The dark side of the sun – managing the risks of exposure to solar ultraviolet radiation

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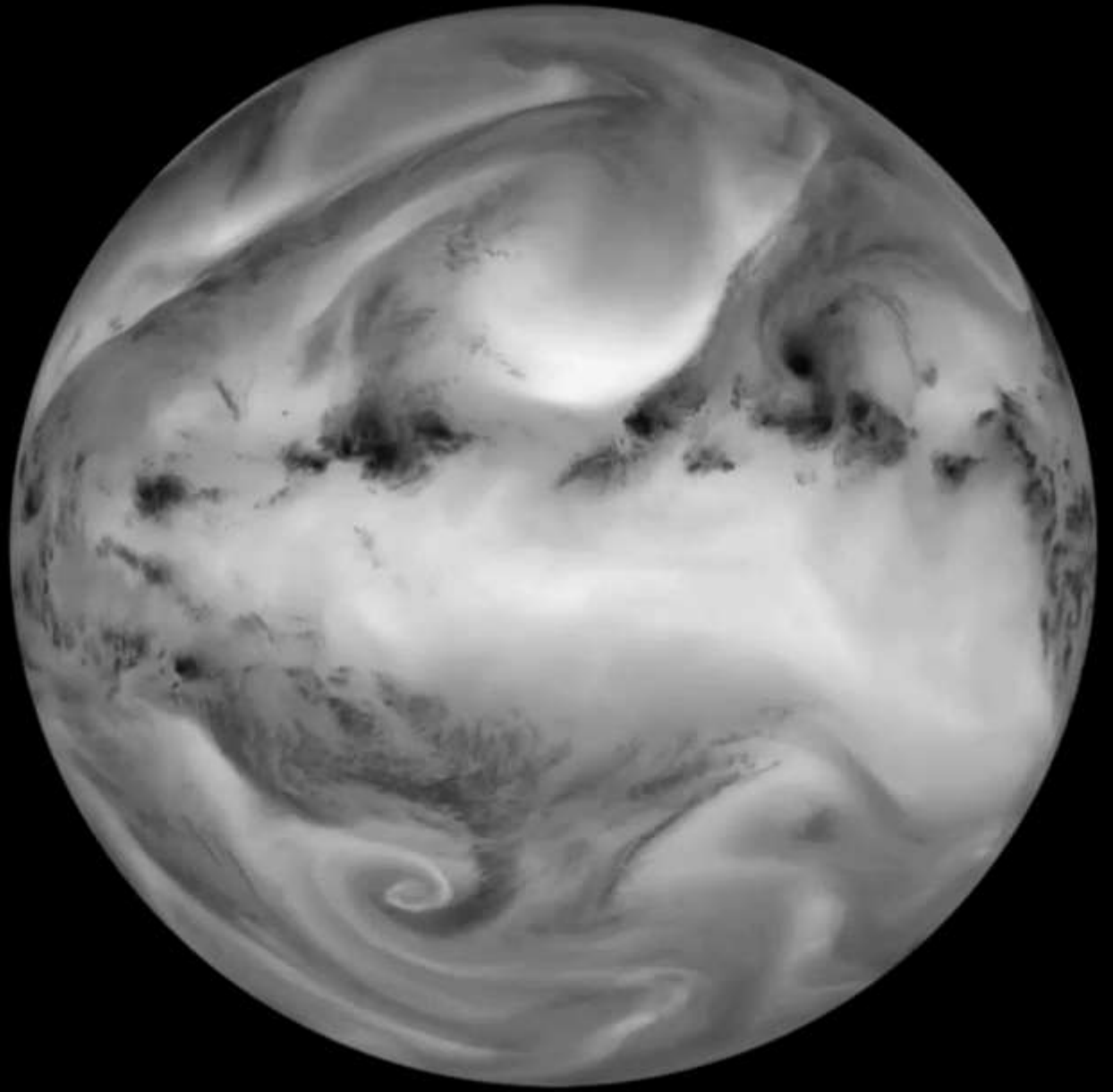
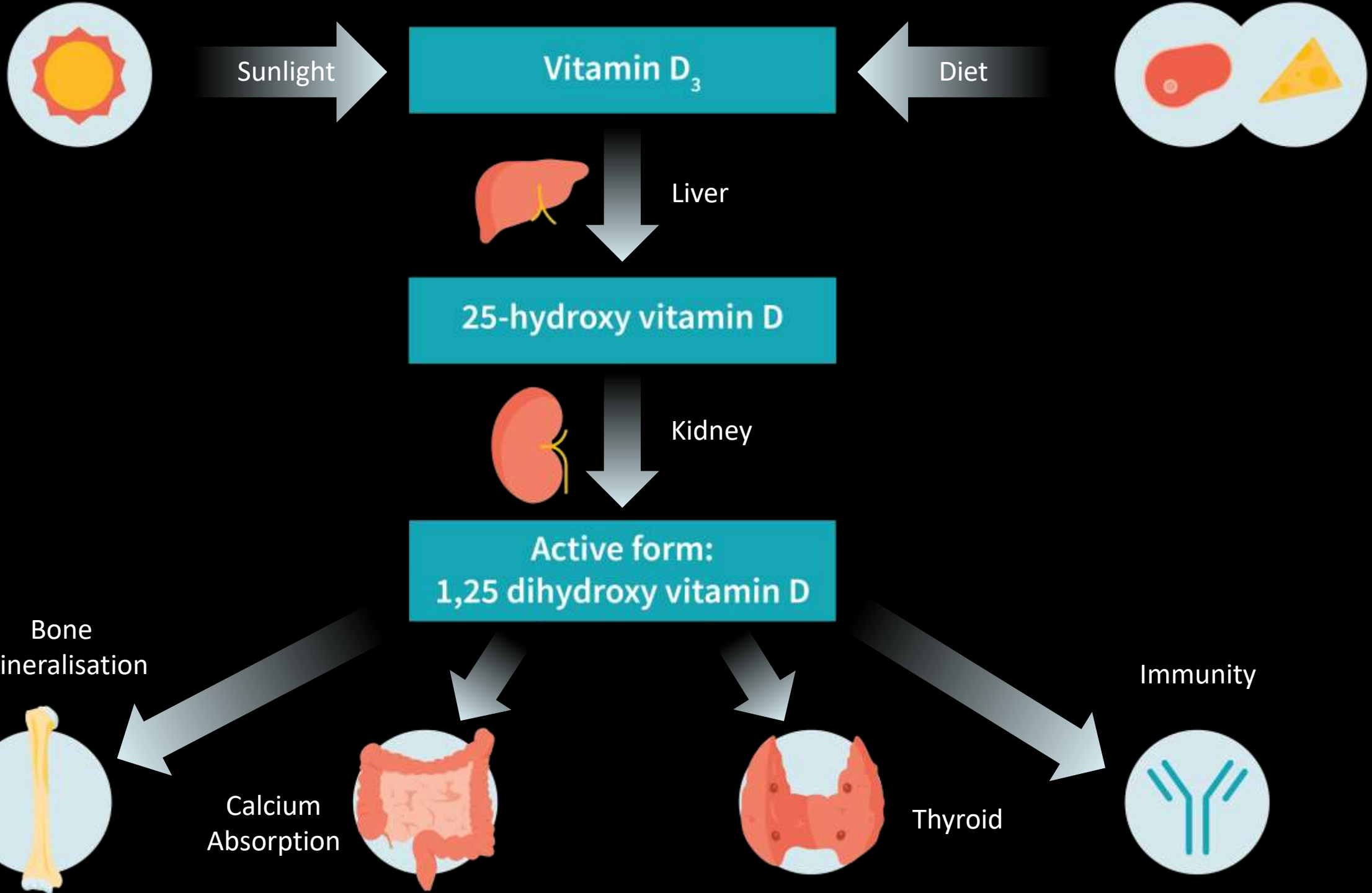
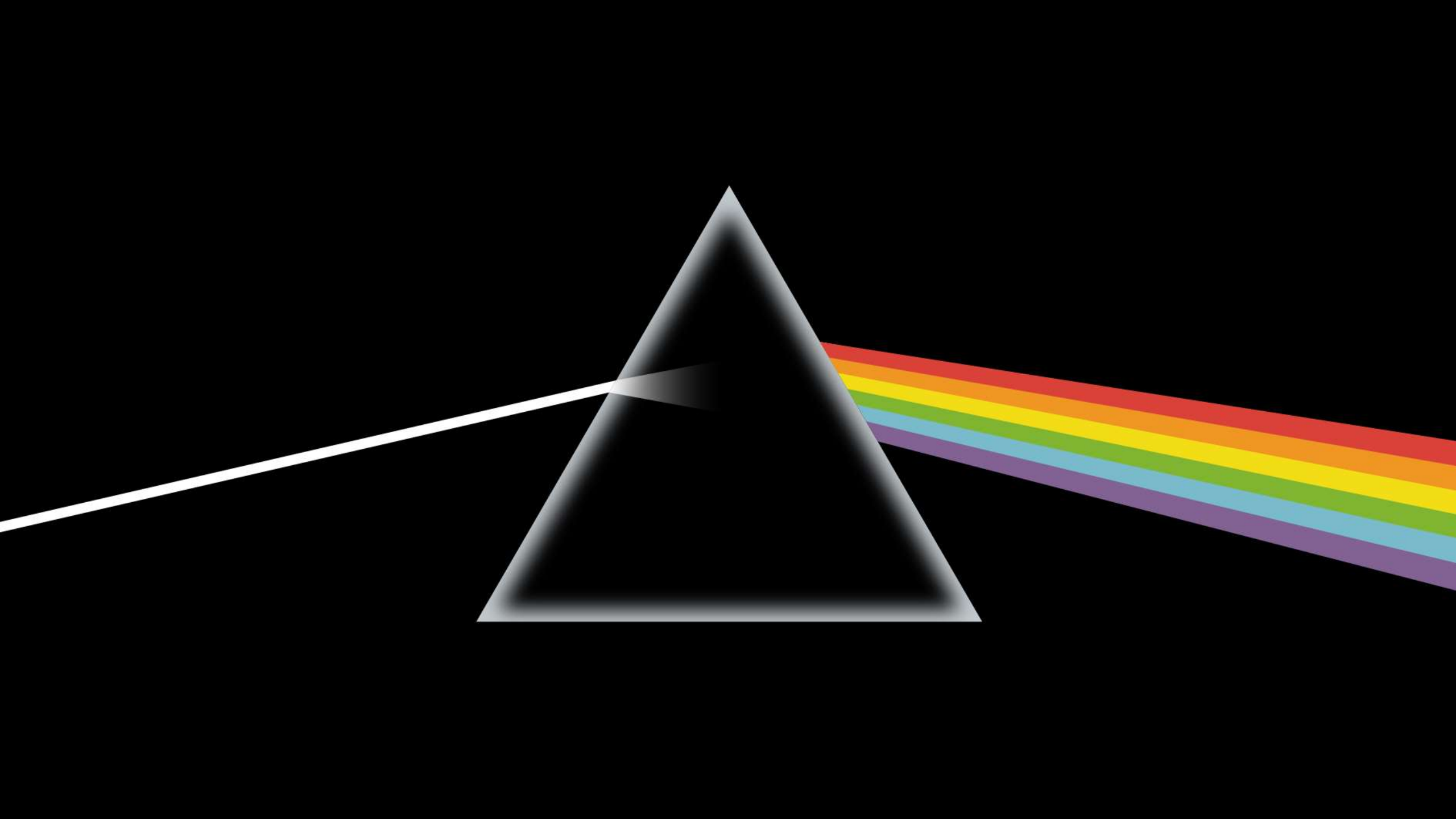
Cosmetics Europe Sun Product *In Vitro* Methods Task Force

British Standards Committee CW/217 Cosmetics

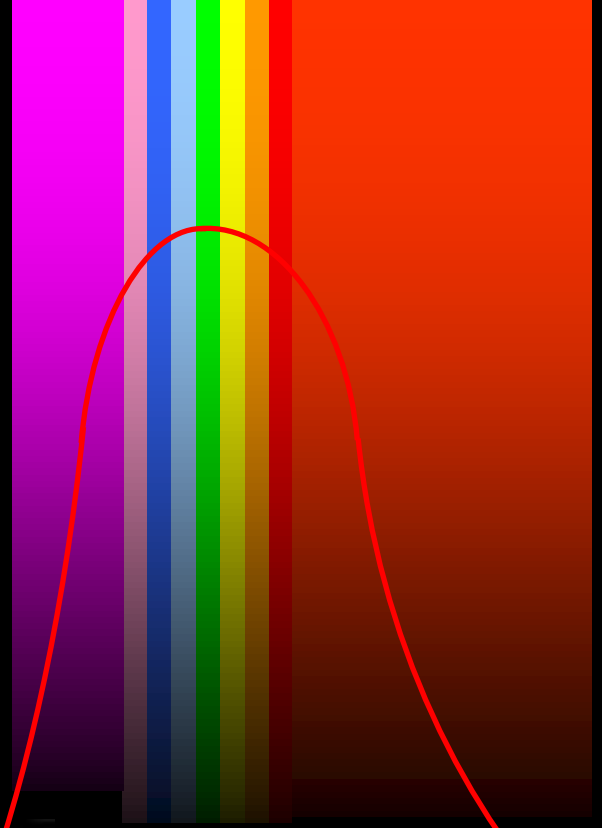
UK Expert to ISO TC217 / WG7 Standardisation of Sun Product Test Methods

