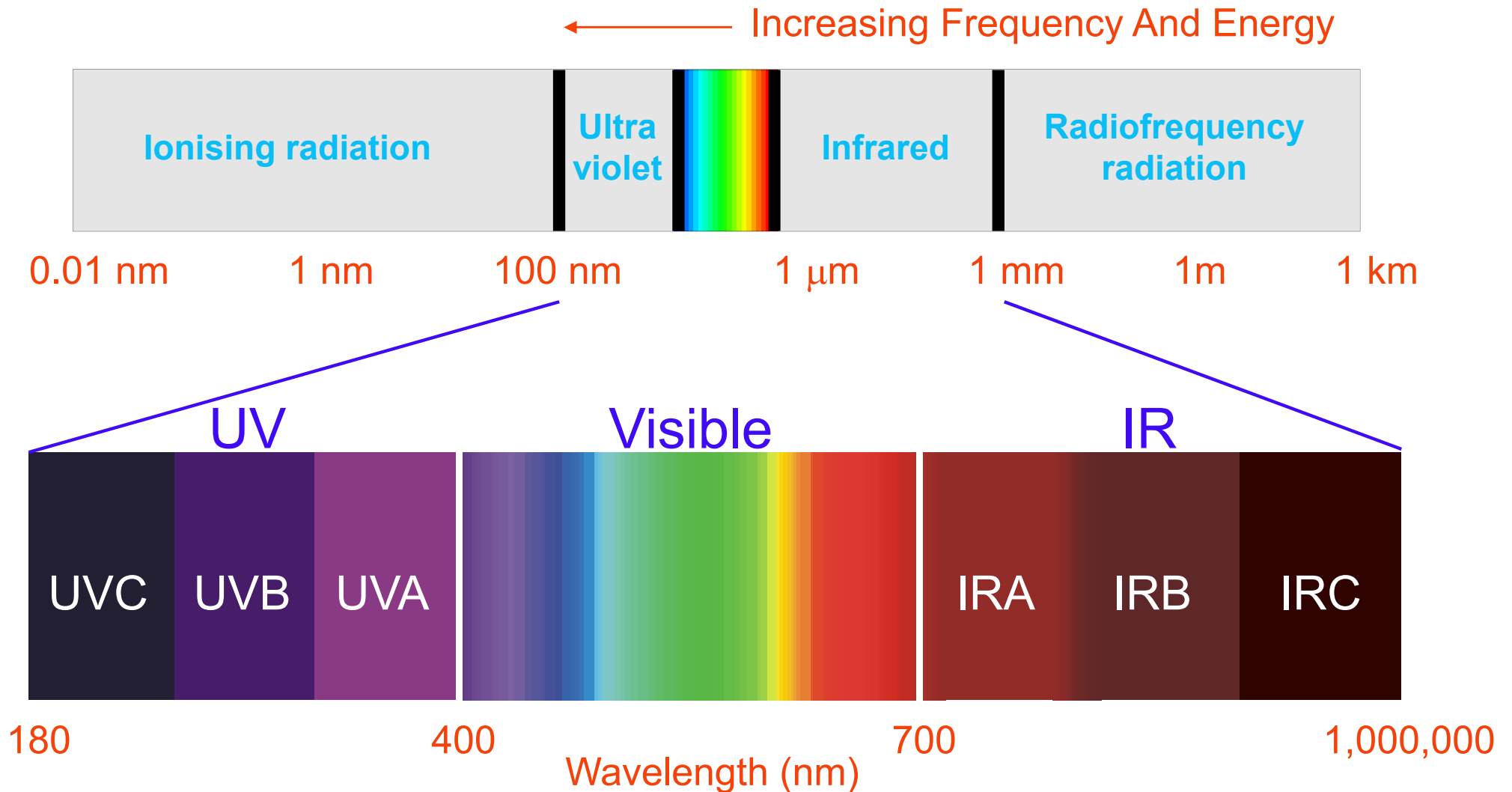


Update on Health Effects of UV Exposure

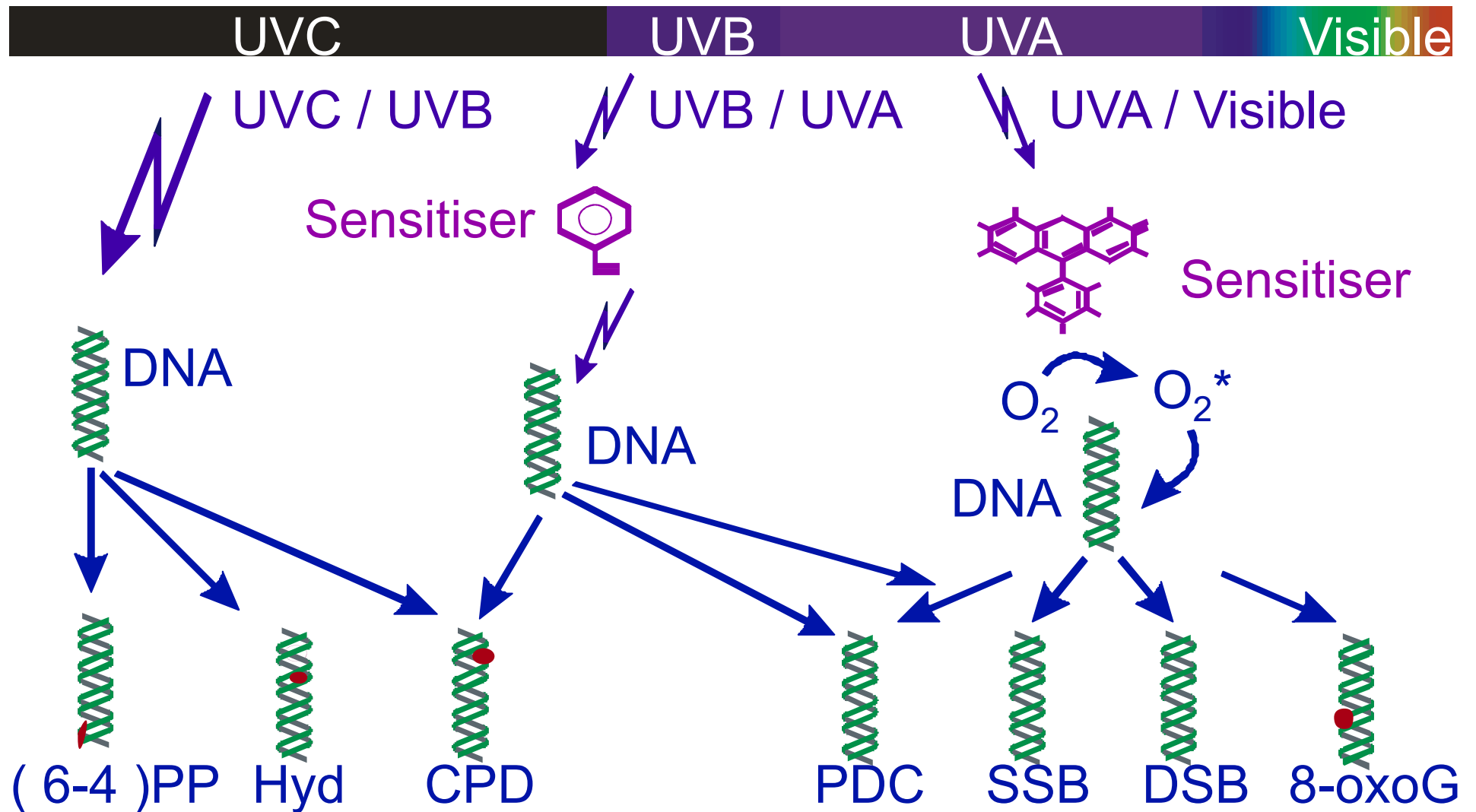
Nigel Cridland
ICNIRP



Electromagnetic spectrum



Interaction mechanisms

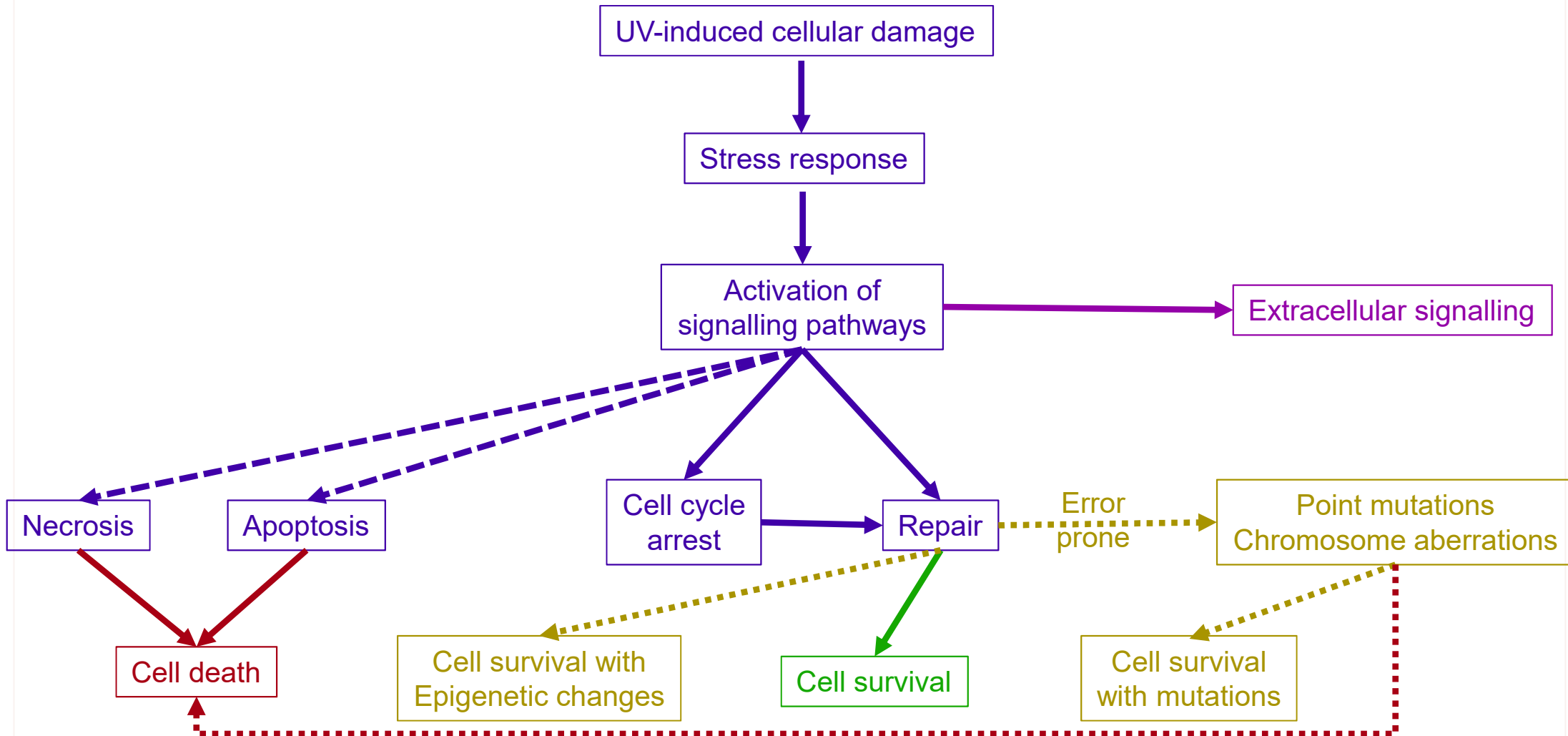


DNA photoproducts

- Cyclobutane pyrimidine dimers (~75%)
 - Thymine-thymine
 - Thymine-cytosine and cytosine-thymine
 - Cytosine-cytosine
- Pyrimidine-pyrimidone (6-4) adducts (~25%)
 - Dewar valence isomer
- Cytosine photohydrates
 - Deamination products



