

**SUNLIGHT**

**UVR**



**FOR HEALTH**

**Michael F. Holick**

**Boston University Medical Center**

# Publics' View of the Sun



EDUCATION

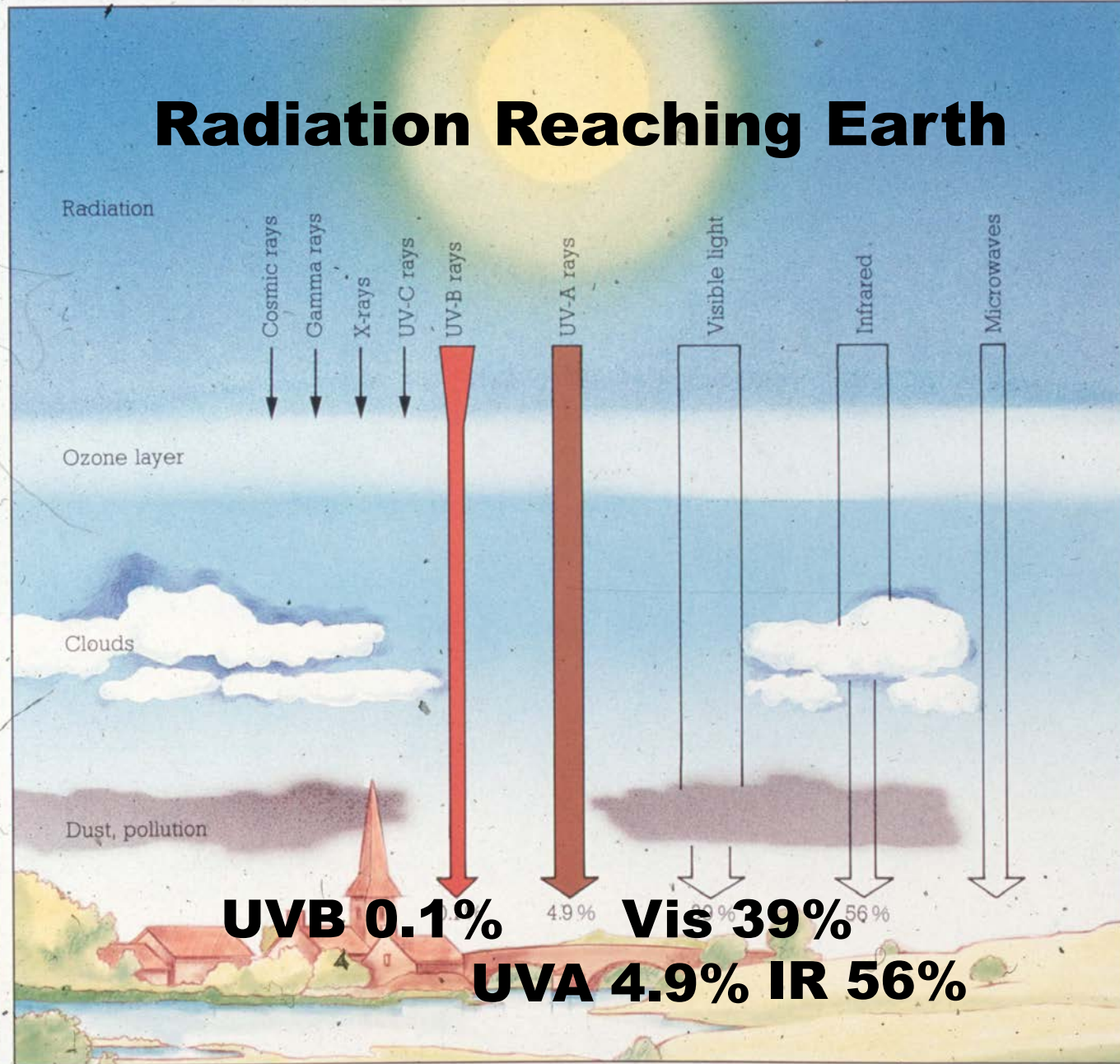
EDUCATION

EDUCATION

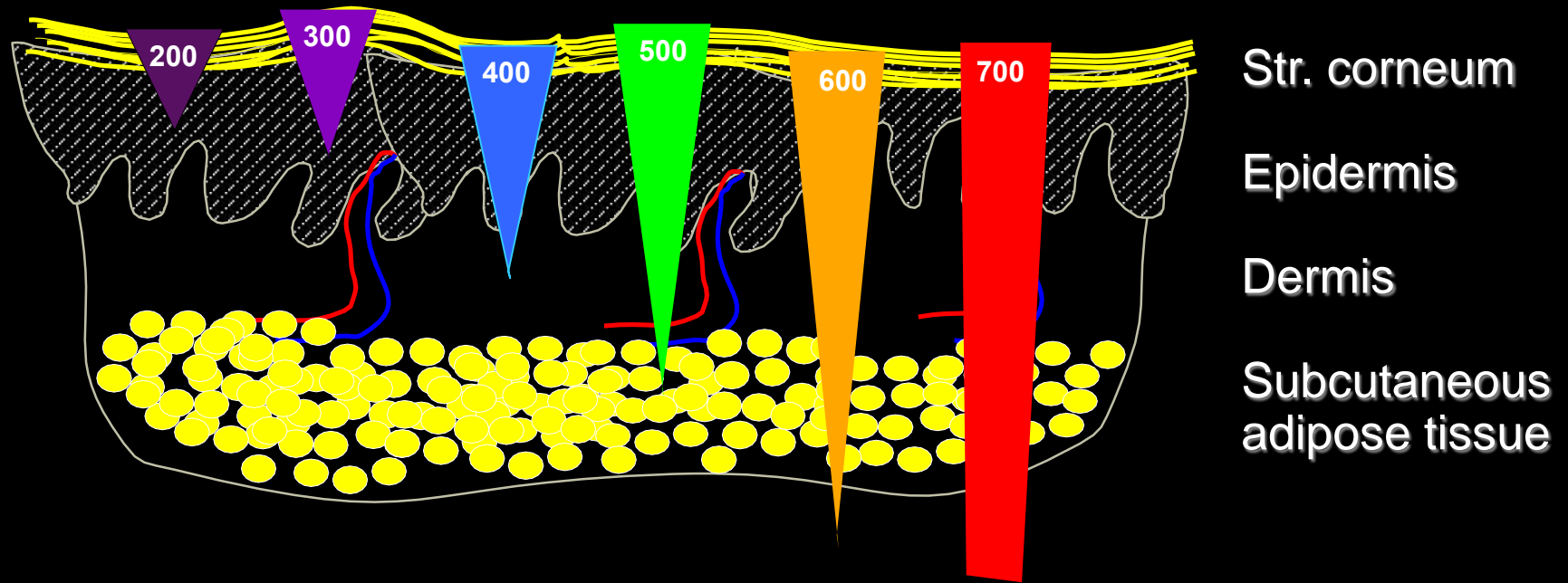
EDUCATION

# Schematic Representation of Electromagnetic Radiations Reaching the Earth Surface

## Radiation Reaching Earth



# Dependence of wavelength and skin penetration



**ENERGY NANOMETERS**

HOW DOES THE SKIN

*RESPOND*

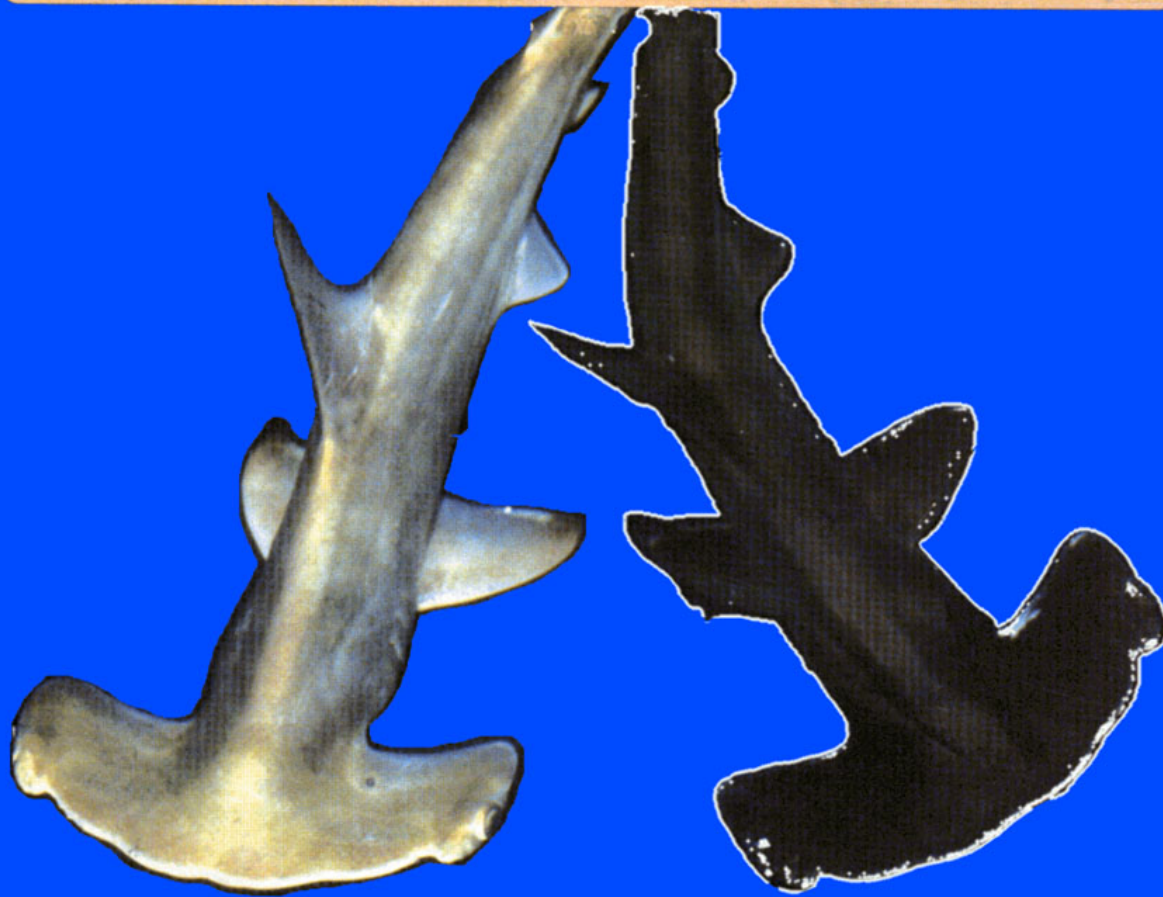
TO THE

**SUN**

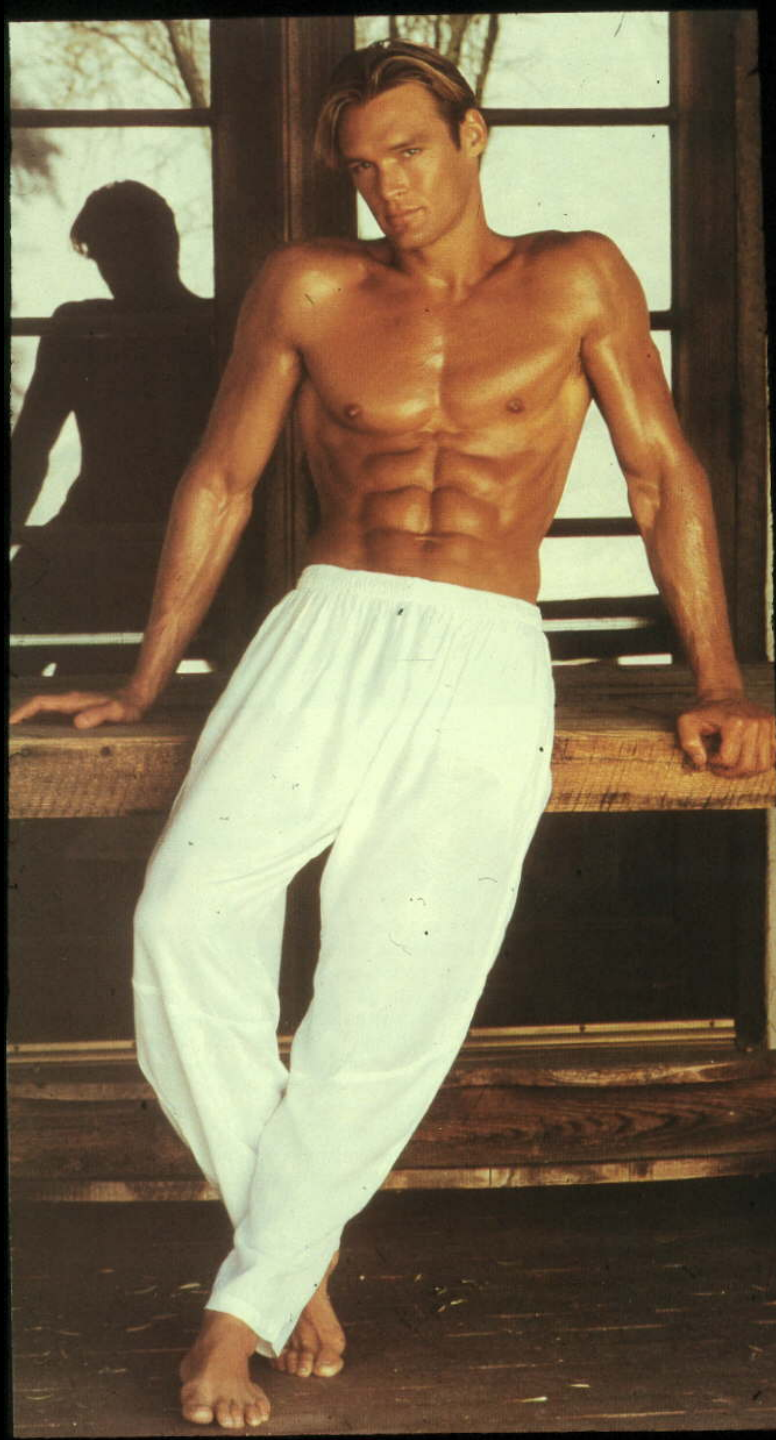
????

# nature

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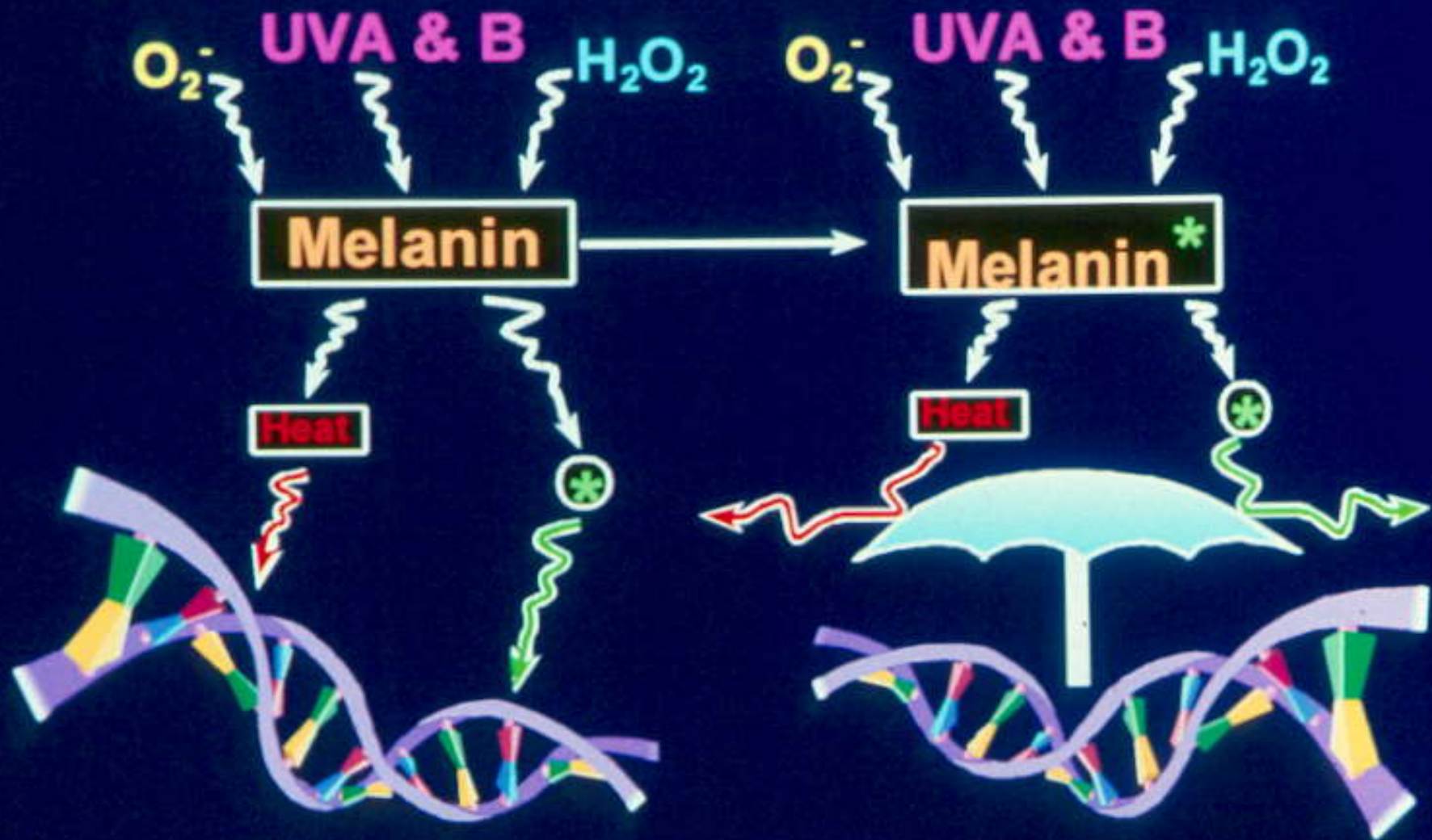


**Suntanned hammerheads**





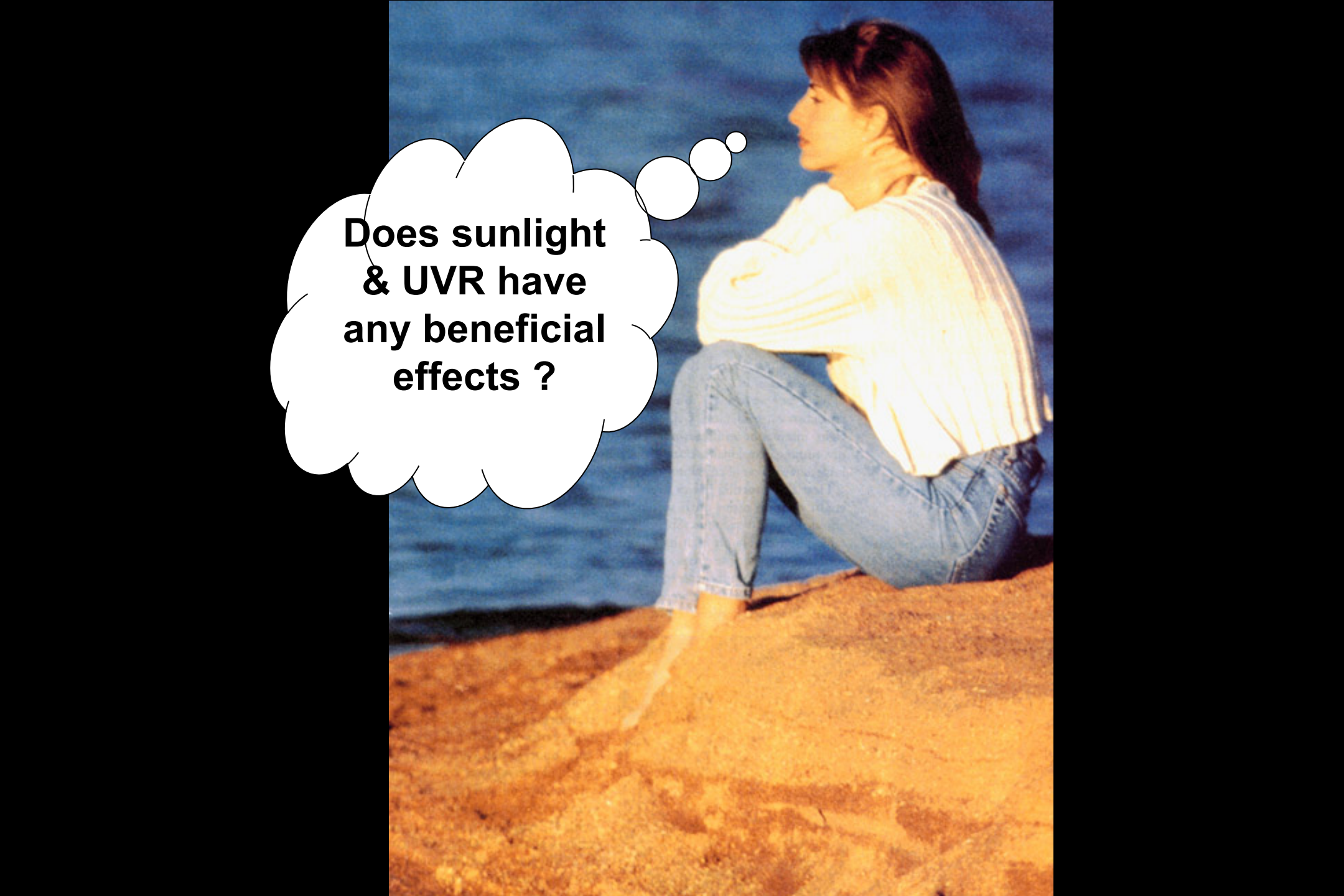
# Protective Effects of Melanin



**NEVER**

***BURN***

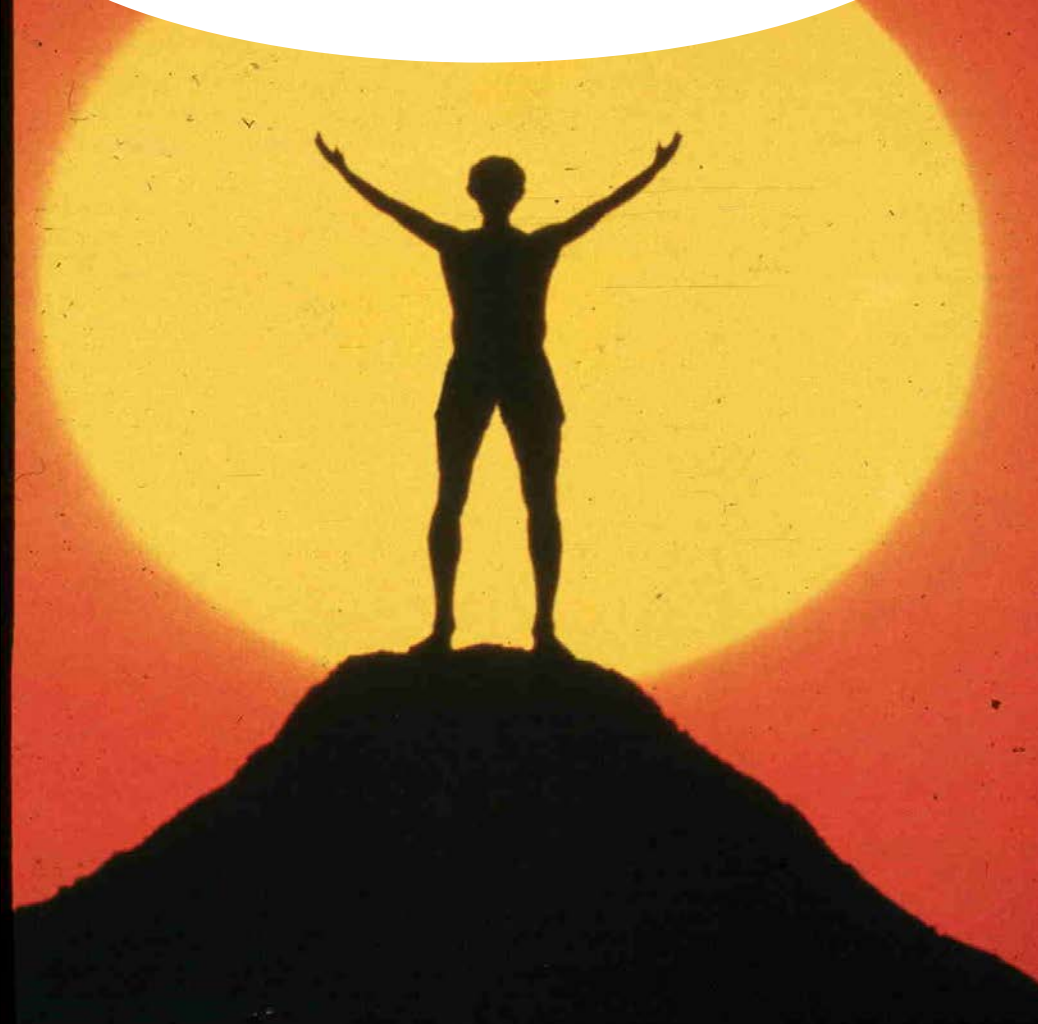


A woman with long dark hair, wearing a white and yellow striped sweater and blue jeans, is sitting on a large, reddish-brown rock. She is looking out towards the ocean. The background shows the blue water of the sea under a clear sky. A white thought bubble with a black outline is positioned to the left of the woman, containing the text: "Does sunlight & UVR have any beneficial effects ?".