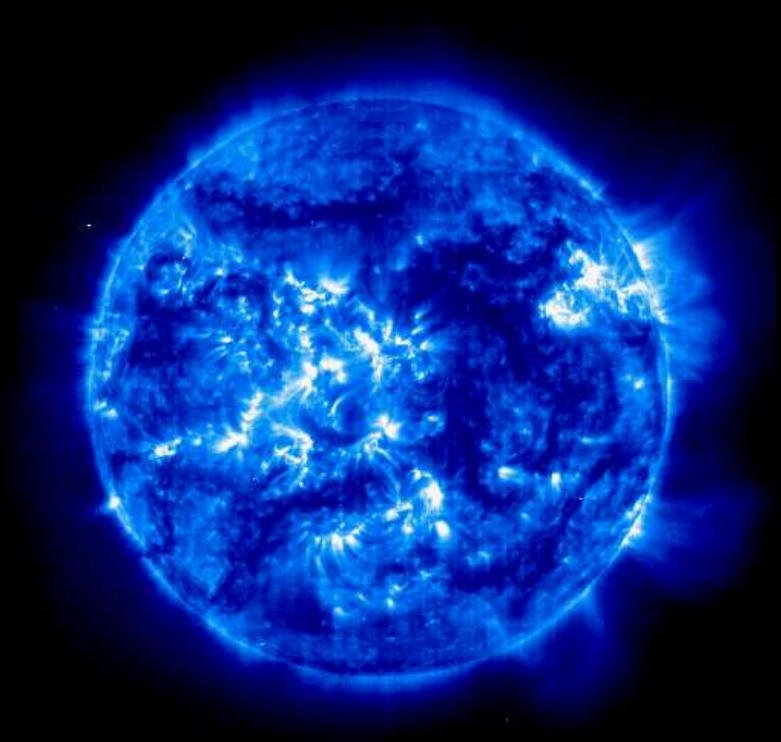


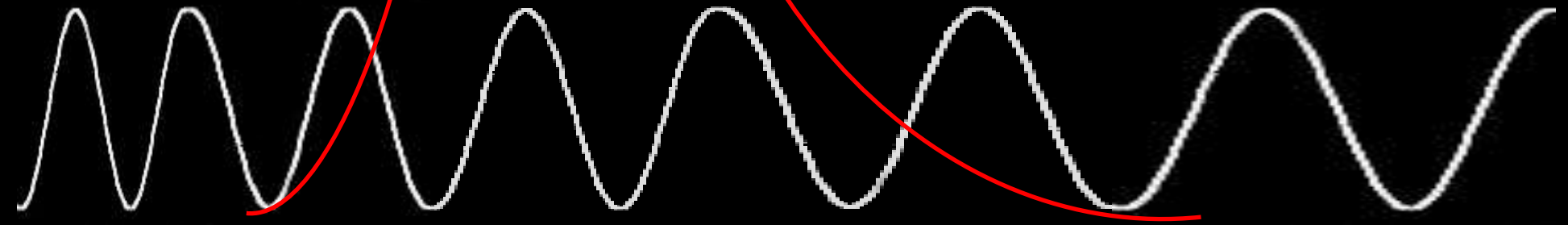

Sunlight
Vitamin D_3
Diet
Liver
25-hydroxy vitamin D
Kidney
Active form:
1,25 dihydroxy vitamin D
Bone
Mineralisation
Calcium
Absorption
Thyroid
Immunity

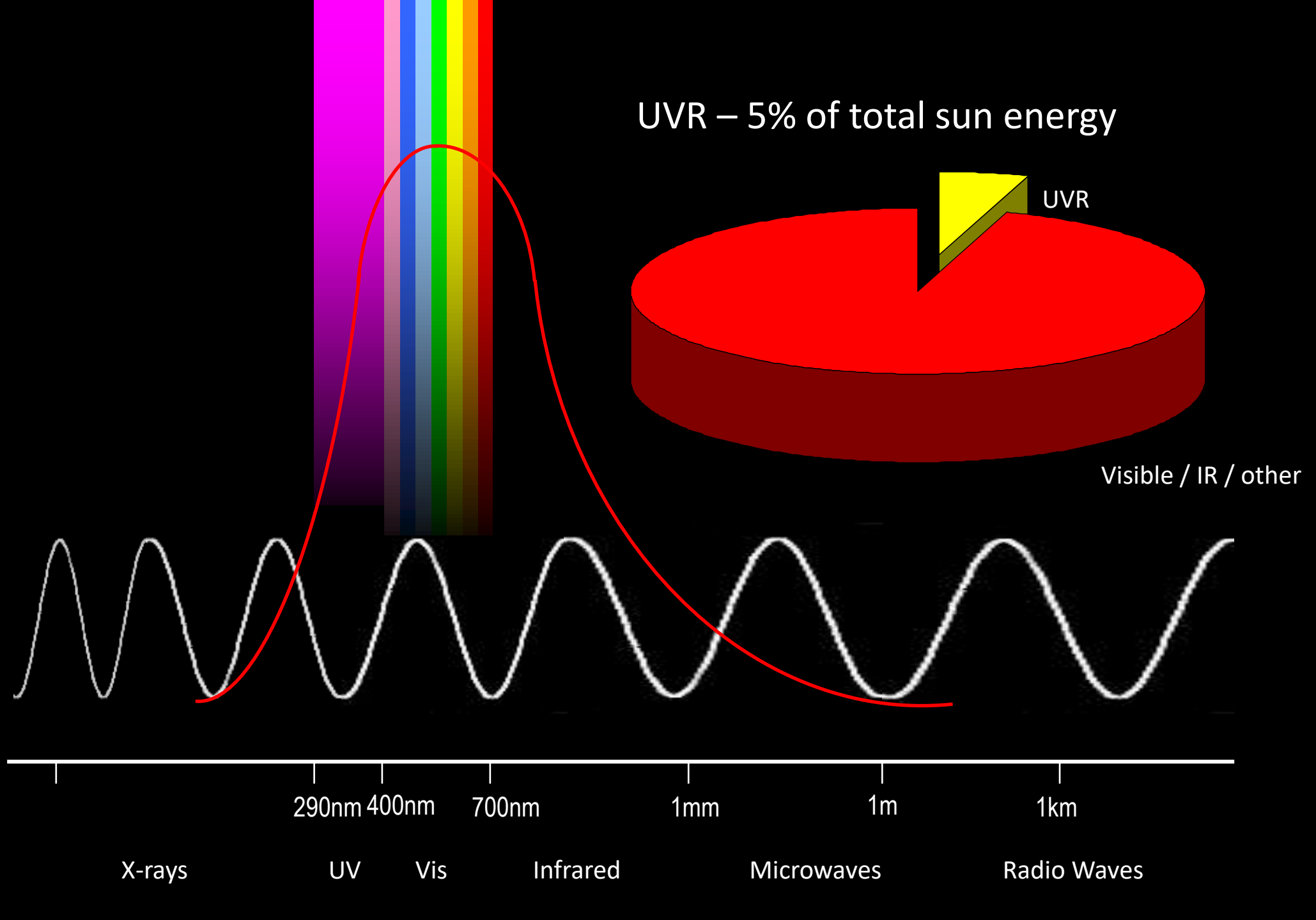


What is Solar Ultraviolet Radiation?

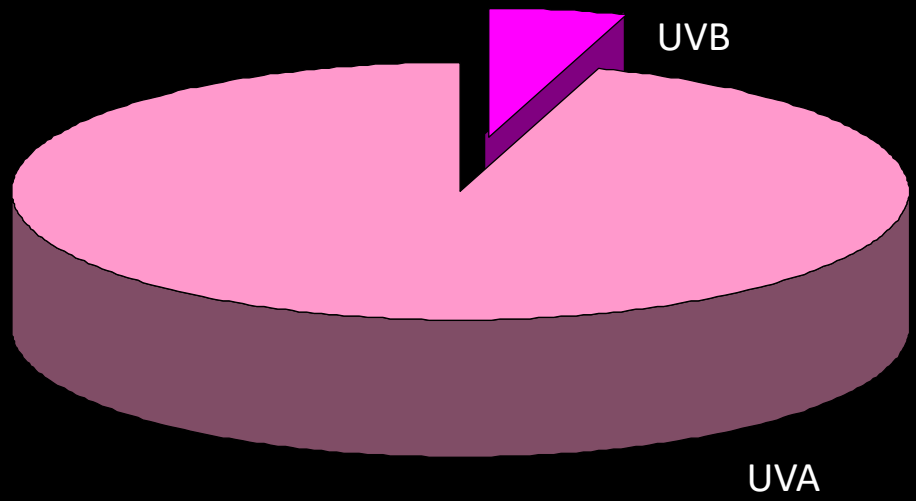




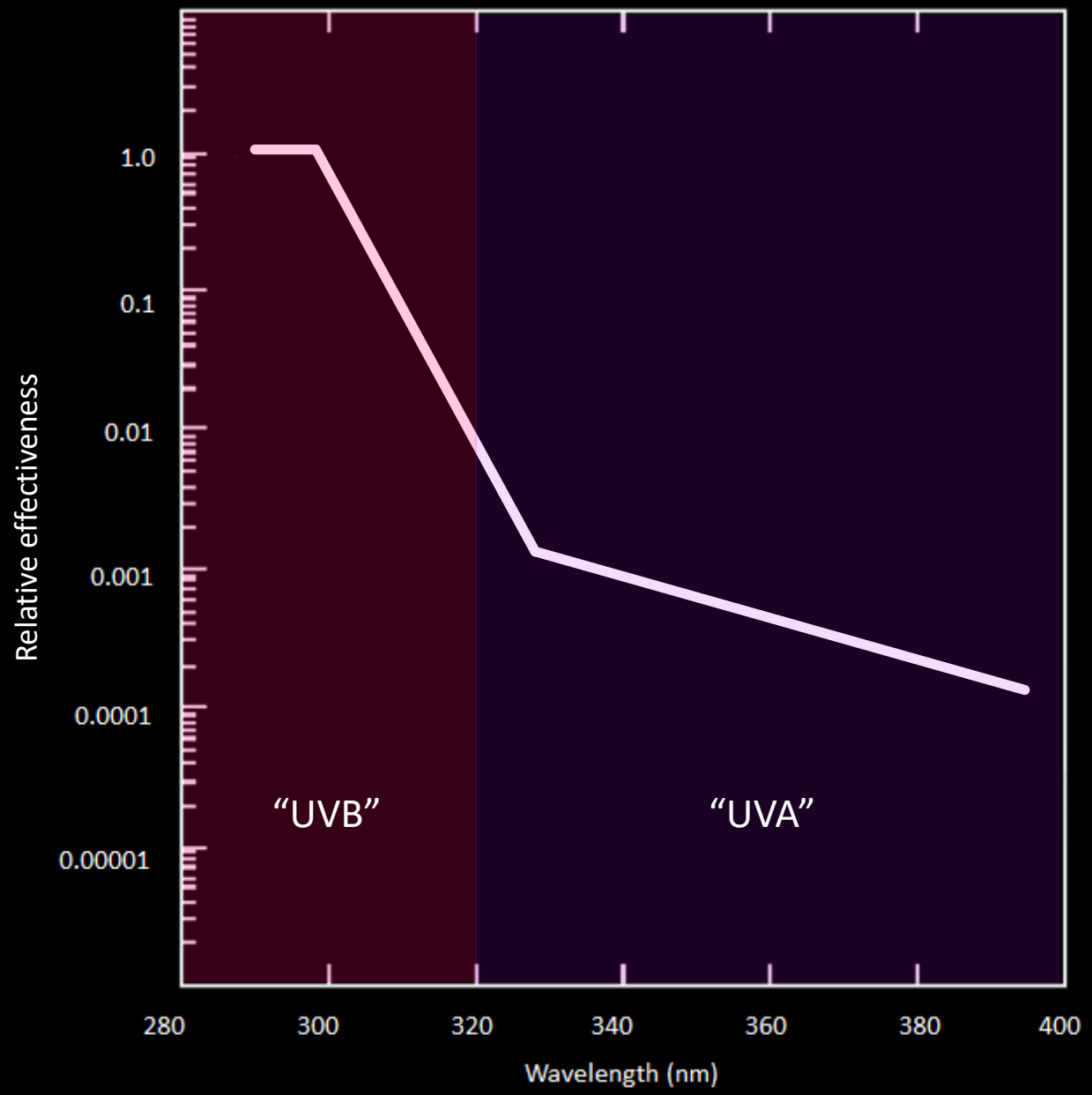

1Å
290nm
400nm
700nm
1mm
1m
1km
X-rays
UV
Vis
Infrared
Microwaves
Radio Waves


UVR – 5% of total sun energy
UVR
Visible / IR / other
290nm
400nm
700nm
1mm
1m
1km
X-rays
UV
Vis
Infrared
Microwaves
Radio Waves

UVR - 5% UVB (290 – 320nm)
95% UVA (320 – 400nm)



UVR Action Spectrum – Erythema (Sunburn)



CIE Erythema (sunburn)
(McKinlay & Diffey, 1987)


Is this ‘just’ about sunburn?