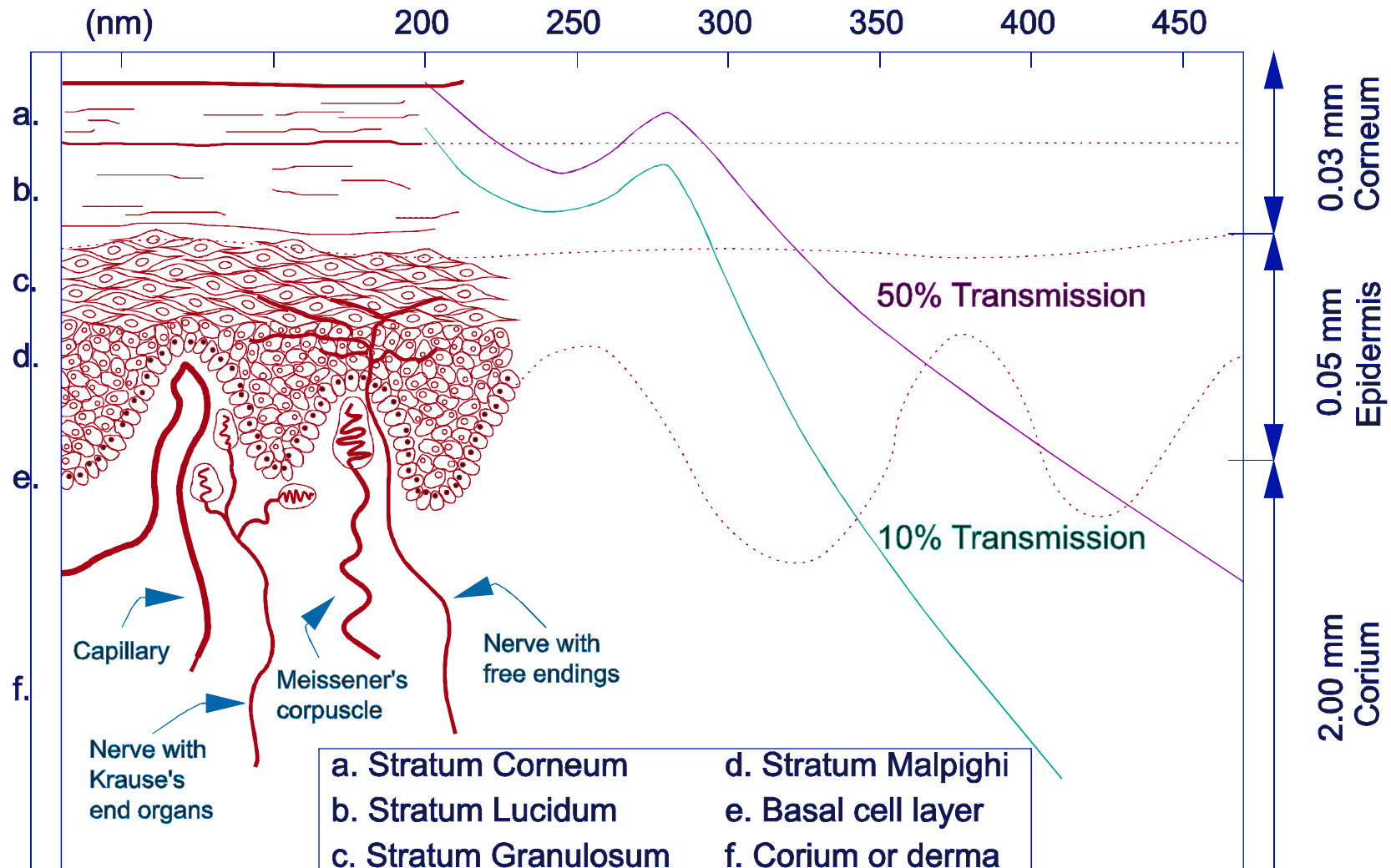
Stress responses



Target tissues



Transmission through skin

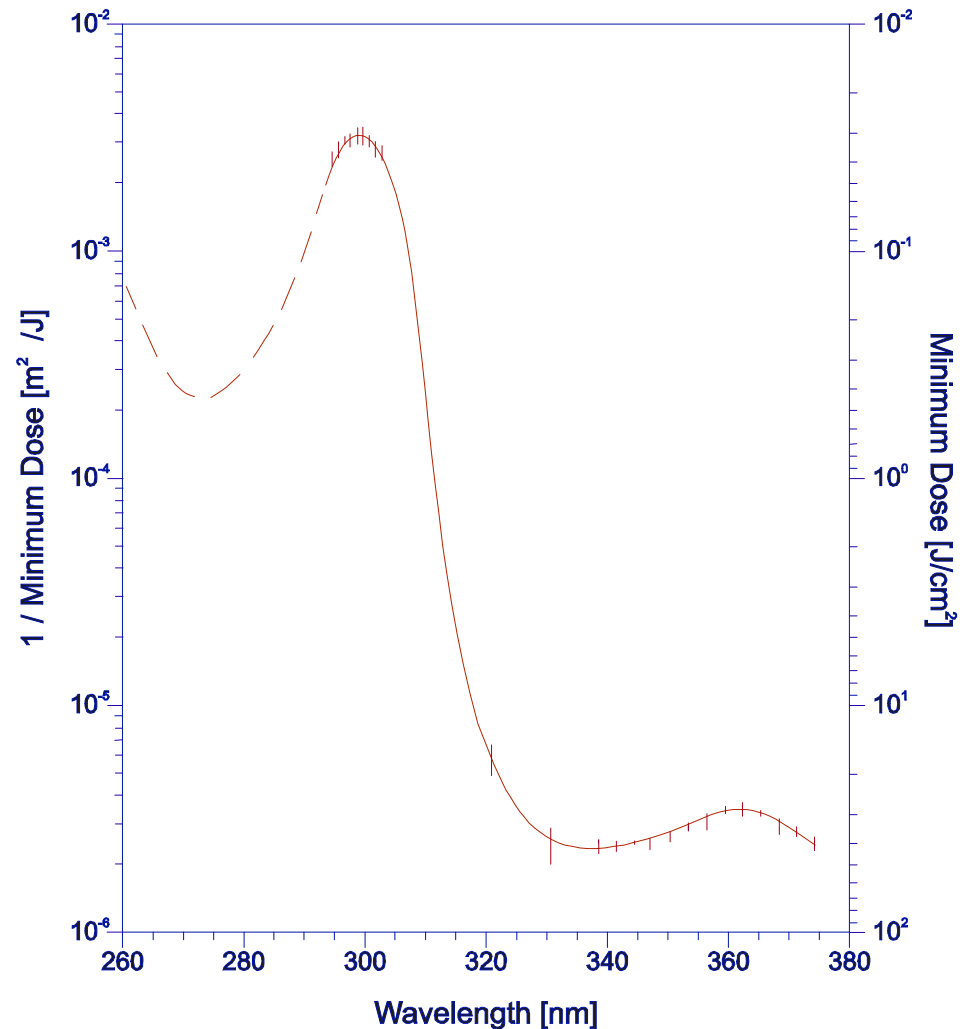


From UNEP/WHO/IRPA (1979)