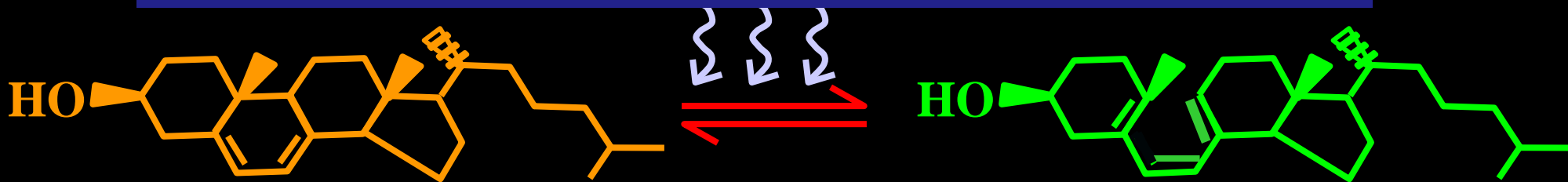
**Does sunlight  
& UVR have  
any beneficial  
effects ?**



**HOW DO YOU MAKE  
VITAMIN D ????**

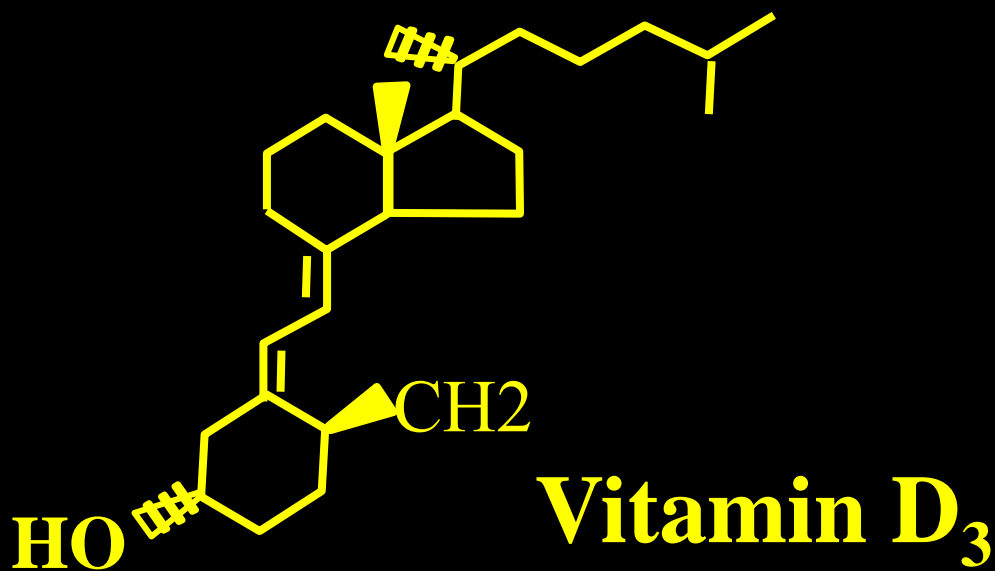


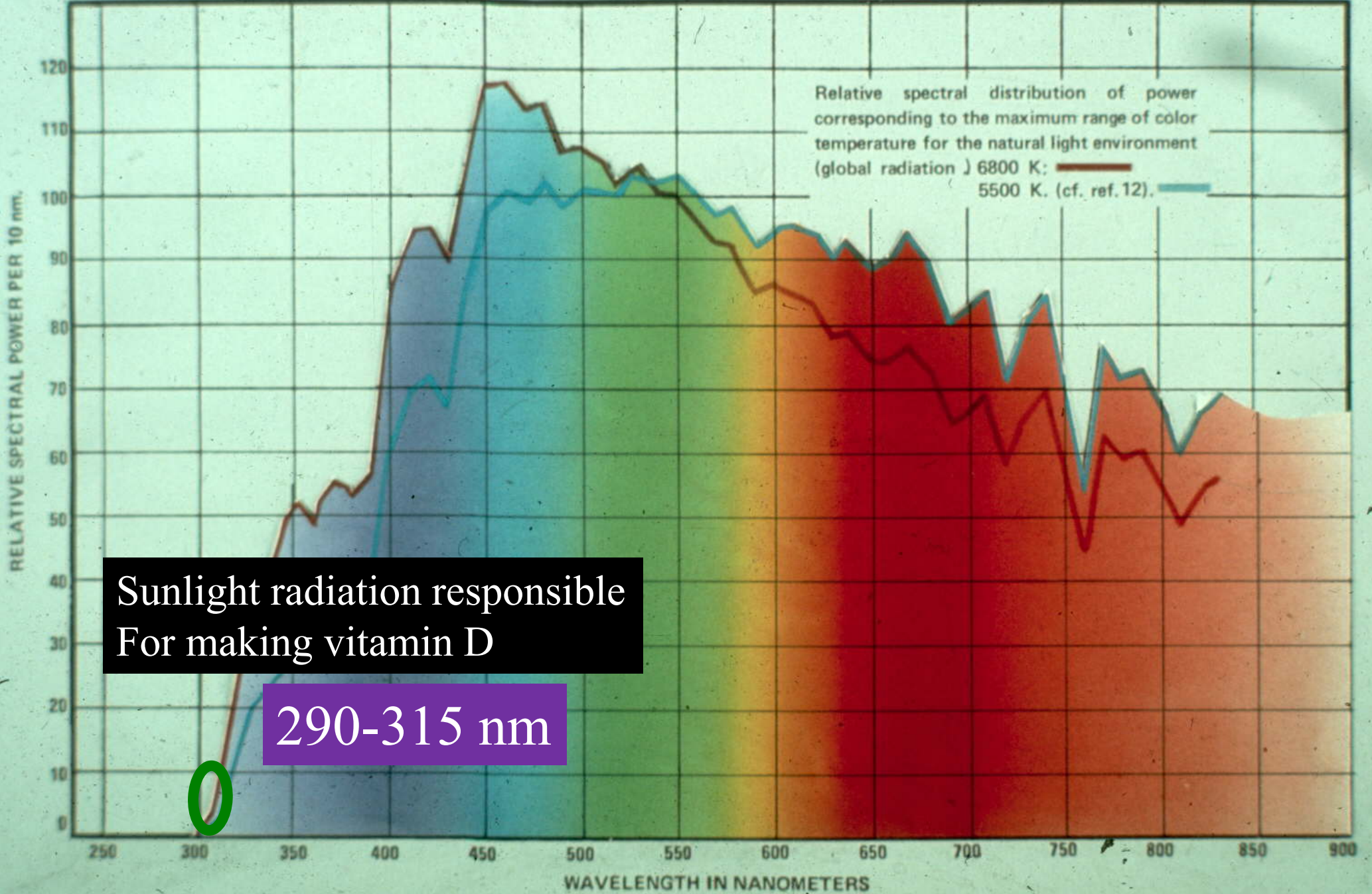
# Solar UV Radiation



7-DHC

PreD<sub>3</sub>





Sunlight radiation responsible  
For making vitamin D

290-315 nm





**HOW MUCH**

**SUN**

**EXPOSURE**

????????????

# Total Body



1X

ORAL  
VITAMIN D



**1 minimal  
erythemal  
dose**



Exposure to  
1 Minimum Erythema  
Dose

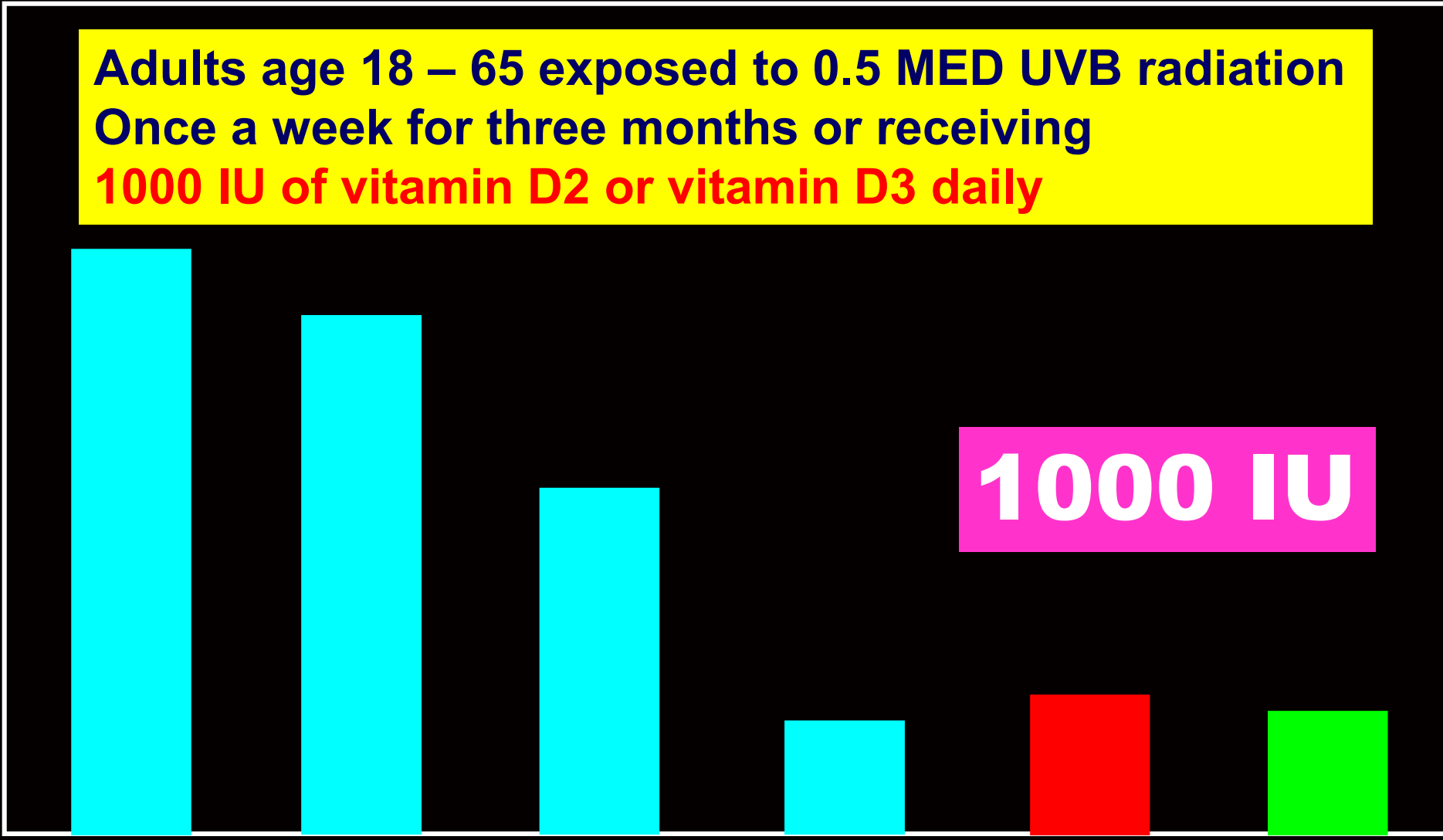
~20,000 IU Vitamin D<sub>3</sub>

(RDA 600-800 IU)

Adults age 18 – 65 exposed to 0.5 MED UVB radiation  
Once a week for three months or receiving  
**1000 IU of vitamin D2 or vitamin D3 daily**

25(OH)D ng/ml

300  
70  
60  
50  
40  
30  
0



1000 IU

UV Exposure by Skin Type

1000 IU Capsule


Is Tanning good  
For Vitamin D  
And your  
Bones  
???????



A0602030A

f Left Hip

Global ROI 

Bone Map 

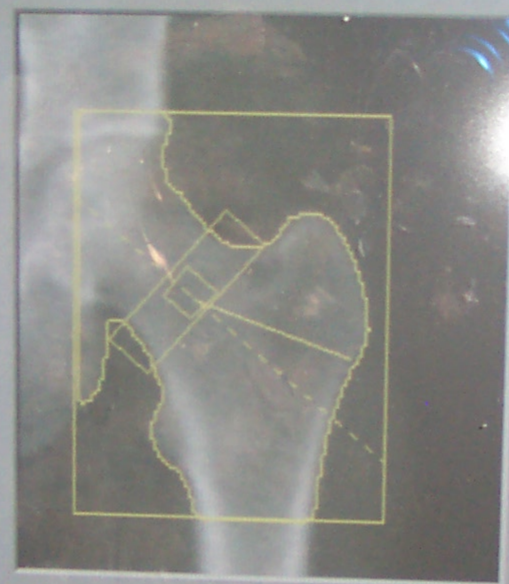
Neck 

Results

Results Toolbox

Auto Analyze

 Close



82 x 110 at [14, 25]

Midline (62, 118) - (134, 56)

Neck -47 x 15 at [24, 10]

Troch 17 x 42 at [0, 0]

Ward's -11 x 11 at [6, 7]

Dual Energy

Patient Data

Scan Date: 06/02/2003

Name: Bier, Jill R

Pat Id: JRB020282

Birthdate: 02/02/1982

Height: 66.0 in

Ethnic: White

Left Hip Analysis

Image not for diagnostic use

k=1.139 d0=47.4 t=6.176

TOTAL BMD CV 1.0%

Region	Area(cm <sup>2</sup> )	BMC(g)	BMD
C.F.	1.027	1.010	1
Neck	5.05	3.82	0
Troch	10.19	6.11	0
Inter	20.96	19.56	0
TOTAL	36.20	29.48	0.8
Ward's	1.13	0.77	0.6

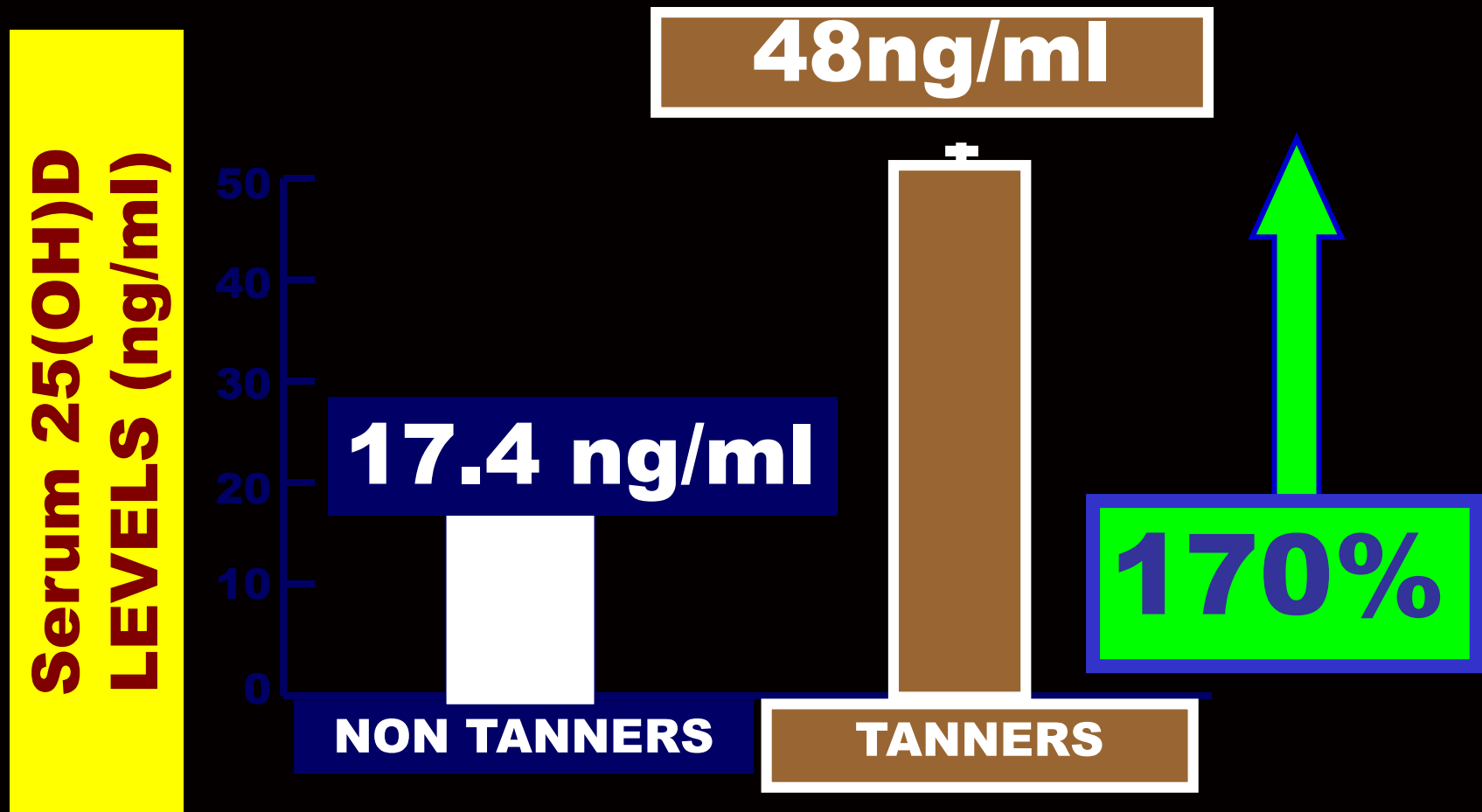
QDR 4500W SN: 49786

Version 11.2 .5

06/02/2003

For Help, press F1

# SERUM 25(OH)D LEVELS IN TANNERS AND NONTANNERS END OF WINTER IN BOSTON

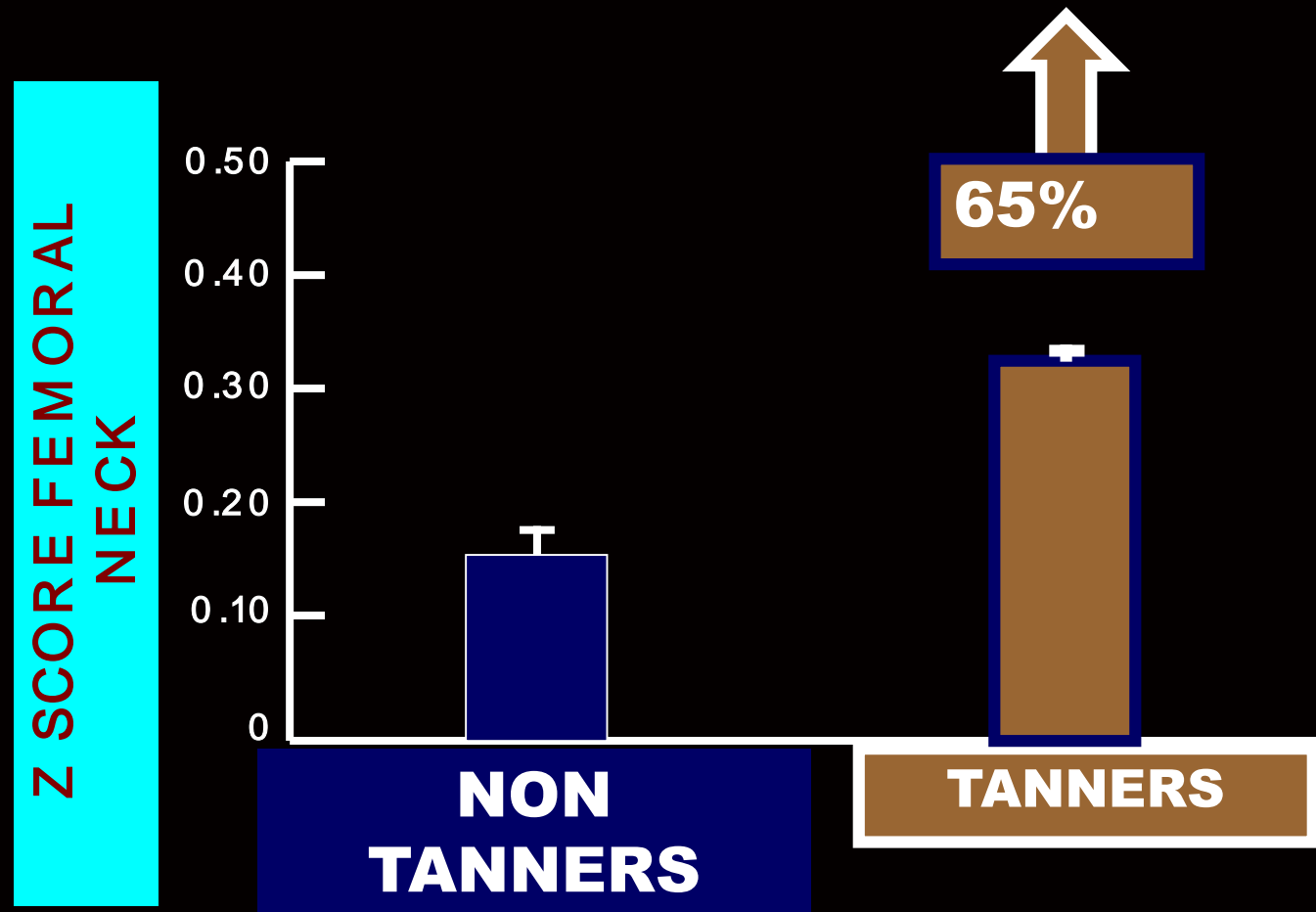


Tangpricha, et al Tanning is associated with optimal vitamin D status (serum 25-hydroxyvitamin D concentration) and higher bone mineral density.

