ISE 112
Occupational Health for Engineers

Nonionizing Radiation

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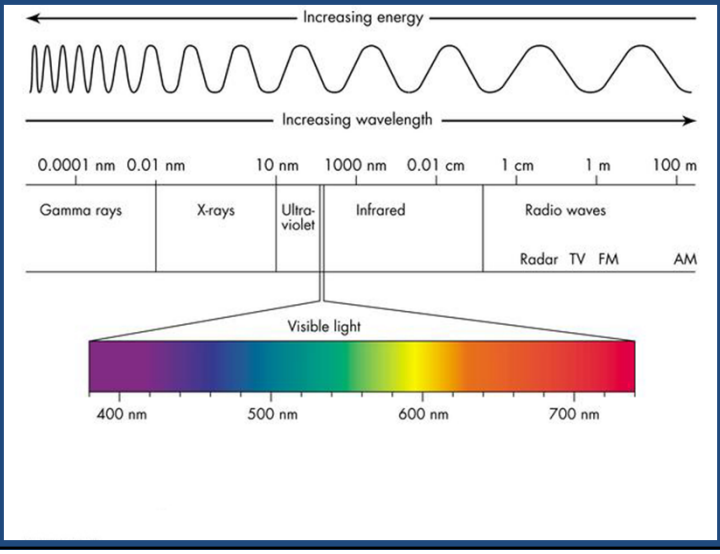
The Electromagnetic Spectrum and Nonionizing Radiation



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Ultra Violet Light

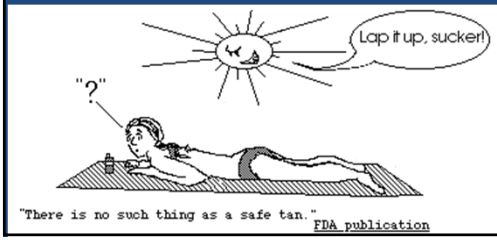
Health effects of UV-B light.

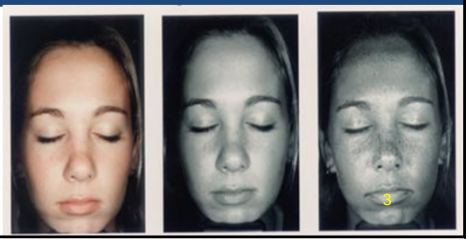
Genetic damage DNA absorbs UV-B light and the absorbed energy can break bonds in the DNA. **Genetic damage of the DNA can lead to skin cancers.**

- Genetically significant doses of solar radiation could penetrate as far as 9 feet into non-turbulent ocean water.

The Skin Cancer link:

- There appears to be a correlation between brief, **high intensity exposures** to UV and the eventual appearance (as long as 10-20yrs!) of melanoma.
- **Twice as many deaths due to melanomas are seen in the southern states** of Texas and Florida, as in the northern states of Wisconsin and Montana.





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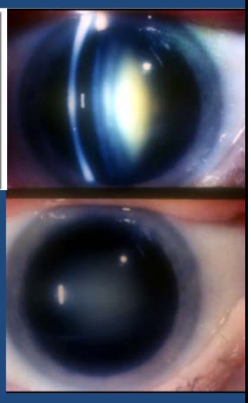
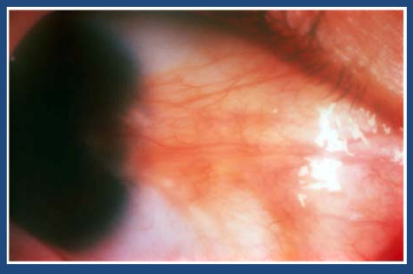
Ultra Violet Light

Band	Wavelength	Primary Visual Hazard	Other Visual Hazards	Other Hazards
UV-A	315-400nm	cataracts of lens		skin cancer, retinal burns
UV-B	280-315nm	corneal injuries	cataracts of lens, photokeratitis	erythema, skin cancer
UV-C	100-280nm	corneal injuries	photokeratitis	erythema, skin cancer



"Arc Welders Flash" Corneal Burns and Retina Damage

- Welders suffer from color-perception deficiencies due to retina damage.
- Photokeratitis



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What workers are at risk?