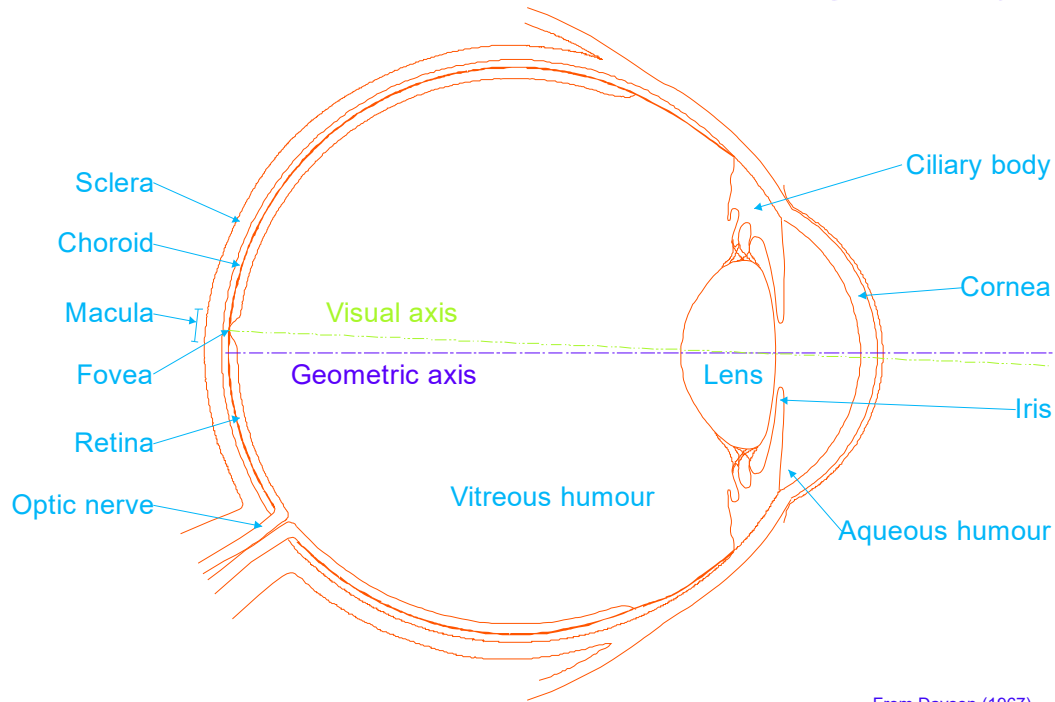
Acute effects on skin



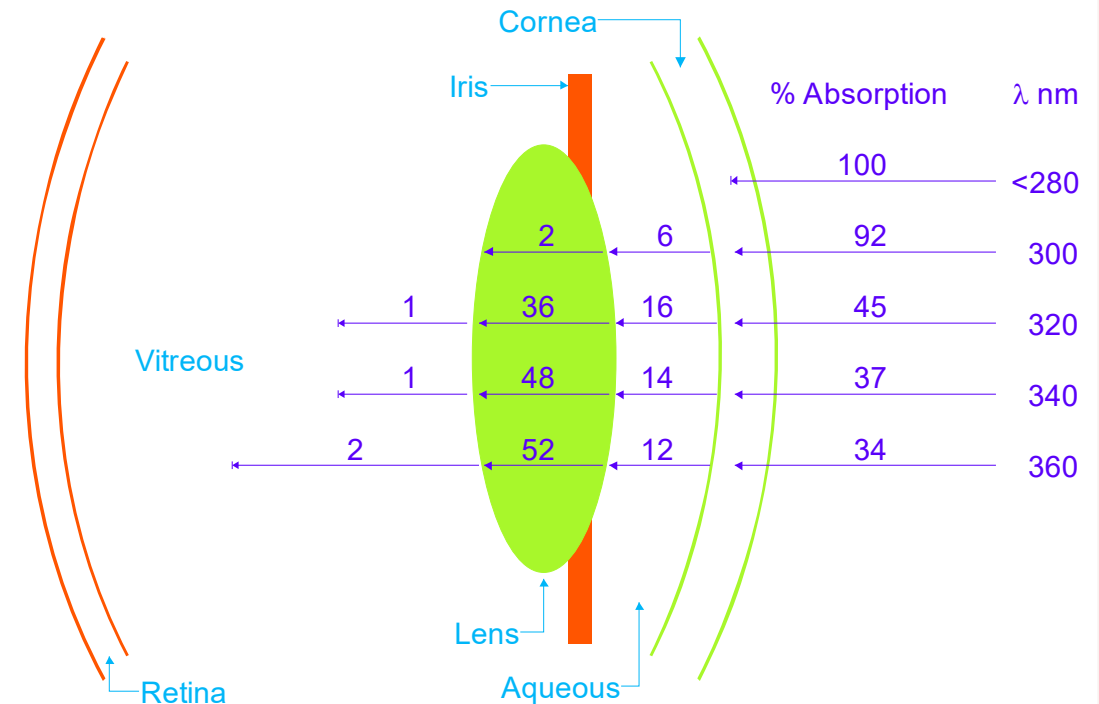
Erythema



Transmission through eye



From Davson (1967)

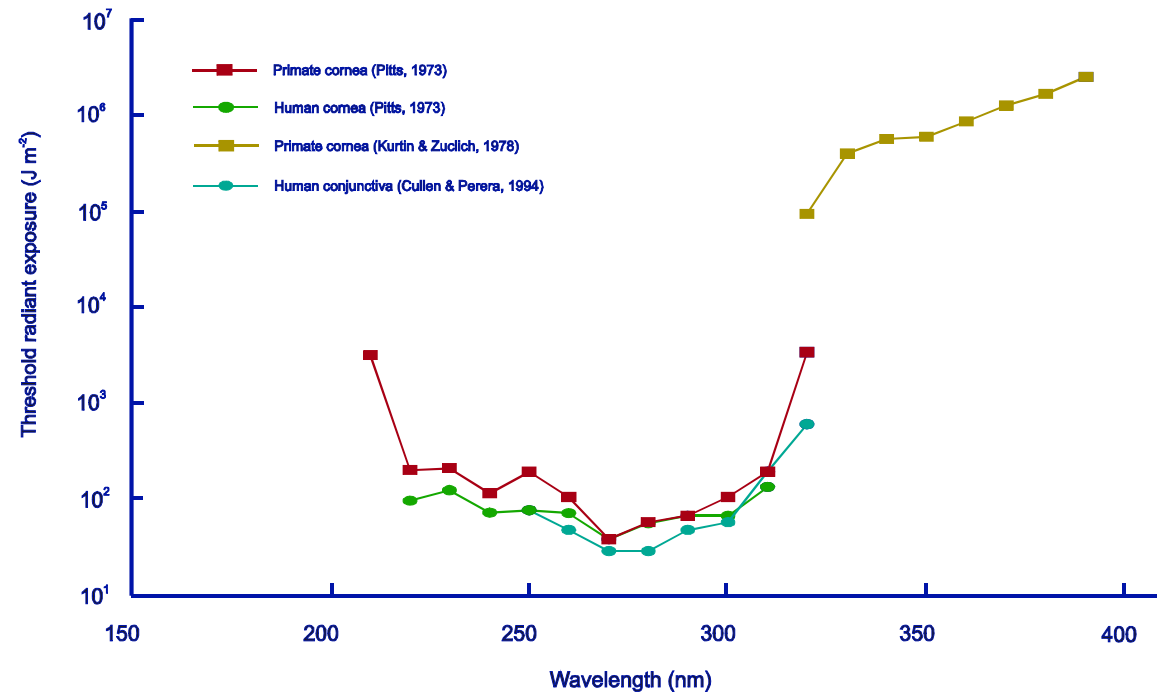


From Slaney and Wolbarsht (1980)