Am J Clin Nutr. 2004. 80:1645-1649.




# Z-SCORE FEMORAL NECK TANNERS VS NONTANNERS



Tangpricha, et al Tanning is associated with optimal vitamin D status (serum 25-hydroxyvitamin D concentration) and higher bone mineral density.

Am J Clin Nutr. 2004. 80:1645-1649.

A close-up photograph of a man with a beard and blue eyes. He is looking slightly to the right with a thoughtful expression, his right hand is raised to his forehead, with his fingers spread. The background is a plain, light color.

**What are the  
Other Beneficial  
Consequences  
Of Being Exposed  
To UVR  
???????**

# Why do People Feel Good in Sunlight

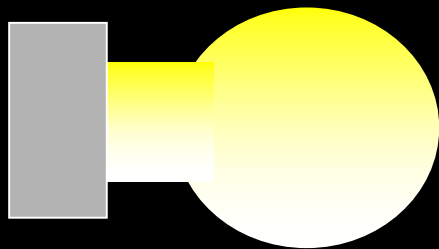
?? ?? ?? ??

**Do Human Skin Cells  
produce a Happy  
Substance in  
response to sunlight**

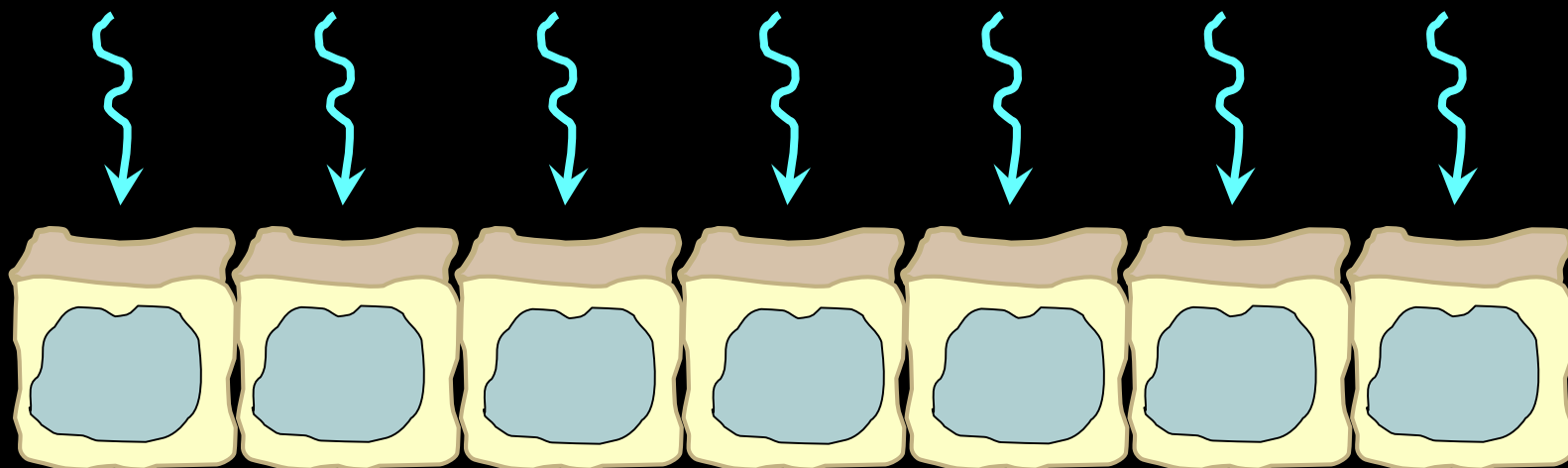
**? ? ? ? ? ? ?**

**Does**  
**Human Skin**  
**Produce**  
 **$\beta$ -Endorphin**

? ? ? ? ? ? ?

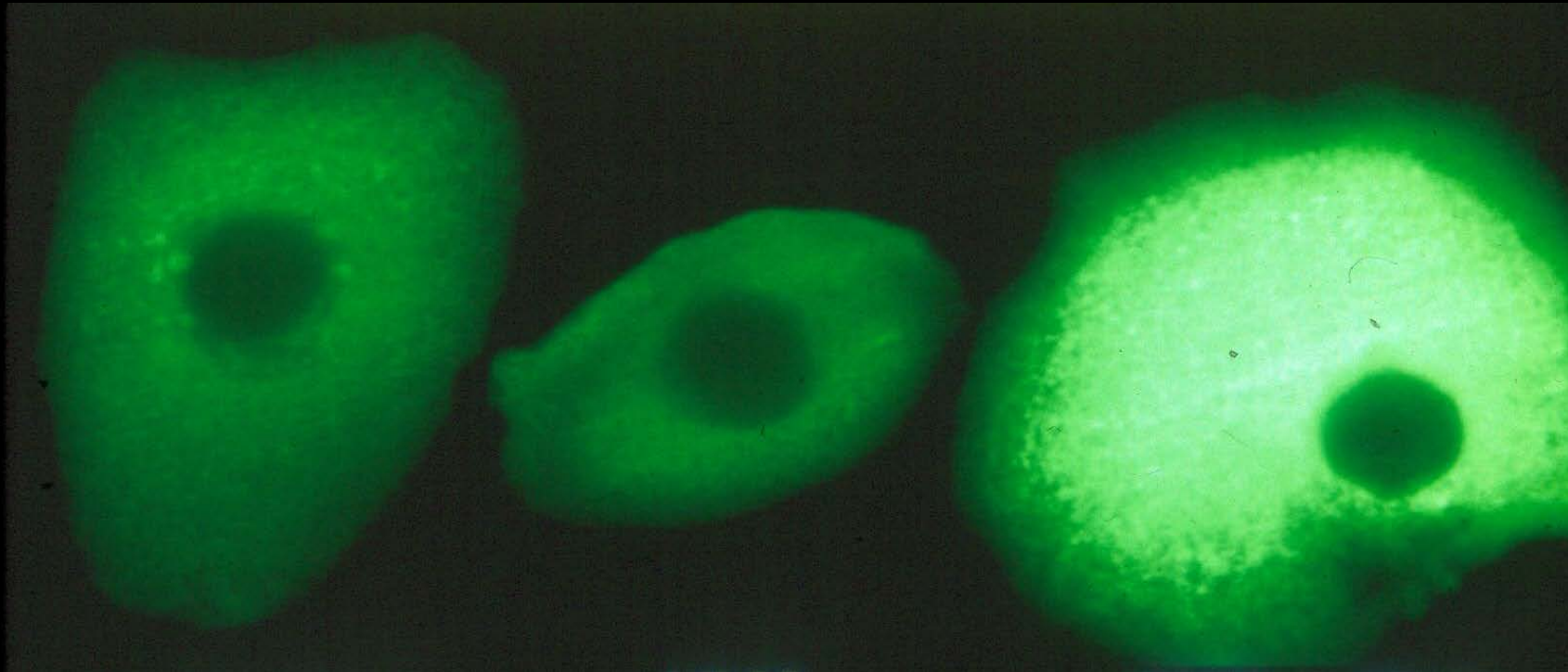


**Simulated Sunlight**



**measure  $\beta$ -endorphin**

# $\beta$ -Endorphin Induced by UVB in Cultured Human Keratinocytes



**Control**

**UVA**

**UVA + UVB**

. Zanello, S., Jackson, D., and Holick, M.F. An immunocytochemical approach to the study of beta-endorphin production in human keratinocytes using confocal microscopy. *Ann NY Acad Sci.* 885:85-99, 1999.

**Does**

**Human Skin Produced**

**$\beta$ -Endorphin**

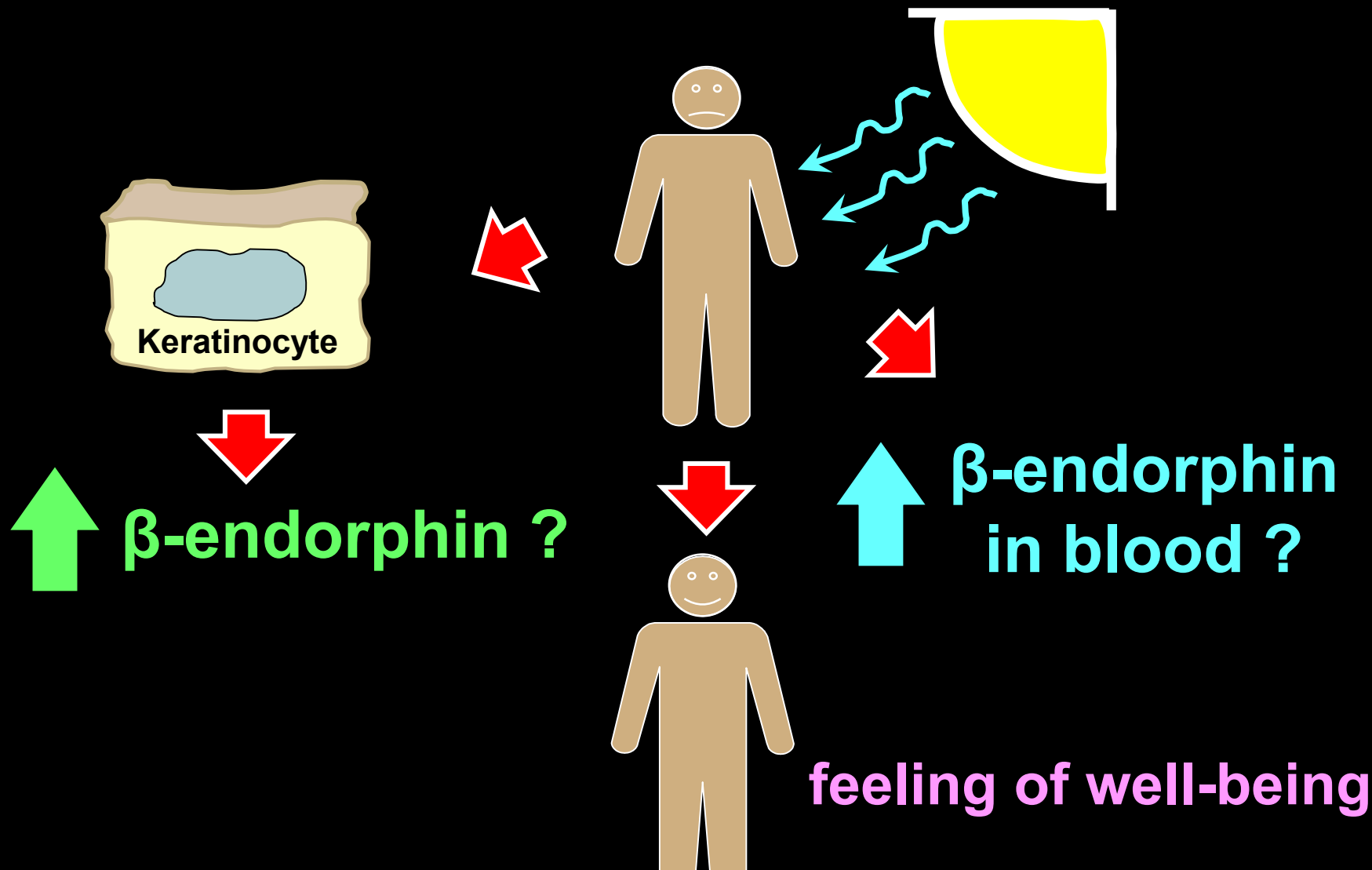
**enter the bloodstream**

**to make you Feel Good**

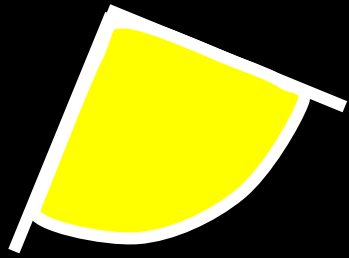
**??????**



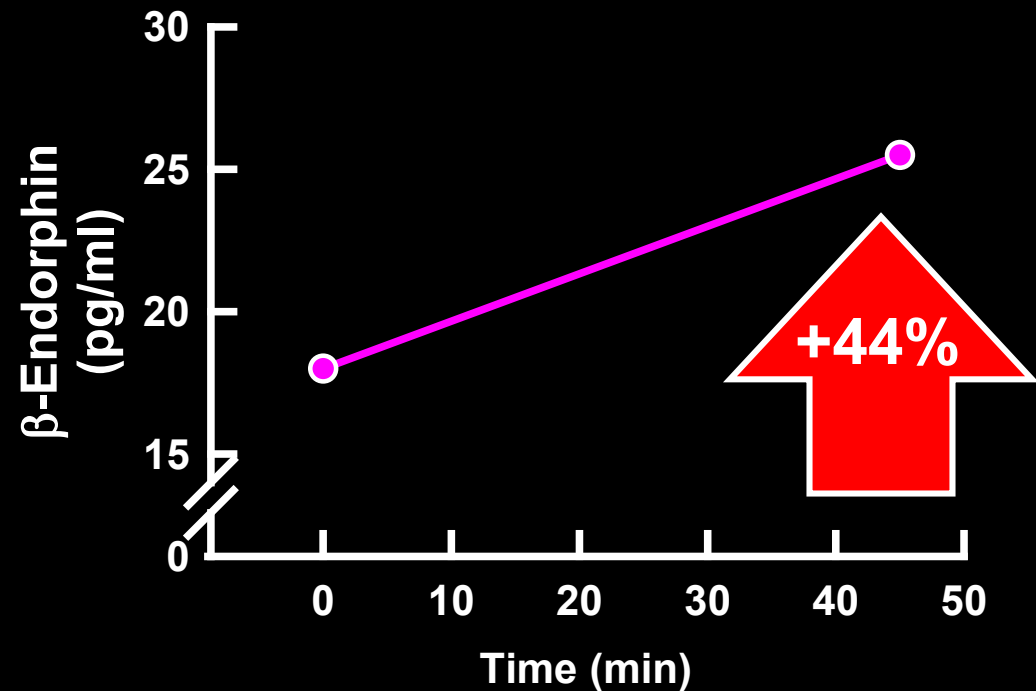
# Sunlight - $\beta$ -endorphin – Skin Connection



# Sunlight Exposure May Elevate Serum $\beta$ -endorphin Levels in Humans



Simulated Sunlight





**I can make  
 $\beta$ -endorphin  
in my skin !**

# $\beta$ -endorphin: opioid peptide



**$\beta$ -endorphins responsible for:**

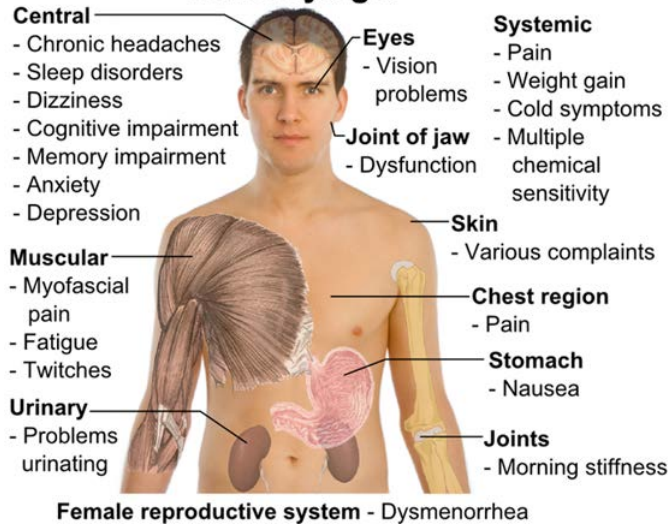
- ✓ Pain relief
- ✓ Feeling of well-being
- ✓ Relaxation

**$\beta$ -endorphin has approximately 33 times the analgesic potency of morphine.**

# Endorphins: Natural Pain and Stress Fighters



## Symptoms of Fibromyalgia



THE JOURNAL OF ALTERNATIVE AND COMPLEMENTARY MEDICINE  
Volume 15, Number 1, 2009, pp. 15–23  
© Mary Ann Liebert, Inc.  
DOI: 10.1089/acm.2008.0167

## Pilot Study of the Effect of Ultraviolet Light on Pain and Mood in Fibromyalgia Syndrome

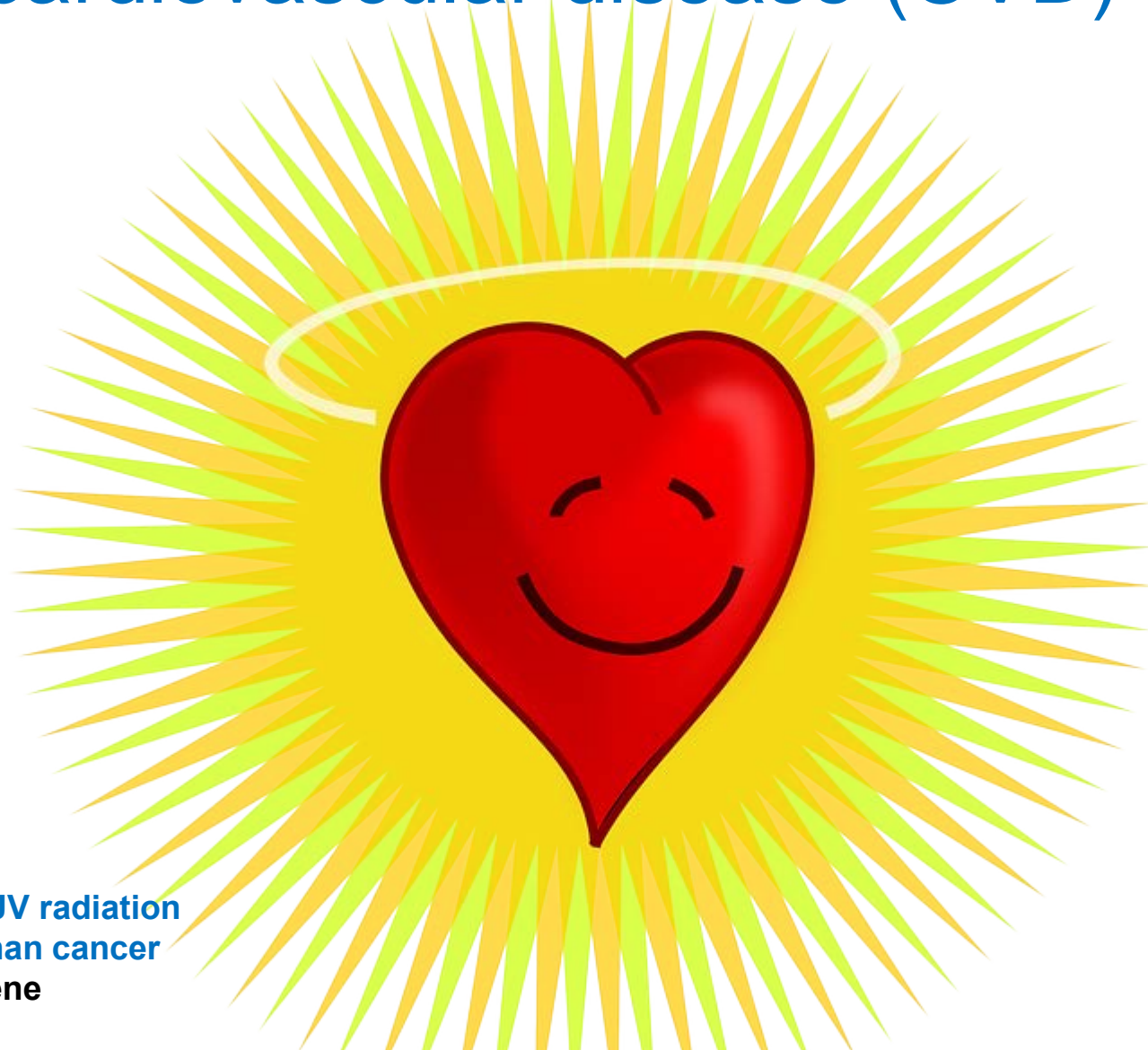
Sarah L. Taylor, M.D., M.P.H.,<sup>1</sup> Mandeep Kaur, M.B.B.S., M.S.,<sup>1</sup> Kristen LoSicco, B.S.,<sup>1</sup> Joy Willard, R.N.,<sup>1</sup> Fabian Camacho, M.S.,<sup>2</sup> Kenneth S. O'Rourke, M.D.,<sup>3</sup> and Steven R. Feldman, M.D., Ph.D.<sup>1,2,4</sup>

UV may have some potential in reducing chronic pain and improving mood in persons with Fibromyalgia syndrome.

