Safety Guidelines

ULTRAVIOLET RADIATION SOURCES IN THE LAB

Principal Investigator:	
Lab Location(s):	
Emergency Contact Information:	
Annual Review Date:	

These guidelines may be used as a template in developing a lab-specific standard operating procedure for the use of equipment with UV radiation sources or when using UV light sources in the lab.

Before working with sources of UV radiation in the lab, you must have:

- the approval from the PI;
- received specific training from the PI (or his/her designate) according to this SOP;
- completed UH lab safety training and Kaka'ako hazardous waste generator training;
- signed this SOP as documentation that you understand the hazards and have been trained in how to work with safely with sources of UV radiation found in the lab.

Statement of Understanding and Compliance

I confirm that I have read and understand this SOP and will comply with the procedures and policies.

Name: **Signature:** **Date:**

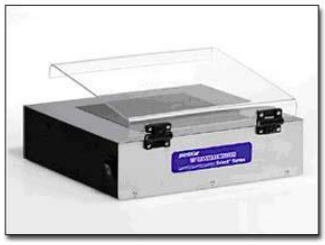
Ultraviolet (UV) light is a non-ionizing radiation, invisible to the naked eye, that falls within the 100-400 nanometer wavelength region of the electromagnetic spectrum. UV rays are commonly broken down into three main regions:

Region	Wavelength (nm)	Hazard Potential	Damage Potential (high exposure)
UV-A	315 – 400	Lowest	Cataracts
UV-B	280 – 315	Mid-High	Skin or eye burns
UV-C	100 – 280	Highest	Skin or eye burns

The main source of UV exposure is the sun. Exposure from the sun is typically limited to the UV-A region, since the earth's atmosphere protects us from the more harmful UV-B and UV-C rays. However, additional precautions should be taken when working in a laboratory because common lab equipment can generate concentrated UV radiation in all three regions. Ultraviolet radiation is found in biological safety cabinets, light boxes, and crosslinkers in many University laboratories and in some patient care rooms. One of the problems in working with UV radiation is that the symptoms of overexposure are not immediately felt so persons exposed do not realize the hazard until after the damage is done.

1. COMMON SOURCES OF UV RADIATION IN THE LABORATORY

UV Light Box / UV Transilluminators:
Commonly used for visualizing nucleic acids (DNA or RNA) that have been stained with chemicals Ethidium Bromide or Sybr Green. This "box-shaped" piece of equipment contains an ultraviolet lamp under a glass top. The clear glass face allows the UV light to illuminate the gel while potentially exposing the user. To reduce the risk of injury and exposure, most models come equipped with a shield to filter the UV light while visualizing your gel. It is important that you ensure your shield has been manufactured and rated for protection against UV light. Most of these transilluminators are stationary but there are hand-held types that carry the same hazards as the stationary models.



UV Crosslinker:
This equipment is used to attach nucleic acids to a surface or membrane following blotting procedures, such as Southern blotting, Northern blotting, dot blotting, and Colony/Plaque lifts. A 254 nm wavelength is commonly used to maximize this adherence. Crosslinkers are equipped with a door safety interlock which prevents operation of the machine when the door is open (similar to microwaves). If the interlock system is not functioning correctly, do not use the equipment and contact the manufacturer.

Germicidal Lamps (Biosafety Cabinets):
Found and used in laminar air flow hoods or biosafety cabinets to disinfect the interior surfaces of the cabinet before and after use. Germicidal lamps emit radiation in the UV wavelength range of 254 nm.

Always avoid working in or around the safety cabinet while the germicidal lamp is on. Always close sash completely when the germicidal lamp is on for extra protection. Even a small opening at the bottom of the sash can exceed occupational exposure standards several feet away. While some UV lamps are built into the cabinet (stationary) there are hand held devices as well that carry the same hazards.

Other UV Radiation Generating Equipment:

Spectrometer	Image Stations
Spectrophotometer	Mineralight (hand held)
Fluorescence Detector	UV Microscopes
Fluorometer	UV Stratalinker
HPLC Machines	UV-VIS Detector

2. HEALTH RISKS, POTENTIAL ROUTES OF EXPOSURE, SYMPTOMS OF EXPOSURE

Overexposure to UV radiation often has no immediate warning signs. Symptoms of overexposure, including different stages of erythema (sunburn) or photokeratitis (welder's flash) typically appear 4-24 hours after an exposure has occurred. The UV light levels found in laboratory UV equipment also greatly exceed the levels found in nature.

Skin:
UV radiation can initiate erythema within exposed skin. This "sunburn" consists of redness ulcerations that can vary in severity. This can be caused by only a few seconds of UV exposure. Symptoms also vary due to one's genetic background. Pale to fair skin individuals are more prone to sunburns. Various medications (i.e. birth control) and certain foods (i.e. celery root, figs) can also increase your photosensitivity to UV radiation. Chronic exposure to UV radiation includes premature skin aging, wrinkles, and skin cancer.