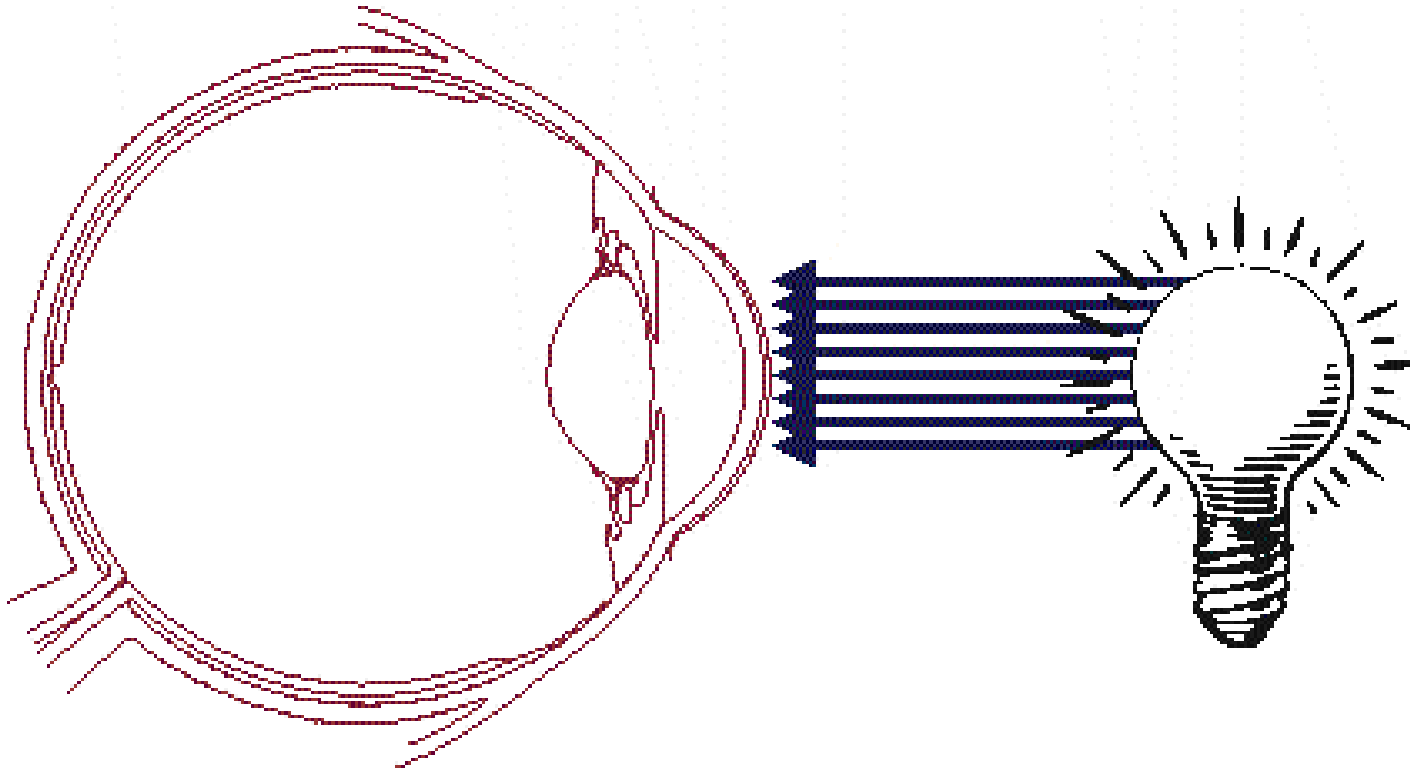
Acute effects on the cornea



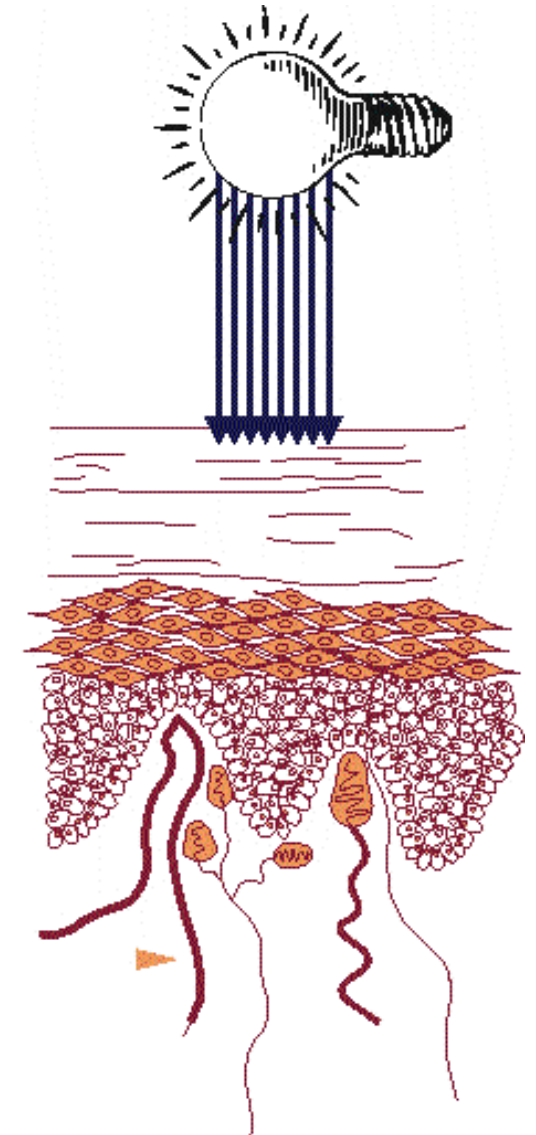
Photokeratitis and Photoconjunctivitis



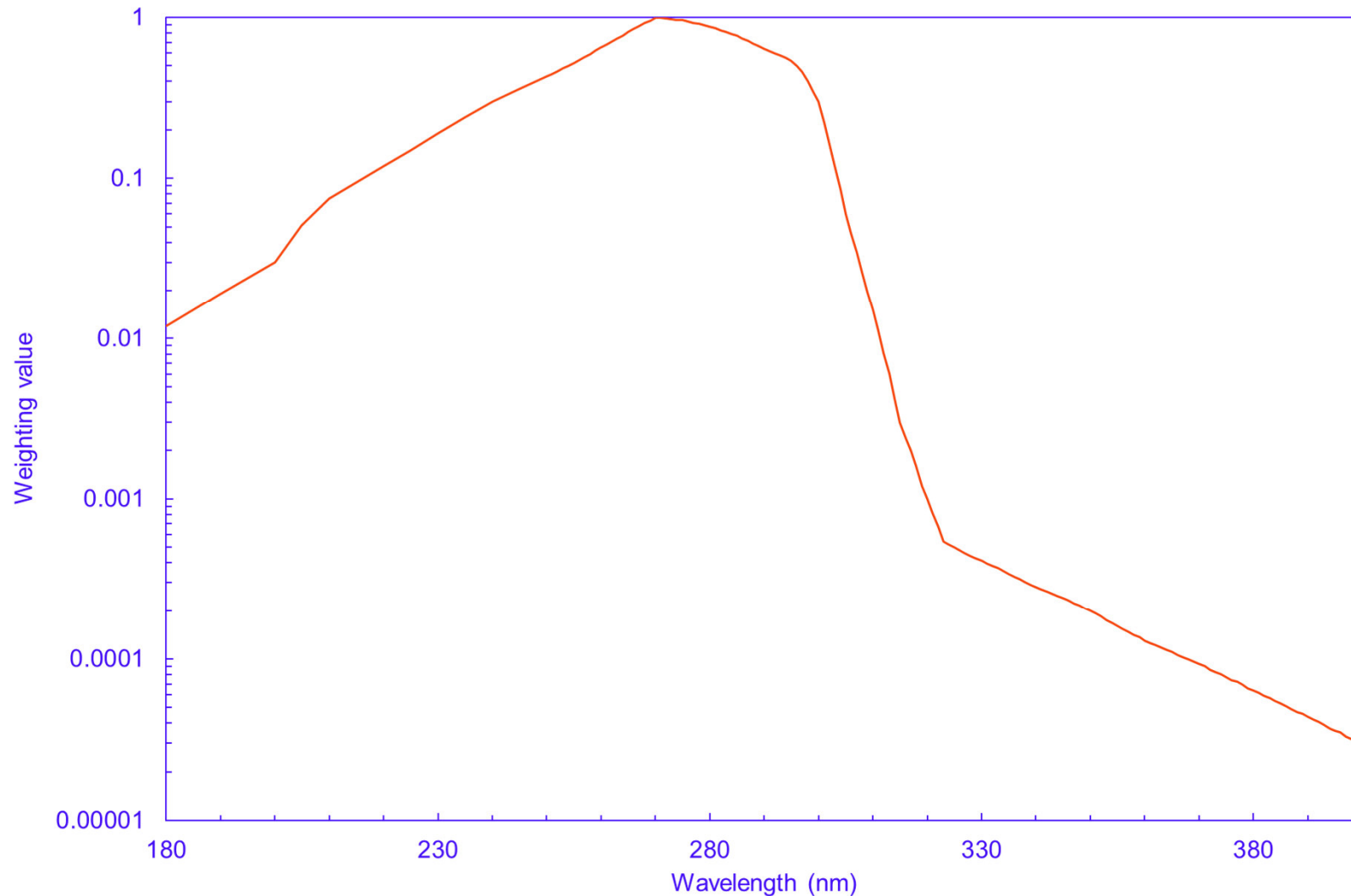
ICNIRP UV exposure limits



Effective radiant exposure of 30 J/m^2
Total UVA radiant exposure of 10 kJ/m^2



$S(\lambda)$ weighting function



Photosensitisation and photosensitivity

- Range of chemicals (including plant products and pharmaceuticals) may confer photosensitivity
 - Systemic or topical exposure
