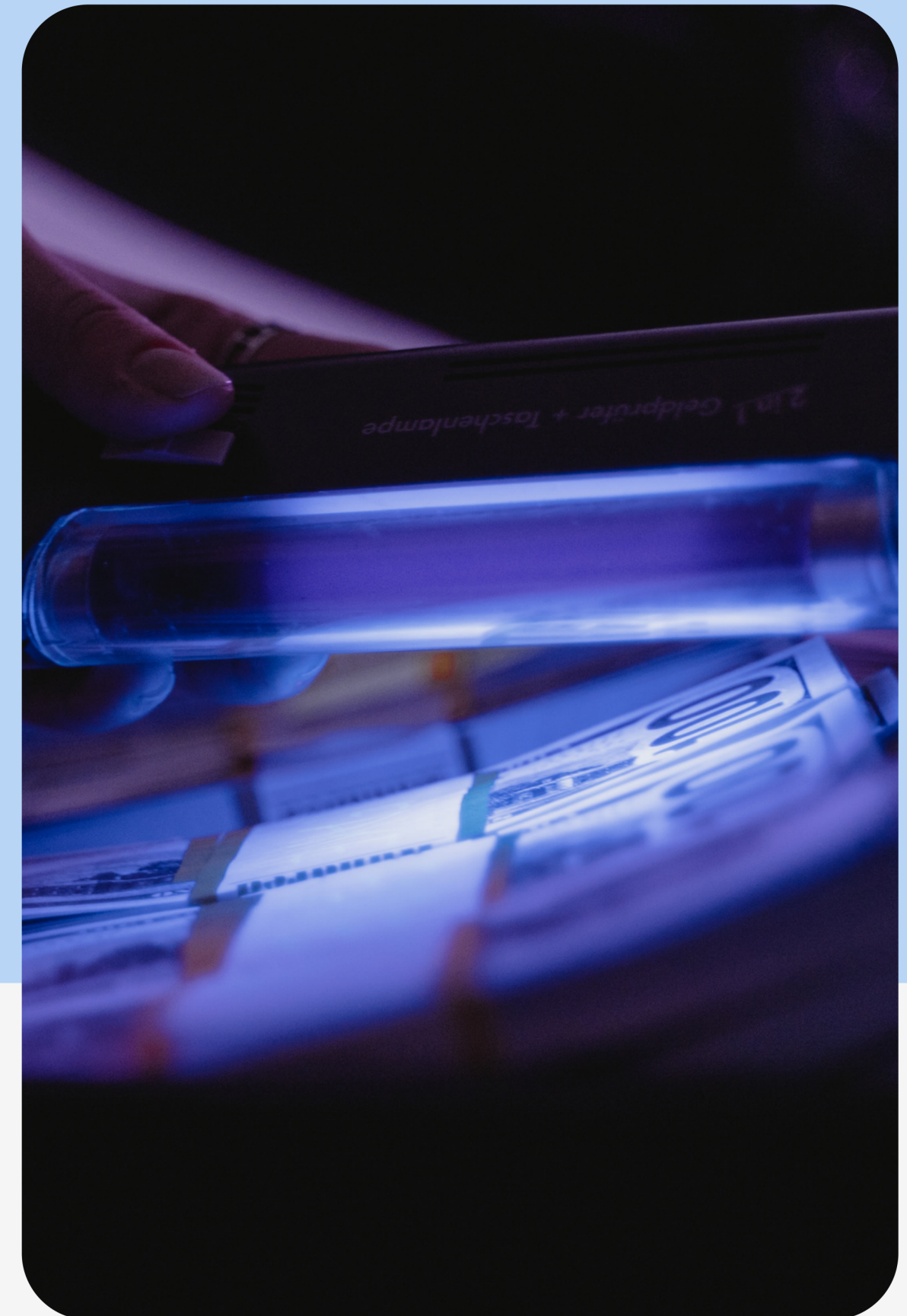


Biophysics

# Spectral regions of UV-radiation and their effects on human health

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# Ultraviolet

Ultraviolet (UV) is a form of electromagnetic radiation with

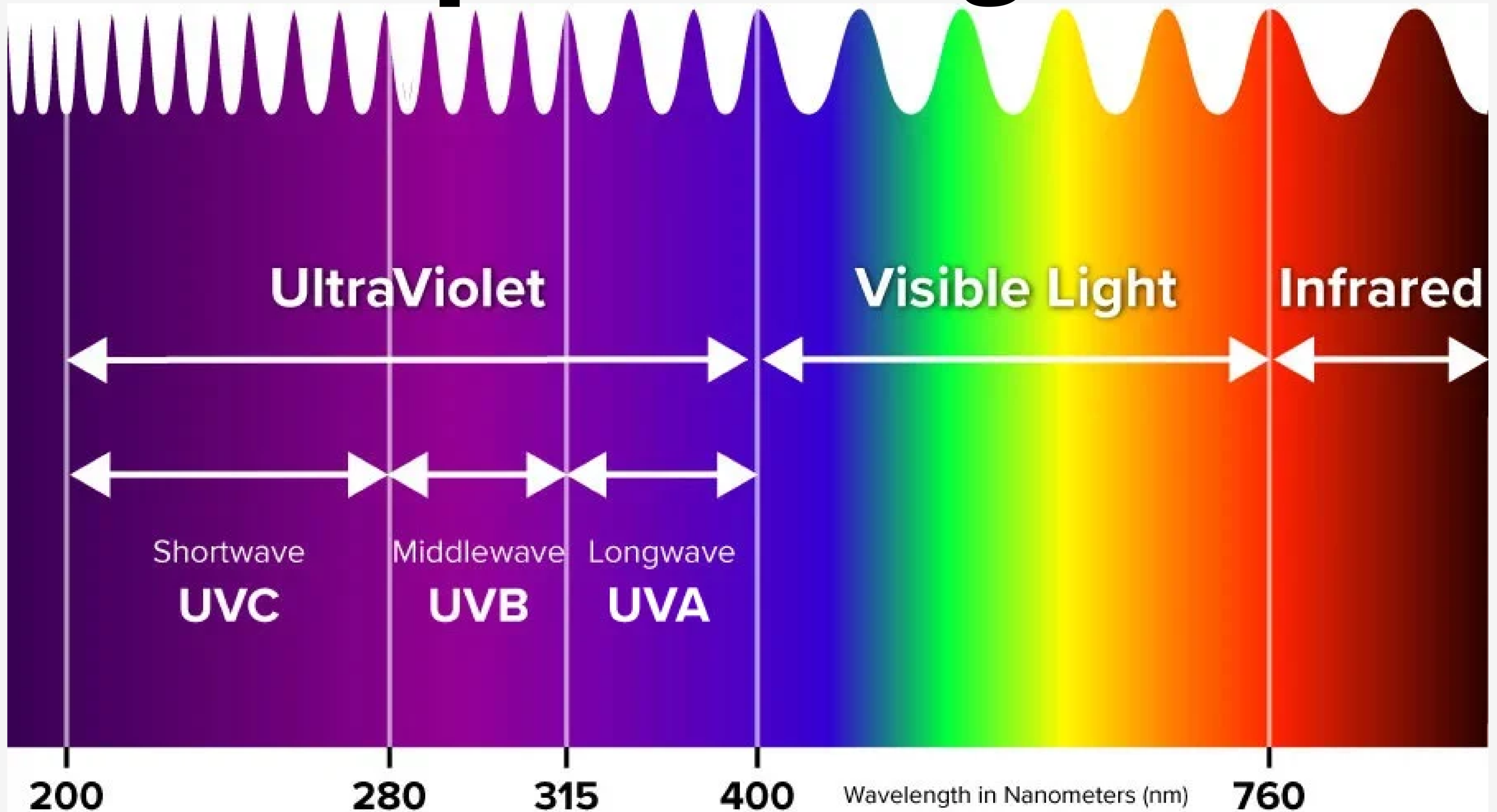
- wavelength from 100-200 nm to 400 nm
- shorter than that of visible light, but longer than X-rays.
- constitutes about 10% of the total electromagnetic radiation output from the Sun.



# UV SPECTRUM

- the spectrum of light recognized as ultra violet light is further divided into three subgroups, UVA, UVB, and UVC, with UVA rays having the shortest wave length and UVC having the longest
- Keep in mind that the longer the wavelengths of a light on the ultraviolet section of the electromagnetic spectrum, the closer it is to what we know as visible light

