ultraviolet rays are invisible to all humans, but insects, birds, and some mammals can see near UV.

• Some animals, including birds, reptiles, and insects such as bees, can see near-ultraviolet wavelengths. Many fruits, flowers, and seeds stand out more strongly from the background in ultraviolet wavelengths as compared to human color vision. Scorpions glow or take on a yellow to green color under UV illumination, thus assisting in the control of these arachnids. Many birds have patterns in their plumage that are invisible at usual wavelengths but observable in ultraviolet, and the urine and other secretions of some animals, including dogs, cats, and human beings, are much easier to spot with ultraviolet. Urine trails of rodents can be detected by pest control technicians for proper treatment of infested dwellings. Reindeer are one known mammal that can see in the UV spectrum. They can deter predation due to this fact.

• Butterflies use ultraviolet as a communication system for sex recognition and mating behavior. For example, in the Colias eurytheme butterfly, males rely on visual cues to locate and identify females. Instead of using chemical stimuli to find mates, males are attracted to the ultraviolet-reflecting color of female hind wings.[102] In Pieris napi butterflies it was shown that females in northern Finland with less UV-radiation present in the environment possessed stronger UV signals to attract their males than those occurring further south. This suggested that it was evolutionarily more difficult to increase the UV-sensitivity of the eyes of the males than to increase the UV-signals emitted by the females.[103]

• Many insects use the ultraviolet wavelength emissions from celestial objects as references for flight navigation. A local ultraviolet emitter will normally disrupt the navigation process and will eventually attract the flying insect.

• Ultraviolet traps called bug zappers are used to eliminate various small flying insects. They are attracted to the UV and are killed using an electric shock, or trapped once they come into contact with the device. Different designs of ultraviolet radiation traps are also used by entomologists for collecting nocturnal insects during faunistic survey studies.
KEY TAKEAWAYS

• Ultraviolet rays are invisible
• insects, birds, and some mammals can see near UV
• fruits, flowers, and seeds stand out more strongly in ultraviolet wavelengths
• Scorpions glow
• the urine and other secretions of some animals, including dogs, cats, easier to spot with ultraviolet
• Butterflies use ultraviolet as a communication system for sex recognition and mating behavior
• Many insects use the ultraviolet wavelength emissions from celestial objects as references for flight navigation
• Ultraviolet traps called bug zappers are used to eliminate various small flying insects
Birds are very visually oriented - they use their sight to forage and hunt for food - and unlike human eyes, bird eyes can detect a fourth color.

Reindeer are one of the few mammals that can see in UV.* Only since they moved to the arctic – 10,000 years ago

*Other mammals such as mice, rats, other rodents, cats, possibly dogs and bats – also have receptors which can determine UV light.
UV light attracts night-flying insects, including many moths, beetles, and others. Many insects can see ultraviolet light, which has shorter wavelengths than light visible to the human eye. For this reason, a black light will attract different insects than a regular incandescent light. These insects navigate by keeping themselves aligned at a certain angle relative to a light source. Some people have postulated that since many flowers reflect UV light, bugs may be attracted to artificial light sources that also emit small amounts of UV because they mistake them for a flower, aka a food source.

Some insects fluoresce in UV light. This aids humans in pest detection. May be due to protection, mating or just a remnant from evolutionary stages.

Visible light

The way bees see in UV
BIOFLUORESCENCE

• Some organisms glow because of a different phenomenon called biofluorescence—the emission of light energy after absorption of light. Unlike bioluminescence, where organisms produce light from a chemical reaction, biofluorescent organisms have proteins that absorb energy from light and then reemit it at a lower energy or longer wavelength. Biofluorescence is also widespread across the tree of life: there are countless marine examples, including fish, jellyfish, and corals. Examples of biofluorescence on land include organisms such as butterflies, arachnids, parrots, and flowers. The adaptive functions of biofluorescence are likely similar to those of bioluminescence; however, it may also serve other functions such as helping to preserve coral health with antioxidant capabilities.
UV light has a high energy level and is harmful to living tissue, so many species have evolved "sunscreens". The most spectacular ones are found among lichens, which produce chemical substances that convert harmful UV radiation into lower-energy visible light. Hence, a white lichen can suddenly glow yellow, pink or blue. The green chlorophyll contained in lichen algae and plants also has a characteristic red fluorescence, so even lichens without "sunscreen" pigments might glow red under UV light.
ROCKS AND MINERALS

What is a Fluorescent Mineral?

• All minerals have the ability to reflect light. That is what makes them visible to the human eye. Some minerals have an interesting physical property known as "fluorescence." These minerals have the ability to temporarily absorb a small amount of light and an instant later release a small amount of light of a different wavelength. This change in wavelength causes a temporary color change of the mineral in the eye of a human observer.

• The color change of fluorescent minerals is most spectacular when they are illuminated in darkness by ultraviolet light (which is not visible to humans) and they release visible light.
How Glowing Tackle Attracts Fish

• Glowing fishing tackle mirrors actual biological triggers that encourage fish to bite.

• When fishing at night or in the gloaming — as dark and light mingle — savvy anglers turn to glowing attractants. In fact, luminous terminal tackle mirrors actual biological triggers that encourage fish to bite.

• “Light-mimicking bioluminescence [could] be a key reason for the fish attraction,” says NOAA fisheries biologist Erik Lang. “Of course the more senses you attack in the fish, the better the results in getting them to bite.”

• Many predatory fish, for instance, eat squid — a bait that commonly shimmers and changes color because of bioluminescence. Anglers have capitalized on that trait by using light sticks to target a known squid predator: the swordfish. Most of those colorful sticks illuminate in blues, greens and whites, or a coupling of more than one, to attract the deep-water billfish.

• Attraction comes down to optimal foraging theory, says Lang. “Fish are constantly looking for the highest reward and the lowest risk when it comes to prey items,” he says. “If a light is stuck in front of their face, they are going to, at the very least, check it out because of the potential that prey is there.”
BATS & BAT DETECTORS

The Echo Meter Touch app transforms the Module’s streaming data into audio that you can hear – in real-time. It shows you the bat calls on an interactive spectrogram, and it employs the latest Kaleidoscope Pro classifiers that instantly identify the most likely species of bat being detected. It uses GPS to mark recordings with your location and path, and of course, it saves the recordings as 16-bit WAV files that can be easily shared for collaboration or transferred to a Mac or PC for further study.
The evening bat (Nycticeius humeralis) is a species of bat in the vesper bat family that is native to North America.[2] Hunting at night, they eat beetles, moths, and other flying insects.
APPS & LASER POINTERS

• Green laser pointers are good for pointing out astronomical features and other things in the dark and daylight.

• Don’t not use where airplanes or other crafts frequent.

• There are a number of Apps for phones and tablets that can be used to enhance nighttime activities.