

RADIATION 360°

all about ionising radiation

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WHAT IS IT?
WHERE DOES IT COME FROM?
WHAT ARE ITS BENEFITS?
DEMONSTRATION

← Q&A
← Q&A
← Q&A

(Optional Visual “Lab Tour”)

**WHAT IS IONISING
RADIATION?**

Radiation is...

energy that comes from the sun
and travels through
the air and through space.

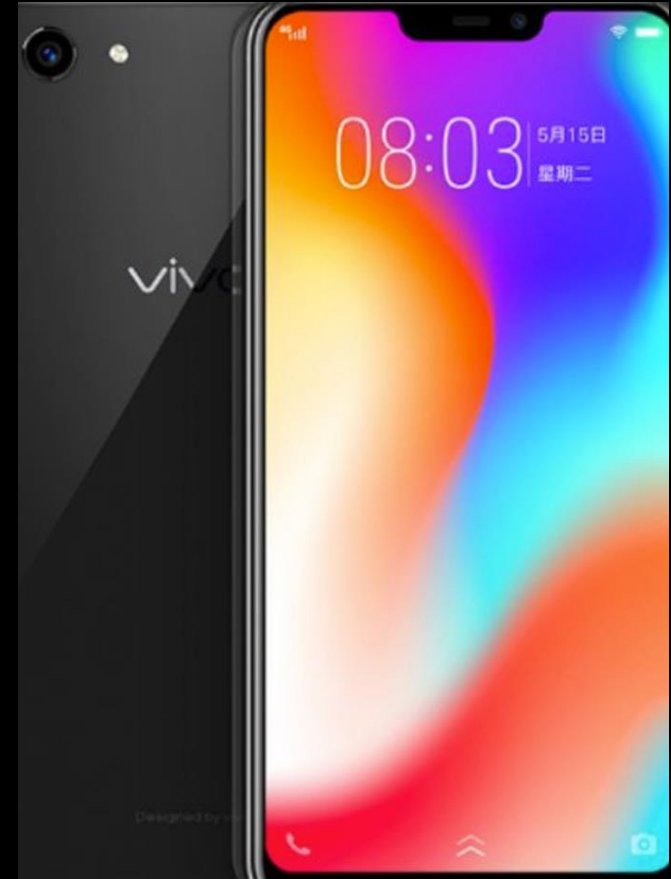
For example..



Radiation is...

energy that comes from the phone
and travels through
the air and through space.

For example..