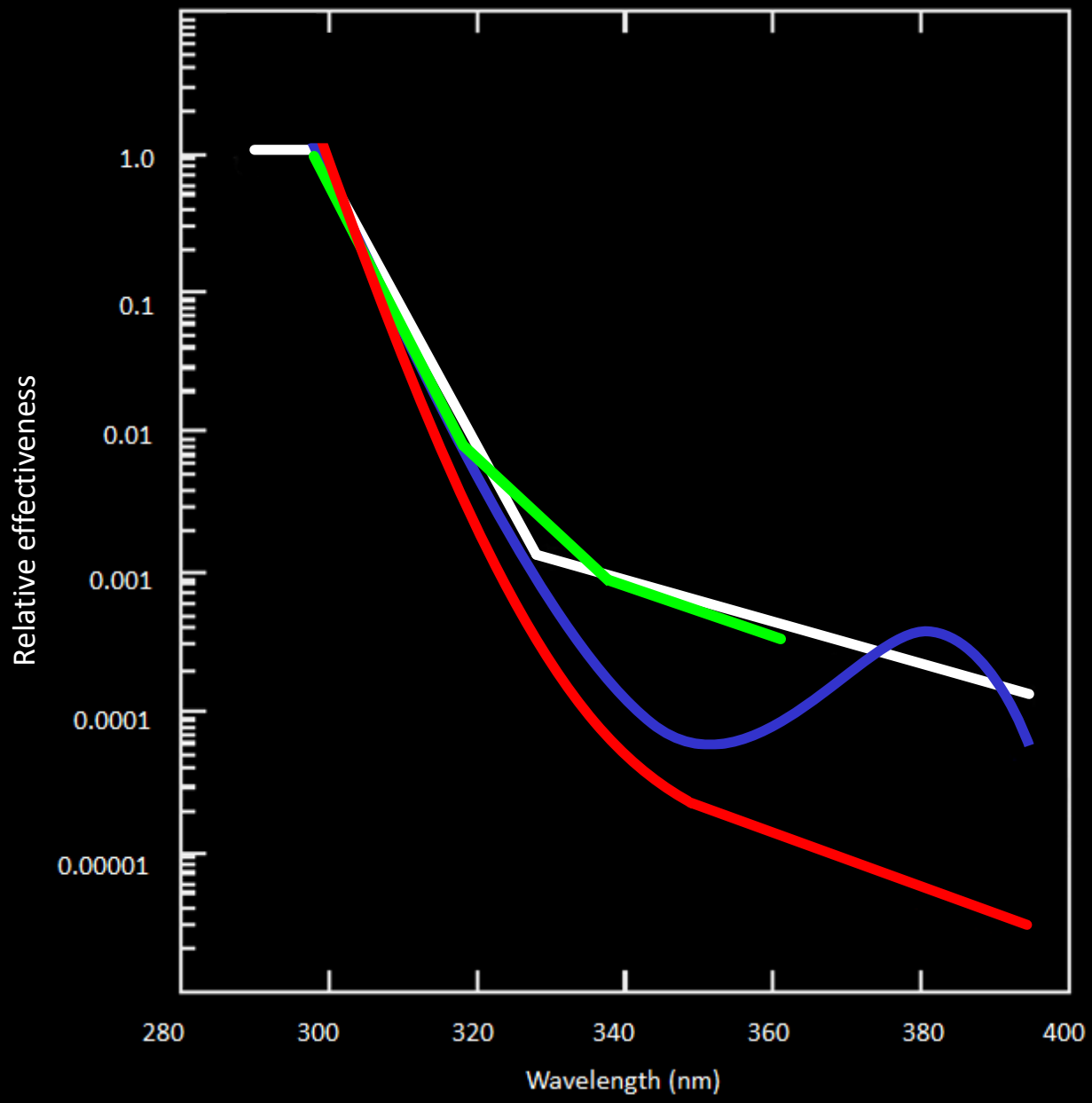
5. Evaluation

There is *sufficient evidence* in humans for the carcinogenicity of solar radiation. Solar radiation causes cutaneous malignant melanoma, squamous cell carcinoma of the skin and basal cell carcinoma of the skin.

El Ghissassi, F., Baan, R., Straif, K., Grosse, Y., Secretan, B., Bouvard, V., Benbrahim-Tallaa, L., Guha, N., Freeman, C., Galichet, L., Cogliano, V. and WHO International Agency for Research on Cancer Monograph Working Group.

A review of human carcinogens — Part D: Radiation. *Lancet Oncol* 10, 751–52, 2009

UVR Action Spectra - Carcinogenic



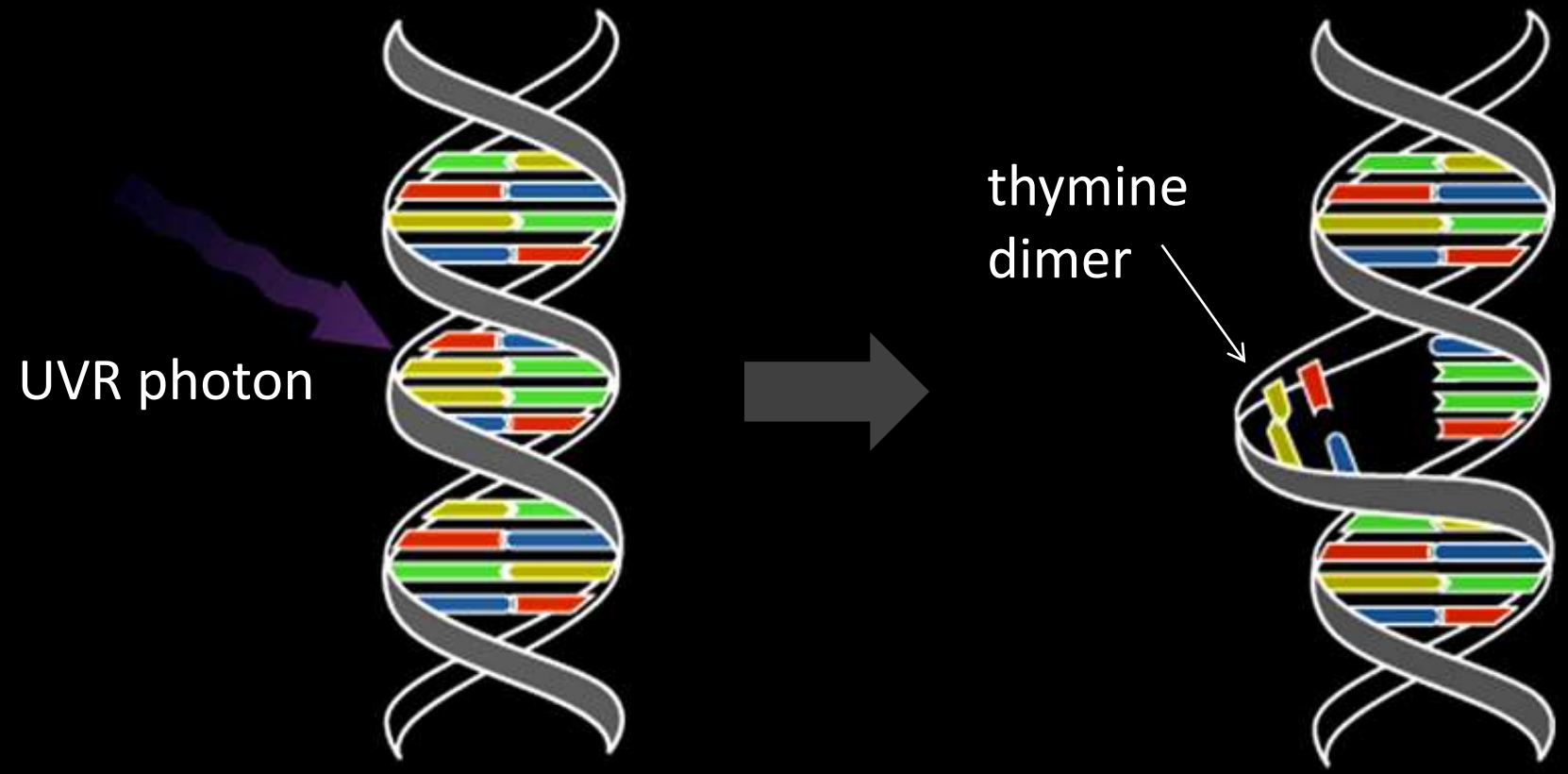
CIE Erythema
(McKinlay & Diffey, 1987)

Non-melanoma skin cancer
(de Gruijl & van der Leun, 1994)

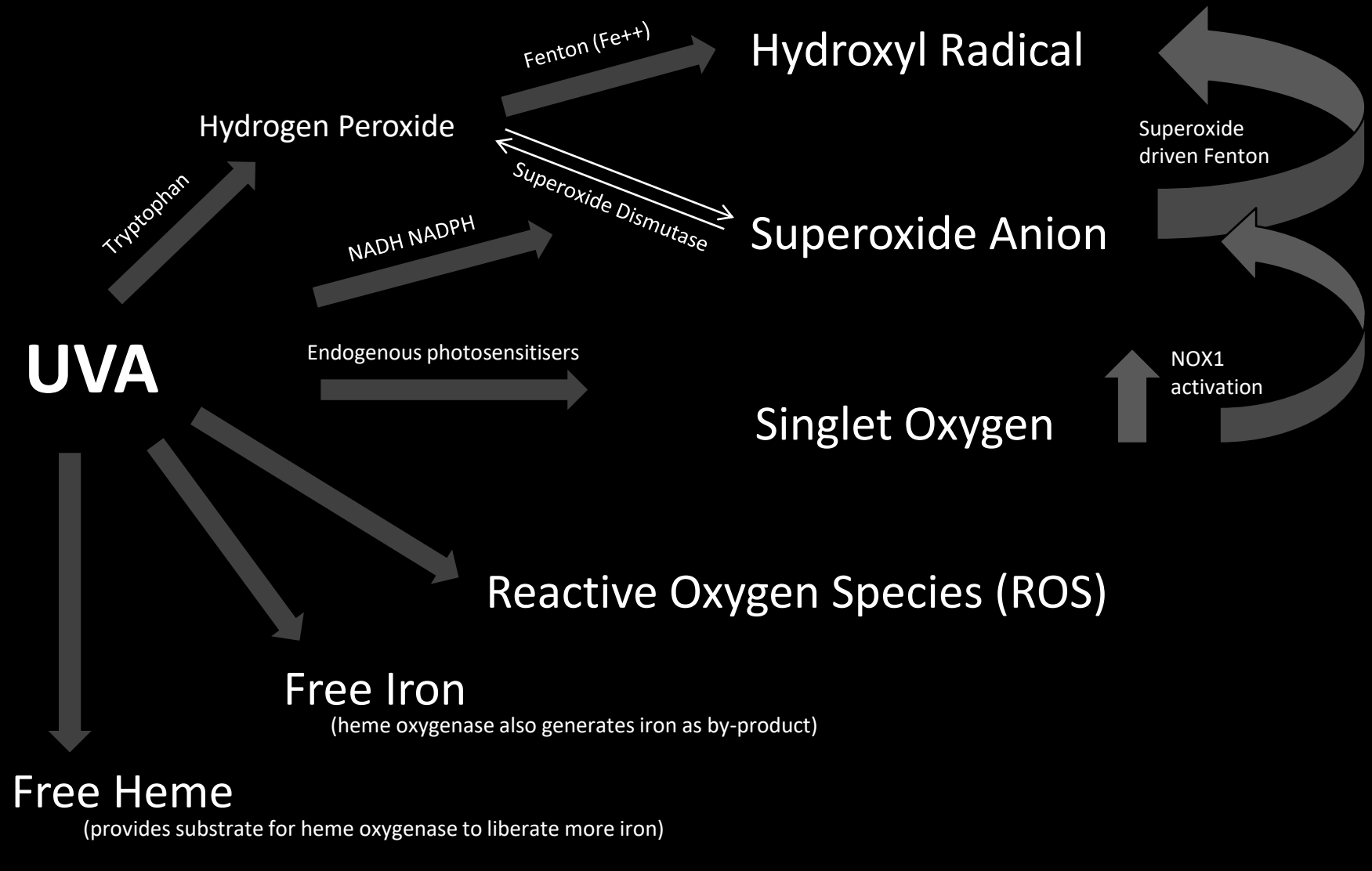
DNA damage
(Setlow, 1974)

Thymine dimer induction
(Young *et al.*, 1998)

The same wavelengths that cause sunburn also cause skin cancer


UVR photon
thymine
dimer

The significant role of UVA in Oxidative Stress



Malignant Melanoma (MM)

Often presents with one or more of the following:

Assymmetry

ragged **B**order

multiple **C**olours

Diameter >5-6mm

Basal Cell Carcinoma (BCC)

Often presents as a persistent open sore that bleeds, oozes, or crusts, or a shiny translucent lump or nodule.

Squamous Cell Carcinoma (SCC)

Often presents as a persistent, scaly red patch with irregular borders that sometimes crusts or bleeds.

Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019

*GBD 2019 Diseases and Injuries Collaborators**

Lancet 2020; 396: 1204–22

This online publication has been corrected. The corrected version first appeared at thelancet.com on October 23, 2020

*For the list of Collaborators see

Summary

Background In an era of shifting global agendas and expanded emphasis on non-communicable diseases and injuries along with communicable diseases, sound evidence on trends by cause at the national level is essential. The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) provides a systematic scientific assessment of published, publicly available, and contributed data on incidence, prevalence, and mortality for a mutually exclusive and collectively exhaustive list of diseases and injuries.

Lancet, 396(10258), 1204-1222, 2020

ORIGINAL ARTICLE

The global burden of skin cancer: A longitudinal analysis from the Global Burden of Disease Study, 1990–2017

Katelyn Urban, MPAS,[a] Sino Mehrmal, DO,[b] Prabhdeep Uppal, DO, MS,[c] Rachel L. Giesey, DO,[d] and Gregory R. Delost, DO[a,e,f]

Greensburg and Erie, Pennsylvania; Oakland, California; Newark, Delaware; and Cleveland and Mayfield Heights, Ohio

Background: Despite efforts toward the earlier detection and prevention of skin cancer, the prevalence of skin cancers continues to increase. Identifying trends in skin cancer burdens among populations can lead to impactful and sustainable interventions.