# UV spectral regions



# UVA

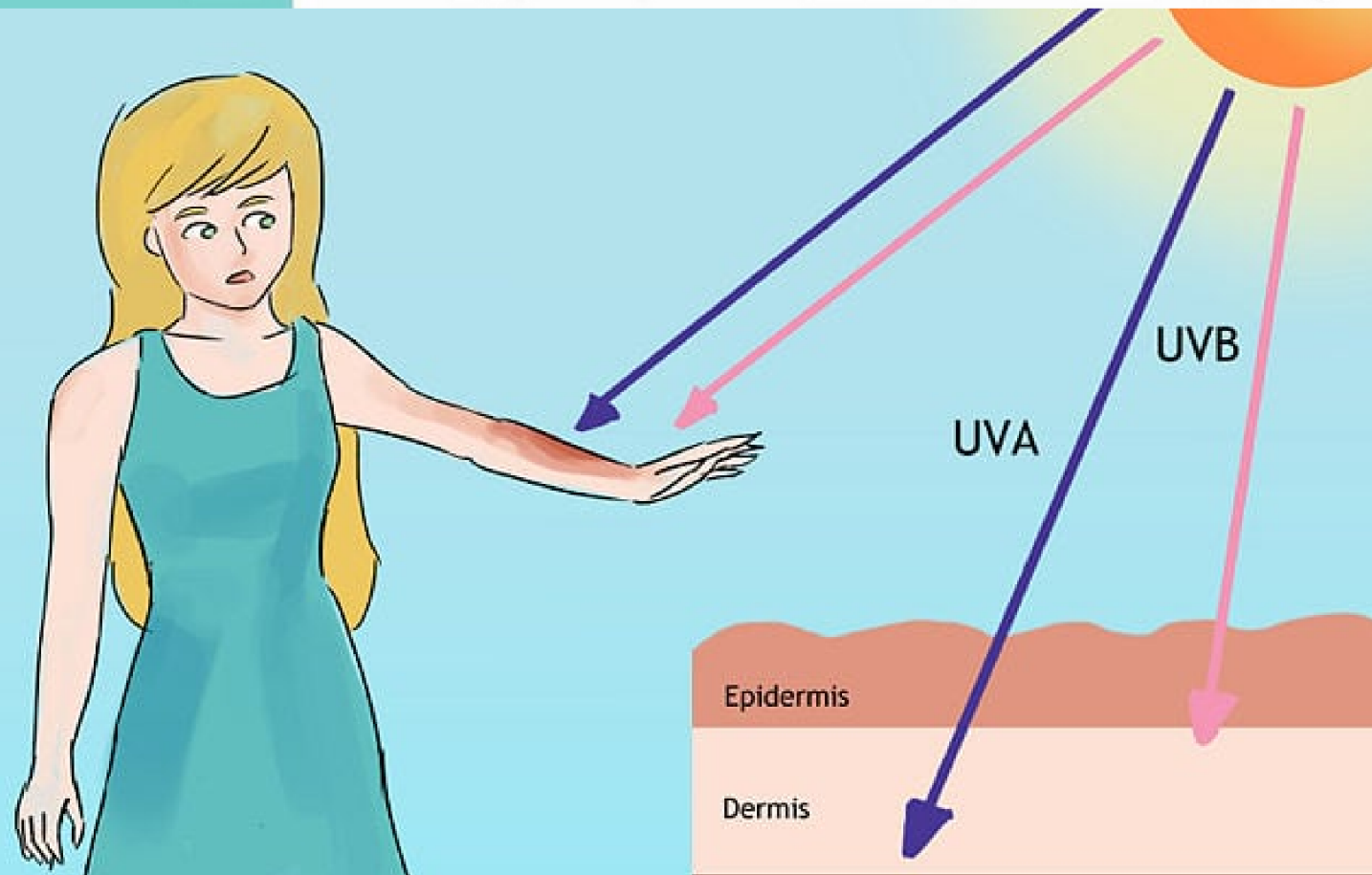
UVA is longest in wavelength

Penetrates deep into the skin

Causes aging, wrinkling, loose skin, and sun spots

Sometimes can affect DNA, which increases risk of skin cancer

Prevalent in all seasons/ all times of day



# Cancer

UVA rays have **the least energy** among UV rays. Although UVA is generally far less carcinogenic than UVB radiation, it is present more **abundantly in sunlight** than UVB radiation (> 20 times radiant energy) and can, therefore, contribute appreciably to the carcinogenicity of sunlight.

# DNA

In contrast to UVB, UVA radiation is hardly absorbed by DNA. UVA (and also UVB) cause indirect **damage to DNA** via absorption of photons by **non-DNA chromophores**. This generates ROS (e.g. oxygen, hydrogen peroxide) that oxidize the DNA bases causing mutations.

# Immunity

**UVA1** rays, which are present in the majority in sunlight, lead to a threefold **greater immunosuppression** than UVB rays at low doses, which can be received during normal daily activities, whereas **UVA2** has **not been shown to be immunosuppressive** in humans