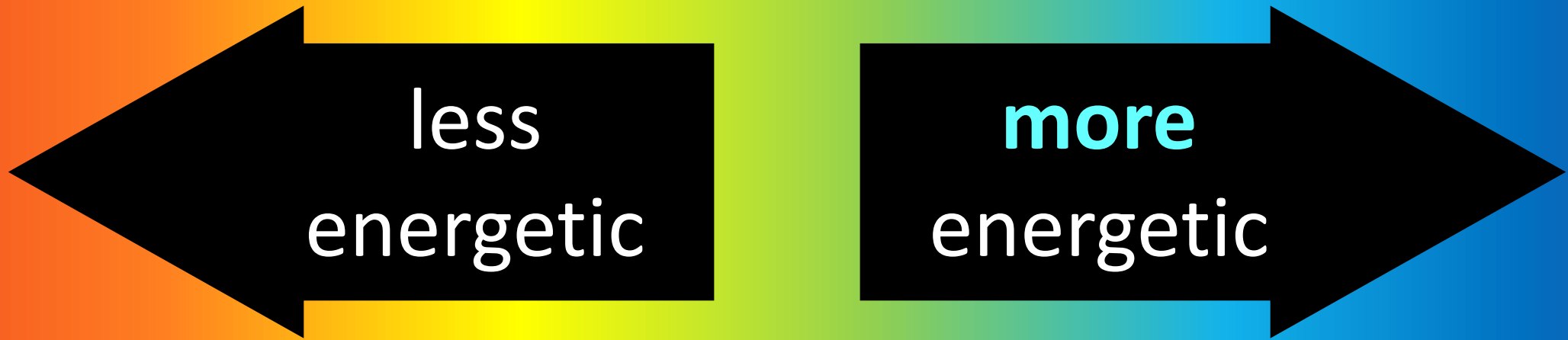


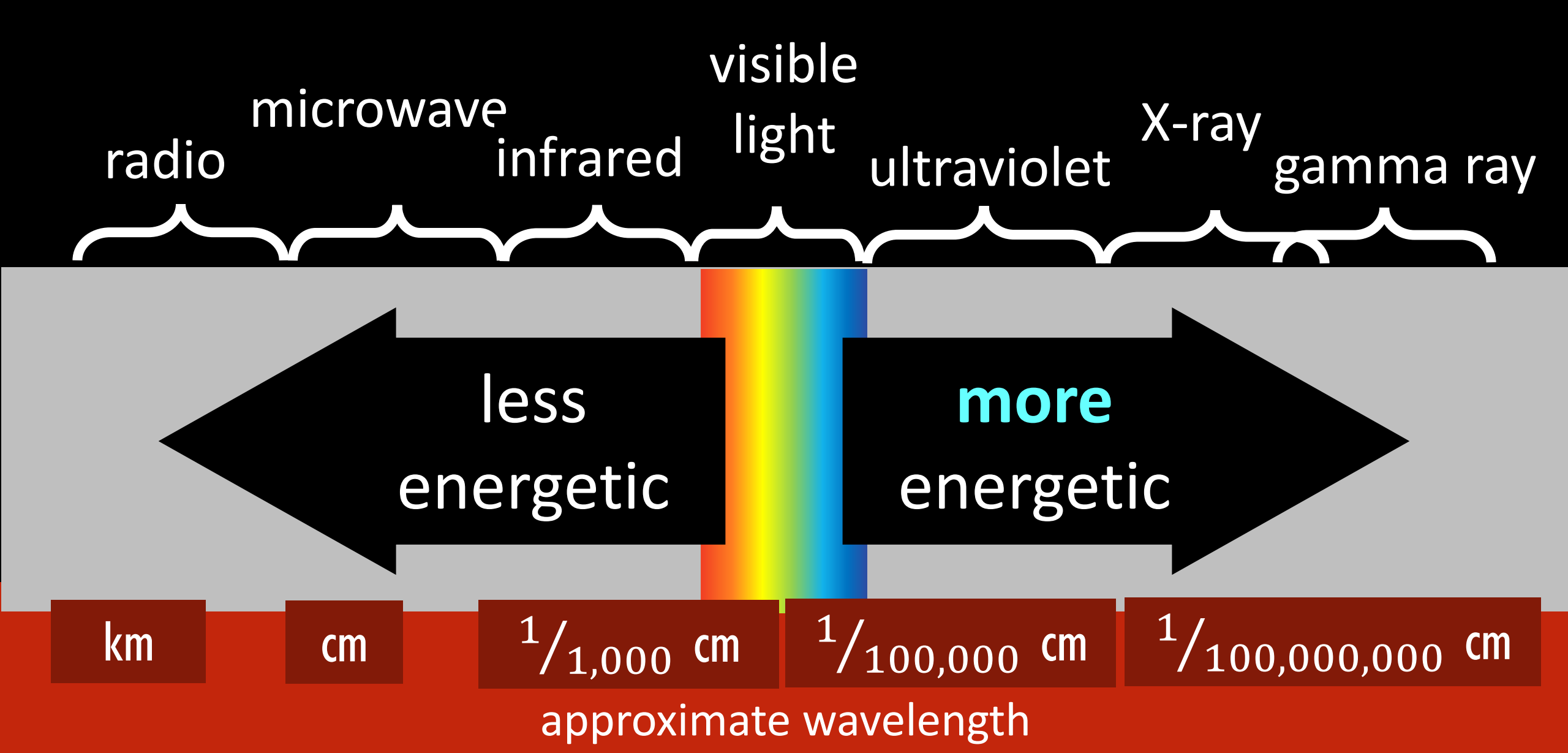
Radiation is...



Light, heat, microwaves, radio waves are all parts of the **electromagnetic radiation spectrum**!