**Beneficial effects of UV radiation  
on diseases other than cancer**

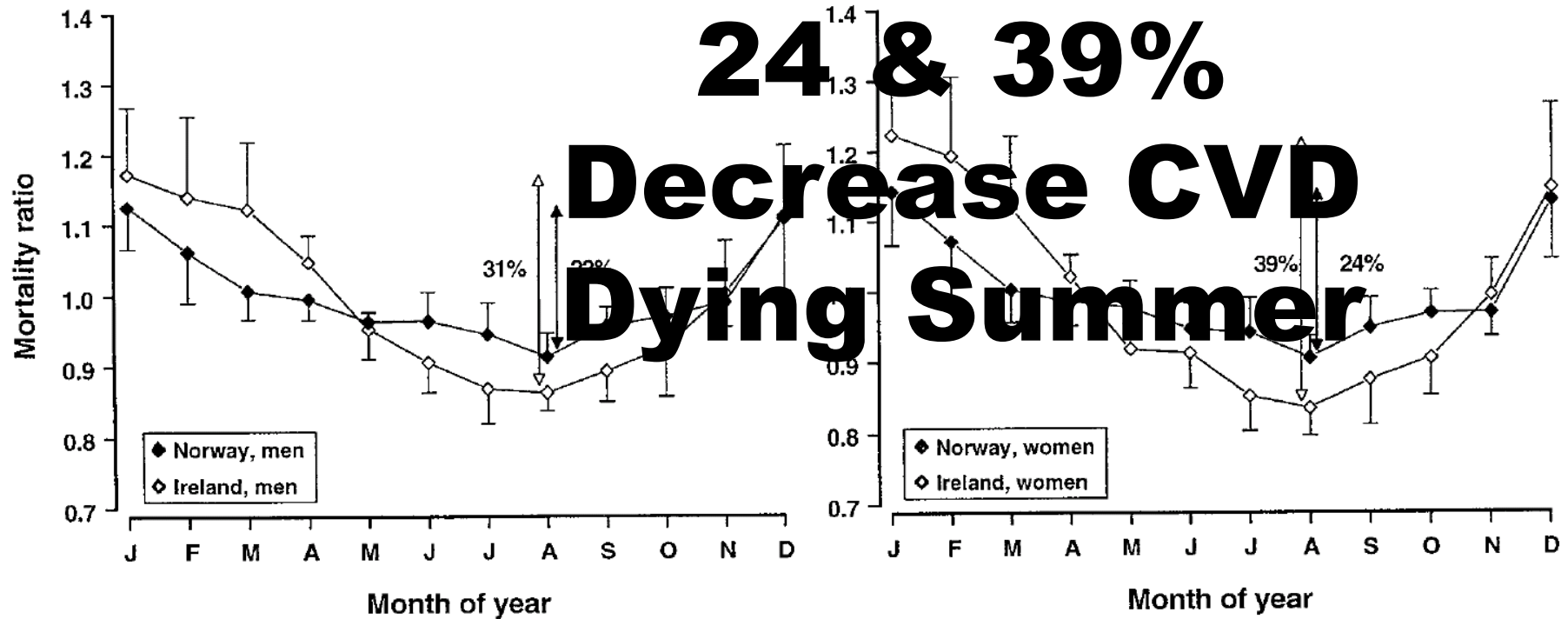
**Asta Juzeniene**

# Ultraviolet radiation and cardiovascular disease (CVD)



**Beneficial effects of UV radiation  
on diseases other than cancer  
Asta Juzeniene**

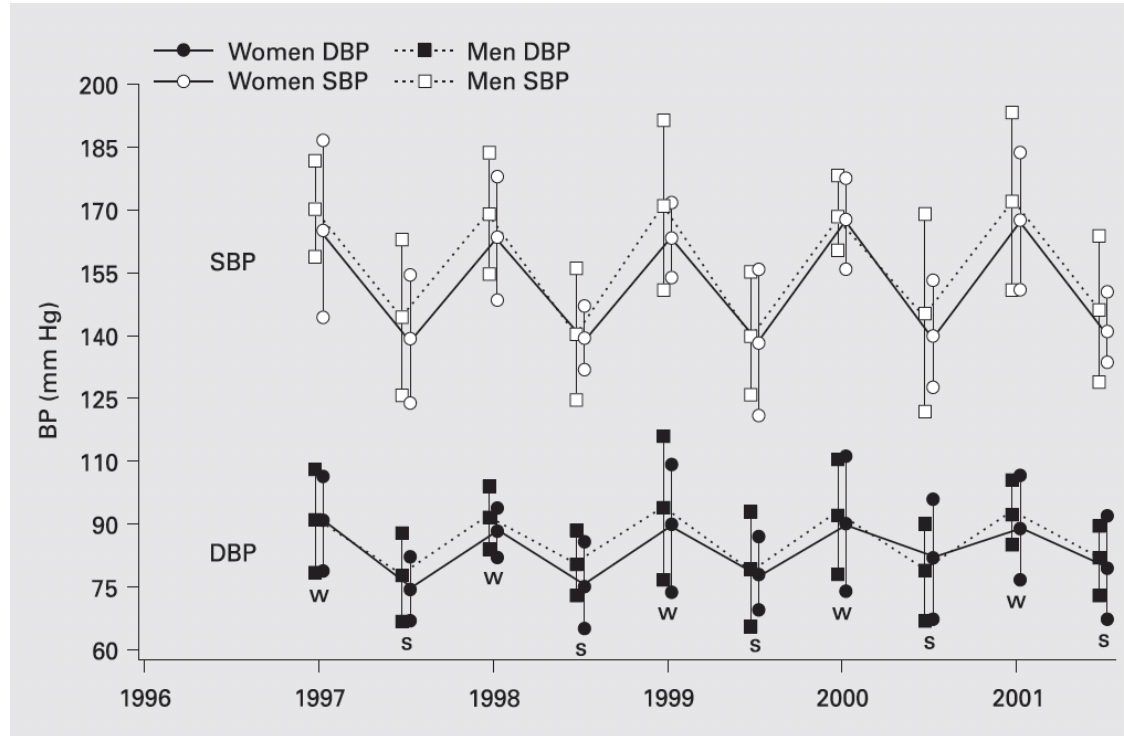
# Seasonal variations in mortality caused by CVDs



Mean monthly CVD mortality ratio (ICD 9: 390–459) in Norway and Ireland for men (left) and women (right) in the age group 60 years and older for the 10-year period 1985–1994. The figures beside the arrows indicate the percentage difference between the lowest summer mortality and the highest winter mortality.

The seasonal variation in CVDs mortality, with an excess in winter, has been documented in many studies.

# Seasonal variations in blood pressure



There is a tendency for both systolic (S) and diastolic (D) blood pressure (BP) to rise in winter.