# UVB light

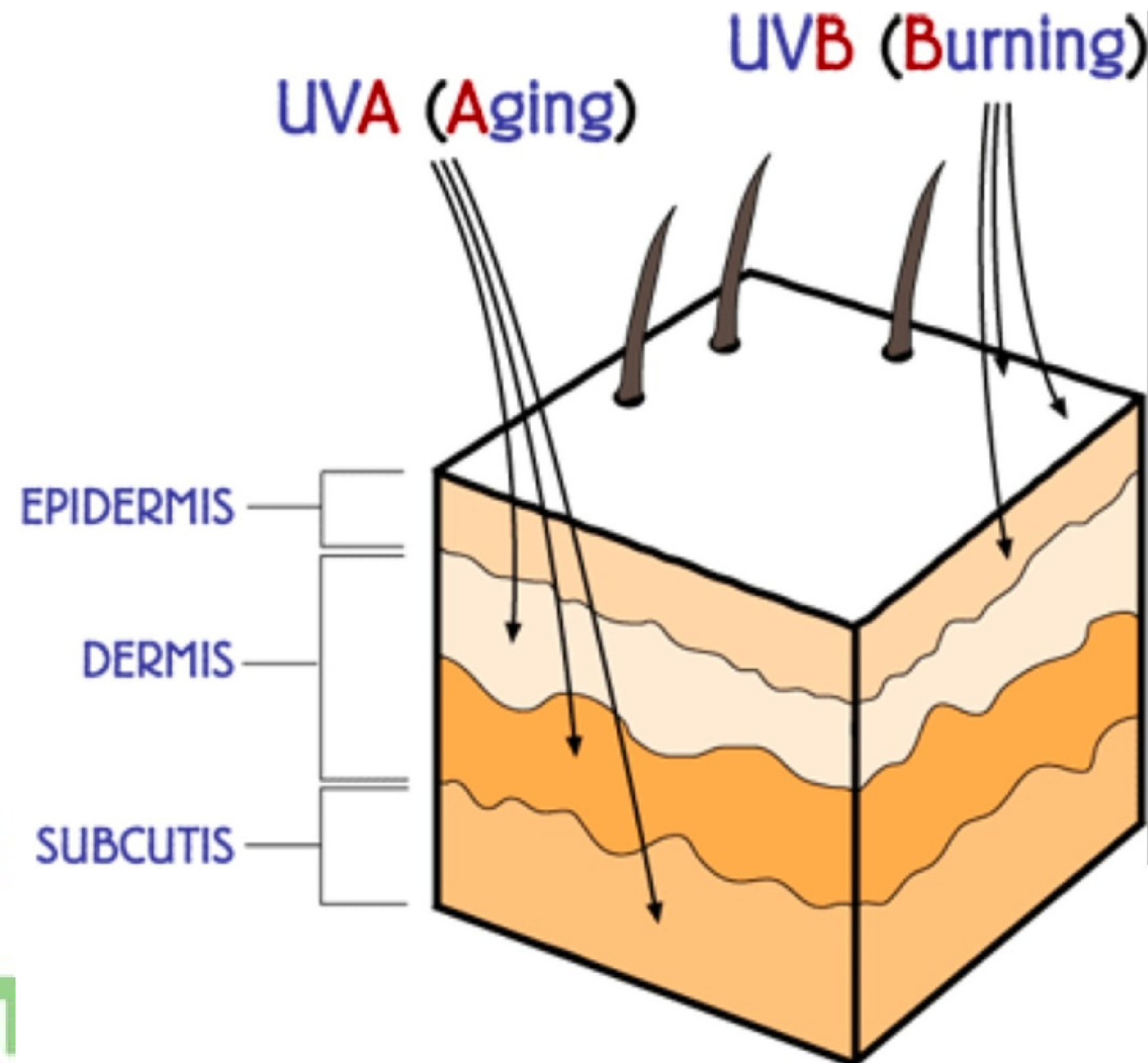
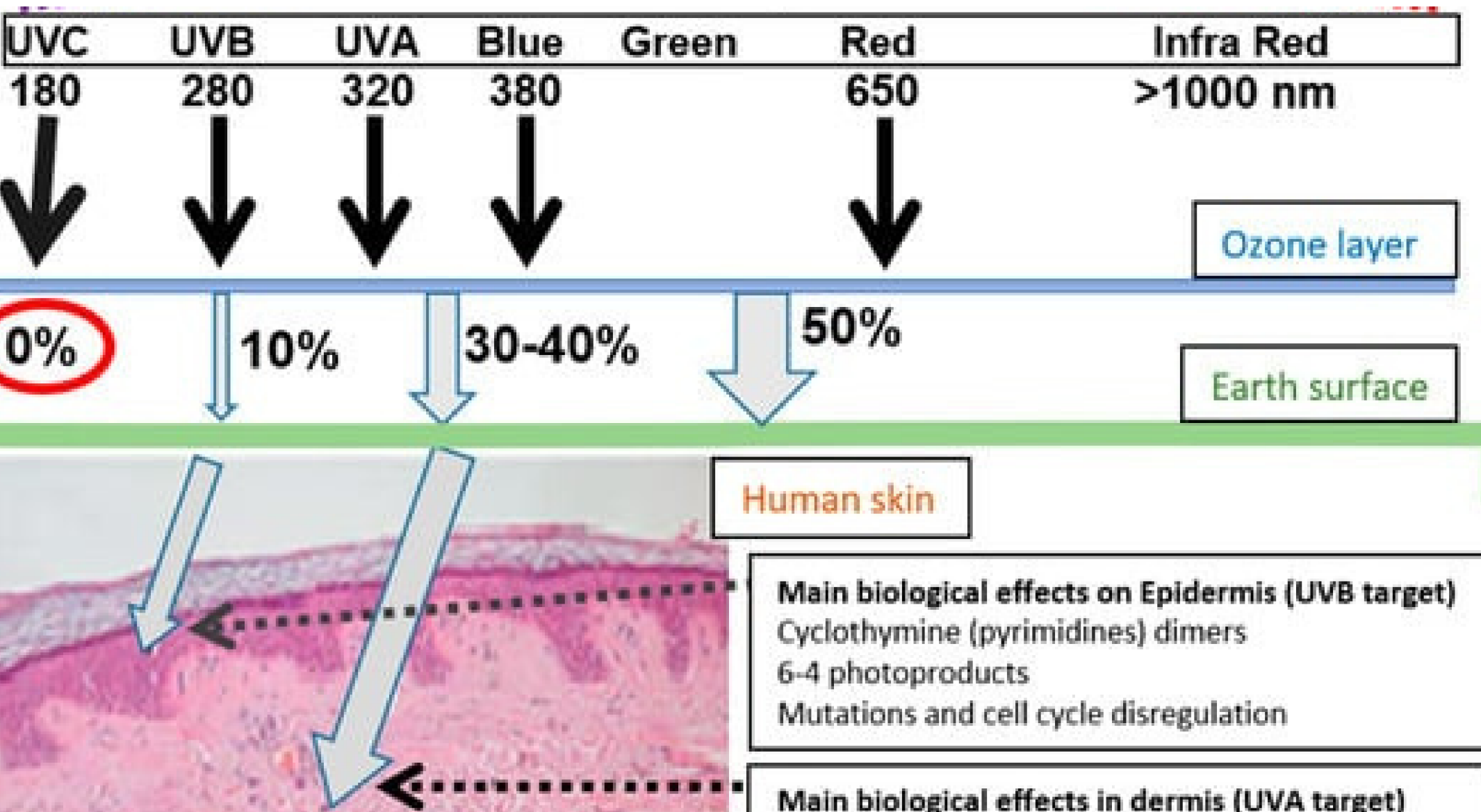
UVB rays have slightly more energy than UVA rays. They can damage skin cells' DNA directly, and are the main rays that cause sunburns. They are also thought to cause most skin cancers.