The shorter wavelength, the higher the energy level

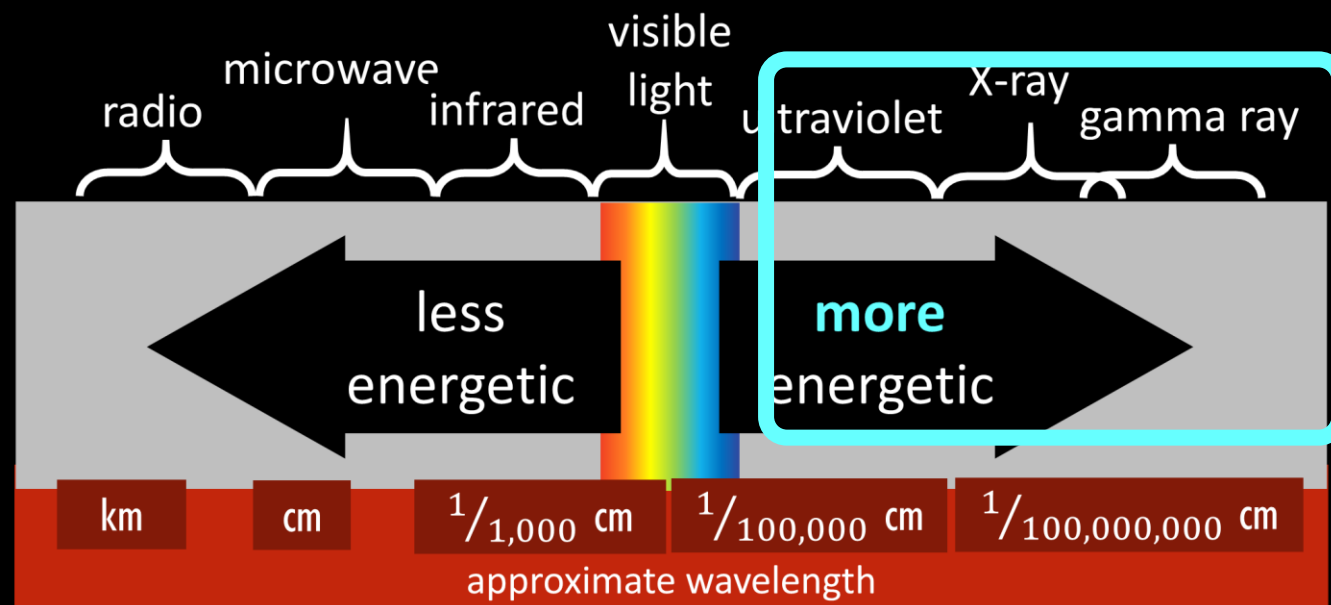




THE ELECTROMAGNETIC SPECTRUM

Ionising radiation

when radiation is **energetic enough** to cause ionisation.



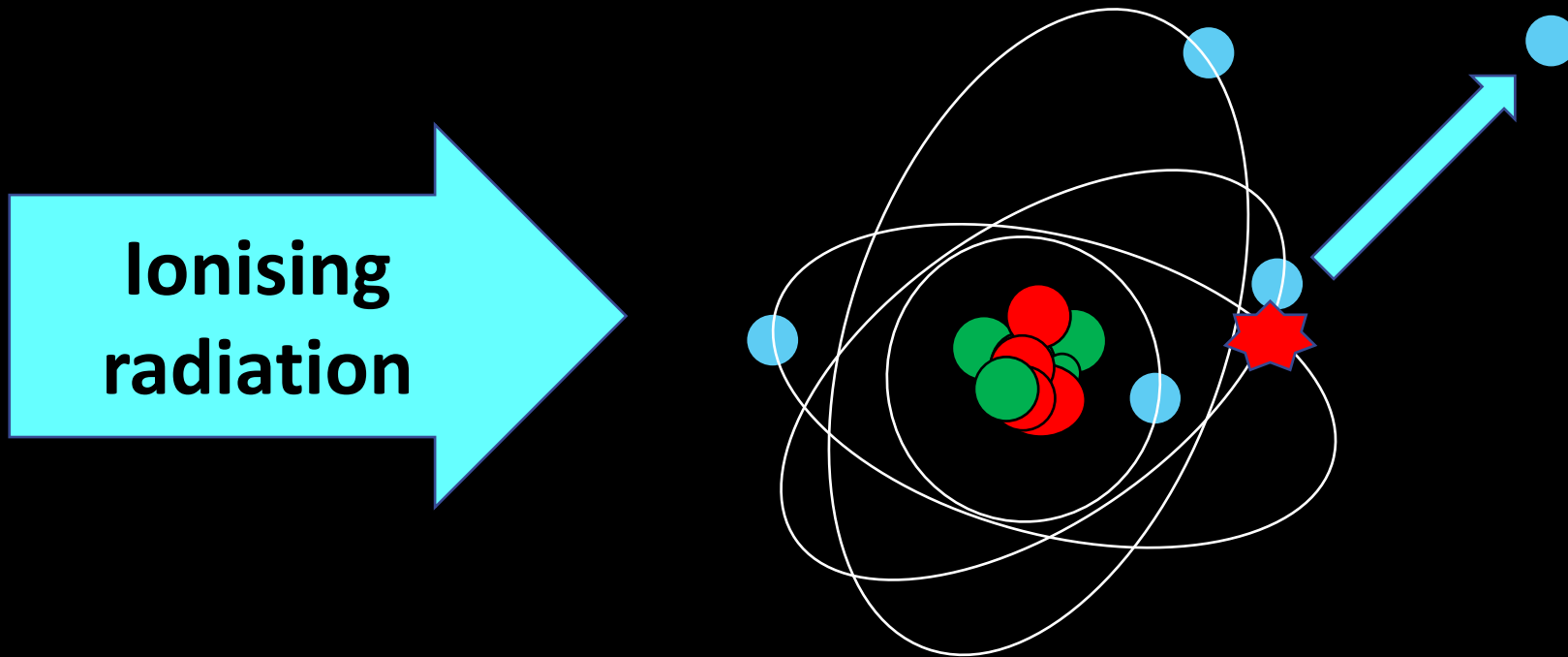
EM wavelengths **shorter than ultraviolet** are **energetic enough** to be considered **ionising radiation**