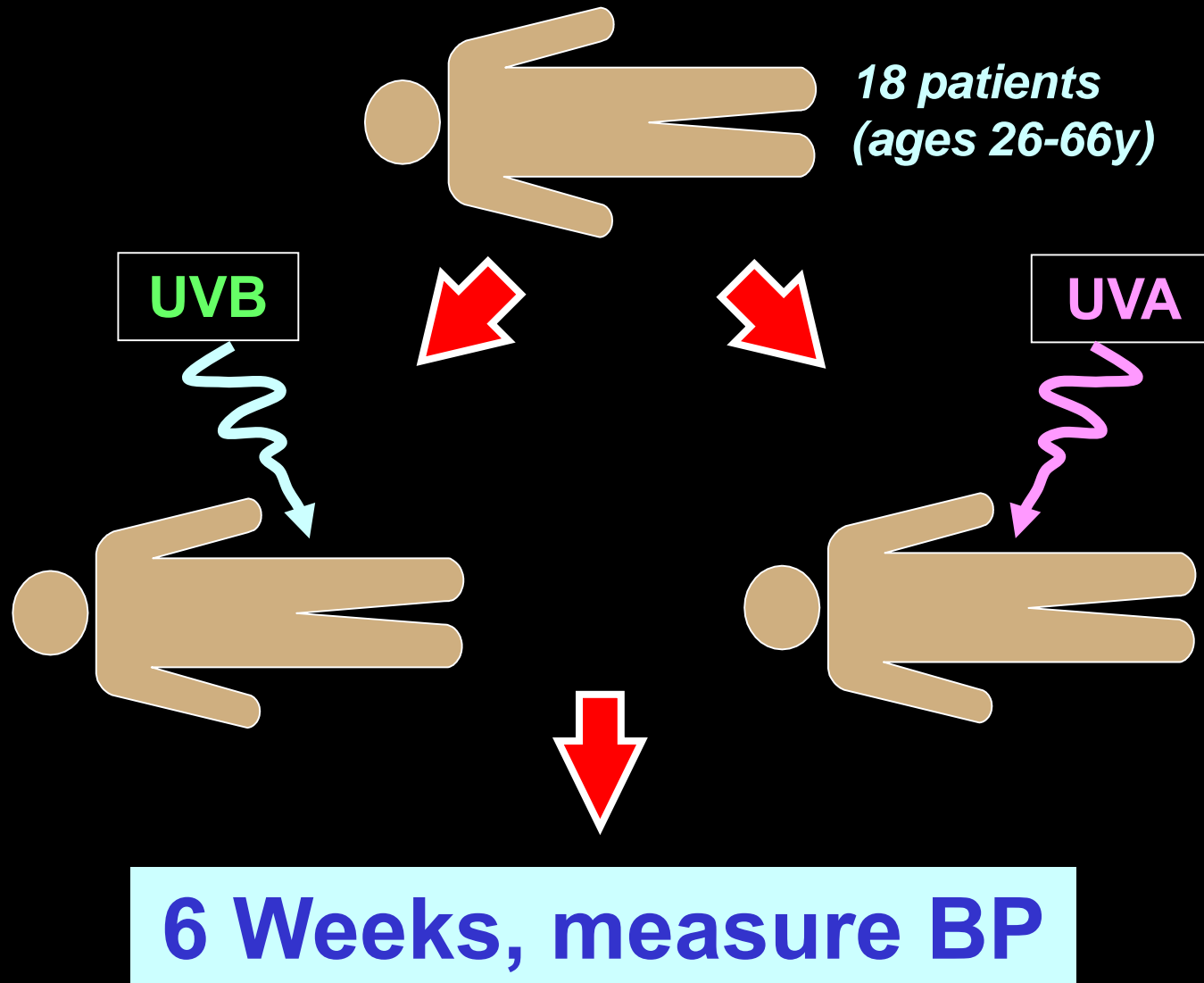


**Will UVB  
irradiation help  
my hypertension**

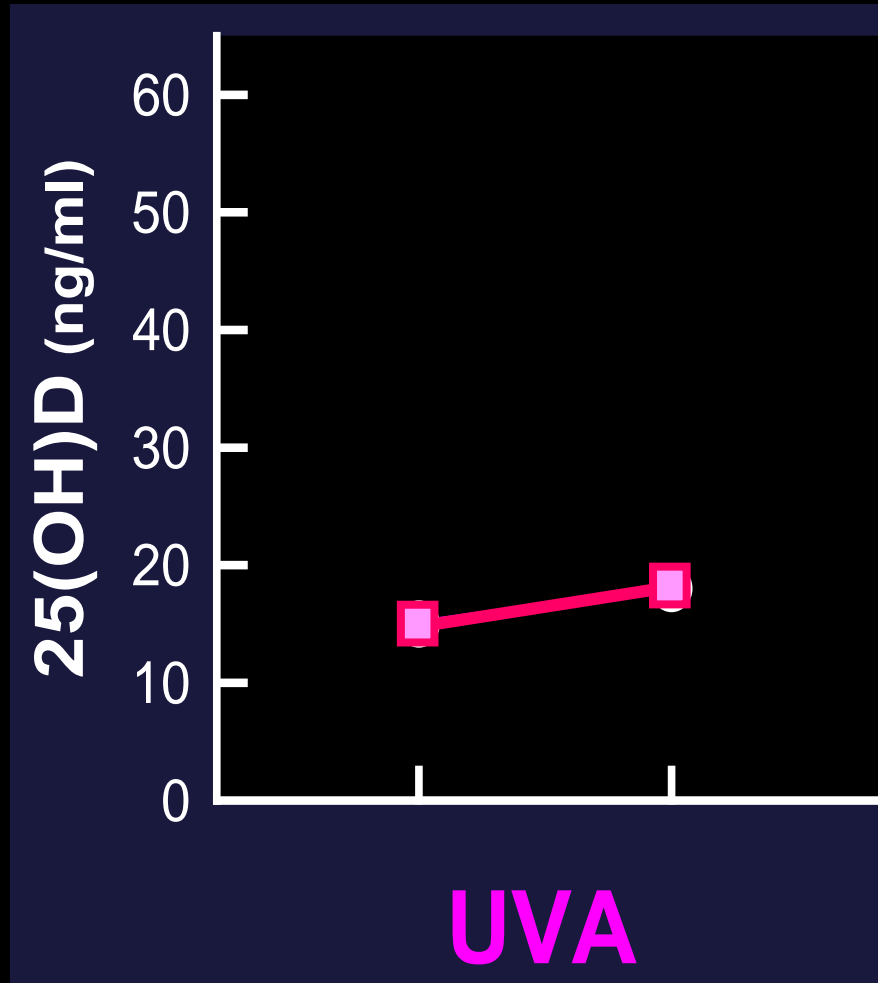
**?**



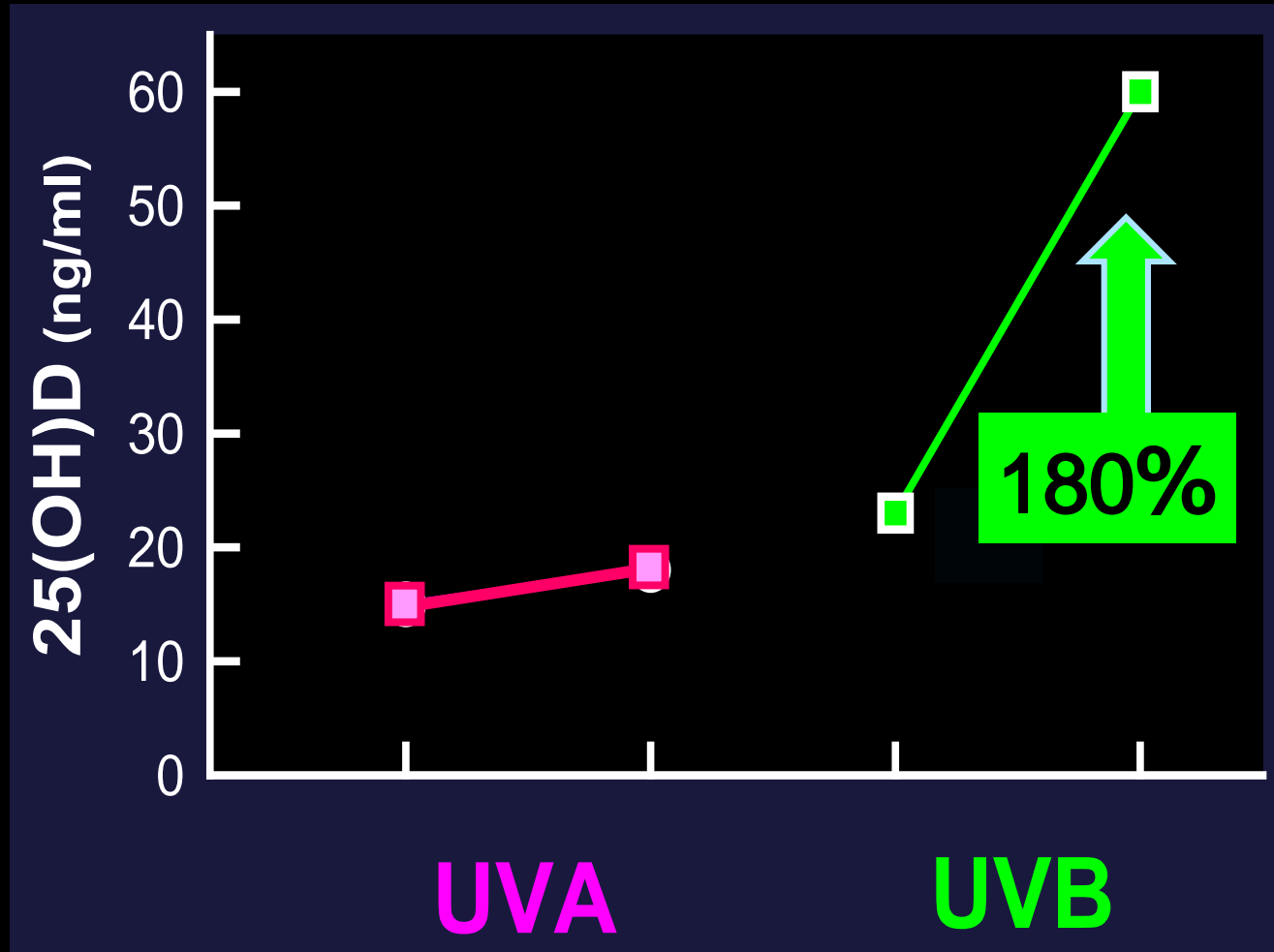
# Hypertension



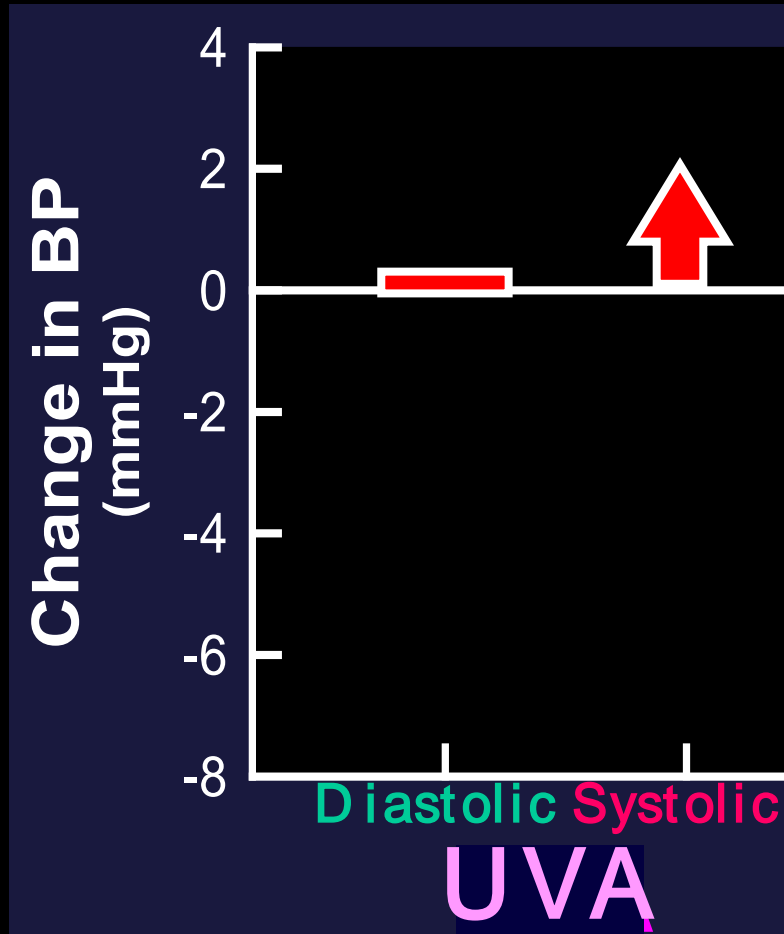
# Serum 25(OH)D



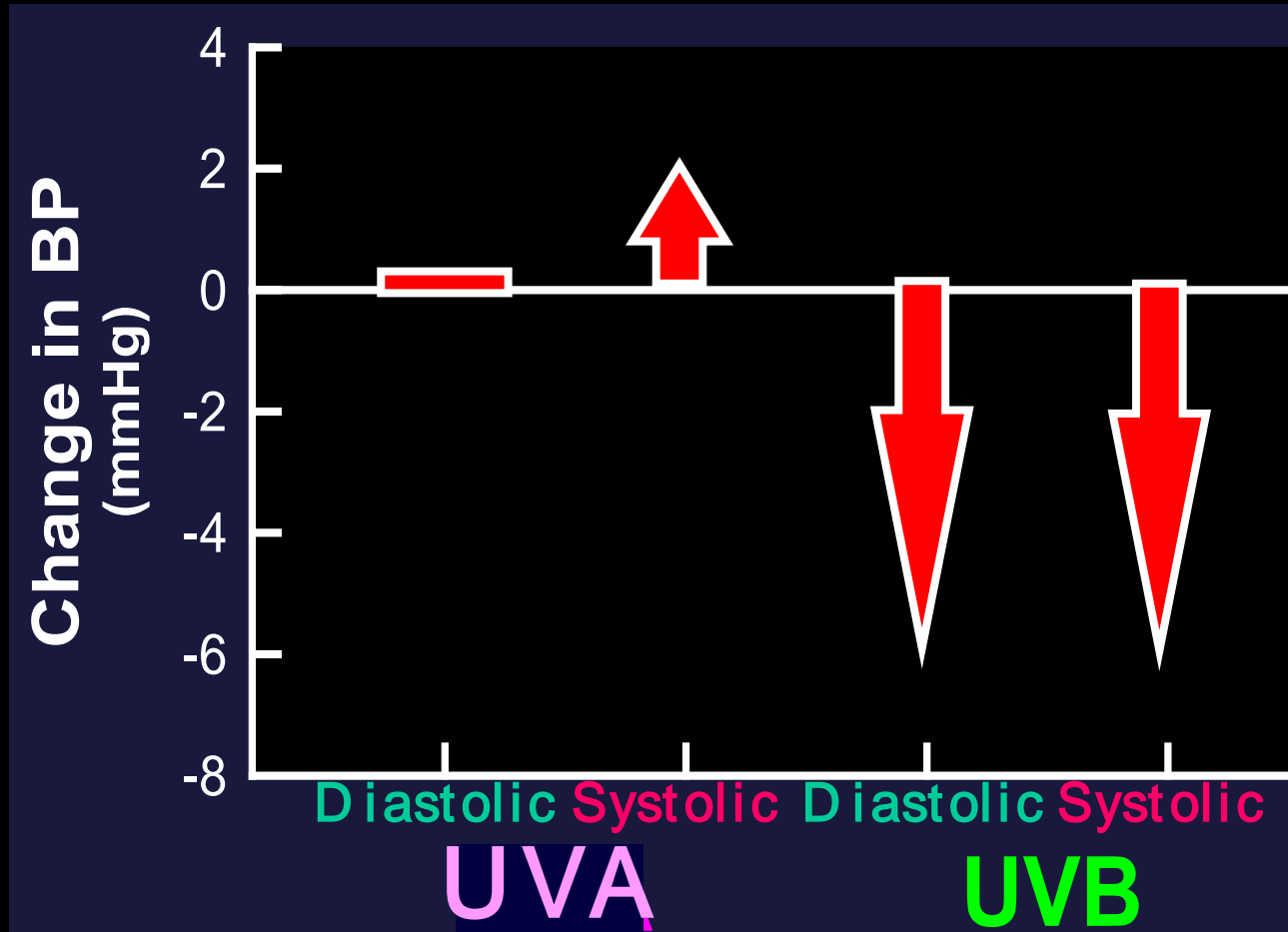
# Serum 25(OH)D



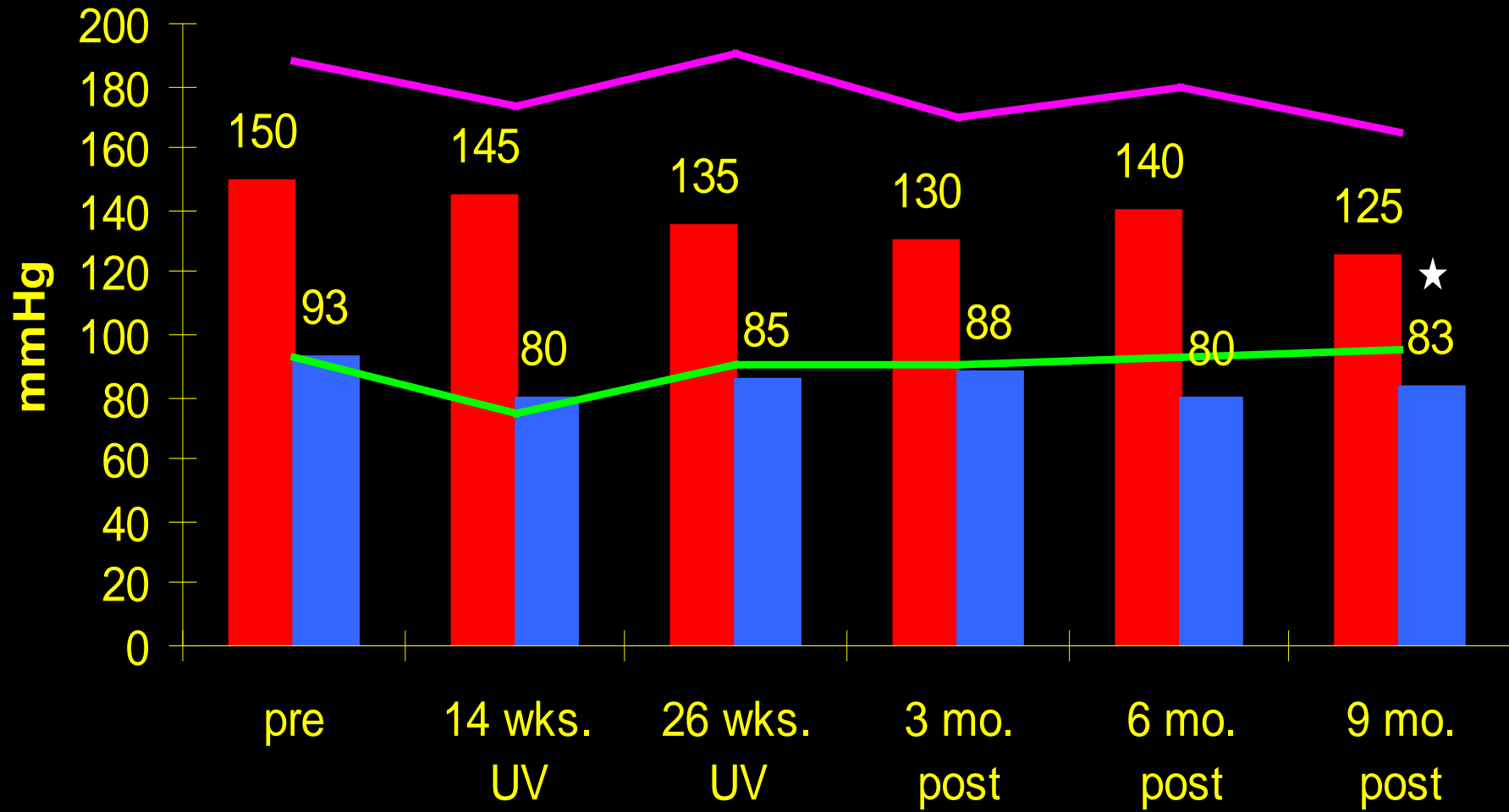
# Effect of UVA on Blood Pressure



# Effect of UVB & UVA on Blood Pressure

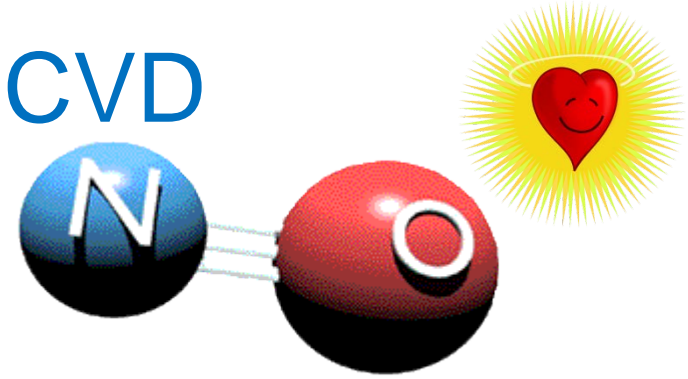


# Blood Pressure



■ BPs rest ■ BPd rest — BPs max — BPd max

# UV radiation and CVD



Vitamin D effects on the cardiovascular system

## Effects on the myocardium

- Antihypertrophic effects
- Modulation of calcium flux and contractility
- Renin suppression
- Modulation of extracellular matrix turnover

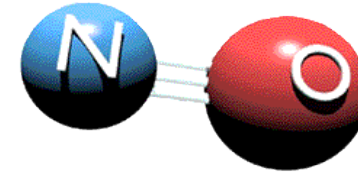
## Effects on the vessels

- Antiatherosclerotic effects
- Inhibition of vascular calcification
- Improvement of endothelial function

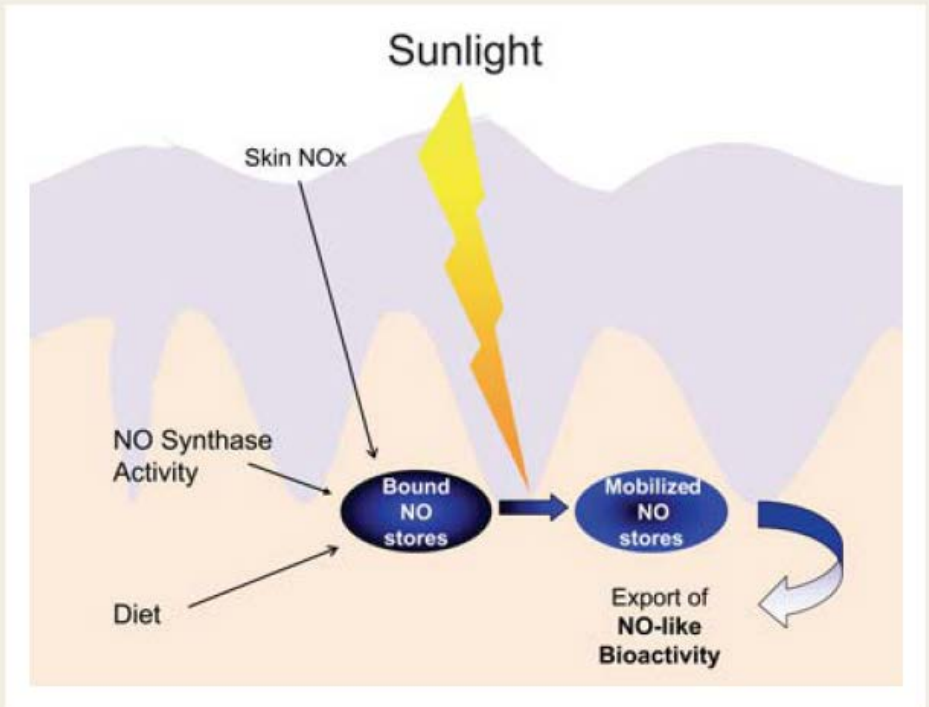
## Effects on cardiovascular risk factors

- Renoprotective effects
- Antihypertensive effects
- Antidiabetic effects
- PTH suppression
- Antiinflammatory effects
- Antioxidative effects





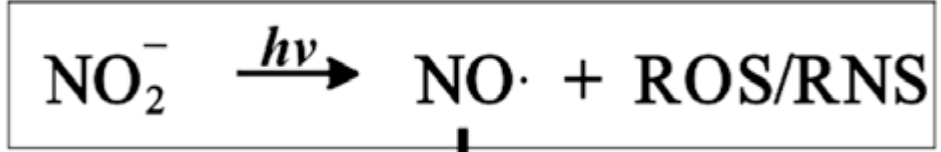
Asta Juzeniene



**Figure 1** Sunlight-induced export of nitric oxide bioactivity from storage forms in the skin.

Feelisch (2010) *Eur Heart J*

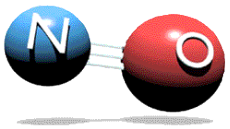
Suschk (2010) *Nitric Oxide*



	Species	Nitrite ( $\mu\text{M}$ )
Plasma	Human	$0.12 \pm 0.01$
Plasma	Human	0.12
Plasma	Human	$0.2 \pm 0.02$
Erythrocytes	Human	$0.29 \pm 0.05$
Whole blood	Human	$0.18 \pm .02$
Saliva	Human	104
Skin tissue	Human	8.4
Skin tissue	Human	5.1
Sweat	Human	8.7
Sweat	Human	3.4

Human skin is capable of releasing nitric oxide (NO) in an enzyme independent manner. This is due to photolysis of nitric oxide stores by UV radiation.

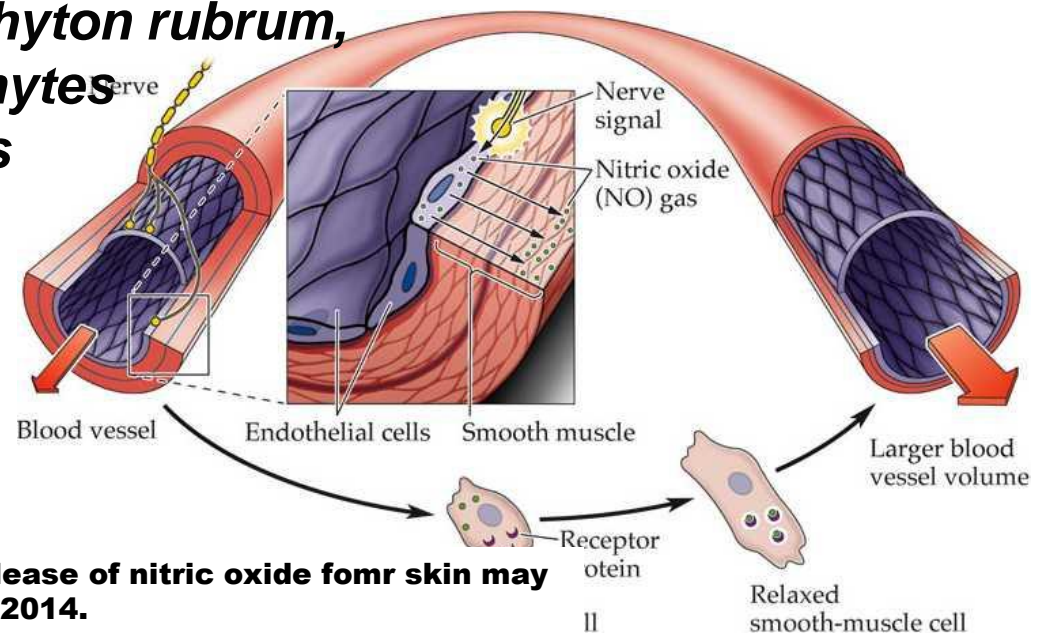
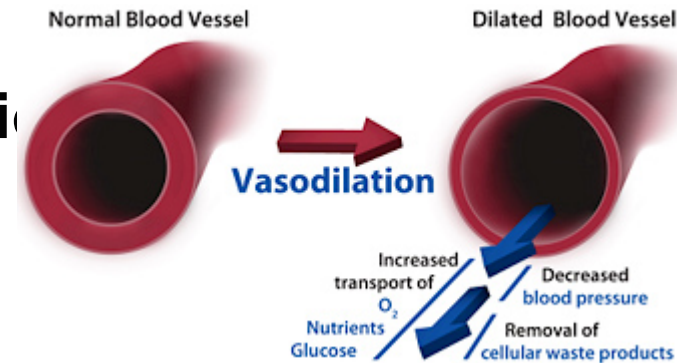
**Liu D et al. UVA irradiation of human skin vasodilates arterial vasculature and lowers blood pressure independently of nitric oxide. Synthase. *J Int. Derm.* 143: 1839-1846, 2014.**



# What is the role of nitric oxide (NO)?

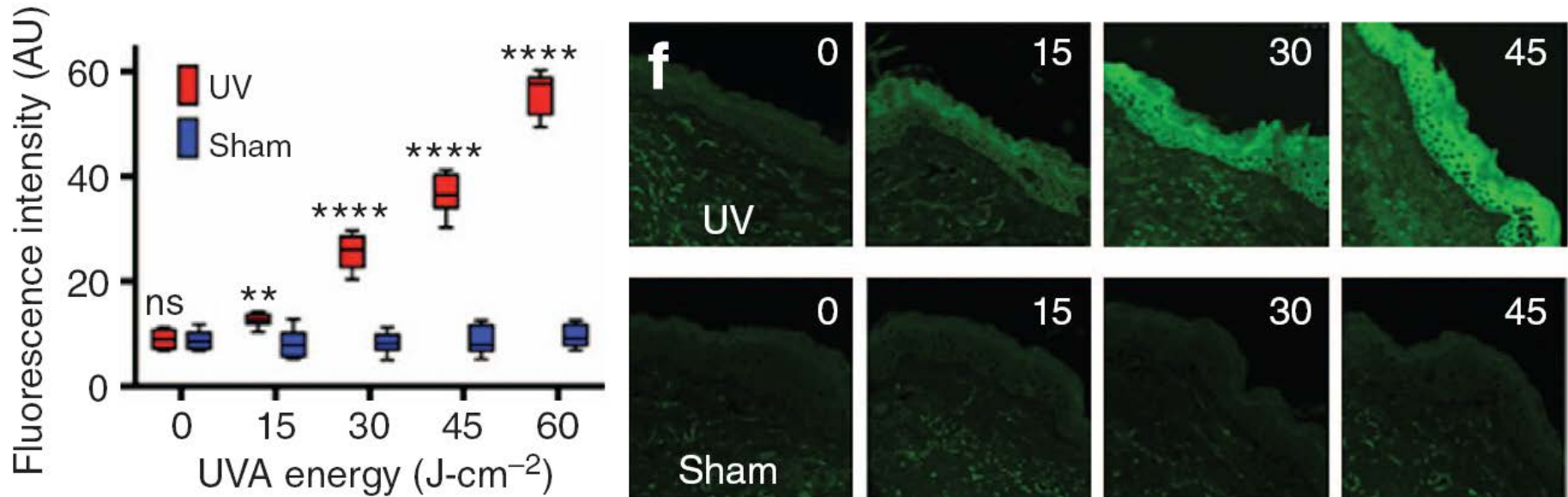


- ✓ Vasodilatation
- ✓ UV-induced melanogenesis
- ✓ UV-induced immunosuppression
- ✓ Inflammation
- ✓ Apoptosis
- ✓ Wound healing
- ✓ Antimicrobial effects
  - Bacteria – *Staphylococcus aureus*
  - Dermatophytes – *Trichophyton rubrum*,  
*Trichophyton mentagrophytes*
  - Yeasts – *Candida albicans*



Halliday GM, Byrne SN. An unexpected role: UVA induced release of nitric oxide from skin may have unexpected health benefits. *J Int Derm.* 134: 1791-94, 2014.

# UVA liberates nitric oxide (NO) from the epidermis



Confocal fluorescence microscopy studies of human skin pre-labeled with the NO-imaging probe diaminofluorescein 2 diacetate revealed that **UVA-induced NO release** occurs in a NOS-independent, dose-dependent manner, with the majority of the light-sensitive NO pool **in the upper epidermis**.

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# **Sunlight Has Cardiovascular Benefits** **Independently of Vitamin D**

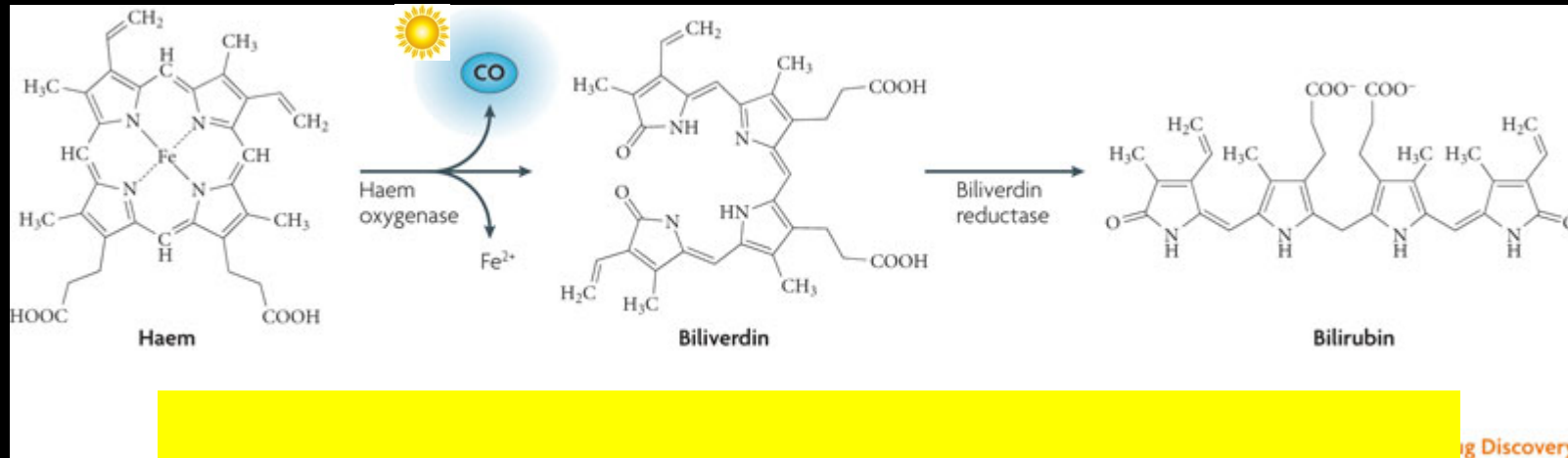
Richard B. Weller

Medical Research Council Centre for Inflammation Research, University of Edinburgh, Queen's Medical Research  
Institute, Edinburgh, UK

***Summary:*** Sunlight has beneficial effects on cardiovascular risk factors independently of vitamin D. ***Key Messages:*** All-cause mortality should be the primary determinant of public health messages. Sunlight is a risk factor for skin cancer, but sun avoidance may carry more of a cost than benefit for overall good health.

