


## The Human Animal: Skin




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## Human Skin



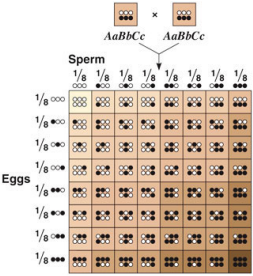
- Colour = melanin
- Absence of colour = connective tissue & hemoglobin



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## Skin Pigments: Melanin


- Skin colour is polygenic
- Effects are additive based on combinations of alleles



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## Melanin

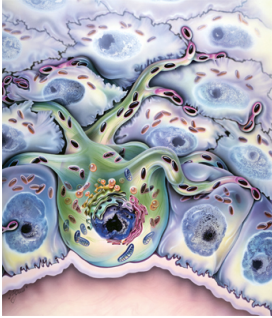
- Absorbs high-energy radiation such as UVR
- Is dark because also absorbs across visible light spectrum
- Is anti-oxidant acting against free radicals
- Protects nucleus of cell against damage



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## Melanocytes


- Produce melanin in melanosomes
- Mature and migrate into dendrites
- Transfer to keratinocytes
- Genetically controlled but enhanced by UVR



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## Melanin as UVR protection

- All humans have same amount of melanocytes
- Differ in size and number of melanosomes
- Dark skin has 4x as many and protected 8x

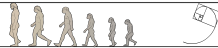


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## Albino and Vitiligo



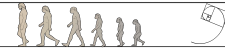
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## Freckles and Liver Spots



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## Evolution of Skin Colour



Chimpanzee

Australopithecus

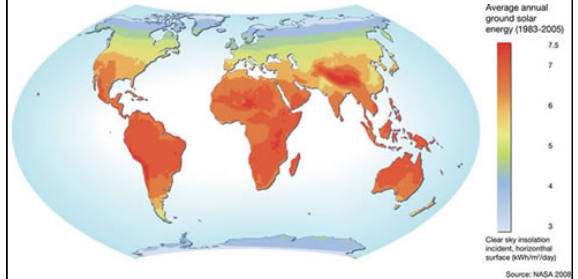
Homo erectus

- Dark skin colour has persisted for over 1MY

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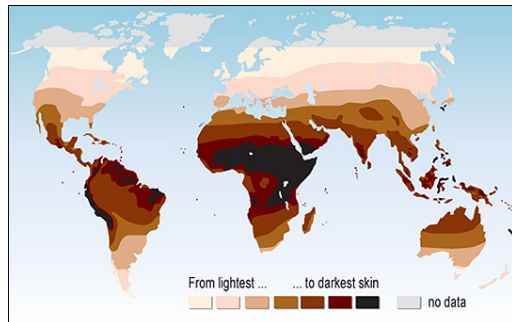
## Solar Radiation Reaching Earth



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## Evolution of Dark Skin

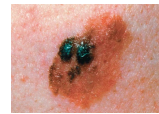
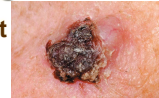


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## Evolutionary Drivers of Pigmentation

- Unlikely due to selection against skin cancers
- Basal and squamous cell cancers affect mostly those past reproductive age
- Melanomas are a recent phenomenon
  - Rates very low prior to 1970s
  - Now caused by light-skinned people receiving more sunlight (tanning and vacationing)



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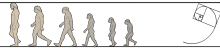


## Dark Skin and Folate

- UVR breaks down Vitamin B<sub>9</sub>
- Found naturally in food
  - Green leafy vegetables
  - Easily broken down
  - Difficult to maintain high levels
- Important role in nucleic acid synthesis, neurotransmitter production

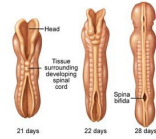


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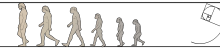


## Folate Deficiencies

- During pregnancy, insufficient levels lead to neural tube defects (NTD) around 4<sup>th</sup> week
  - Zipping shut of neural tube
  - High levels of cell proliferation involving folate
  - Folate deficiency at anterior end leads to anencephaly, posterior end spina bifida

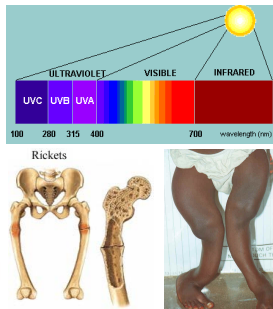


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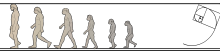


## Photosynthesis of Vitamin D<sub>3</sub>

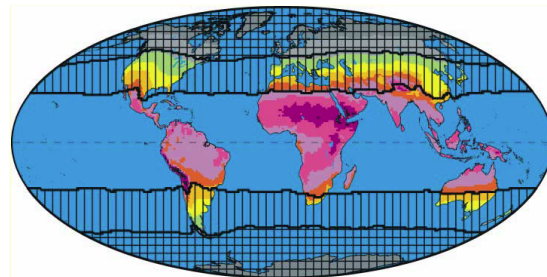
- Cholecalciferol formed in vertebrate skin at 290-315 nm (UVB)
- Regulates Ca & P absorption from gut for bone formation
- Deficiencies associated with a range of cancers, impaired immunity and brain function