Other ionising radiation: **particles** like electrons, ions, protons, neutrons

THE ELECTROMAGNETIC SPECTRUM

Ionising radiation

when radiation is **energetic enough** to cause **ionisation**.



**WHERE DOES IONISING
RADIATION COME FROM?**

Ionising Radiation is everywhere!

The **air** you breathe

The **house** you live in

The **water** you drink

Your friends

Yourself..

The **food** you eat

The **ground** you stand on



Ionising radiation in our daily life

90

232

Th

Thorium

92

235, 238

U

Uranium

19

40

K

Potassium

6

14

C

Carbon

86

222

Rn

Radon

Present in the ground
and building materials
like concrete

Minerals in
food and
water

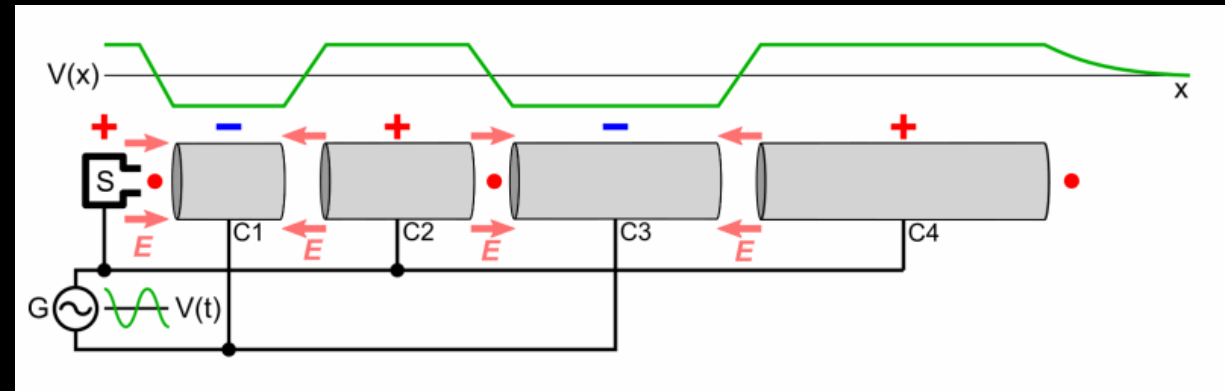
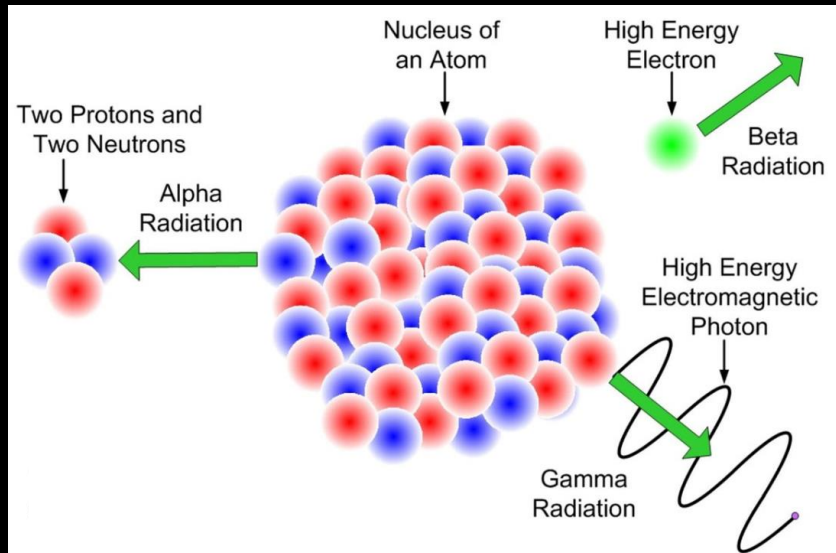
In organic
matter