## UVB

- Responsible for sunburn
- directly damage DNA & stimulate melanin production
- Longer wavelength penetrate deeper into skin but contain more energy.
- Accounts for less than 5% of total UV radiation
- Intensity higher during summer months during midday hours.
- Uable to pass thorough glass
- Measured by sun protection factor (SPF)

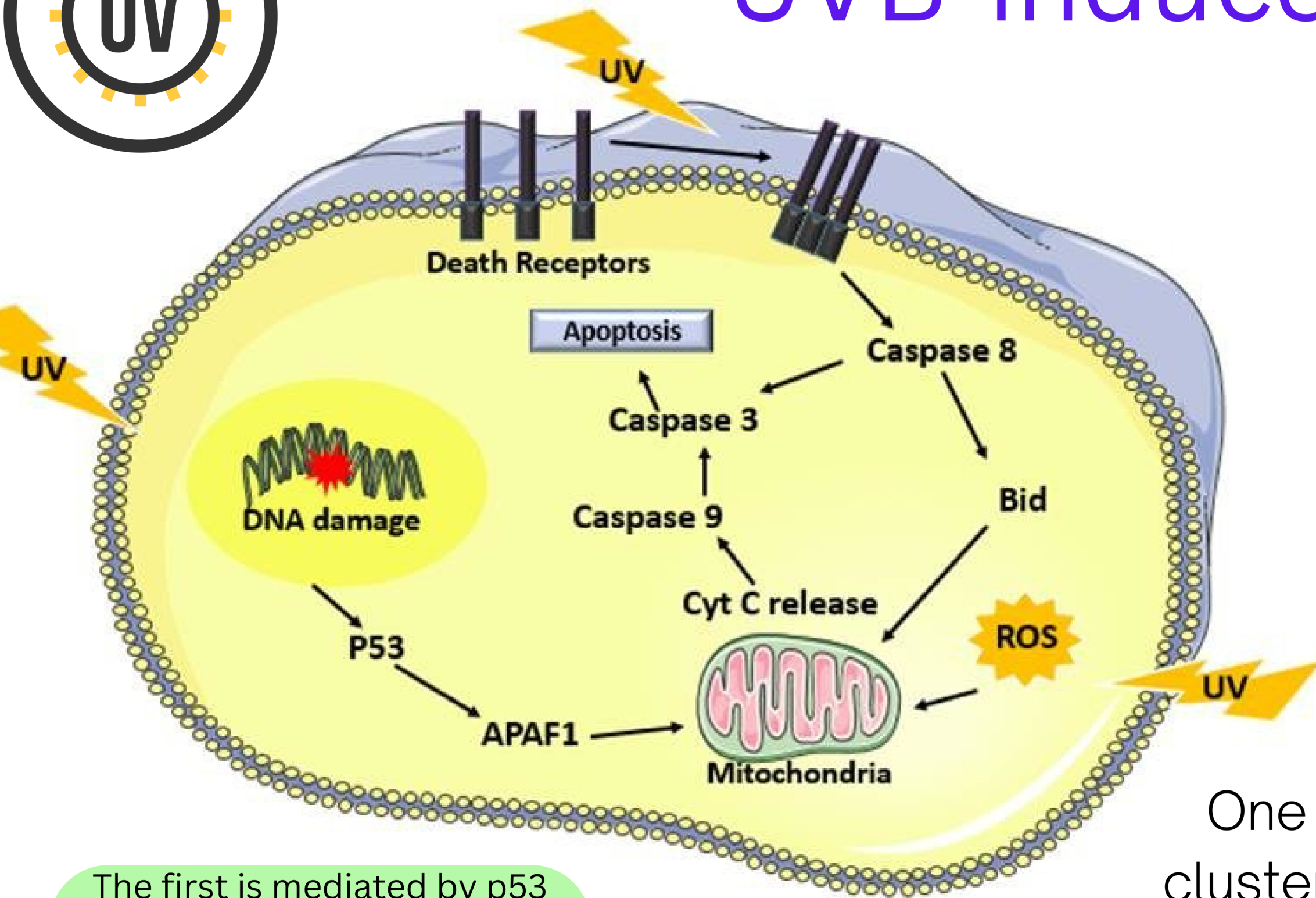
# UVB effects on human skin

UVB penetrates mainly the epidermis.





# UVB-induced apoptosis



**UV irradiation triggers cell apoptosis by three different mechanisms.**

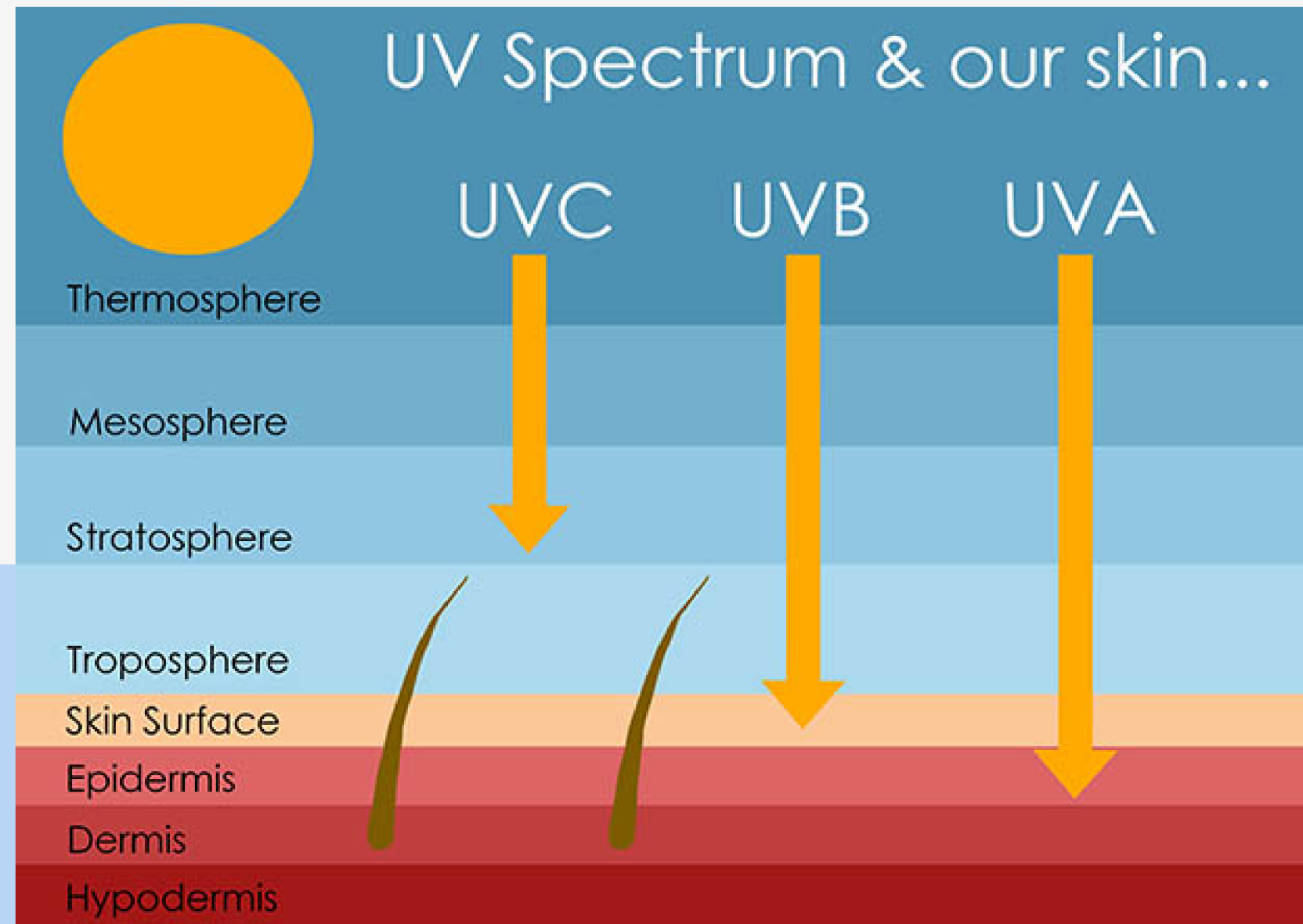
Reactive oxygen species generated by UV also induce apoptosis by enabling the release of cytochrome c from the mitochondria.