J Amer Acad Dermatol International, Volume 2, 98-108, 2021

The global burden of skin cancer: A longitudinal analysis from the Global Burden of Disease Study, 1990–2017

	No. of cases globally, 2017
Skin cancer: basal cell carcinoma	5,884,759
Lung cancer	2,163,132
Breast cancer	1,960,682
Colorectal cancer	1,833,451
Skin cancer: squamous cell carcinoma	1,778,829
Prostate cancer	1,334,315
Stomach cancer	1,220,662
Melanoma	308,684

The global burden of skin cancer: A longitudinal analysis from the Global Burden of Disease Study, 1990–2017

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Prostate cancer	1,334,315
Stomach cancer	1,220,662
Melanoma	**308,684**
Total Skin Cancer	**7,972,272**

Global all-age deaths from skin cancer, 2005 – 2015 (1000s)

	2005	2015	% ↑
Melanoma	47.0	59.8	**27.2**
NMSC	36.3	51.9	**42.9**

The Lancet **388**:1459–1544, 2015

Today, 1 in every 3 diagnosed cancers worldwide is a skin cancer

(With a vast majority caused by solar UVR)

Urban, K., Mehrmal, S., Uppal, P., Giesey, R.L. and Delost, G.R. The global burden of skin 655 cancer: A longitudinal analysis from the Global Burden of Disease Study, 1990-2017. *J Amer* 656 *Acad Dermatol* 2, 98-108, 2021

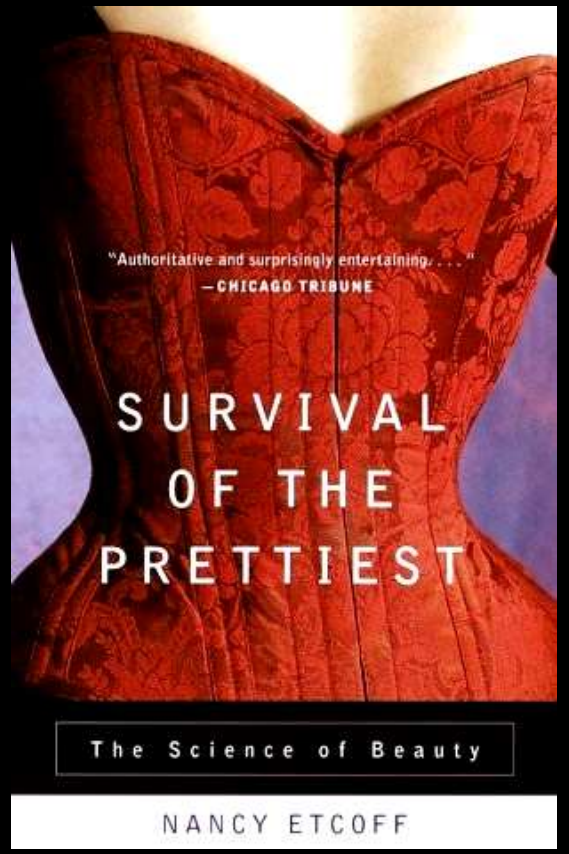
Every death from skin cancer is an avoidable tragedy.

And… ***many more people live <u>with</u> skin cancer than die from it.***

age

health

(“attractiveness”)



Visible Skin Colour Distribution Plays a Major Role in the Perception of Age, Attractiveness and Health in Female Faces, Fink, B., Grammer, K. and Matts, P.J., *Evolution and Human Behaviour*, 27(6), 433-442, 2006

Colour homogeneity and visual perception of age, health and attractiveness of female facial skin, Matts, P.J, Fink, B., Grammer, K. and Burquest, M., J. Am. Acad. Dermatol., 57(6), 977-984, 2007

The effects of skin colour distribution and topography cues on the perception of female facial age and health, Fink, B. and Matts, P.J., *Euro. J. Dermatol. Venereol*., 493-498, 2008

Visual Attention to Variation in Female Facial Skin Colour Distribution, Fink, B., Matts, P.J., Klingenberg, H., Kuntze1, S., Weege, B. and Grammer, K., *J. Cosmet. Derm*., 7(2), 155-161, 2008

Visible skin condition and perception of human facial appearance, Samson, N., Fink, B. Matts, P.J., *Int J Cosmet Sci*., 32(3):167-84, 2010

Chronic sun damage and perception of age, health and attractiveness, Matts, P.J. Fink, B., *Photochem. Photobiol. Sci.,* 9(4):421-31, 2010

Visible changes of female facial skin surface topography in relation to age and attractiveness perception, Samson, N., Fink, B., Matts, P.J., Dawes, N.C. and Weitz, S.M., *J. Cosmet. Dermatol*., 9, 79–88, 2010

Differences in visual perception of age and attractiveness of female facial and body skin, Fink, B., Röder, S., Burquest, M., Johnson, R., and Matts, P.J., *Int. J. Cosmet. Sci*, 33(2):126-31, 2011

Interaction of skin colour distribution and skin surface topography cues in the perception of female facial age and health, Samson, N., Fink, B. and Matts, P.J., *J. Cosmet. Dermatol.,* 10(1):78-84, 2011

Does a woman's skin colour indicate her fertility level? Preliminary findings, Samson, N., Fink, B. and Matts, P.J., *Swiss Journal of Psychology*, 70 (4), 2011

Visible skin colouration predicts perception of male facial age, health and attractiveness, Fink, B., Bunse, L., Matts, P.J. and D'Emiliano, D., *Int. J. Cosmet. Sci*., 34(4):307-10, 2012

Colour homogeneity and visual perception of age, health and attractiveness of male facial skin, Fink, B., Matts, P.J., D'Emiliano, D., Bunse, L., Weege, B. and Röder, S., *Euro. J. Dermatol. Venereol.,* 26(12):1486-92, 2013

Visual attention to and perception of undamaged and damaged versions of natural and coloured female hair, Fink, B., Neuser, F., Deloux, G., Röder, S. and Matts, P.J., *J. Cosmet. Derm.,* 12(1):78-84, 2013

ELSEVIER

Evolution and Human Behavior 27 (2006) 433–442

Evolution and Human Behavior

Visible skin color distribution plays a role in the perception of age, attractiveness, and health in female faces☆

Bernhard Fink[a,*], Karl Grammer[b], Paul J. Matts[c]

[a]*Department for Sociobiology/Anthropology, Institute for Zoology and Anthropology, University of Göttingen, D-37073 Göttingen, Germany*

[b]*Ludwig-Boltzmann-Institute for Urban Ethology, c/o Department for Anthropology, A-1090 Vienna, Austria*

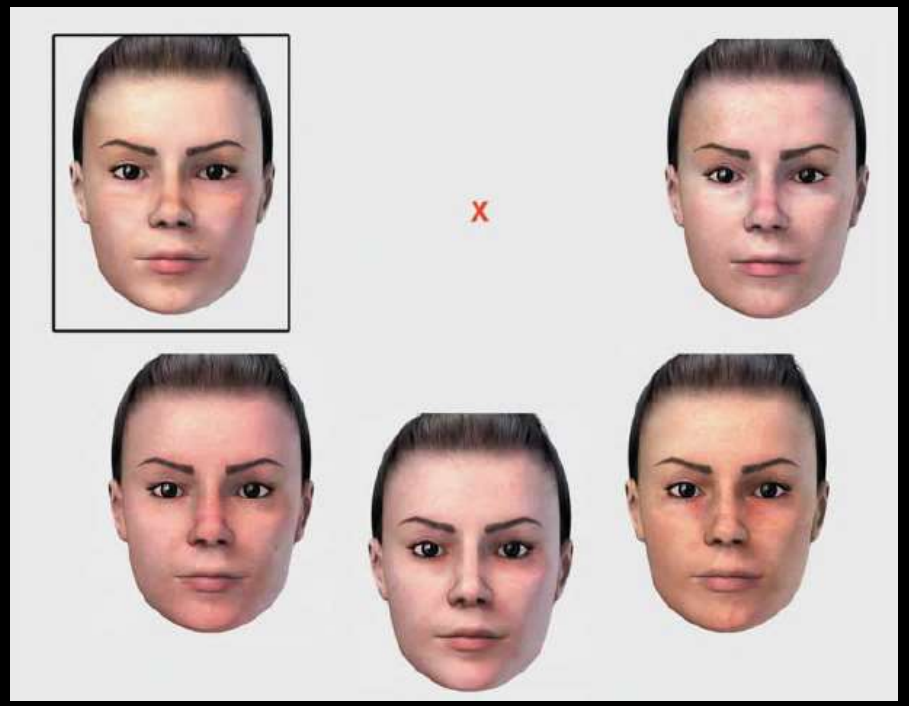
[c]*P&G Beauty, Rusham Park Technical Centre, Whitehall Lane, Egham, KT15 2HT Surrey, United Kingdom*

Visual attention to variation in female facial skin color distribution

Bernhard Fink, PhD,[1] Paul J Matts, PhD,[2] Heiner Klingenberg,[1] Sebastian Kuntze,[1] Bettina Weege,[1] & Karl Grammer, PhD[3]

[1]*Department of Sociobiology/Anthropology, Institute of Zoology & Anthropology, University of Göttingen, Göttingen, Germany*
[2]*P&G Beauty, Rusham Park Technical Center, Whitehall Lane, Egham, Surrey, UK*
[3]*Ludwig-Boltzmann-Institute for Urban Ethology, Vienna, Austria*

Journal of Cosmetic Dermatology, **7**, 155–161



We look longer and harder at faces with skin featuring less contrast (more flawless / homogeneous skin)

Original Article

Visual Perception of British Women's Skin Color Distribution in Two Nonindustrialized Societies, the Maasai and the Tsimane'

Evolutionary Psychology
July-September 2017: 1–4

DOI: 10.1177/1474704917718957
journals.sagepub.com/home/evp
SAGE

Bernhard Fink[1,2], Marina Butovskaya[3,4], Piotr Sorokowski[5], Agnieszka Sorokowska[5,6], and Paul J. Matts[7]

“Quality of Life”

"An individual's perception of their position in life in the context of culture and value systems in which they live in relation to their goals, expectations, standards and concerns affected by the person's physical health, psychological state, level of independence, social relationships and their relationships to salient features in their environment."

World Health Organization

Skin health has a profound effect on Quality of Life and Self-Esteem

- The impaired physical and mental functioning caused by a skin condition is often comparable to that seen in terminal cancer, arthritis, hypertension, heart disease, diabetes or depression (Rapp *et al*., 1999).

- Serious consequences...

  - Personal / social relationships and employment suffer.
  - Shame and embarrassment are common.
  - Frequent crises of confidence, feelings of depression.
  - Suicide.

"It's ok... it's not Melanoma..."

Less than 5% of BCC cases become locally advanced or metastasise.

Miller *et al*., J Natl Compr Canc Netw. 2010;8:836–64

However, if untreated, local lesions can cause substantial tissue destruction and visible disfigurement.

National Comprehensive Cancer Network. Basal and Squamous Cell Skin Cancer (Version 1.2014)

While most BCC lesions can be removed surgically, a percentage of patients are unsuitable for surgery or develop a more advanced stage of disease, with consequent greater negative outcome.

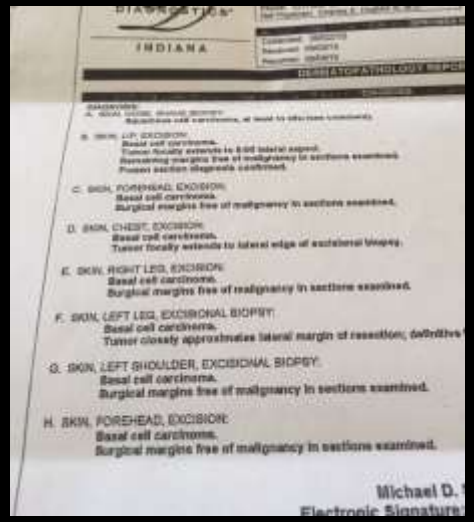
Nunes *et al*., Dermatol Surg. 2013;39:620–6.