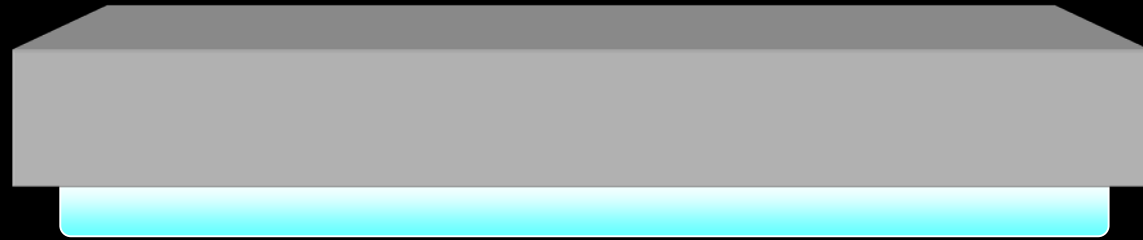
© 2016 S. Karger AG, Basel

# Carbon monoxide (CO) and UV

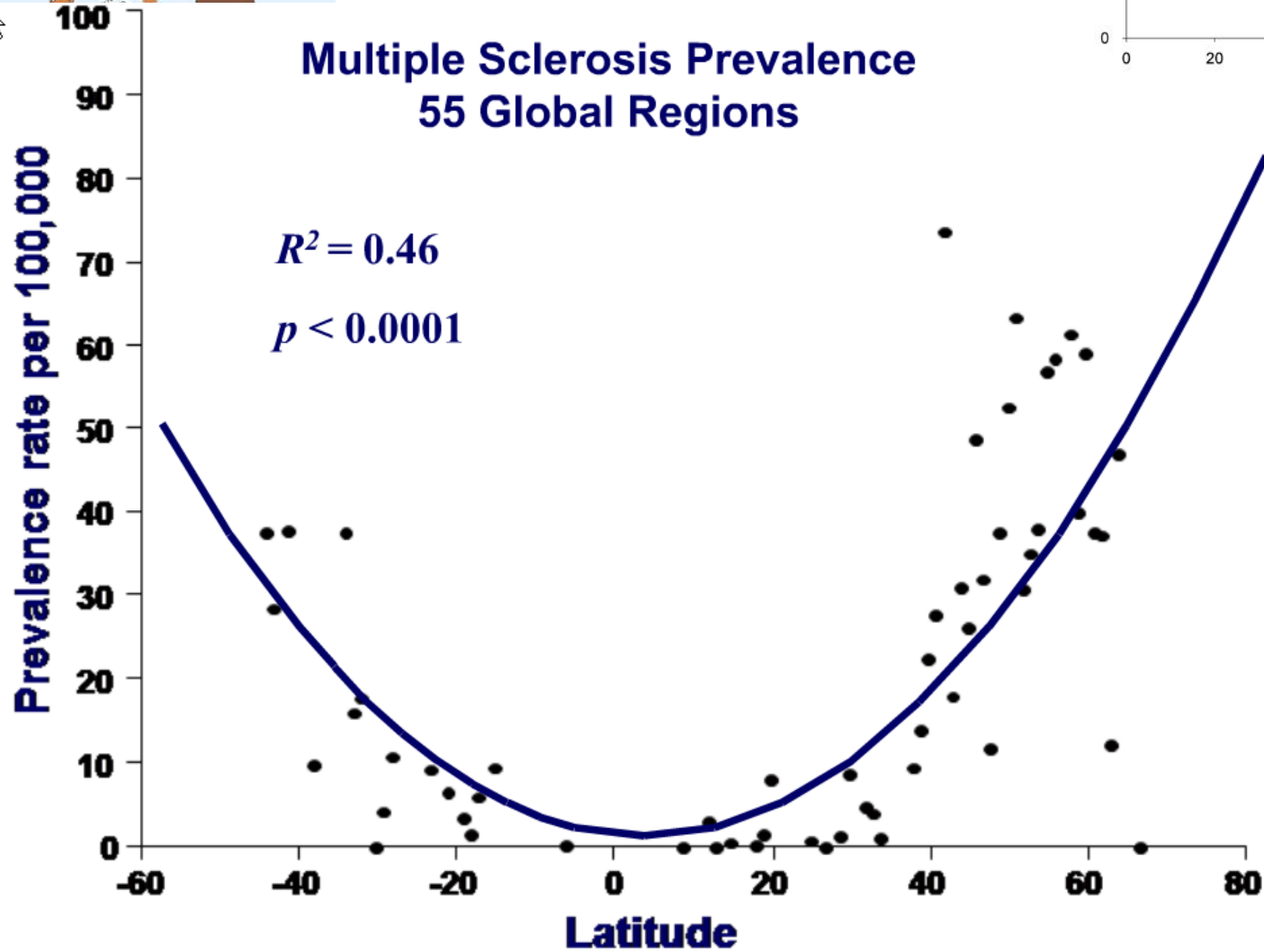
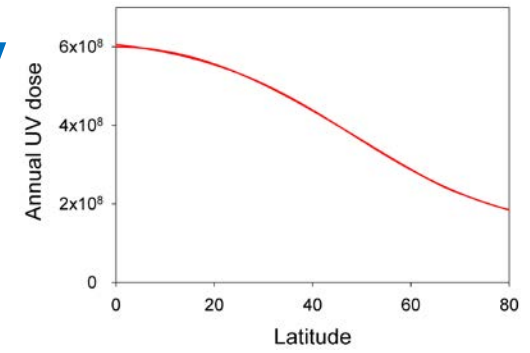
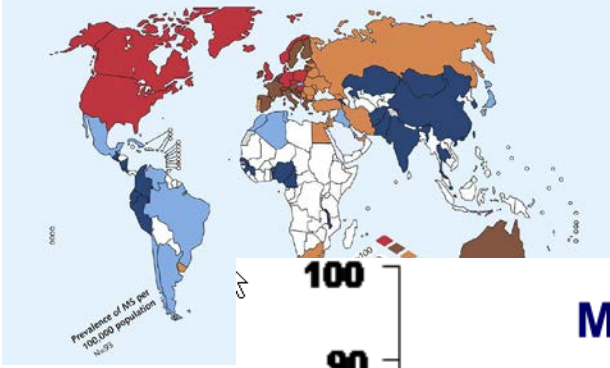


- ✓ **Vasodilation**
- ✓ **Neurotransmitter**
- ✓ **Cell signaling**
- ✓ **Relaxation**
- ✓ **Antioxidant**
- ✓ **Anti-inflammation**
- ✓ **Ani-apoptosis**

# How Does UVR Effect my IMMUNE SYSTEM?



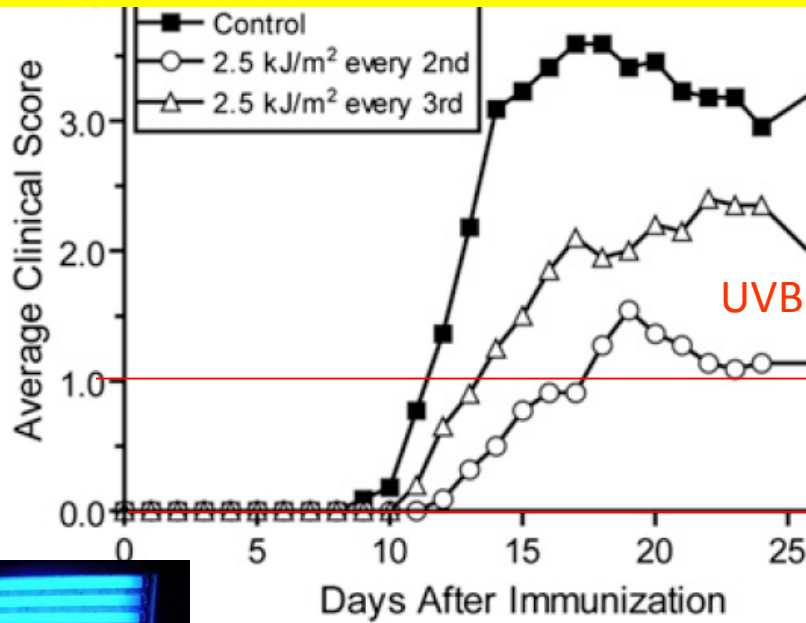
# MS, latitude and UV



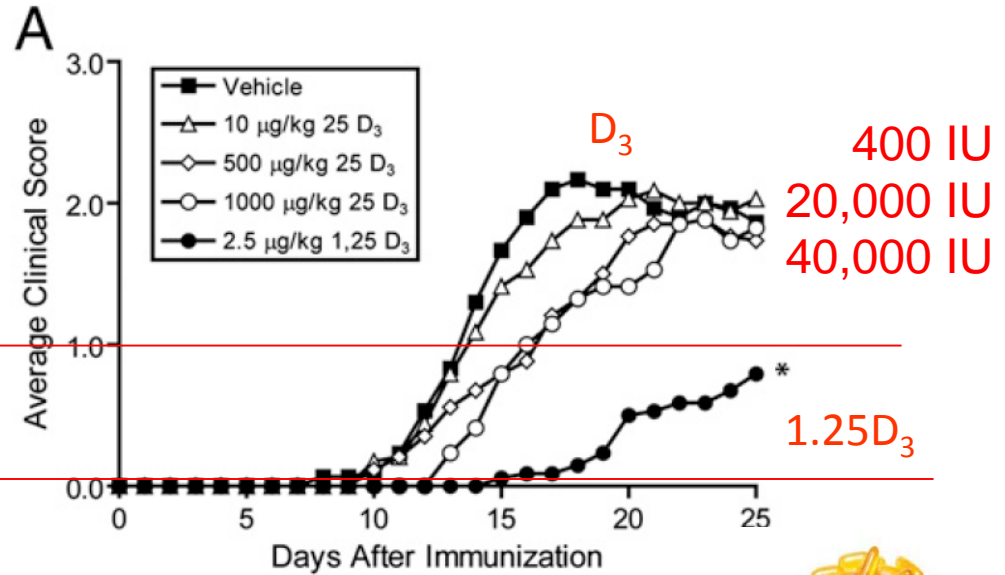
Kurtzke J F. Geographic distribution of multiple sclerosis: an update with special reference to Europe and the Mediterranean region *Acta Neurol. Scand.* 62 65–80, 1980.



# MS animal model study: UV more beneficial than vitamin D



UVB treatment



Vitamin D treatment



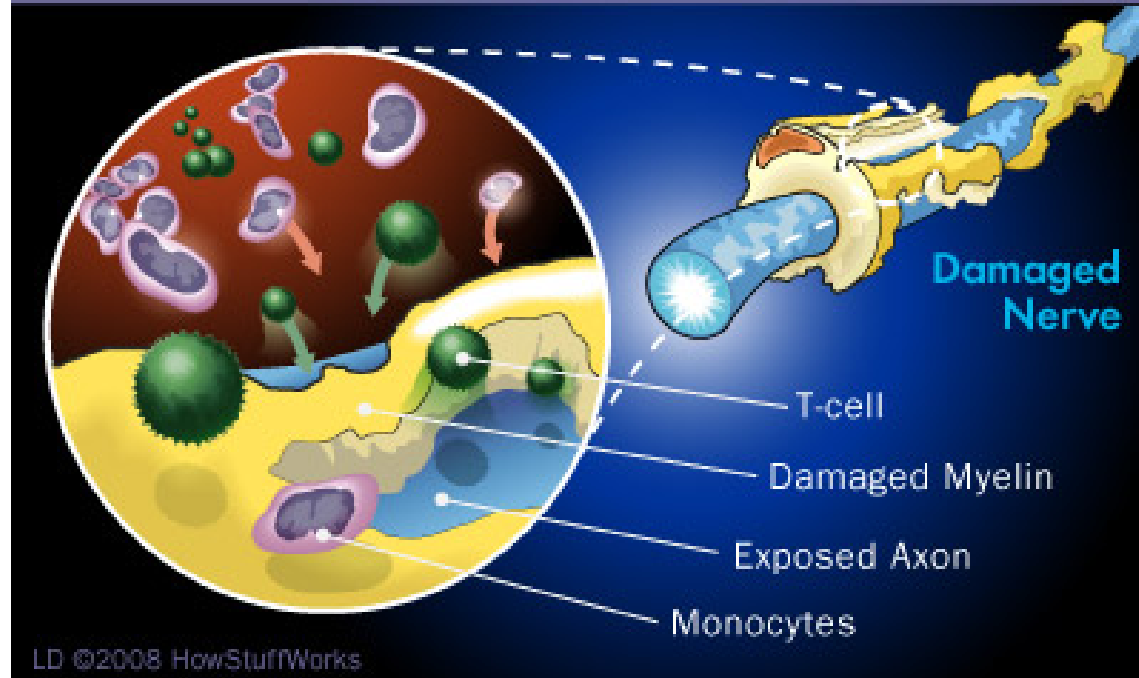
Continuous treatment with UVR dramatically suppresses clinical signs of experimental autoimmune encephalomyelitis (MS).



# Multiple sclerosis



## How Multiple Sclerosis Works T-Cells and Monocytes



**Effect of UVR:**  
Protection against disease  
Development and reduces  
symptoms of MS

**Down-regulation of T helper 1 activity involved in demyelination through T regulatory cells and/or B regulatory cells and/or immunosuppressive cytokines**

# Multiple sclerosis and adrenocorticotrophic hormone (ACTH)

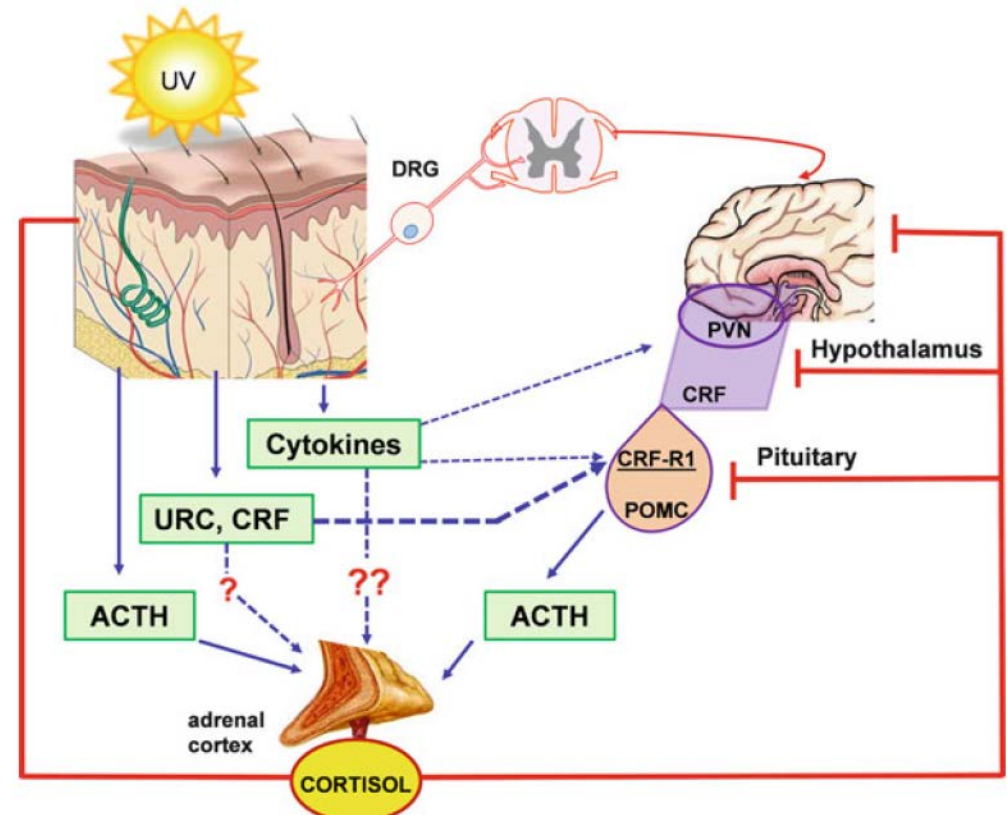


## H.P. Acthar® Gel

- Highly purified preparation of adrenocorticotrophic hormone (ACTH)
- Key approved indications:
  - Multiple sclerosis (MS) exacerbations
  - Nephrotic syndrome
- Significant off-label usage



A five-day course of intramuscular or subcutaneous ACTH gel improves symptoms associated with acute exacerbations of multiple sclerosis.



Slominski *et al.* (2012)  
Embryology and Cell Biology

**How about UV phototherapy for MS?**

# Type 1 Diabetes/100,000 Boys <14 yrs

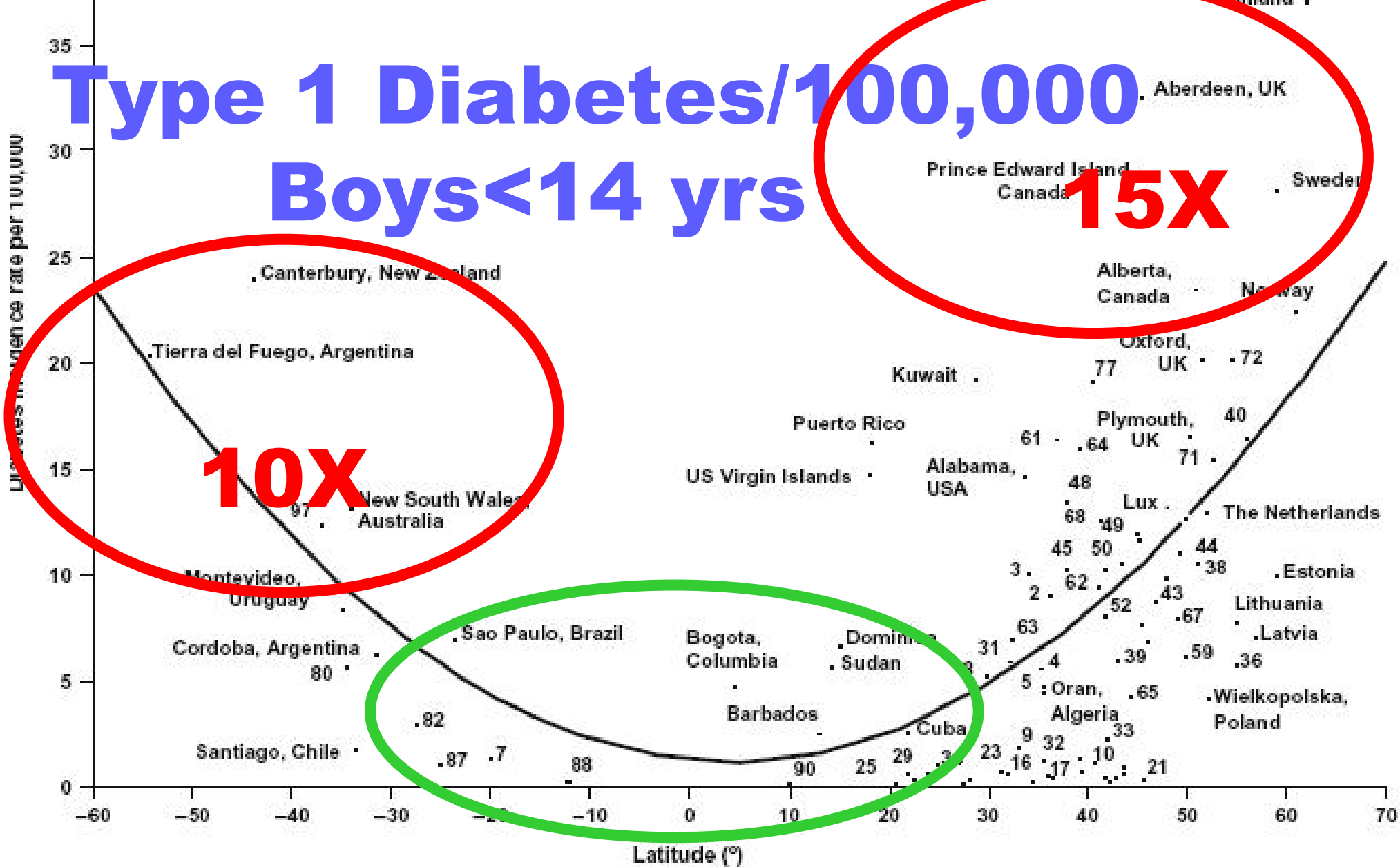


Fig. 1 Age-standardised incidence rates of type 1 diabetes per 100,000 boys <14 years of age, by latitude, in 51 regions worldwide, Madeira Island, Portugal; 64. Portalegre, Portugal; 65. Bucharest, Romania; 67. Slovakia; 68. Catalonia, Spain; 71. Leicestershire, UK;

Mohr SB, Garland CF, Gorham ED, Garland FC. The association between ultraviolet B irradiance, vitamin D status and incidence rates of type 1 diabetes in 51 regions worldwide. *Diabetologia*. 51:1391-8, 2008.

Ramune Jacobsen\*, Peder Frederiksen and Berit L. Heitmann

**Exposure to sunshine early in life prevented  
development of type 1 diabetes in Danish boys**

**Methods:** The study population included 331,623 individuals born in Denmark from 1983 to 1988; 886 (0.26%) developed T1D by the age of 15 years. The values of sunshine hours were obtained from the Danish Meteorologi-

**40 % Reduction  
More Sun third trimester**

linear variable then was split into two categories separated by the median value.

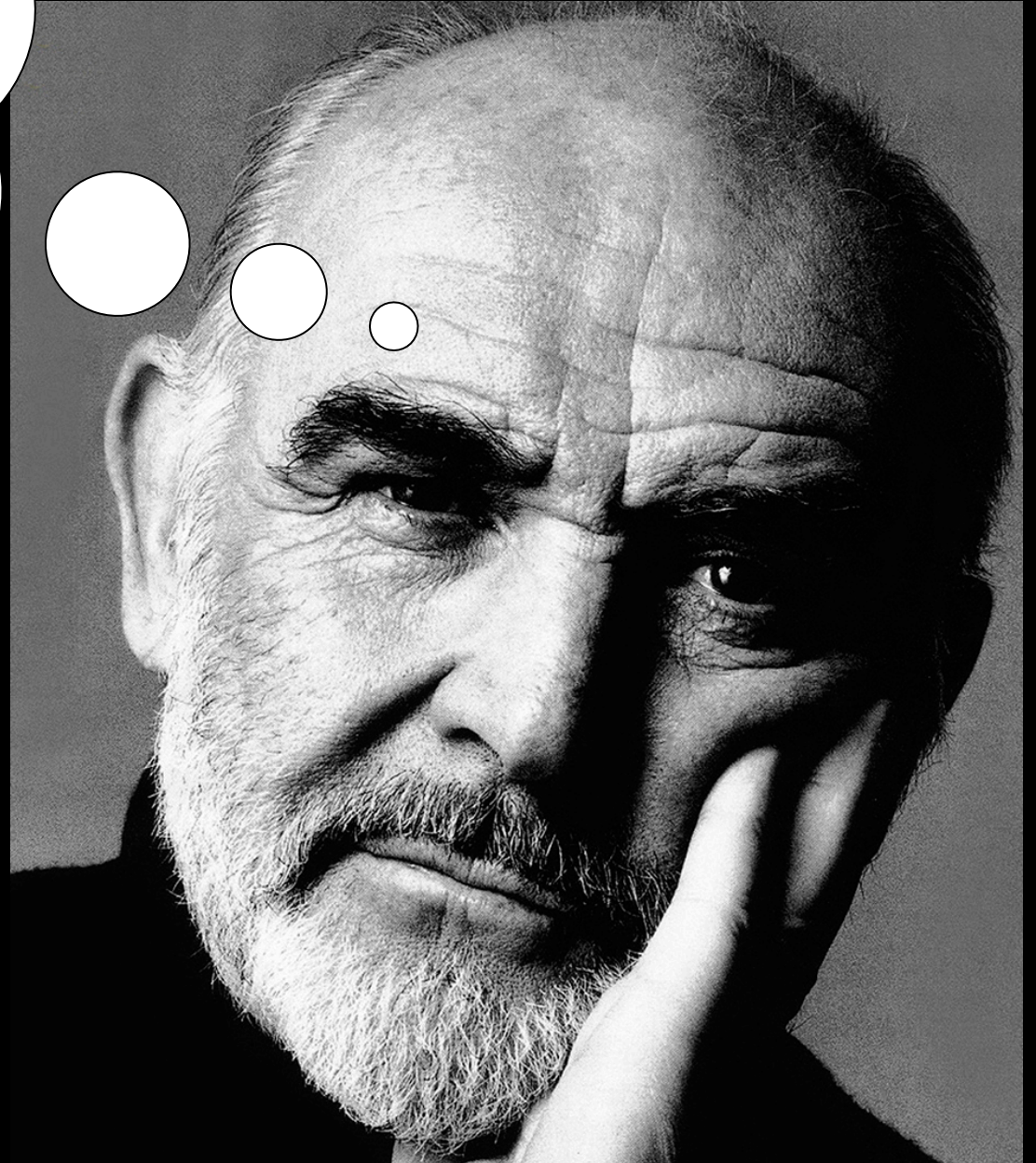
**Results and Conclusions:** Cox regression models showed that more sunshine during the third gestational trimester was associated with lower hazards (HR) of T1D at age 5–9 years in males: HR (95% CI): 0.60 (0.43–0.84),  $p=0.003$ . Our results should be considered in the context of evidence-based recommendations to the public about skin protection from the sun.