All outdoor workers potentially exposed to the sun's ultraviolet radiation are at risk, including:

- agricultural workers
- farmers
- horticultural workers
- maintenance workers
- pipeline workers
- ranchers
- athletes
- fishermen
- landscapers
- military personnel
- police
- ski instructors
- brick masons
- gardeners
- lifeguards
- oilfield workers
- postal carriers
- sailors
- construction workers
- greens keepers
- loggers
- open-pit miners
- railroad track workers
- surveyors

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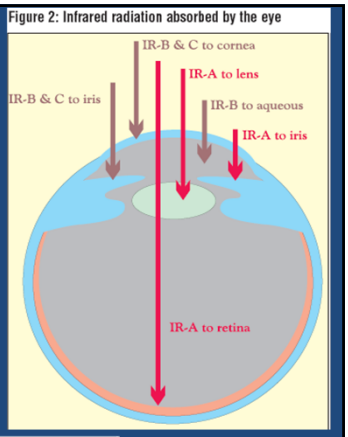
Infra Red

- Burn to Skin, permanent capillary dilation, skin always looks red.
- Eye Hazard: IR absorbed in the lens of the eye, causing cataracts, aka glassblowers cataracts.



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Microwave Radiation

The polar ends of a molecule tend to align themselves and oscillate in step with the oscillating electrical field of the microwaves.

- Collisions and friction between the moving molecules result in heating.
- Broadly, the more polar a molecule, the more effectively it will couple with (and be influenced by) the microwave field.
  - A compound, such as water or liquid ammonia, that is composed of polar molecules. Polar solvents can dissolve ionic compounds or covalent compounds that ionize.
  - *Nonpolar solvents*, such as benzene, will only dissolve nonpolar covalent compounds.

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Microwave Radiation

Produces heat in aqueous systems.

- Power densities of > 100 mW per square centimeter for 1 hour or more at frequencies from 1.2 to 24.5 10^9 Hz **can affect body temperature, produce cataracts.**
  - Skin Burn
  - Eye hazards: cataracts by absorption of energy in the lens.
- Power densities < 100 mW/ sq cm produce **no biological affect.**

OSHA Standards: Continuous and Intermittent Exposures.

- Power density: 10mW / sq cm for periods over a 6 minutes average exposure time.
- Energy density: 1 mW - hr / sq cm

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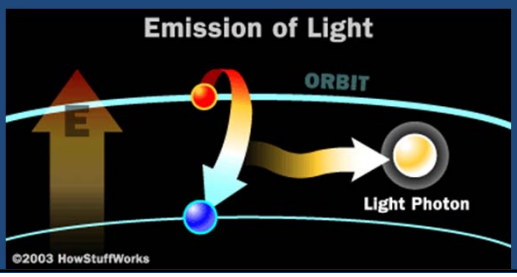
Laser

Light Amplification by Stimulated Emission of Radiation,

- The light released is **monochromatic.**
- The light released is **coherent**. It is “organized” -- each photon moves in step with the others.
- The light is very **directional**.
  A laser light has a very tight beam and is very strong and concentrated.



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Laser Classifications

Lasers are classified into four broad areas depending on the potential for causing **biological damage**.

- **Class I** - These lasers cannot emit laser radiation at known hazard levels.
- **Class I.A.** - This is a special designation that applies only to lasers that are "not intended for viewing," such as a supermarket laser scanner. The upper power limit of Class I.A. is 4.0 mW.
- **Class II** - These are low-power visible lasers that emit above Class I levels but at a radiant power not above 1 mW. The concept is that the human aversion reaction to bright light will protect a person.
- **Class IIIA** - These are intermediate-power lasers (cw: 1-5 mW), which are hazardous only for intrabeam viewing. Most pen-like pointing lasers are in this class.
- **Class IIIB** - These are moderate-power lasers.
- **Class IV** - These are high-power lasers (cw: 500 mW, pulsed: 10 J/cm2 or the diffuse reflection limit), which are hazardous to view under any condition (directly or diffusely scattered), and are a potential fire hazard and a skin hazard. Significant controls are required of Class IV laser facilities.