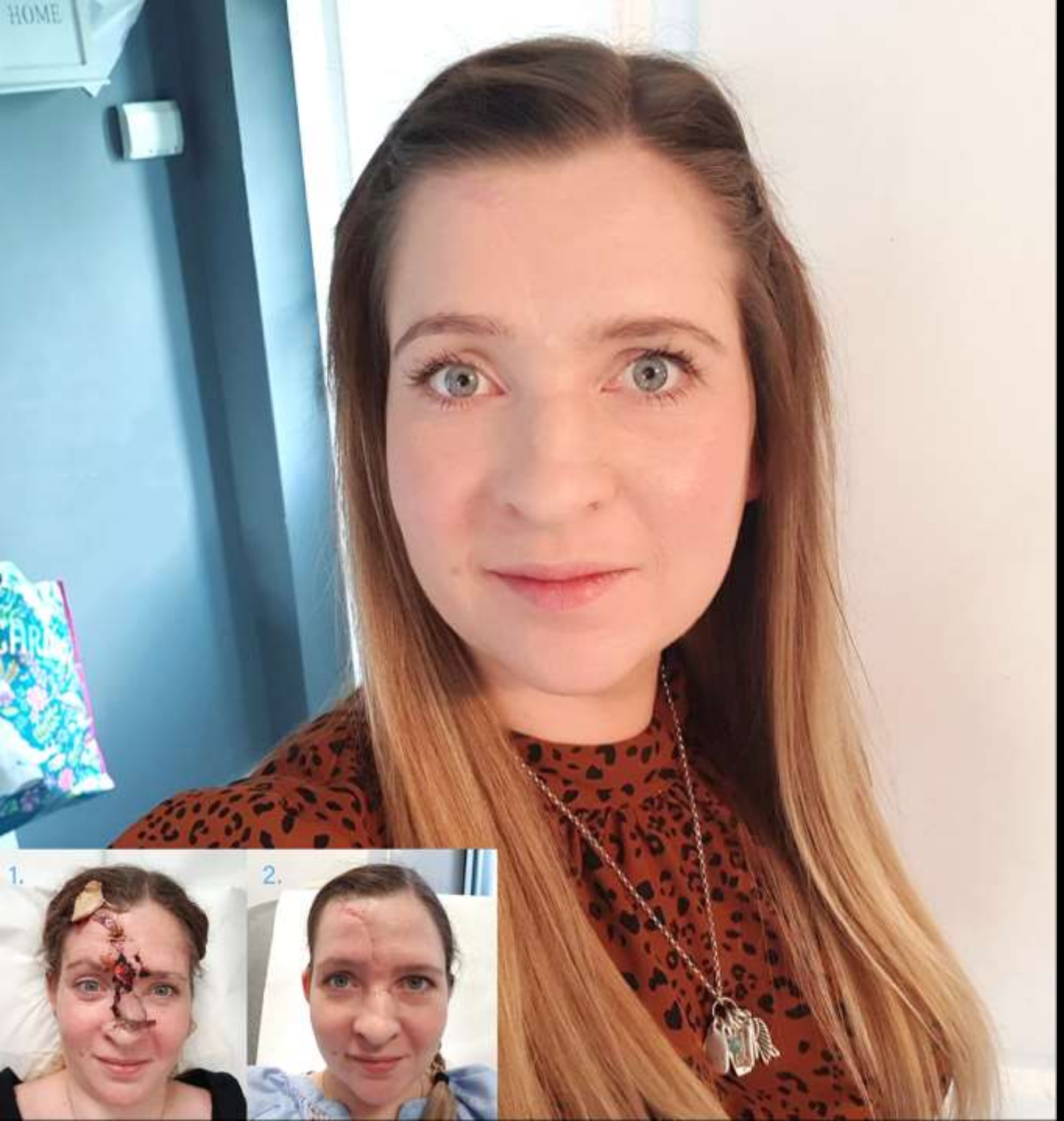

In 2015 Judy Cloud, 49, shared her series of BCC surgeries publicly on Facebook.

Ms Cloud was left with permanent facial scarring, numbness and some immobility.



"I'm really hoping the thought of going to a tanning bed no longer sounds quite so attractive to you..."



Katy Flynn's story (thank you Marie Tudor, SKCIN for use of this account)

"At the age of just 30 I was diagnosed with BCC...

I had a 6 hour operation and following this I was sent for plastic surgery. The surgeon had to use skin from my forehead to cover the parts of my nose they had to cut away. I now have a 4" scar across my face. I was worried what my little girls would think. I didn't want them to be scared when mummy came home from surgery.

You can't hide your face. So I'm getting used to how my skin looks now. It is something I have to live with. But to be honest I'm lucky to be alive...".

"Well, I don't... I don't like it when people stare at me. Um, it makes me a little bit uneasy; especially the little children. That bothers me..."

"I'm tired of having my body cut. I mean, you could say it's at times mildly depressing..."

"A great, gaping wound on my face and no ears, I mean as soon as you look at me you can tell something is definitely wrong with this guy..."

"Well, I wear the hat and the wig because after all these surgeries, I... I have no hair, it's all scar tissue and... I think my mind has shut down..."

Steenrod *et al.*, Dermatol Ther (Heidelb) (2015) 5:183–199

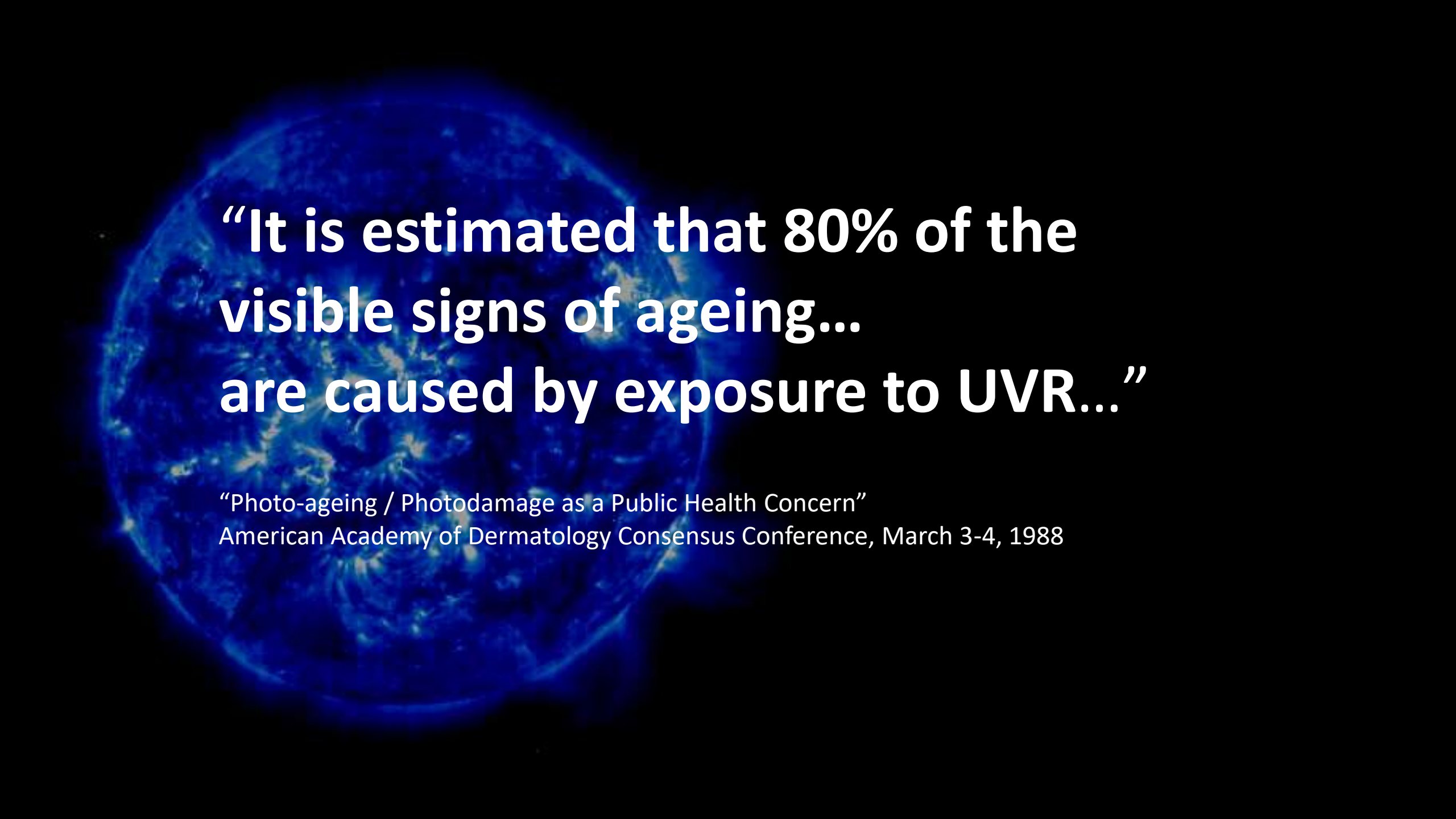
The crushing burden of skin cancer on our health system

- GP referrals to dermatology increased by 15% between 2014 and 2018.
- Approximately a quarter of UK dermatology posts remain unfilled.
- In 2019, the total cost of in-patient care for KC was an estimated £150 million – an increase of 8% vs 2018.
- **Up to 50% of a dermatologist's workload in England is taken up in delivering outpatient skin cancer care.**

'State of the Nation: NMSC', 2020

A minority will develop skin cancer.

And… ***100% of humans look older, less healthy and less attractive than they should because of chronic UVR exposure.***



“It is estimated that 80% of the visible signs of ageing… are caused by exposure to UVR…”

“Photo-ageing / Photodamage as a Public Health Concern”
American Academy of Dermatology Consensus Conference, March 3-4, 1988

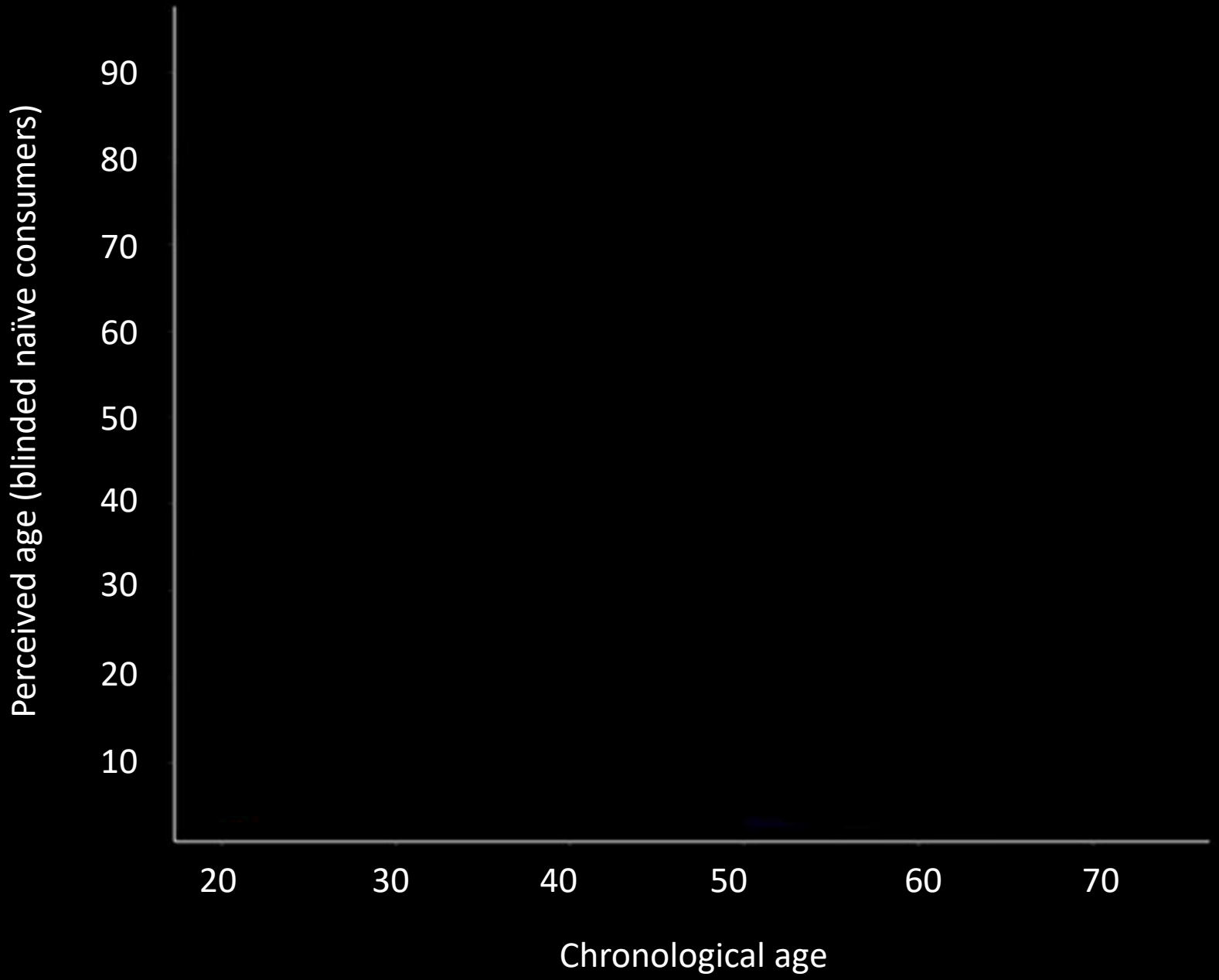
It all adds up…

It is estimated that the majority of our yearly UVR exposure is from multiple brief exposures as a consequence of normal, everyday life