„Der Zauberberg“ (Thomas Mann 1924)

# Treat and Prevent TB



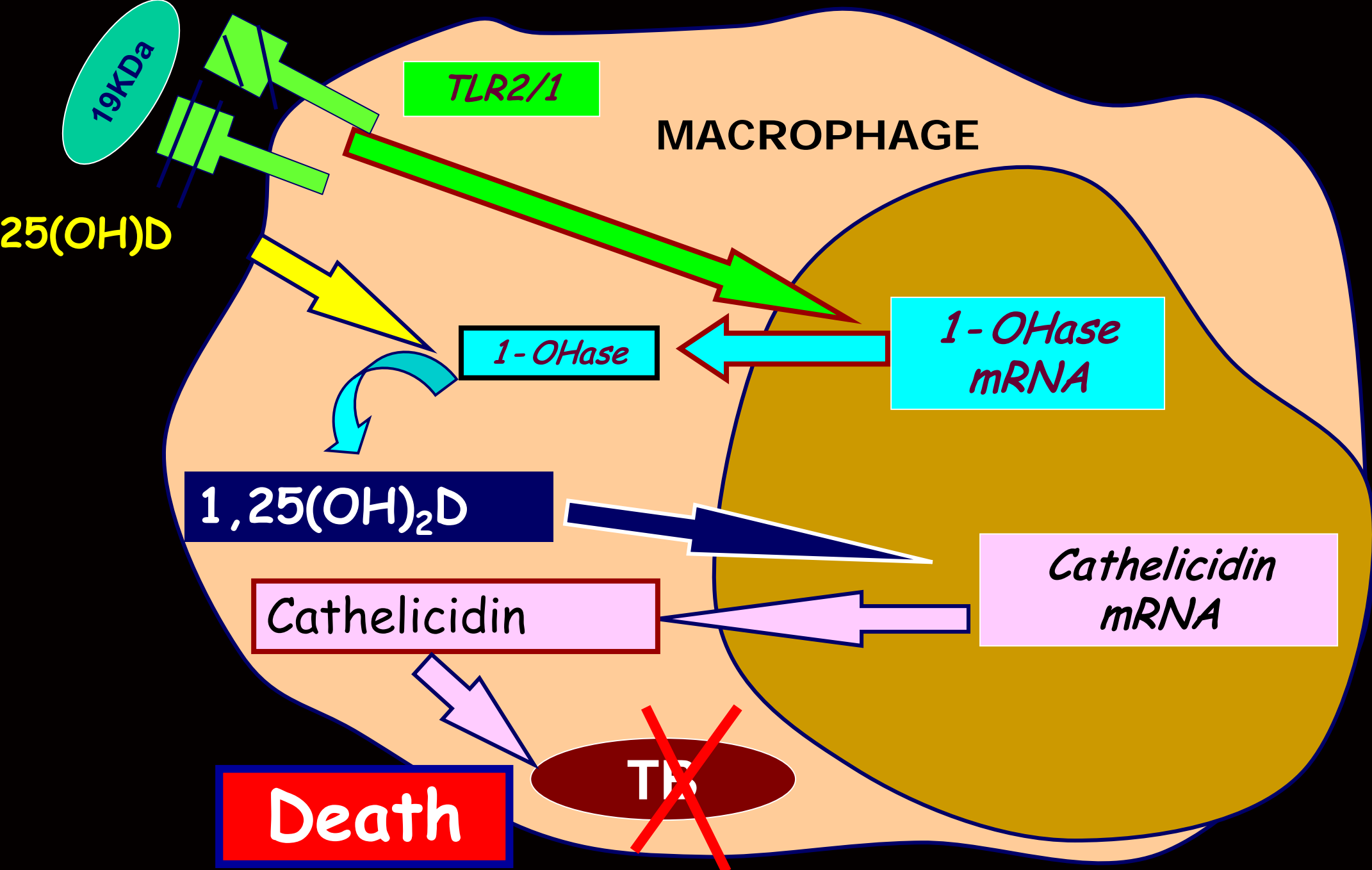
**WHAT IS  
THE EFFECT OF  
VITAMIN D ON  
THE  
IMMUNE SYSTEM  
?????????**





# Vitamin D Protects Against Tuberculosis

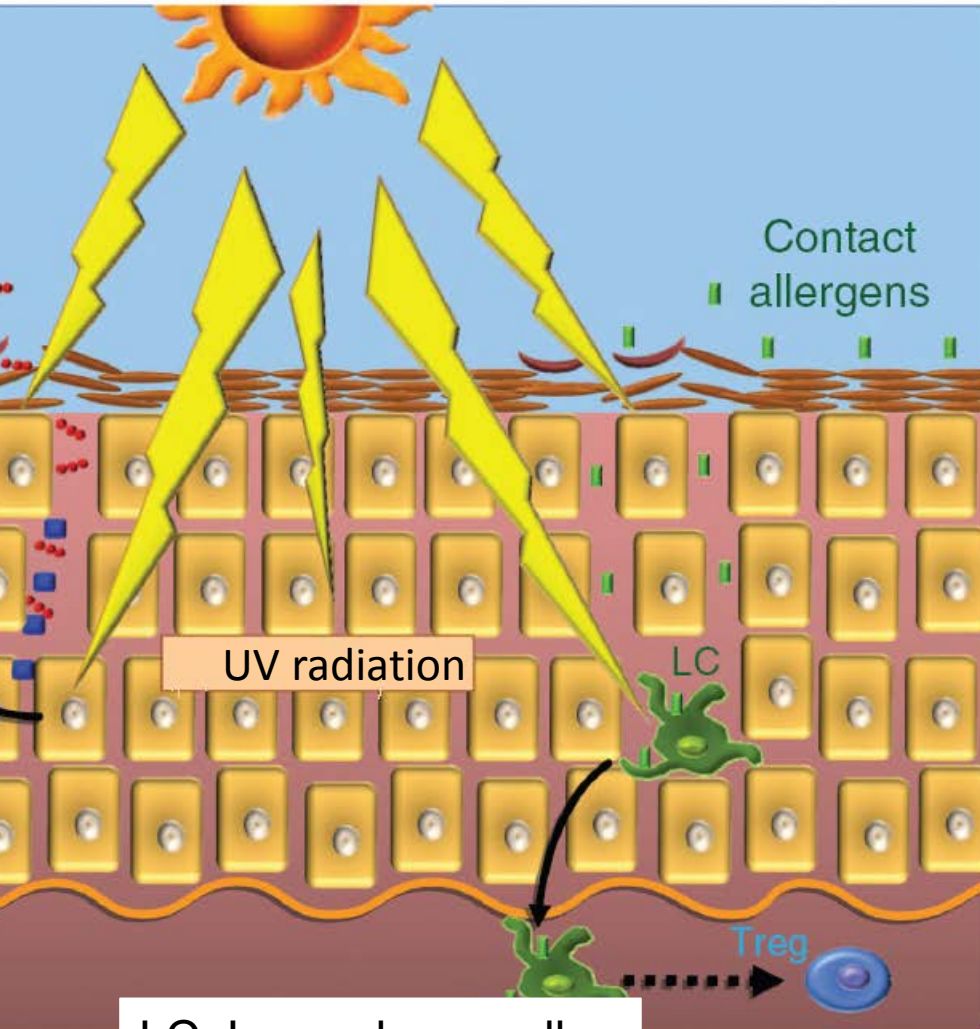
02.23.06, 12:00 AM ET



# UV Effects on Other Diseases ( $T_{reg}$ cells $\uparrow$ )

Beneficial effects of UV radiation  
on diseases other than cancer

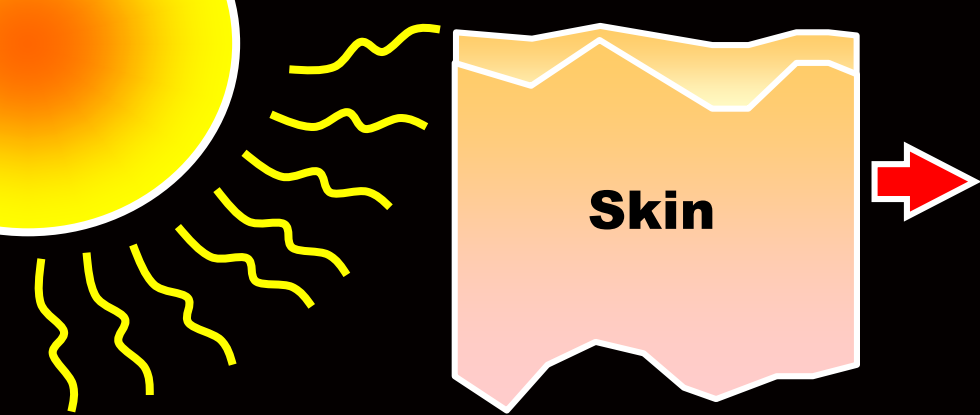
Asta Juzeniene



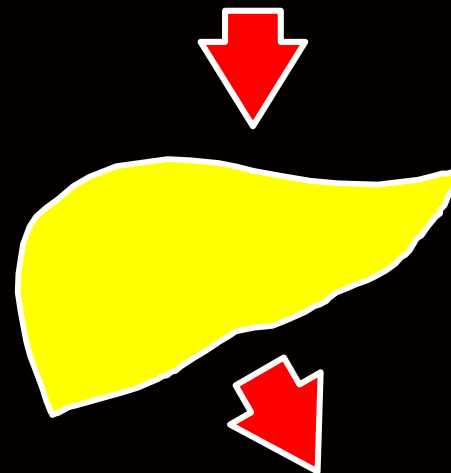
LC, Langerhans cells  
 $T_{reg}$ , regulatory T cells

**UVR increases the number of regulatory T cells and reduces immune responsiveness**

- **Suppression of allergy and asthma**
- **Suppression of chronic inflammatory diseases**
- **Prevention of autoimmune diseases (Type 1 Diabetes, Multiple sclerosis)**



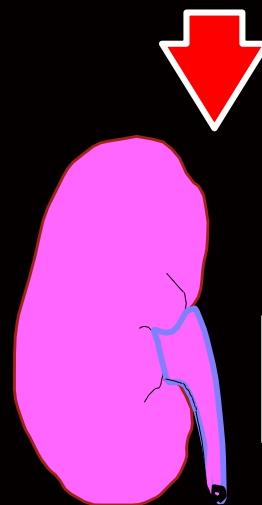
**VITAMIN D**



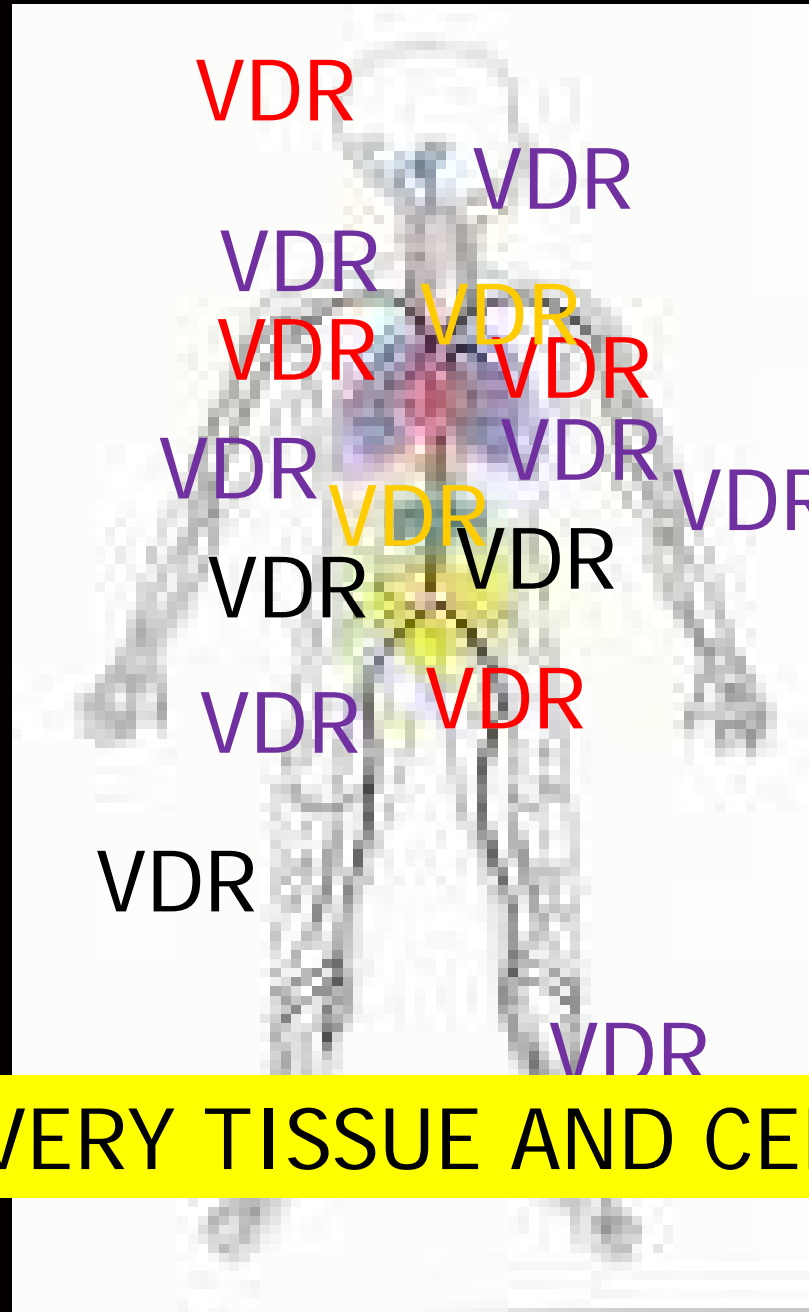
**Liver**  
**25-OHase**

**25(OH)D<sub>3</sub>**

**Kidney**  
**1 $\alpha$ -OHase**



**1,25(OH)<sub>2</sub>D<sub>3</sub>**



ESSENTIALLY EVERY TISSUE AND CELL HAS A VDR

VITAMIN D

&

CANCER

# Vitamin D and Reduced Risk of Breast Cancer: A Population-Based Case-Control Study

Julia A. Knight,<sup>1</sup> Maia Lesosky,<sup>1</sup> Heidi Barnett,<sup>1</sup> Janet M. Raboud,<sup>1</sup> and Reinhold Vieth<sup>2</sup>

Table 2. ORs and 95% CIs for an association between vitamin D–related exposure variables at ages 10 to 19 (sun exposure and dietary vitamin D) and breast cancer in cases and controls

	Cases (%)	Controls (%)	OR* (95% CI)	OR <sup>†</sup> (95% CI)
<b>Girls 10-19 yrs most sun</b>				<b>↓ 69%</b>
5-6	150 (14)	165 (15)	0.80 (0.67-1.10)	0.82 (0.65-1.06)
7	700 (73)	835 (74)	1.00	1.00

Table 3. ORs and 95% CIs for an association between vitamin D–related exposure variables at ages 20 to 29 (sun exposure and dietary vitamin D) and breast cancer in cases and controls

	Cases (%)	Controls (%)	OR* (95% CI)	OR <sup>†</sup> (95% CI)
<b>Women 20-29 yrs most sun</b>				<b>↓ 51%</b>
5-6	132 (14)	209 (19)	0.74 (0.58-0.95)	0.72 (0.56-0.93)
7	557 (58)	645 (57)	1.00	1.00

**Women 45-54 yrs most sun 0.0%**

**25(OH)D > 30 ng/ml**

**Colon Cell**

**Mitochondria**

**1-OHase**

**~ 2000 Genes  
Affected  
By 1,25(OH)<sub>2</sub>D**

**Bcl-2  
Bcl-XL  
Mcl-1  
BAG1  
XIAP  
cIAP1  
cIAP2**

**Differentiation  
MATURATION**

**CDK2, p21, p27, p53  
Ki67, E-Cadherin**

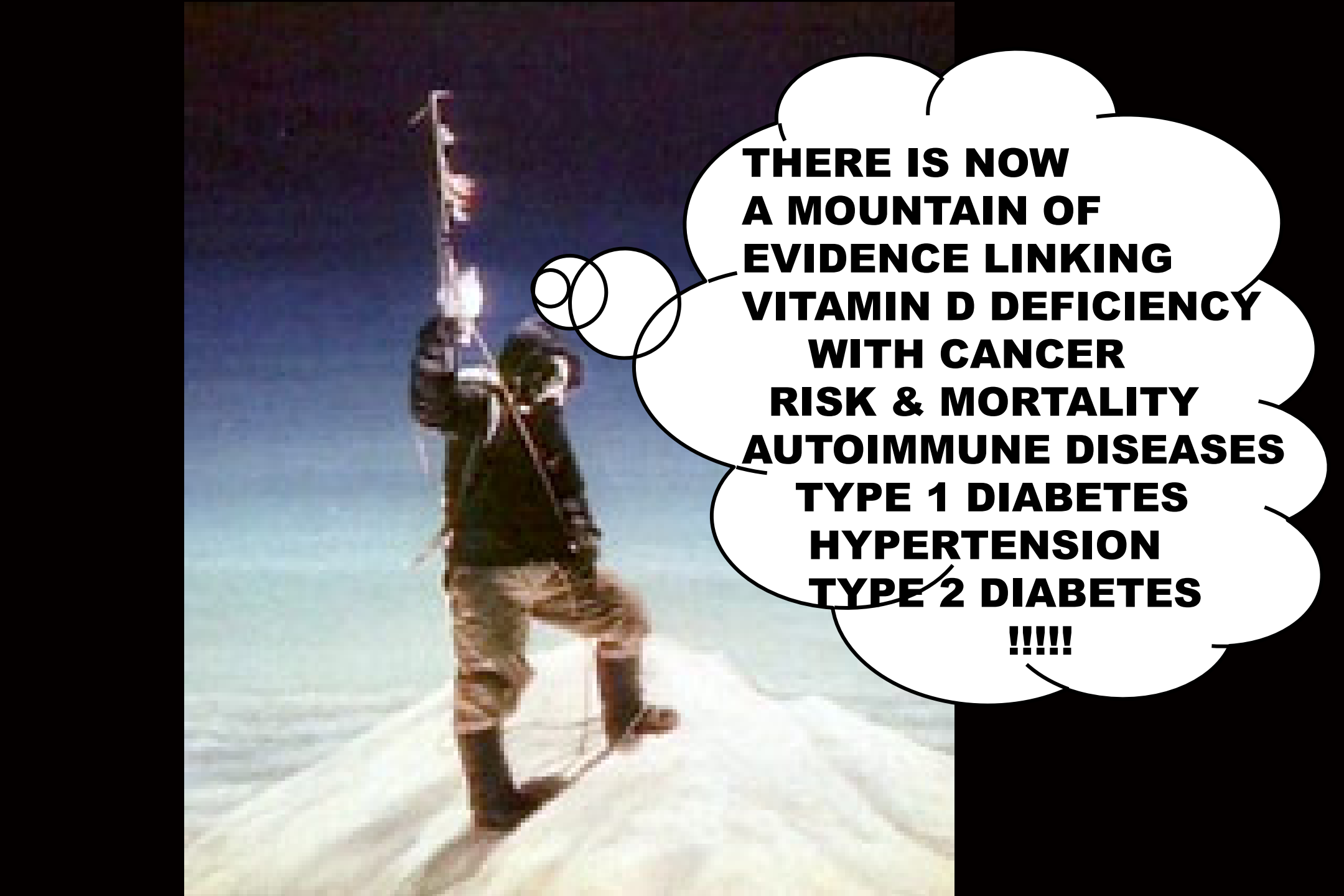
**le  
Arrest**



VITAMIN D

***DEFICIENCY***

IS A DISEASE OF NEGLECT

A person is climbing a rope on the deck of a ship. The person is wearing a dark jacket and light-colored pants. The background shows the blue sky and the white foam of the sea. The text is overlaid on the right side of the image.

**THERE IS NOW  
A MOUNTAIN OF  
EVIDENCE LINKING  
VITAMIN D DEFICIENCY  
WITH CANCER  
RISK & MORTALITY  
AUTOIMMUNE DISEASES  
TYPE 1 DIABETES  
HYPERTENSION  
TYPE 2 DIABETES**

**!!!!**

WHAT IS A

**NORMAL**

VERSUS

**HEALTHY**

25(OH)D LEVEL

????????

OUR 25(OH)D  
40-60 ng/ml

GOOD MUSCLE STRENGTH  
LOW CANCER RISK  
LOW RISK AUTOIMMUNE &  
HBP & CVD DISEASE



1) Luxwolda, ME, Kuipers, RS, Kema, IP, Dijck-Brouwer, DAJ, a Muskiet, FAJ. Traditionally living populations in East Africa have a mean serum 25-hydroxyvitamin D concentration of 115 nmol/l. *Nutr.* 2012. 23:1-5.

**MICHAEL F. HOLICK, Ph.D., M.D.**

Foreword by **ANDREW WEIL, M.D.**

# THE VITAMIN D SOLUTION

A 3-Step Strategy to Cure Our  
Most Common Health Problems

**PREVENT AND TREAT:**

Osteoporosis • Heart Disease • Cancer • Autoimmune Diseases • Depression  
• Insomnia • Arthritis • Diabetes • Chronic Pain • Psoriasis • Fibromyalgia •  
Autism...as well as other diseases, chronic conditions, and mild ailments

# The Influence of Painful Sunburns and Lifetime Sun Exposure on the Risk of Actinic Keratoses, Seborrhheic Warts, Melanocytic Nevi, Atypical Nevi, and Skin Cancer

Cornelis Kennedy, Chris D. Bajdik,\* Rein Willemze, Frank R. de Gruijl, and Jan N. Bouwes Bavinck, for the members of the Leiden Skin Cancer Study


Departments of Dermatology, Leiden University Medical Center, Leiden, The Netherlands; \*British Columbia Cancer Agency, Vancouver, British Columbia, Canada

Lifetime sun exposure was predominantly associated with an increased risk of squamous cell carcinoma (p-value for trend = 0.03) and actinic keratoses (p-value for trend < 0.0001) and to a lesser degree with the two types of basal cell carcinoma. By contrast, lifetime sun exposure



I should Avoid ALL  
Sunlight to Prevent  
Melanoma

!!!!!!