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Laser Hazards

Laser Hazards dependent on frequency and power density.

Burn Hazards

- Eye Hazards: Retinal damage.
- Skin Hazards

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314 HAZARDS AND THEIR CONTROL

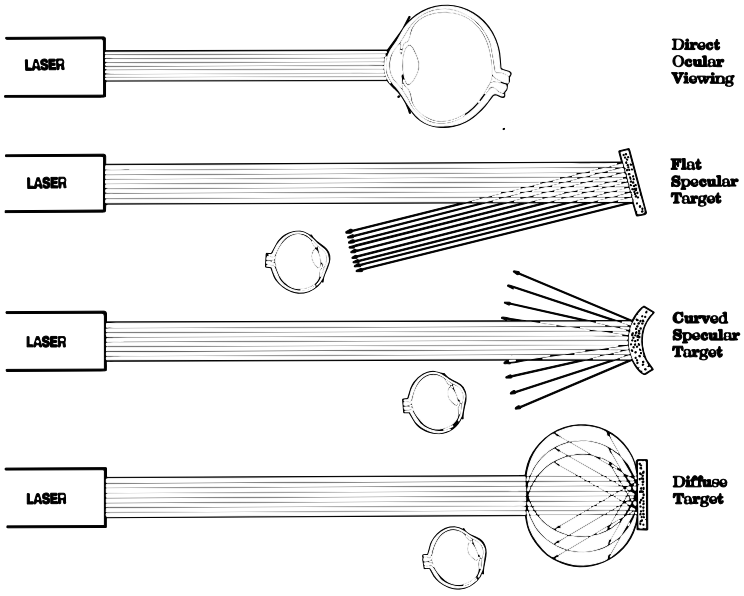

Figure 21-3 Laser radiation may be viewed (a) directly or (b) – (d) reflected; (b) Flat specular reflection; (c) curved specular reflection; (d) diffuse reflection.

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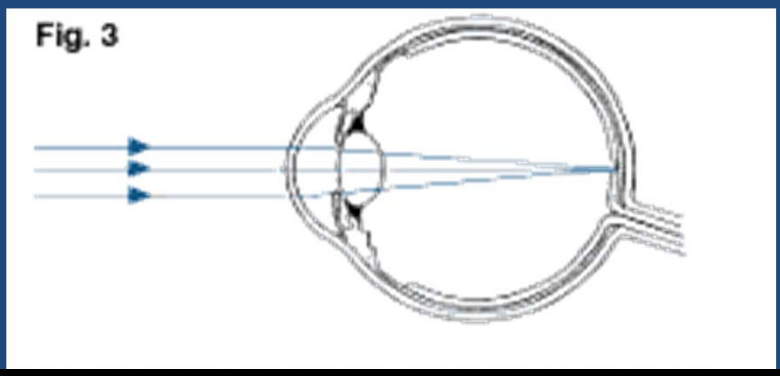
Laser Eye Hazard



The opticall gain of the eye is about 100,000 times.

If irradiance entering the eye is 1 mW/cm^2, the irradiance at the retina will be 100 W/cm^2.

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Laser Pointer Tips:

- Never shine a laser pointer at anyone.
  Laser pointers are designed to illustrate inanimate objects.
- Do not allow minors to use a pointer unsupervised.
  Laser pointers are not toys.
- Do not point a laser pointer at mirror-like surfaces.
  A reflected beam can act like a direct beam on the eye.
- Be aware of irresponsible uses of pointers so the psychological effect will be minimized if you are illuminated by one.
- Do not purchase a laser pointer if it does not have a caution or danger sticker on it identifying its class.
  Report suspicious devices to the FDA.

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The End

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