Sun damage is, therefore, **cumulative**

"…the skin never forgets…" Professor Albert Kligman

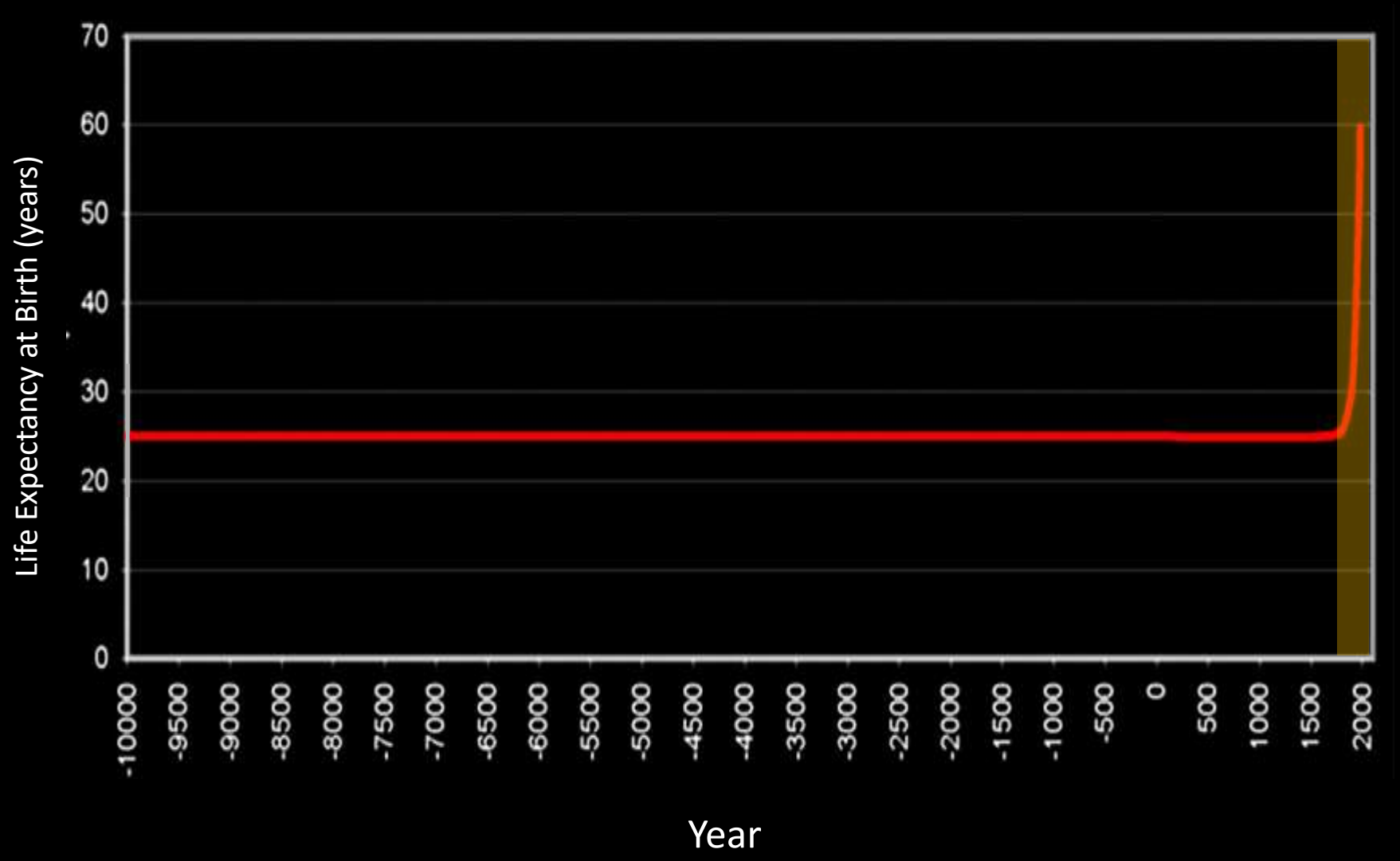
?



By age 50, African-descent ladies were perceived as >10yrs younger than their actual, chronological age.

P Matts, P&G data on file

Life expectancy, 10,000BCE - Present



Indur & Goklany, 2007

Chronic sun damage and the perception of age, health and attractiveness

Paul J. Matts*[a] and Bernhard Fink[b]

Received 14th November 2009, Accepted 28th December 2009
First published as an Advance Article on the web 11th February 2010
DOI: 10.1039/b9pp00166b

Young and healthy-looking skin is a feature that is universally admired and considered attractive among humans. However, as we age, skin condition deteriorates due to a variety of intrinsic and extrinsic factors determined not only by genetics and physiological health but also by behaviour and lifestyle choice. As regards the latter, cumulative, repeated exposure to solar ultraviolet radiation (UVR) is linked intrinsically to the induction of specific types of skin cancer and the expression of cutaneous damage markers responsible for the majority of the visible signs of skin ageing. Here we review empirical evidence for skin-specific effects of chronic UVR exposure and relate it to perception of visible skin condition. In contrast to other dermatological accounts, we stress an evolutionary psychology context in understanding the significance of age-related changes in visible skin condition in human social cognition and interaction. We suggest that the "marriage" of the scientific fields of skin biology and evolutionary psychology provides a modern, powerful framework for investigating the causes, mechanisms and perception of chronic sun damage of skin, as it explains the human obsession with a youthful and healthy appearance. Hence, it may be that these insights bring true emotional impetus to the adoption of sun protection strategies, which could conceivably impact skin cancer rates in coming years.

“… the global cosmetic surgery market continues to expand at an astonishing rate, with projected growth from $56 billion in 2022 to $72 billion by 2029, at a compound annual growth rate of 4%, driven in no small way by longevity-potentiated photoageing…”

Matts PJ & Nash JF*, J Cosmet Sci*, **45**:20–32 2023

Do Sunscreens Work?

The 'Nambour Study' (Prof Adele Green): 1621 subjects in Nambour, Queensland, Australia randomly assigned to either a supplied daily SPF16 sunscreen (Intervention), or continued with their own regime (Control), for four years (1992 – 1996).

Prolonged Prevention of Squamous Cell Carcinoma of the Skin by Regular Sunscreen Use

Jolieke C. van der Pols,[1,2] Gail M. Williams,[1] Nirmala Pandeya,[2] Valerie Logan,[2] and Adèle C. Green[2]

[1]Longitudinal Studies Unit, School of Population Health, University of Queensland and [2]Cancer and Population Studies Unit, Queensland Institute of Medical Research, Brisbane, Queensland, Australia

VOLUME 29 · NUMBER 3 · JANUARY 20 2011

JOURNAL OF CLINICAL ONCOLOGY

ORIGINAL REPORT

Reduced Melanoma After Regular Sunscreen Use: Randomized Trial Follow-Up

Adèle C. Green, Gail M. Williams, Valerie Logan, and Geoffrey M. Strutton

The ‘Nambour Study’ (Prof Adele Green): 1621 subjects in Nambour, Queensland, Australia randomly assigned to either a supplied daily SPF16 sunscreen (Intervention), or continued with their own regime (Control), for four years (1992 – 1996).

Annals of Internal Medicine

Established in 1927 by the American College of Physicians

4 June 2013, Vol 158, No. 11

Sunscreen and Prevention of Skin Aging: A Randomized Trial

Maria Celia B. Hughes, MMedSci; Gail M. Williams, PhD; Peter Baker, PhD; and Adèle C. Green, MBBS, PhD

Background: Sunscreen use and dietary antioxidants are advocated as preventives of skin aging, but supporting evidence is lacking.

Objective: To determine whether regular use of sunscreen compared with discretionary use or β-carotene supplements compared with placebo retard skin aging, measured by degree of photoaging.

Design: Randomized, controlled, community-based intervention. (Australian New Zealand Clinical Trials Registry: ACTRN12610000086066).

Setting: Nambour, Australia (latitude 26° S).

Patients: 903 adults younger than 55 years out of 1621 adults randomly selected from a community register.

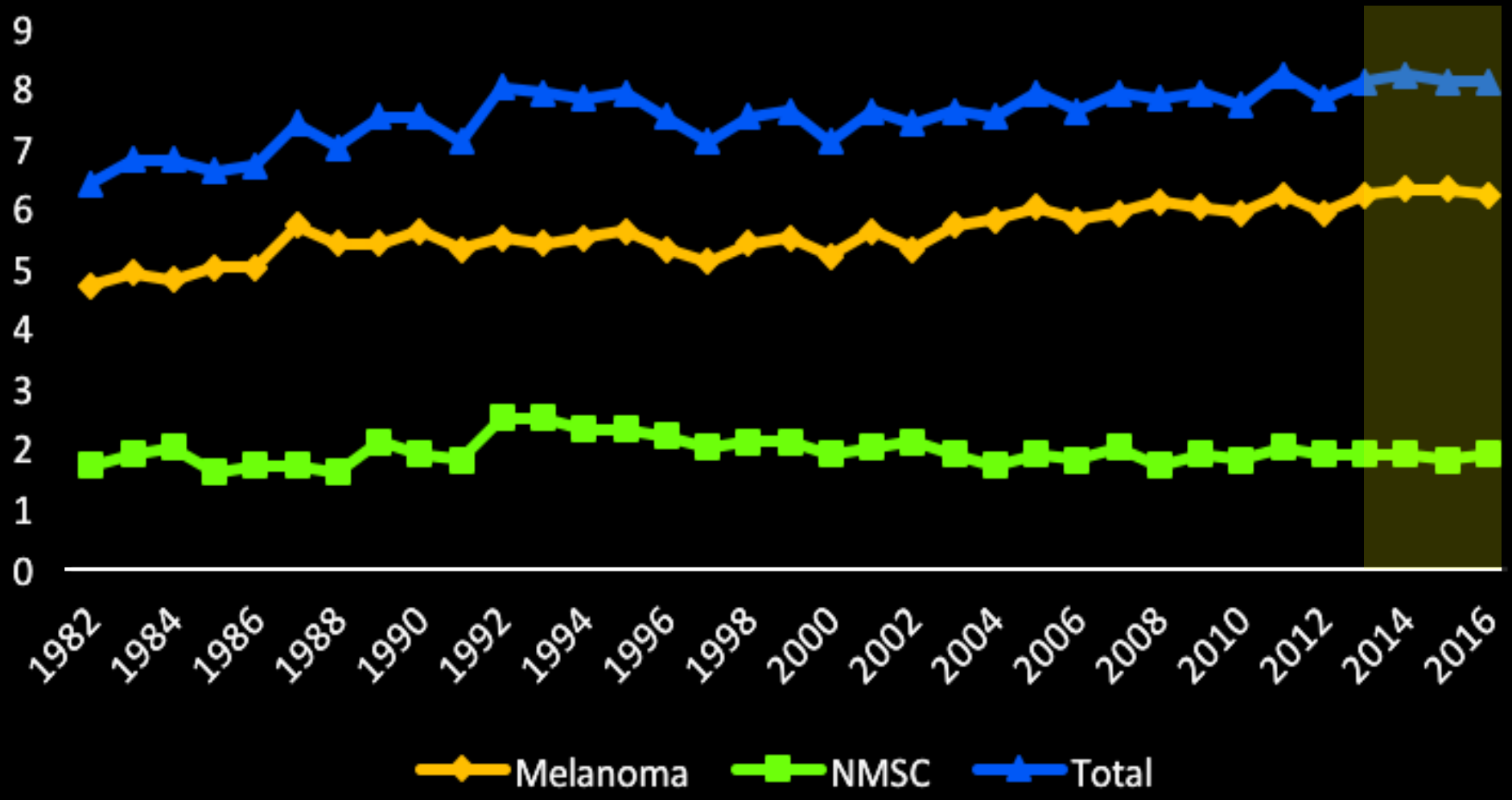
Intervention: Random assignment into 4 groups: daily use of broad-spectrum sunscreen and 30 mg of β-carotene, daily use of sunscreen and placebo, discretionary use of sunscreen and 30 mg of β-carotene, and discretionary use of sunscreen and placebo.

Measurements: Change in microtopography between 1992 and 1996 in the sunscreen and β-carotene groups compared with controls, graded by assessors blinded to treatment allocation.

Results: The daily sunscreen group showed no detectable increase in skin aging after 4.5 years. Skin aging from baseline to the end of the trial was 24% less in the daily sunscreen group than in the discretionary sunscreen group (relative odds, 0.76 [95% CI, 0.59 to 0.98]). β-Carotene supplementation had no overall effect on skin aging, although contrasting associations were seen in subgroups with different severity of aging at baseline.

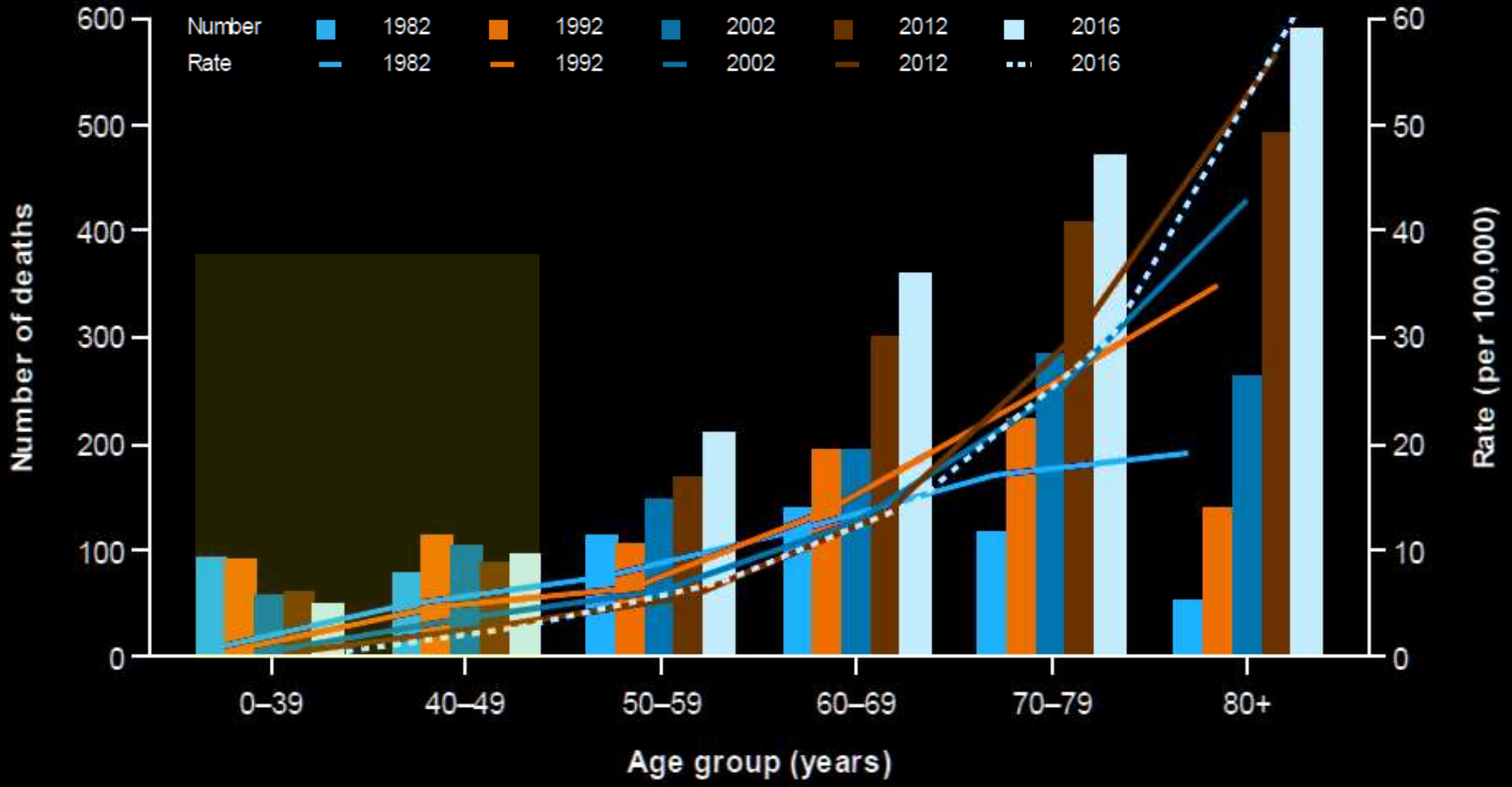
SUNSMART®

Australia – mortality rates for melanoma and NMSC (per 100,000), all ages, 1982 - 2016