A close-up photograph of a man with dark hair, wearing dark sunglasses and a black turtleneck. He has a serious expression. A white thought bubble with a black outline is positioned over the right side of his face. Inside the bubble, the text reads: "Did you Know Most Melanomas Occur on the Least Sun Exposed Areas ???????".

Did you Know  
Most Melanomas  
Occur on the  
Least Sun Exposed Areas  
???????





**Occupational  
sun exposure  
Decreases risk  
melanoma**

# The Influence of Painful Sunburns and Lifetime Sun Exposure on the Risk of Actinic Keratoses, Seborrheic Warts, Melanocytic Nevi, Atypical Nevi, and Skin Cancer

Cornelis Kennedy, Chris D. Bajdik,\* Rein Willemze, Frank R. de Gruijl, and Jan N. Bouwes Bavinck, for the members of the Leiden Skin Cancer Study

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By contrast, lifetime sun exposure appeared to be associated with a lower risk of malignant melanoma, despite the fact that lifetime sun exposure did not diminish the number of melanocytic nevi or atypical nevi. Neither painful sunburns nor lifetime sun exposure were associated with an increased risk of seborrheic warts. *Key words: actinic keratoses/atypical nevi/melanocytic nevi/seborrheic warts/skin cancer/ultraviolet light. J Invest Dermatol 120:1087–1093, 2003*

**WHAT DID THE AUTHORS CONCLUDE ?**

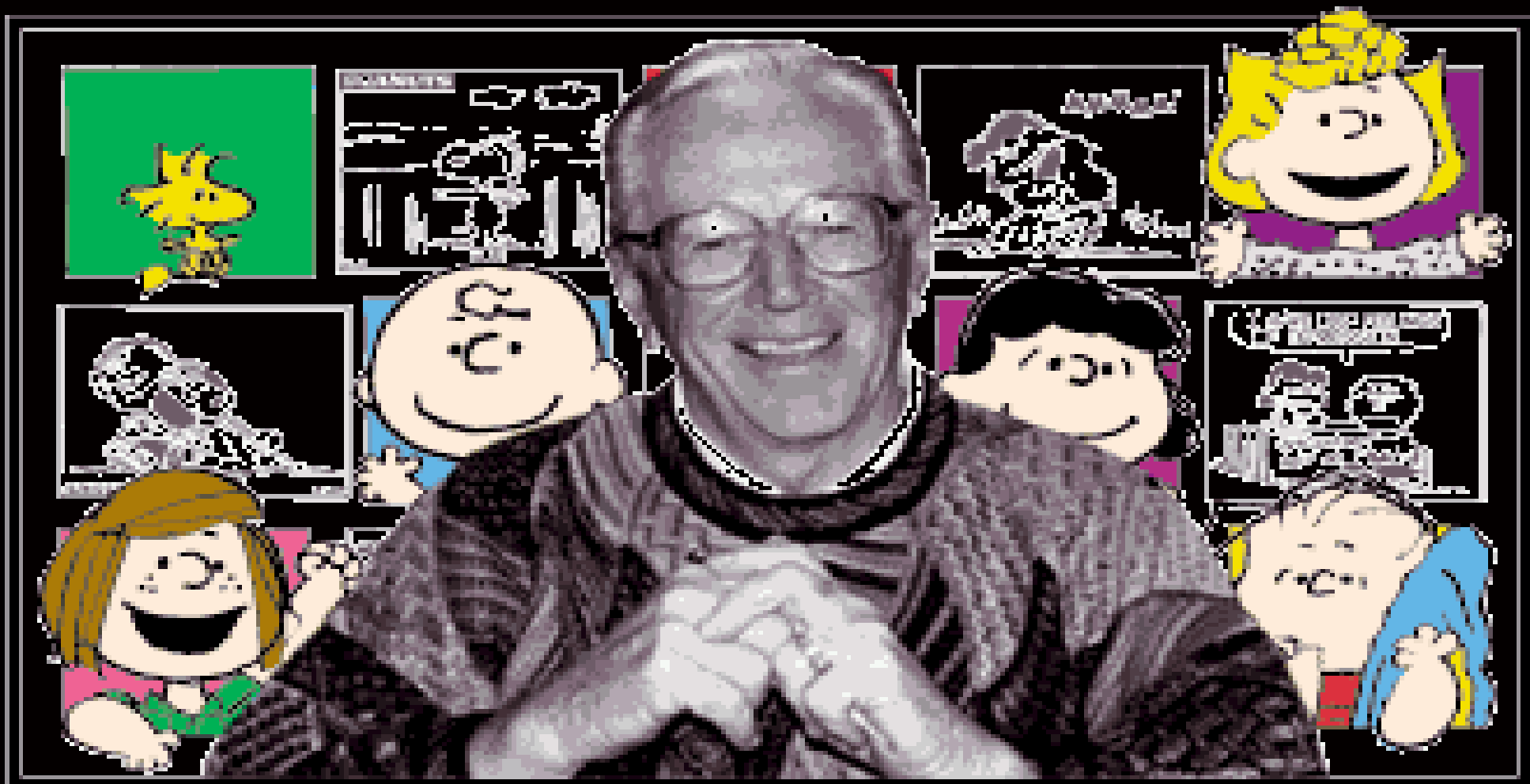
**INCREASES RISK MELANOMA**

**INCREASED # MOLES**

**BAD GENETICS**

**RED HAIR COLOR**

**# SUNBURNS as CHILD  
YOUNG ADULT**



CHARLES M. SCHULZ

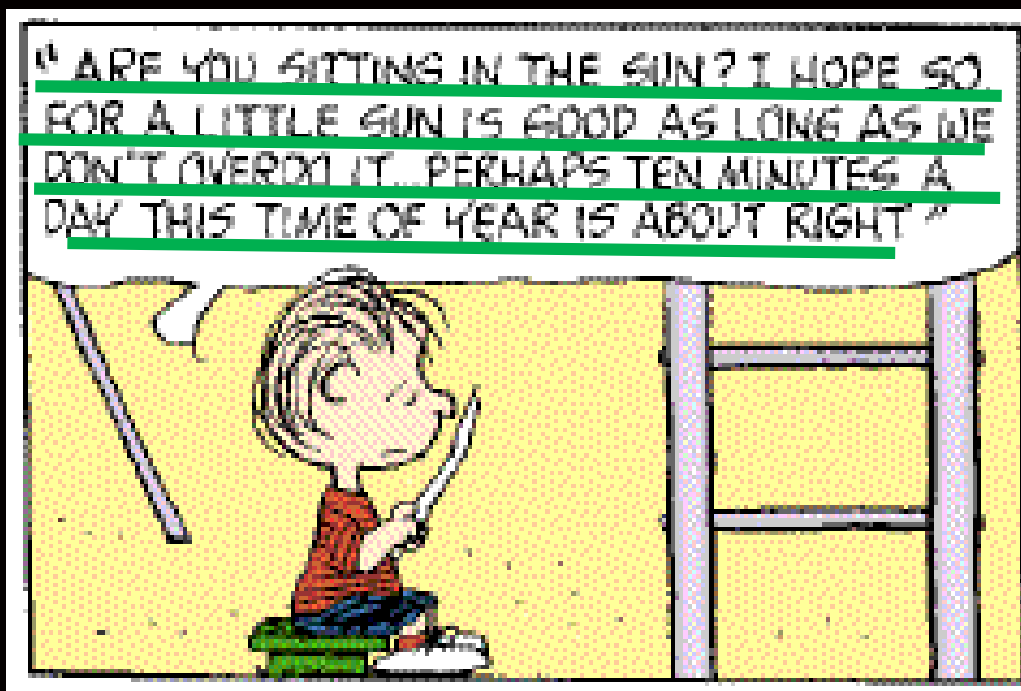
1922 - 2000

Thank You For Giving The World Such Happiness.

Classic  
**PEANUTS**

featuring  
"Good ol'  
Charlie Brown"

by SCHULZ



What is the  
Best  
Source of  
SENSIBLE  
SUNLIGHT



**WHEN CAN YOU MAKE  
VITAMIN D ????**

**How about an App???**

**<http://dminder.info>**

**Lack of  
Adequate Sunlight  
&  
Vitamin D  
Deficiency  
Has a  
Major Impact  
On Health**



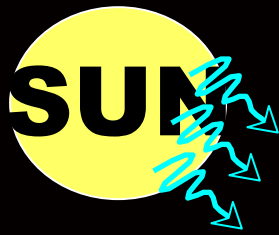
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# CAUSES

# VITAMIN D DEFICIENCY

# CONSEQUENCES



**SUNSCREEN**  
**MELANIN**  
**LATITUDE**  
**WINTER**

**MEDICATIONS**  
Antiseizure  
Glucocorticoids  
Rifampin  
HAART  
St John's Wart

**Hepatic Failure**

**Renal Failure**  
**Nephrotic syndrome**

**MALABSORPTION**  
Crohn's  
Whipple's  
Cystic Fibrosis  
Celiac  
Liver disease

**Obesity**

**Schizophrenia**  
**Depression**

**INFECTIONS**  
URI  
TB

**HBP**  
**CHD**

**FEV1**  
**Wheezing illnesses**

**Autoimmune**  
Type 1 Diabetes  
MS  
Crohn's  
RA

**AODM**  
**Syndrome X**

**CANCER**  
Colon  
Breast  
Prostate  
etc.

**Muscle weakness**  
**Muscle aches**

**Osteoarthritis**

**Osteoporosis**  
**Osteomalacia**  
**Rickets**

**There Is No  
Downside  
To  
Obtaining  
Sensible  
Sun Exposure  
!!!!**



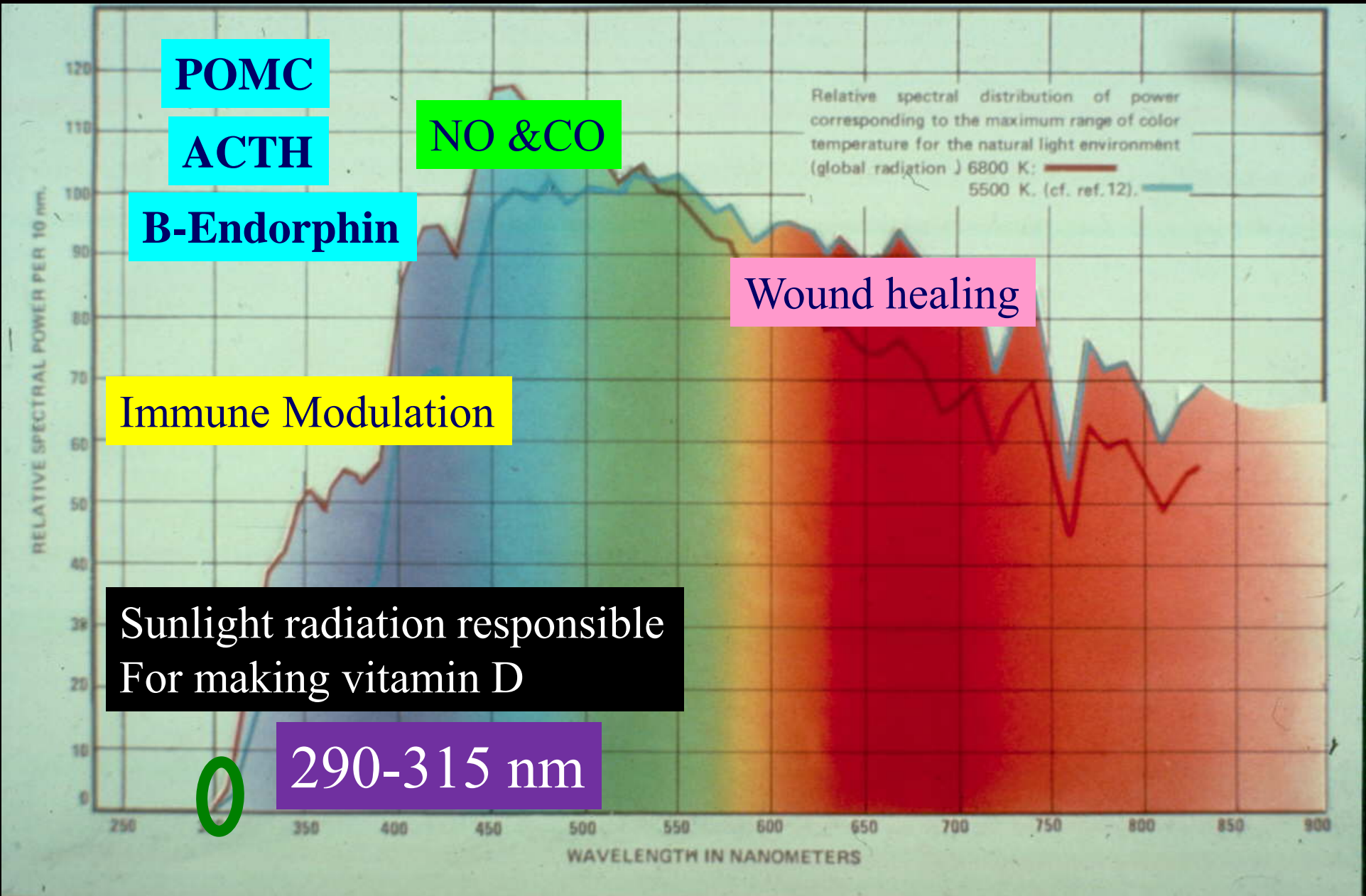
***DrHolick.com***

A man in a dark suit and tie is shown from the chest up, looking slightly to the right. He has a thoughtful expression. A large white thought bubble with a black outline is positioned above his head on the right side. The background is a textured, light brown color.

**This is  
NOT  
HYPOTHESIS**

**We Need  
Sensible  
Sun + UVR  
&  
Vitamin D  
Supplementation  
Recommendations  
!!!!!!!**

**You Do Not Need To  
Be A Genius To Know**





**World Health  
Organization**

Knowing how to limit exposure to UV radiation is the key to a healthy and fun sun experience.

- Limit your UV risk when you are working outdoors!
- Enjoy your holiday without getting burnt by the Sun!

**AVOID  
OVEREXPOSURE  
TO SUNLIGHT**

WHO INTERSUN -  
the global UV project



Through INTERSUN, WHO provides scientific information and practical advice on the health impact and environmental effects of exposure to UV radiation.

INTERSUN collaborators:

- UNEP: United Nations Environmental Programme
- WMO: World Meteorological Organization
- IARC: International Agency for Research on Cancer
- ICNIRP: International Commission on Non-Ionizing Radiation Protection.

Several WHO collaborating centres are also actively involved in INTERSUN.

More information on WHO INTERSUN can be found at:  
[www.who.int/uv/intersunprogramme](http://www.who.int/uv/intersunprogramme)

World Health Organization (WHO)  
Department of Public Health and Environment (PHE)  
20, avenue Appia - CH - 1211 Geneva 27  
[www.who.int/phe](http://www.who.int/phe)  
Email: [phedoc@who.int](mailto:phedoc@who.int)

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# Sunshine and health

## How to enjoy the Sun safely



World Health  
Organization



# WHO Recommendations

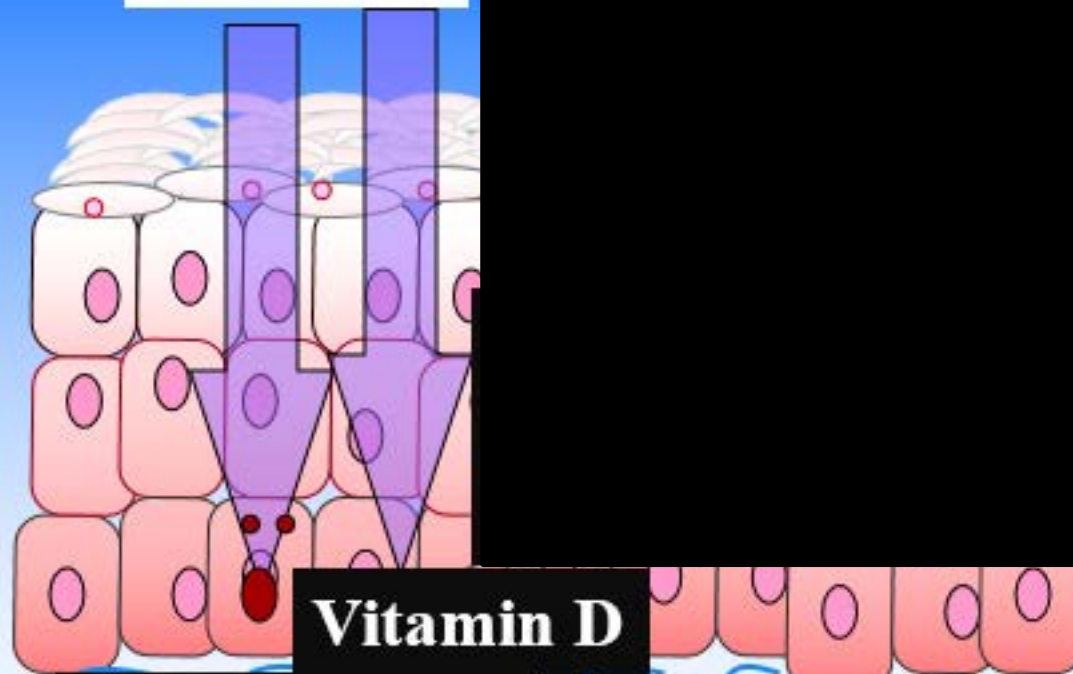
## The known health effects of UV

---

### Are there beneficial effects of UV radiation?

The sun's rays provide warmth and light that enhance your general feeling of well-being and stimulate blood circulation. Some UV radiation is essential to the body as it stimulates the production of vitamin D. Vitamin D has an important function in increasing calcium and phosphorus absorption from food and plays a crucial role in skeletal development, immune function and blood cell formation. There is no doubt that a little sunlight is good for you! But 5 to 15 minutes of casual sun exposure of hands, face and arms two to three times a week during the summer months is sufficient to keep your vitamin D levels high. Closer to the equator, where UV levels are higher, even shorter periods of exposure suffice.

**UVB**  
**290-320 nm**



**Vitamin D**

**Melanogenesis**

**Stratum corneum**  
**Stratum granulosum**

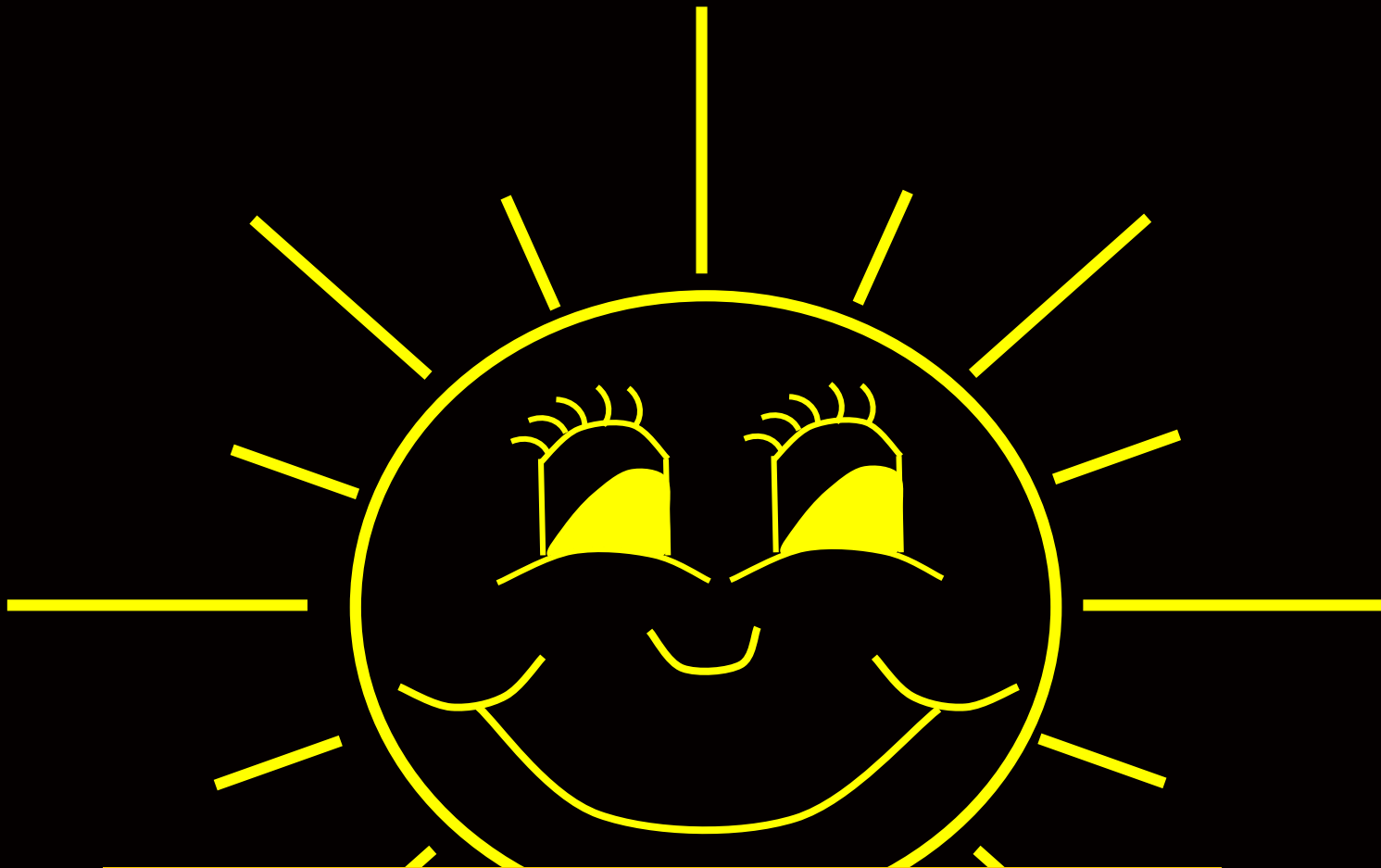
**Spiny layer**

**Basal layer**

**Dermis**

**Subcutaneous  
adipose tissue**





**DrHolick.com**

**<http://dminder.info>**