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## Evolution of Light Skin – Vitamin D



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## Vitamin D-Rich Foods

- Fatty fish
- Marine mammals
- Reindeer/Caribou offal
- Lichen
- All are eaten by Inuit and Saami



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## Human Skin



- Conclusion: human skin colour is an adaption to balance the opposing needs for protection against UVR in the tropics and Vitamin D production towards the poles



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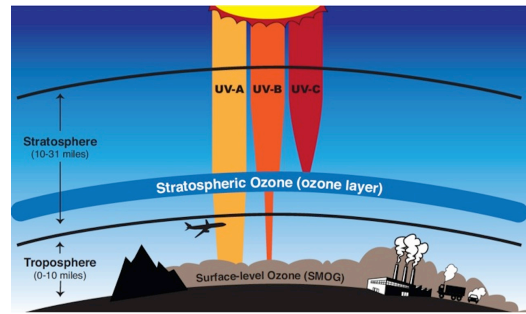
## UVR and the Ozone Layer



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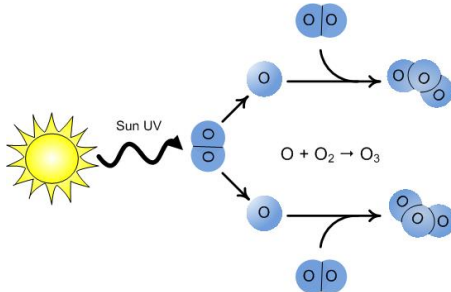
## Atmospheric Layers



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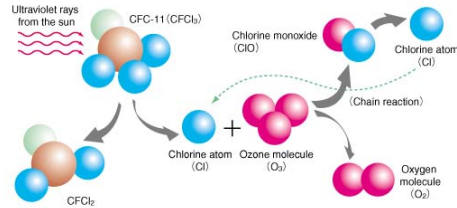
## Formation of Ozone (O<sub>3</sub>)



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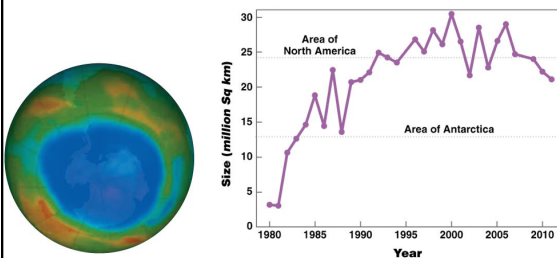
## Chlorofluorocarbons and Ozone



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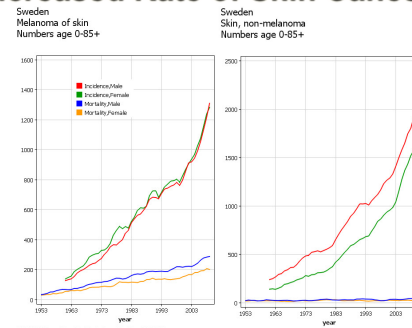
## Ozone Holes



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## Increased Rate of Skin Cancers

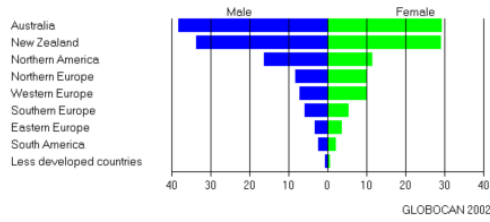


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## Increased Rate of Skin Cancers

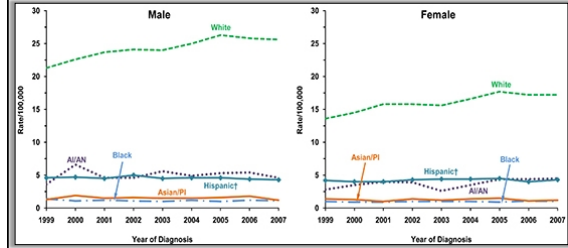
Melanoma of skin, Incidence: ASR (World) (per 100,000) (All ages)



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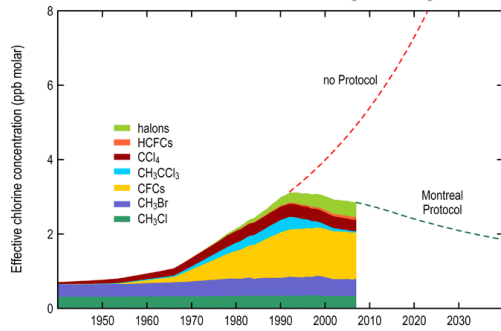
## Cancers by Skin Colour



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## Montreal Protocol (1987)



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## Skin Protection the New Reality



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## Questions?



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