Skin Cancer in Australia, Australian Institute of Health and Welfare, 2016

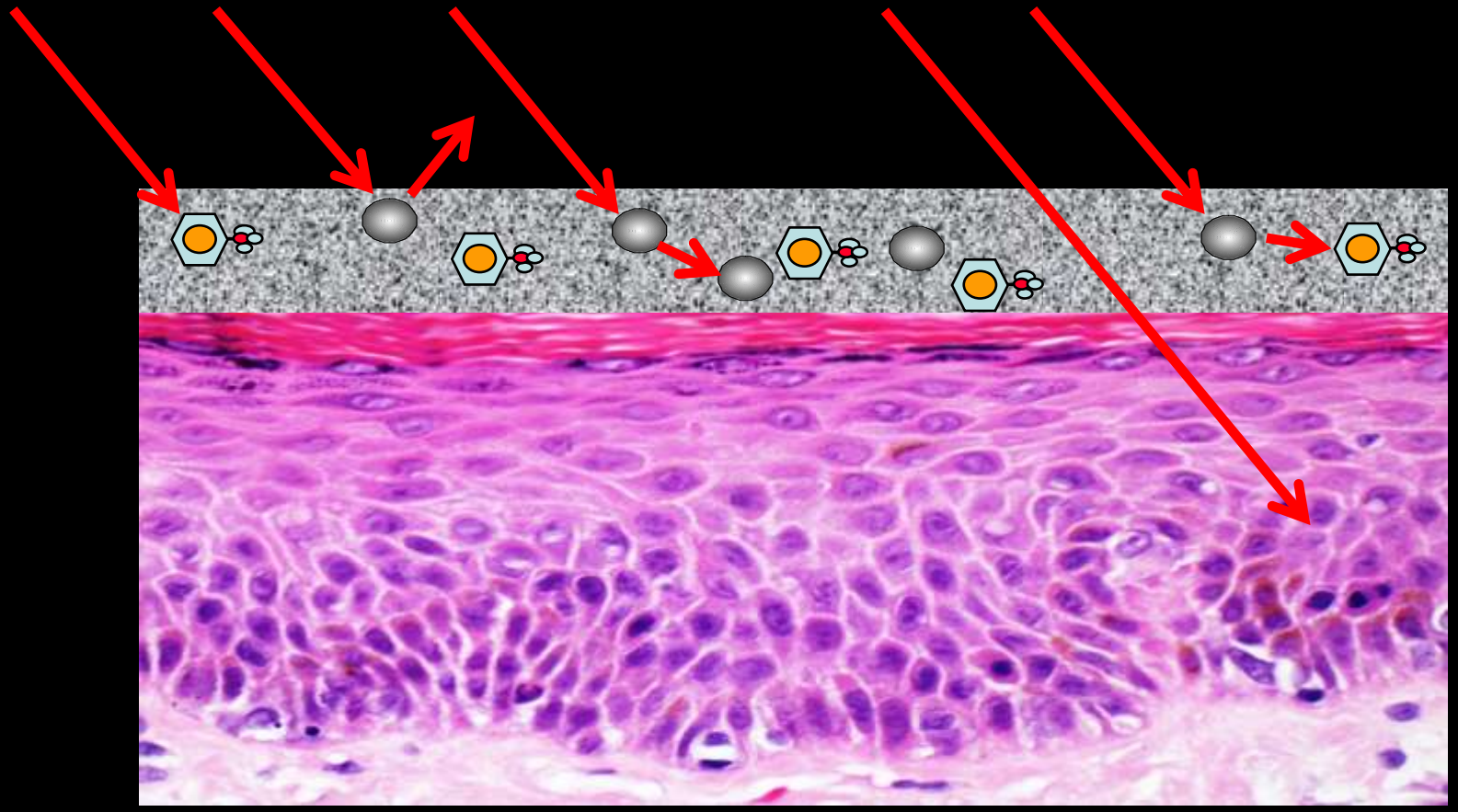
Mortality rate (per 100,000) and deaths for melanoma, by age group, 1982 - 2016



Skin Cancer in Australia, Australian Institute of Health and Welfare, 2016

How Do Sunscreens Work?

How UVR filters work – reducing the flux (and cumulative dose) of UVR photons to the skin



"Organic" chemistry
(solubilised)

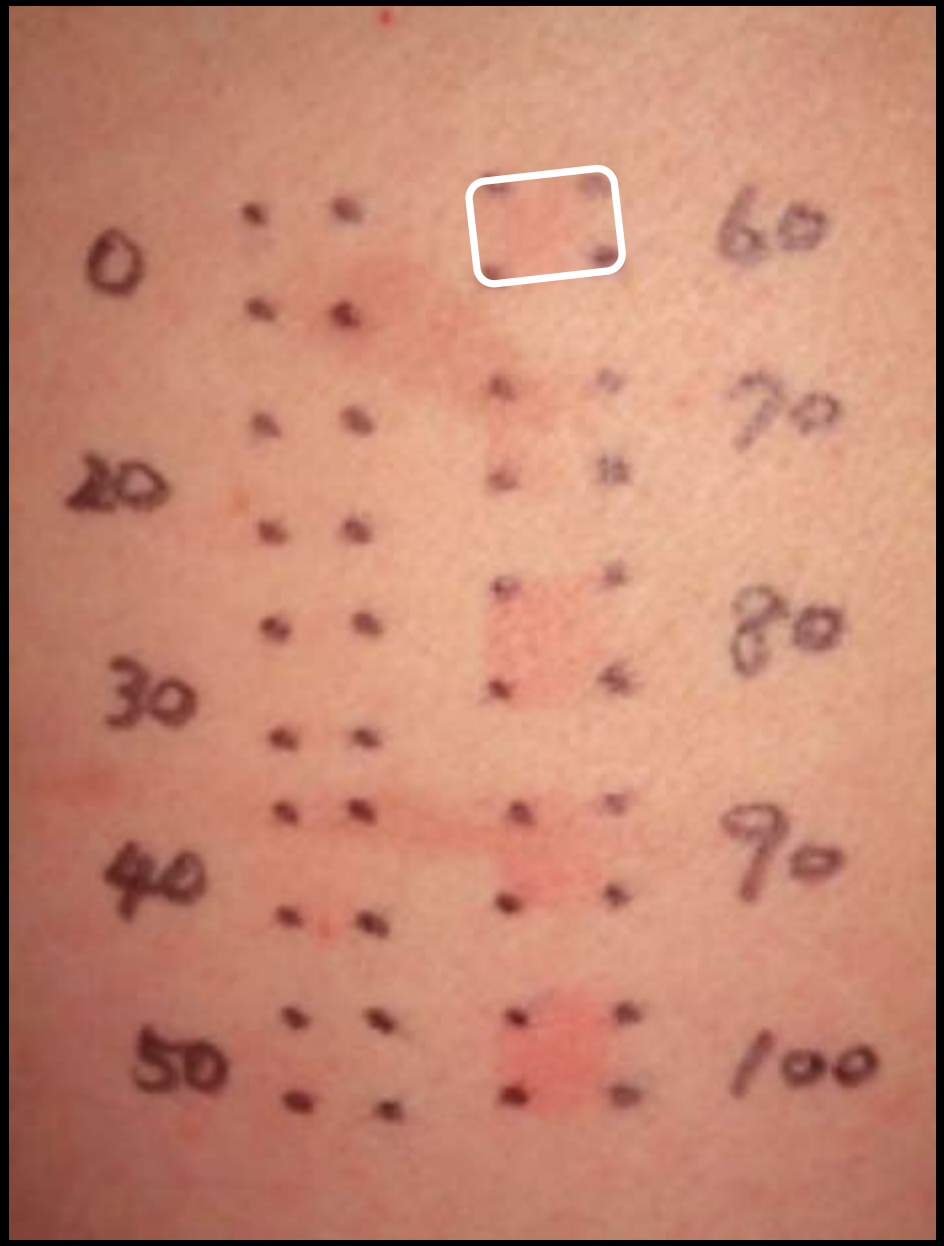
"Inorganic"
(particulate)

How Are Sunscreens Tested?

UVR delivered by a xenon source, “solar simulator”

Sun Protection Factor

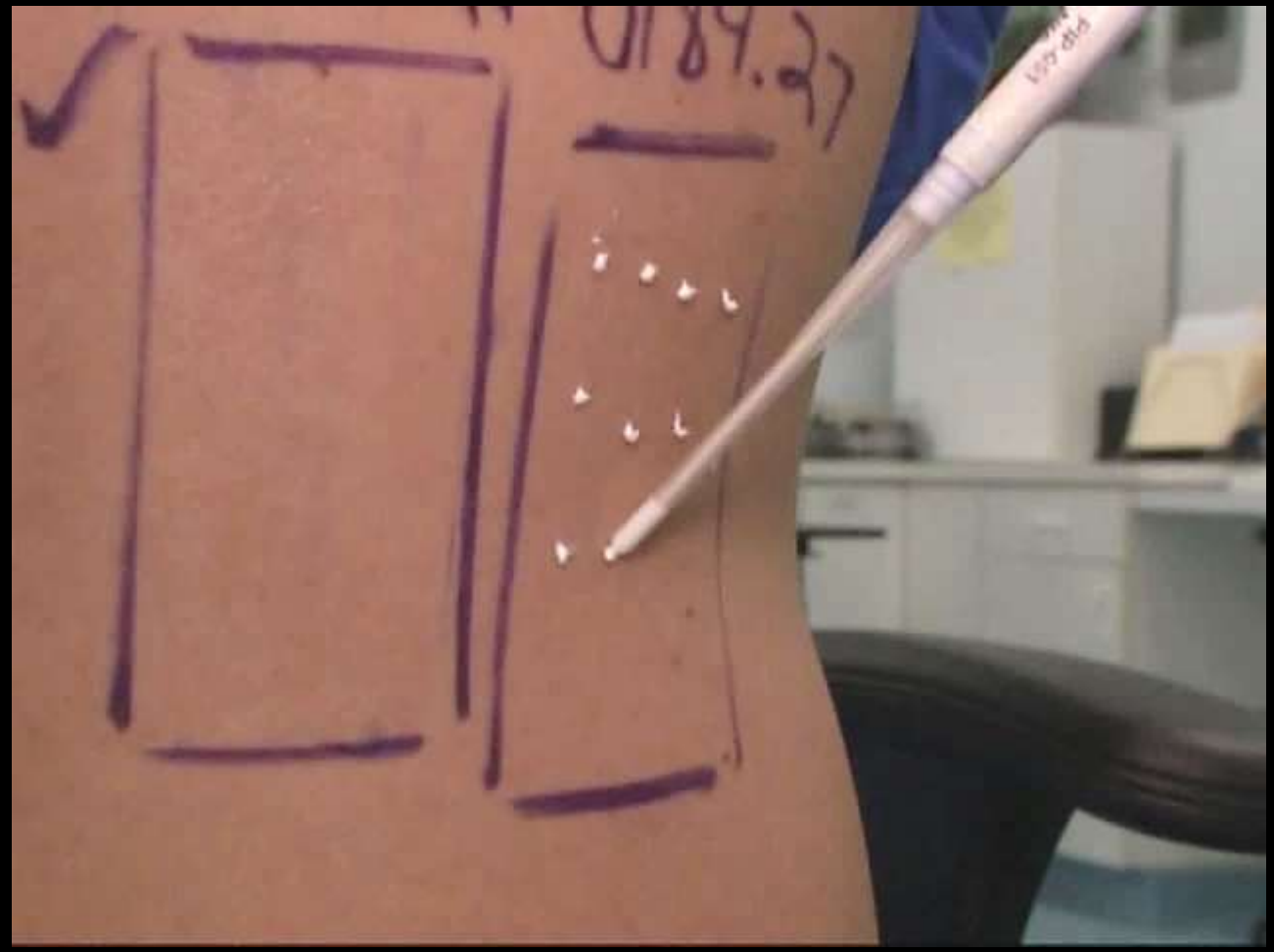
SPF



“Minimum Erythemal Dose”