 - Limits may not provide adequate protection
- Range of medical conditions may confer photosensitivity
 - Most manifest from an early age
 - Some develop in middle age or later
 - Some may develop after exposure to trigger
 - Limits may not provide adequate protection

Effects of chronic UV exposure on skin



Photoageing



Solar keratoses



Basal cell carcinoma



Squamous cell carcinoma

Malignant melanoma



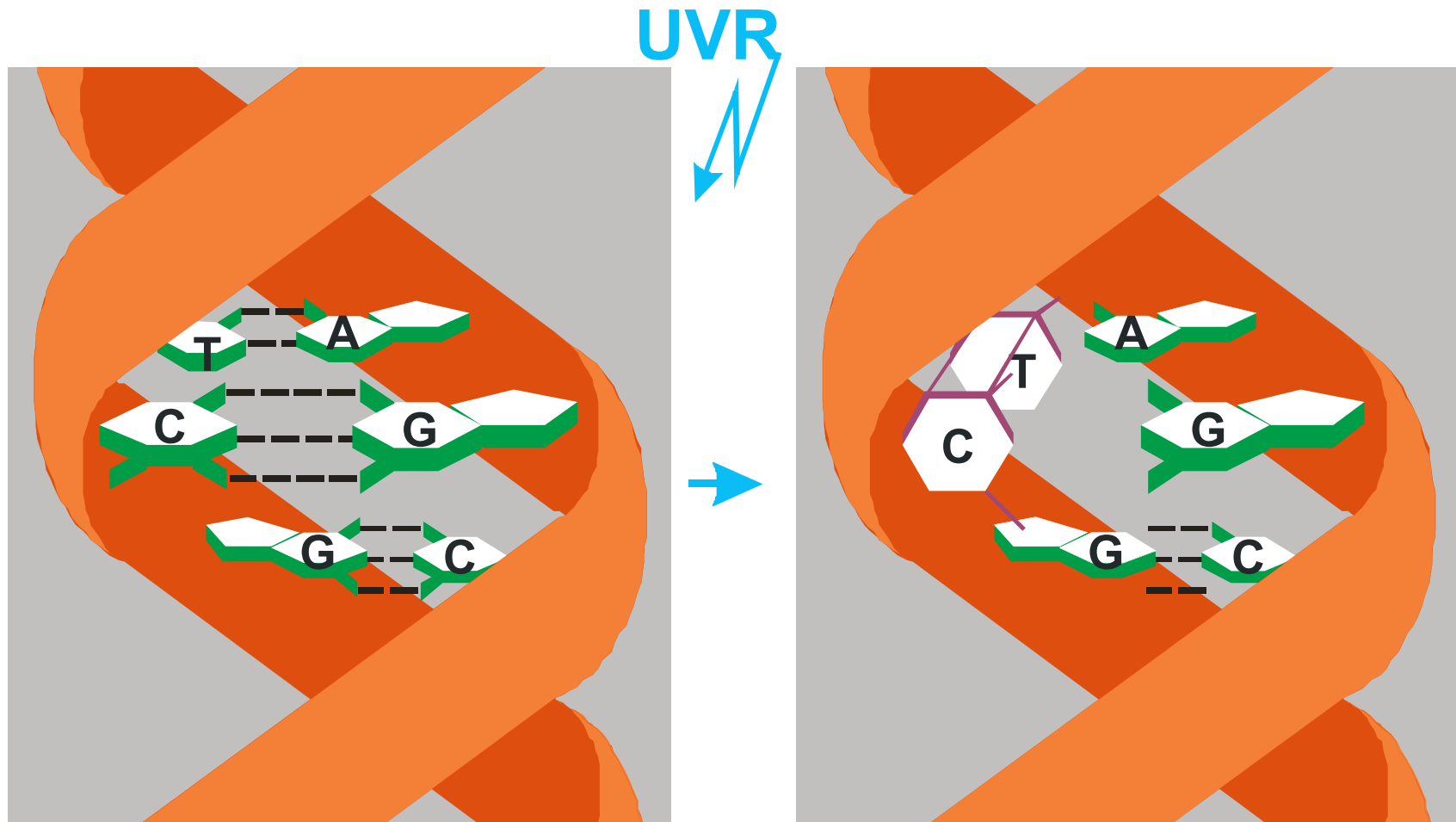
Dysplastic nevus and
superficial spreading
melanoma