The first is mediated by p53 activation due to DNA damage that ultimately leads to the activation of caspase 9 followed by caspase 3

One final mechanism is via UV mediated clustering of death receptors leading to the activation of caspase 8.

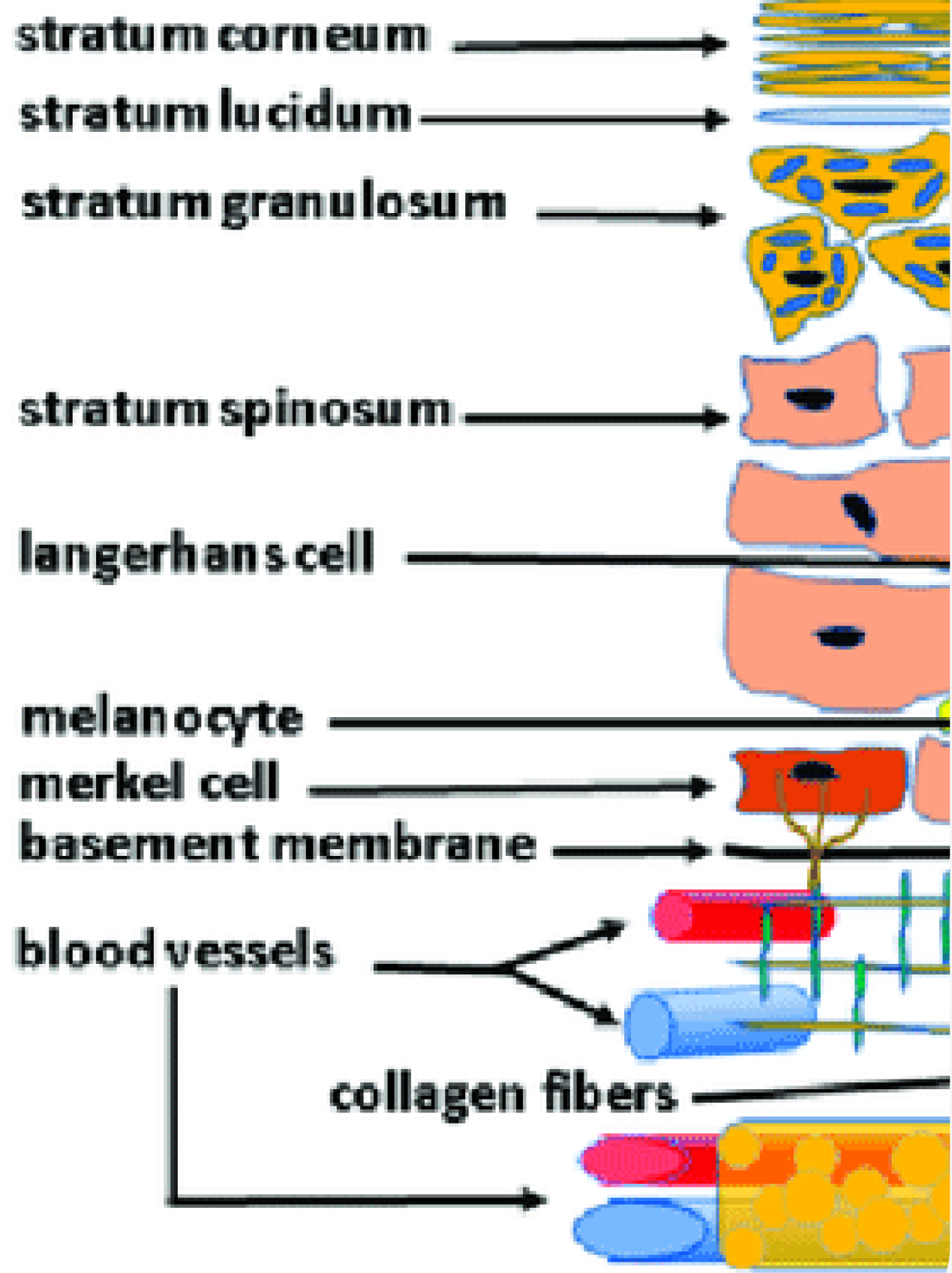


## What is UVC Radiation?



- UVC radiation is the highest energy portion of the UV radiation spectrum.
- UVC radiation from the sun does not reach the earth's surface because it is blocked by the ozone layer in the atmosphere. Thus, the only way that humans can be exposed to UVC radiation is from an artificial source like a lamp or laser.