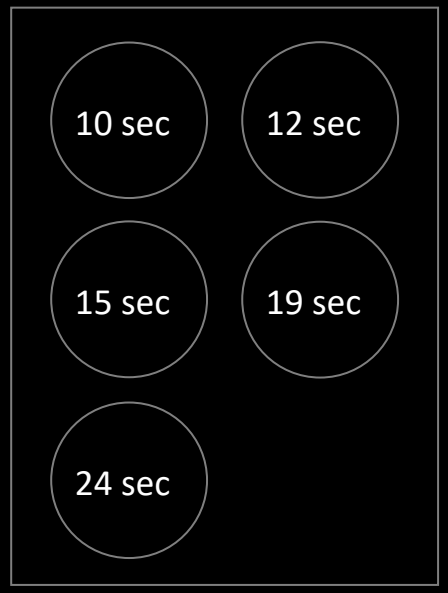
(MED; UVR dose required to produce barely-perceptible skin reddening 24h after UV exposure)

Sunscreen applied and spread at a standard dose (2mg / cm^2)



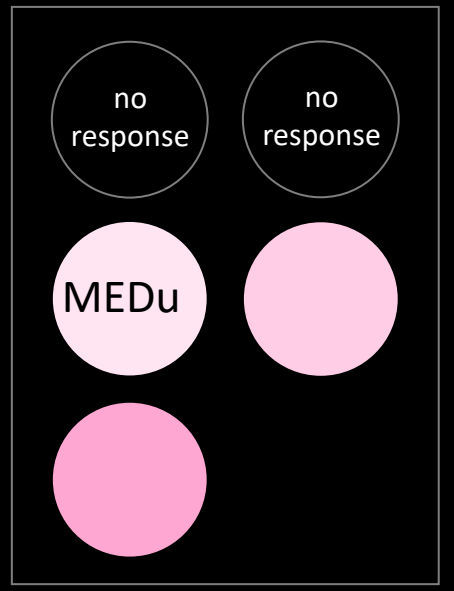
SPF Testing

Untreated site



Increasing doses of UV

24hr after UV exposure



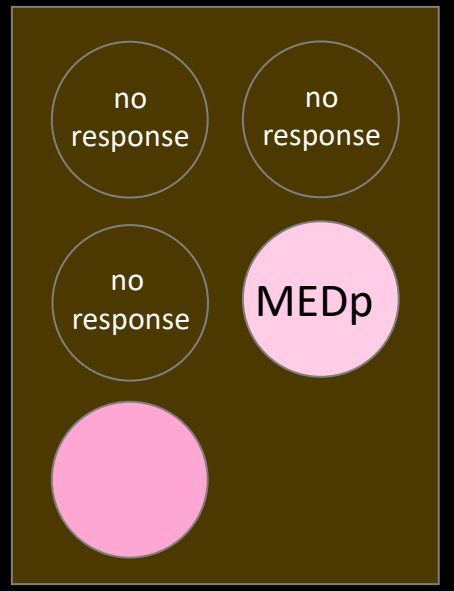
MEDu = 15sec

SPF Testing

Sunscreen-treated site

Increasing doses of UV

24hr after UV exposure



MEDp = 285 sec

$$SPF = \frac{MED_{protected}}{MED_{unprotected}}$$

$$SPF = \frac{285}{15} = \mathbf{19}$$

COLIPA
The European Cosmetics Association

The COLIPA SPF Test Method

1994

Method 94/289

INTERNATIONAL SUN PROTECTION FACTOR (SPF) TEST METHOD

ctfa

COLIPA

JCIA
JAPAN COSMETIC INDUSTRY ASSOCIATION

CTFA
Cosmetic, Toiletry, and Fragrance Association

May 2005

INTERNATIONAL STANDARD

ISO 24444

First edition
2010-11-15

Cosmetics — Sun protection test methods — *In vivo* determination of the sun protection factor (SPF)

Cosmétiques — Méthodes d'essai de protection solaire — Détermination in vivo du facteur de protection solaire (FPS)

ISO

Reference number
ISO 24444:2010(E)

INTERNATIONAL STANDARD

ISO 24444

Second edition
2019-12

AMENDMENT 1
2022-03

Cosmetics — Sun protection test methods — In vivo determination of the sun protection factor (SPF)

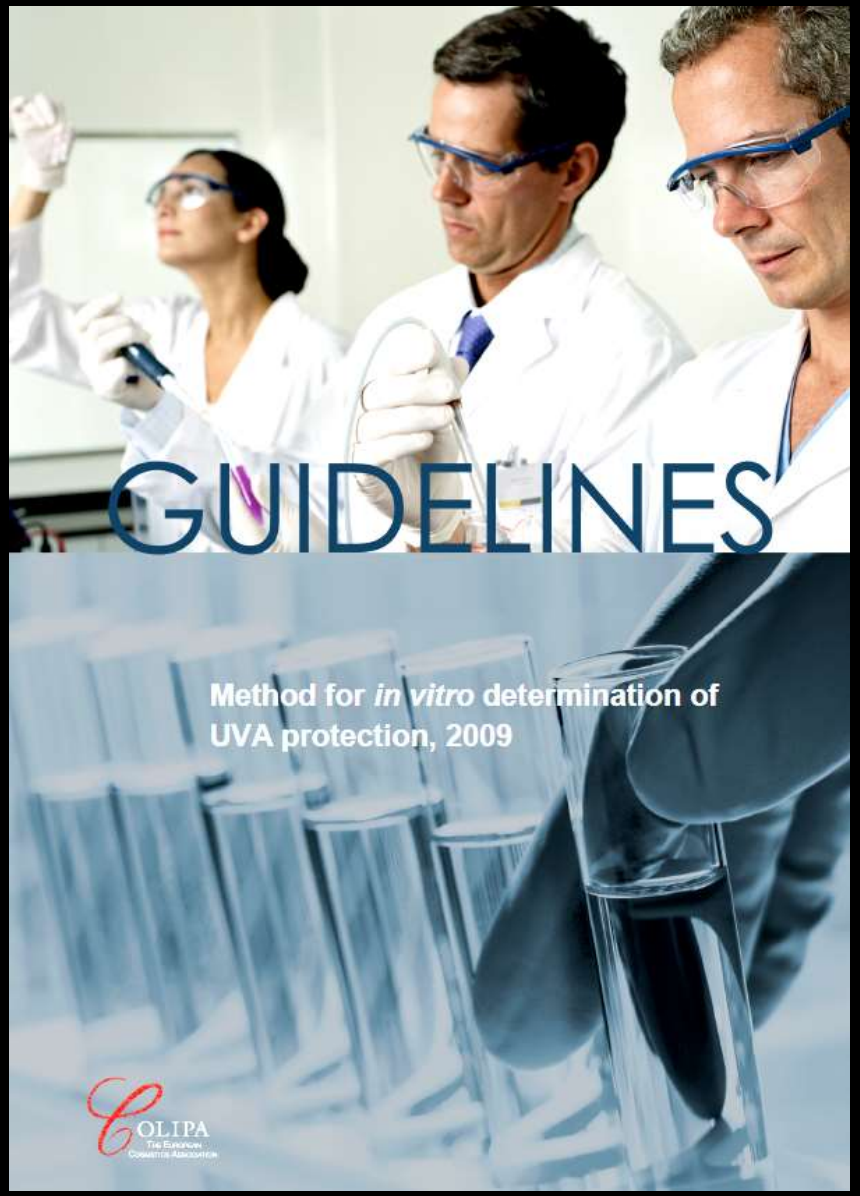
AMENDMENT 1

Cosmétiques — Méthodes d'essai de protection solaire — Détermination in vivo du facteur de protection solaire (FPS)

AMENDEMENT 1

ISO

Reference number
ISO 24444:2019/Amd.1:2022(E)



International Journal of Cosmetic Science

International Journal of Cosmetic Science, 2010, **32**, 35–46 doi: 10.1111/j.1468-2494.2009.00542.x

The COLIPA *in vitro* UVA method: a standard and reproducible measure of sunscreen UVA protection

P. J. Matts*, V. Alard†, M. W. Brown‡, L. Ferrero§, H. Gers-Barlag¶, N. Issachar**, D. Moyal†† and R. Wolber¶

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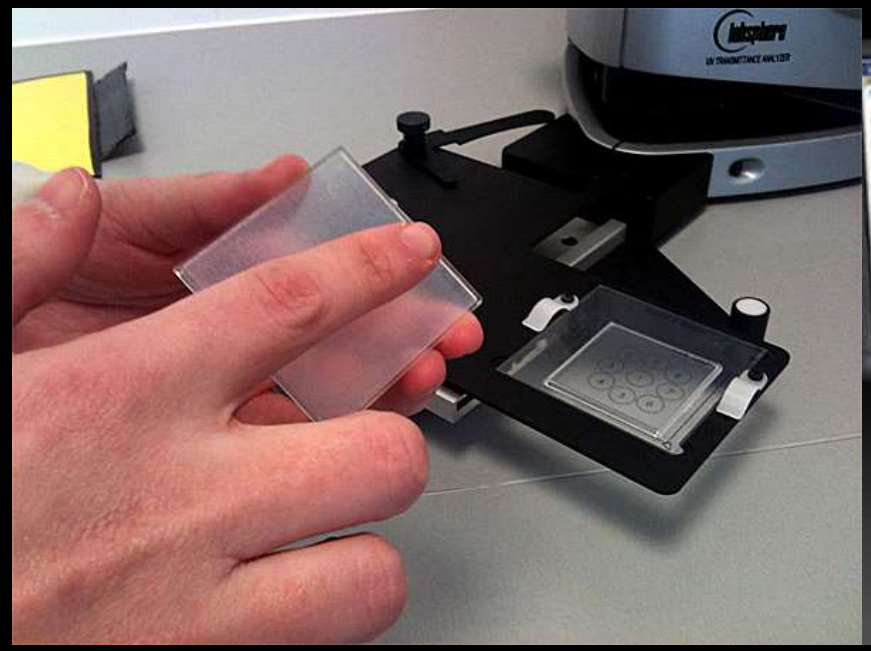
INTERNATIONAL STANDARD **ISO 24443**

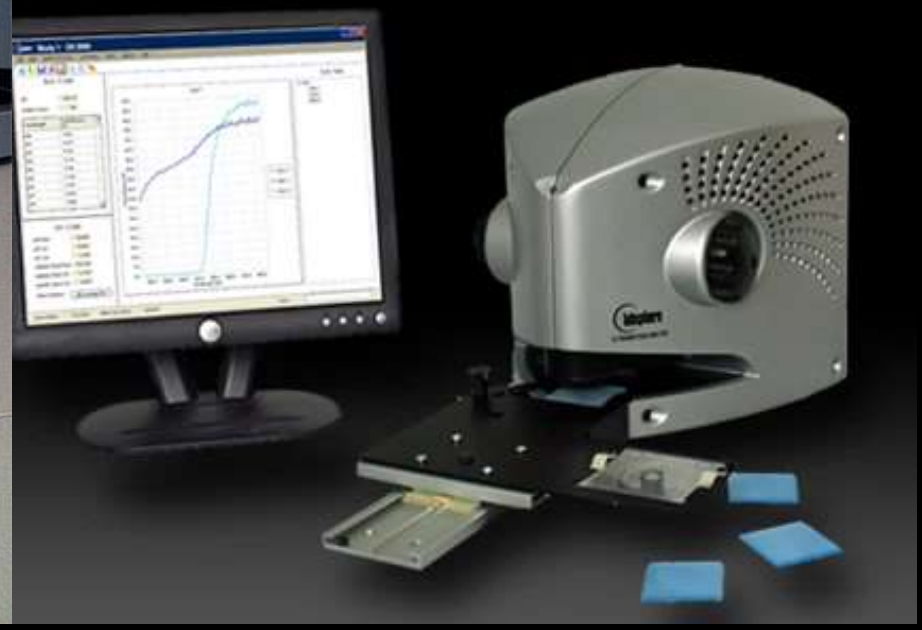
Determination of sunscreen UVA photoprotection *in vitro*

Reference number
ISO 24443:2012(E)

UVA Protection Factor

UVA-PF





Human skin is replaced with a UVR-transparent, textured polymethacrylate plate; UVR transmission is measured using substrate spectrophotometry.

How Are Sunscreens Labelled (in the UK)?

15 15

European harmonised labelling system

15

UK Boots ‘Star System’

What does all this mean for me?

We do not have to fear / avoid the sun… but we do need to manage our exposure to it…

Cancer Council of Australia national **SunSmart** program

Skcin – UK's leading skin cancer charity

Marie Tudor, Skcin CEO

Myth busting

- **The "healthy tan".** **There is no such thing**. Tanning is only a defense response to DNA damage *already* in your skin.

- **An SPF15 is an SPF15 – right?** **No** – the SPF test is performed at a relatively high application rate and, unless you likewise apply generously, you will achieve a *significantly lower protection factor*.

- **Water reflects UVR.** **No** – but snow and other light surfaces do (approx. 90%). However… water can *transmit* UVR down to approximately 2 metres.

Myth busting

- **Daily Sun-Block.** **Not necessary (unless you have a photosensitive medical condition).** However, a moisturiser (or foundation, etc.) with e.g., SPF15 protection may be a wise choice to manage incidental outdoor sun exposure between May and September.

- **Sun protection will stop Vitamin D production.** **Untrue** – peer-reviewed published research shows that relatively little UVR is needed for natural vitamin D synthesis... and that use of sunscreen does not disrupt this process.

Myth busting

- **'A' is for 'Ageing', 'B' is for 'Burning'.** **Untrue –** 'UVB' and 'UVA' are technical terms derived from experiments in the 1930's. Both UVB and UVA can drive erythema and photoageing.

- **Darker skin does not need sun protection.** **Untrue –** while cancer rates are lower and photoageing is less in darker skin, there is still significant cumulative risk.

- **Sunscreens cause skin cancer.** **Patent nonsense** – there is ***no*** evidence that this is true.

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