Eye:
The danger to the eye is enhanced by the fact that light can enter from all angles around the eye and not only in the direction you are looking. UV radiation exposure can damage the cornea, the outer protective coating of the eye. Photokeratitis is a painful inflammation of the eye caused by UV radiation-induced lesions on the cornea. Symptoms include a "sand-like" feeling in the eye that can last for several days. The lens can also be damaged, but since the cornea acts as a filter, the chances are reduced. This should not lessen the concern over lens damage because cataracts are the direct result of lens damage. Chronic exposures to UV radiation can lead to the formation of cataracts.

3. PERSONAL PROTECTIVE EQUIPMENT

- **Eye protection** should be worn at all times when there is potential for UV exposure. Eyeglasses should be ANSI-Z87 rated and provide protection from side exposure via a side lens or "wrap around" lens. Normal eye protection, prescription glasses, or contacts offer little to no protection. Look for the *Z 87.1* label on the lens for appropriate protection.

- **Full face shields** should be worn in addition to safety glasses or goggles. Face shields protect your whole face, especially under the chin where severe skin burns can occur in a short time exposure. A full face shield is the appropriate protective equipment to wear especially when working with UV light boxes for more than a few seconds.

- **Gloves** protect your hands from being exposed not only from the UV light but from the hazards of chemicals being worked with. Nitrile gloves may be used for UV protection.

- **Lab Coats** protect exposed skin and arms from UV exposure.

4. ENGINEERING CONTROLS:

- **Containment/Location:** Store UV equipment in a separate room or low traffic area in the lab. To avoid exposure to other unprotected employees, avoid placing equipment in the direct vicinity of desk areas or near other equipment used frequently. The use of shields, curtains, UV-radiation absorbing glass, or plastic is recommended.

- **Interlocks:** Some equipment come with interlocking devices to prevent the operation of the equipment without the use of safety equipment. Most biosafety cabinets will have an interlocking feature so the UV light will only operate if the sash is completely down. Ensure interlocks are not tampered with and are working properly. They should also be replaced or repaired immediately if defective.

- **Eliminating Reflection:** Many surfaces, especially those that are shiny, easily reflect UV-radiation. To reduce the intensity of reflections, painting problematic surfaces with non-UV radiation material is effective.

5. ADMINISTRATIVE CONTROLS:

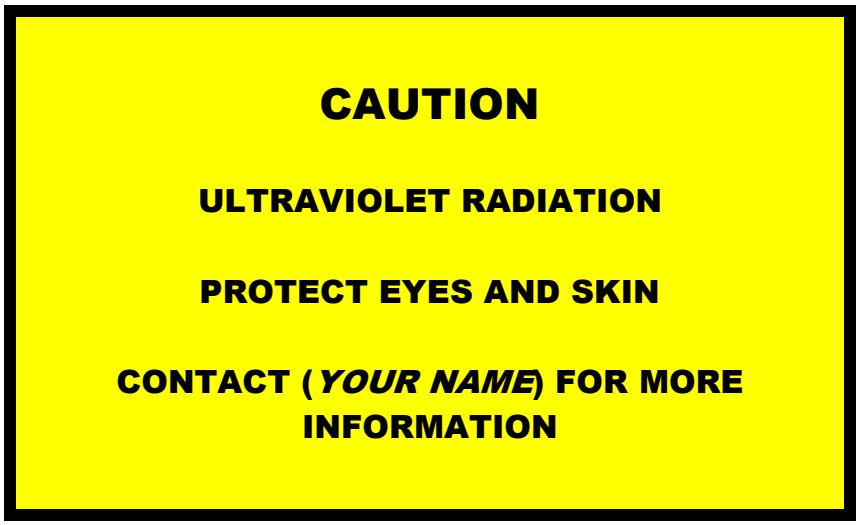
- **Training:** All personnel working in the lab, regardless of whether they use the equipment or not, should be trained and familiarized with the correct and safe way of using UV equipment, as well as the hazards associated with it. The manufacturer (user's guide) of the equipment and Kaka'ako EHSO can assist employees on safe operating procedures. At a minimum, lab personnel should be familiar with the warning signs, protective equipment, and symptoms of exposure of working with or around UV light and UV equipment.

- **Substituting Ethidium Bromide:** Use an alternative chemical, such as EvaGreen, to allow DNA to fluoresce when exposed to visible light. This eliminates not only the use of UV light but the use of hazardous chemicals, although it is not highly preferred by researchers due to weak bonding with the nucleic acids and therefore poor visual intensity.

- **Access:** Access to the UV equipment should be limited to trained employees who are directly working with it. Limiting the distance and time an employee works with or around UV radiation producing equipment significantly reduces the risk for injury and exposure. If experiments using UV radiation will be conducted in shared spaces, all occupants must receive prior notification and warning signs must be clearly posted.

- **Warning Signs and Labels:** Most incidents of overexposure to UV radiation result from employees not being aware of the hazards associated with UV producing equipment. To avoid employees from

being unknowingly overexposed, all UV equipment should be labeled with a hazard sign (examples shown). Post warning signs on entrances to spaces in which experiments involving UV radiation will take place.



5. EMERGENCY PROCEDURES

If medical attention is needed due to overexposure to UV radiation to eyes or skin, contact your supervisor and report to the nearest medical clinic. All incidents to UV exposure must be reported to the Kaka'ako Environmental Health & Safety Office (692-1854 / 692-1855).