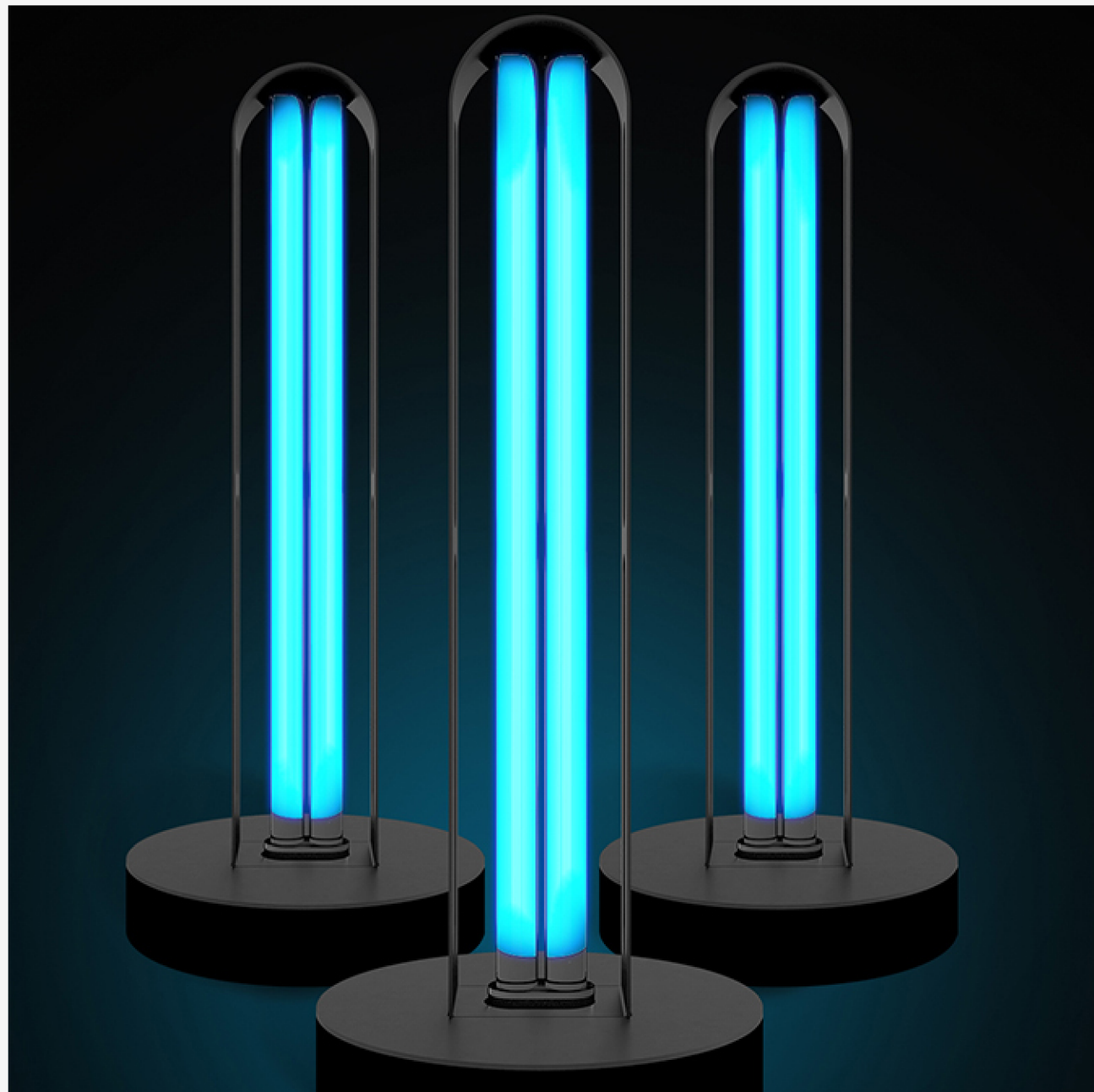
Blocked by ozone layer  
and do not reach the  
surface of the earth



- UVC radiation can cause severe burns of the skin and eye injuries (photokeratitis). Avoid direct skin exposure to UVC radiation and never look directly into a UVC light source, even briefly.
- Skin burns and eye injuries from UVC exposure usually resolve within a week with no known long-term damage.

**Since the penetration depth of UVC radiation is very low, the risk of skin cancer, cataracts or permanent vision loss is also thought to be very low.**

# What are the risks associated with using some UVC lamps?



- Some UVC lamps emit small amounts of UVB radiation. Therefore, exposure to a high dose or prolonged low dose of radiation from some UVC lamps can potentially contribute to effects like cataracts or skin cancer that are caused by cumulative exposure to UVB radiation.
- Additionally, some UVC lamps generate ozone which could cause irritation to breathing passages (that is nose, throat, and lungs), particularly for those who have respiratory sensitivity such as asthma or allergies. Exposure to high levels of ozone gas may also worsen chronic respiratory diseases, such as asthma, or increase vulnerability to respiratory infection.

## Conclusion

Both UVA and UVB rays can cause damage to your skin. Sunburn is a sign of short-term overexposure, while premature aging and skin cancer are side effects of prolonged UV exposure.

Certain oral and topical medicines, such as antibiotics, birth control pills, benzoyl peroxide products, and cosmetics, may increase skin and eye sensitivity to UV in all skin types. Check the label and ask your doctor for more information.

Sunlight is not the only source of UV radiation you may encounter. Other sources include:

- Tanning booths
- Mercury vapor lighting (often found in stadiums and school gyms)
- Some halogen, fluorescent, and incandescent lights
- Some types of lasers