Superficial spreading melanoma
and amelanotic vertical growth
phase melanoma

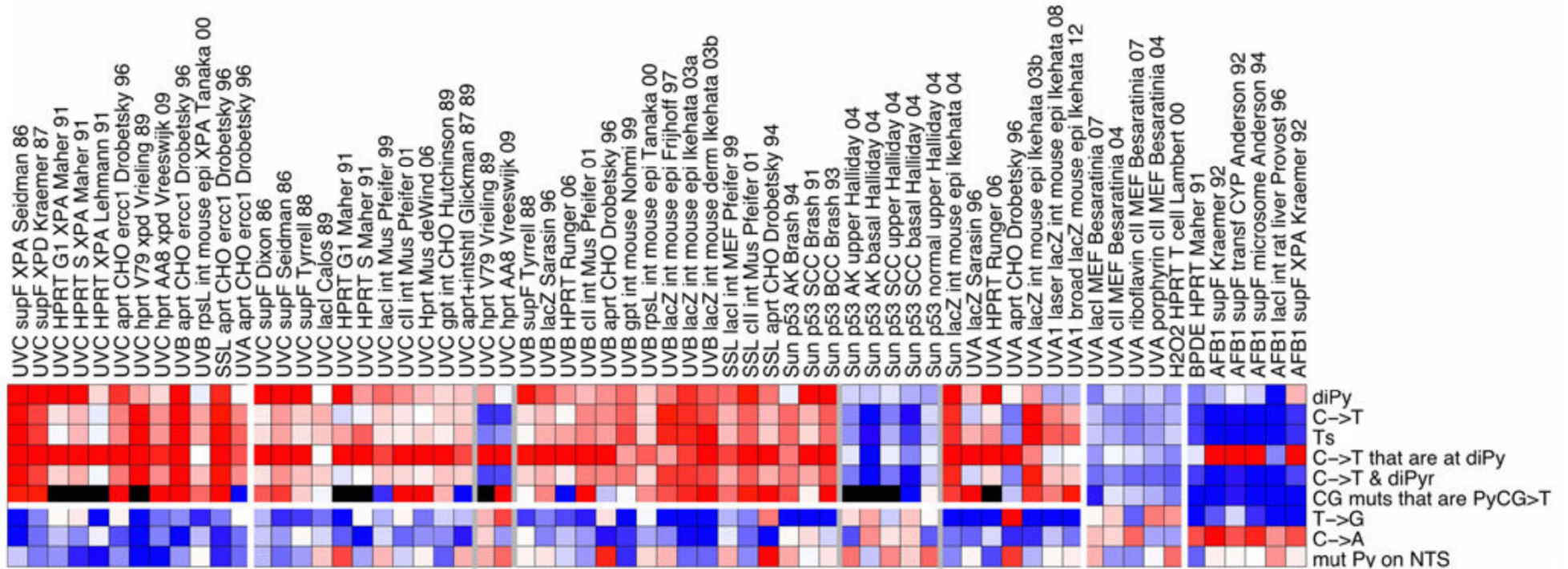


DNA photodamage



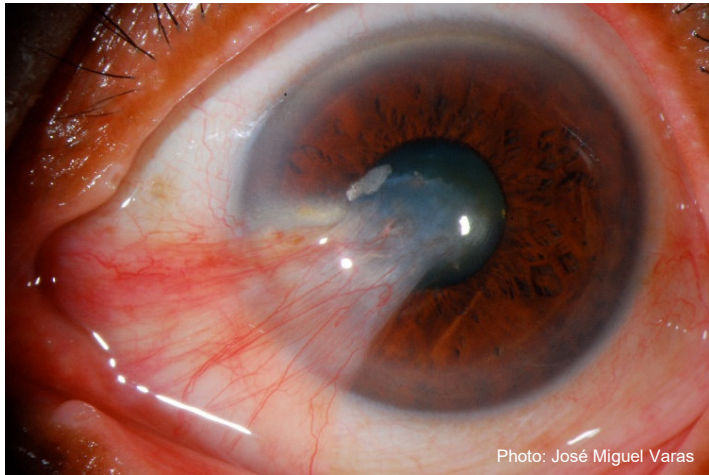
UV signature mutations

- C→T
- CC→TT

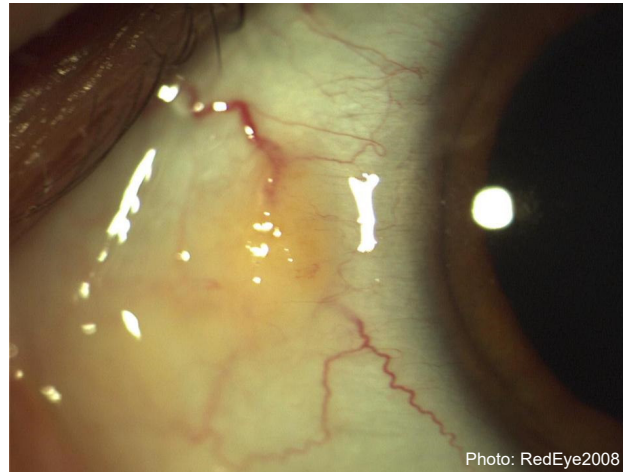


From Brash (2015)

Corneal effects of chronic exposure



Pterygium

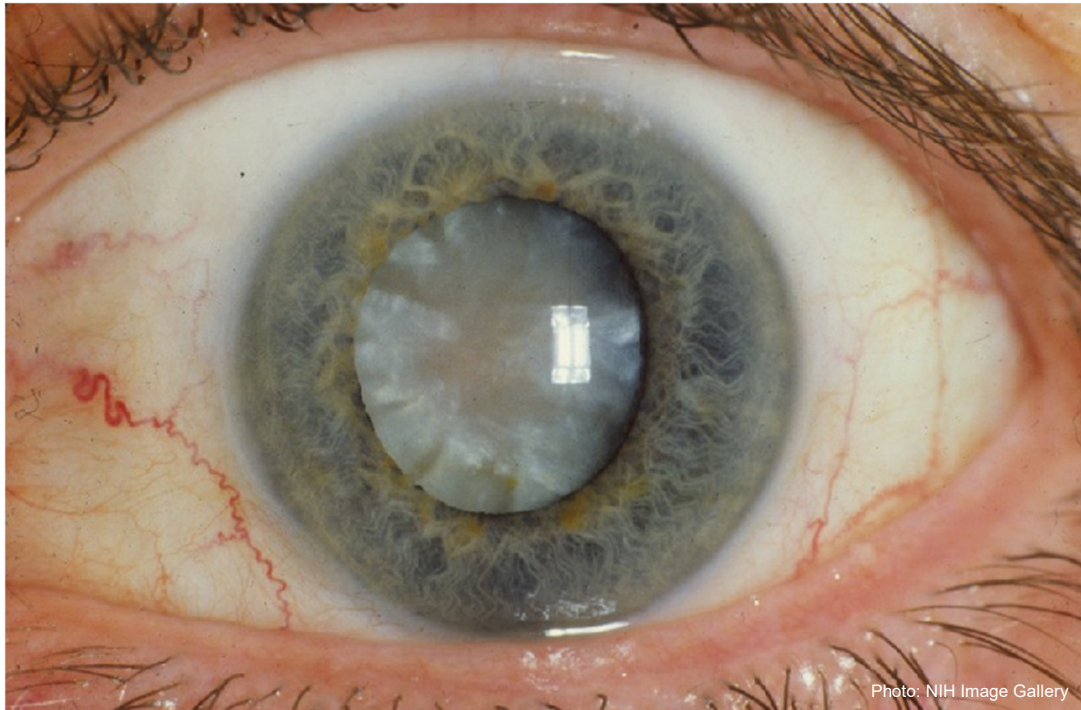


Pinguecula

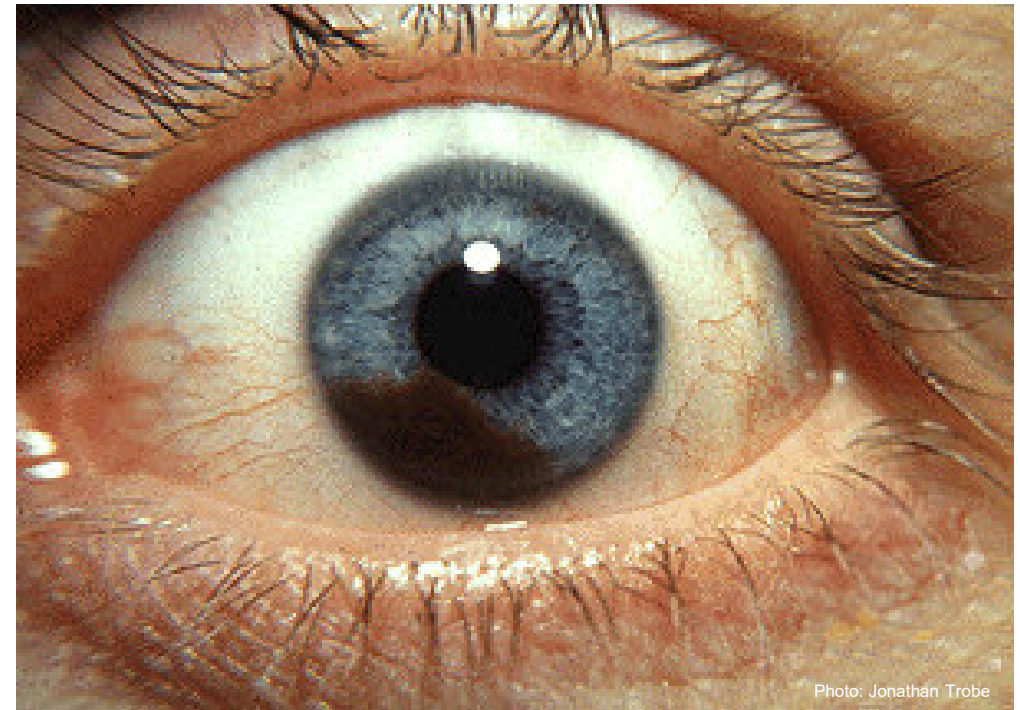


Climatic droplet keratopathy

Other anterior structures



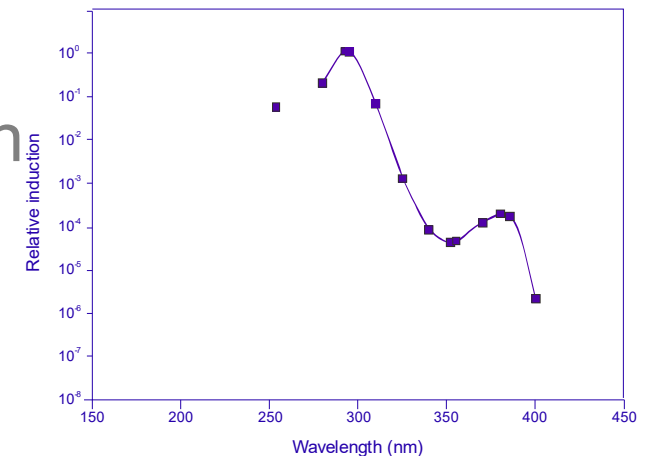
Cataract



Ocular tumours

Difficulties deriving limits

- Expect marked dependence on wavelength
 - Good data for SCC in mice
 - Most other data lacks spectral resolution
 - Sun-exposed populations
 - Artificial sources typically broadband
- Dose dependence
 - Retrospective estimation of dose often problematic
 - Eye exposure estimates often overlook exposure geometry
- Population variability



Need to balance detriment and benefit



- Vitamin D synthesis
 - Musculoskeletal health
 - Possibly protective for all cancer mortality
 - Possibly protective for all cause mortality
- Downregulation of immune responses
 - Adverse for skin cancer and viral infections
 - Beneficial for autoimmune diseases
- Balance probably depends on population

Summary

- Well-established adverse effects of acute exposure
- Long established limits to provide protection
- Chronic exposure lead to long-term adverse effects
 - Skin
 - Eye
- Beneficial effects from sun exposure
- Guidelines need to balance adverse and beneficial effects
 - Take account of populations differences

Any questions