Present in
the air

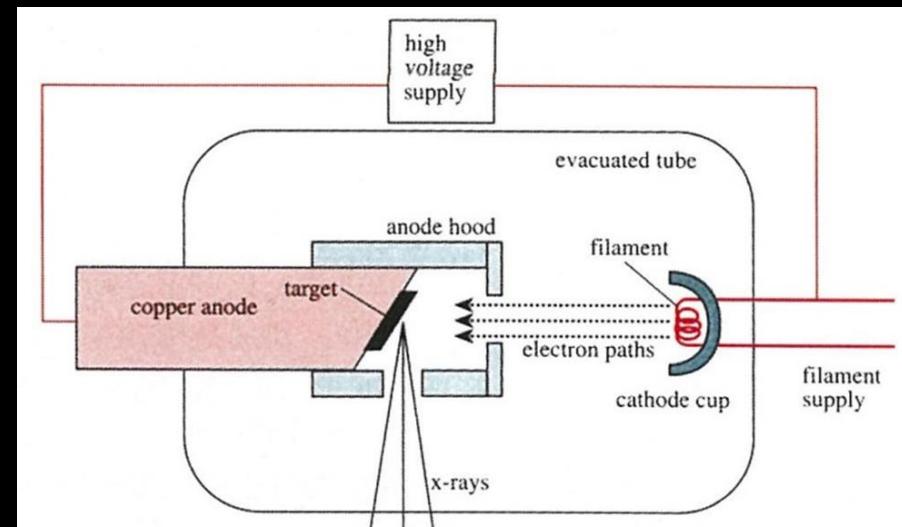
Ionising radiation sources

Particle accelerators

Unstable atomic nuclei



X ray from
charged particles
in targets



ONE YEAR OF RADIATION

NATURAL SOURCES

Radon gas	2 mSv
Cosmic rays	0.3 mSv
Terrestrial (ground)	0.3 mSv
Yourself	0.4 mSv

ELECTIVE

Short flight	0.02 mSv
Natural gas usage	0.06 mSv
Sleeping with another person	0.01 mSv

ARTIFICIAL SOURCES

Medical procedures	0.5 mSv
Consumer products	0.1 mSv
Industry, weapons testing	0.01 mSv



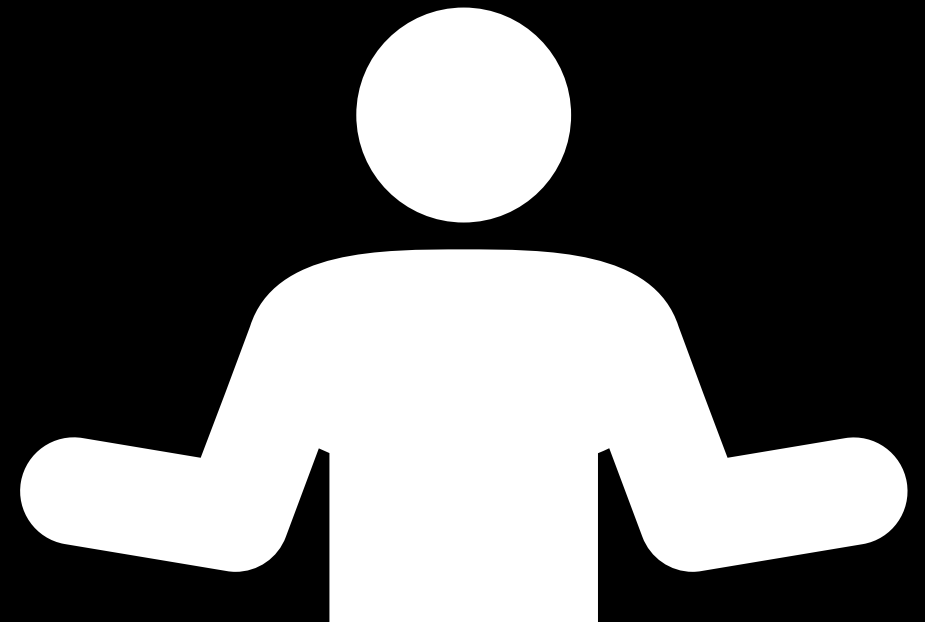
Why are we mostly unaware of it?

In our daily life, the level of ionising radiation is **extremely low**. There are no significant health effects.

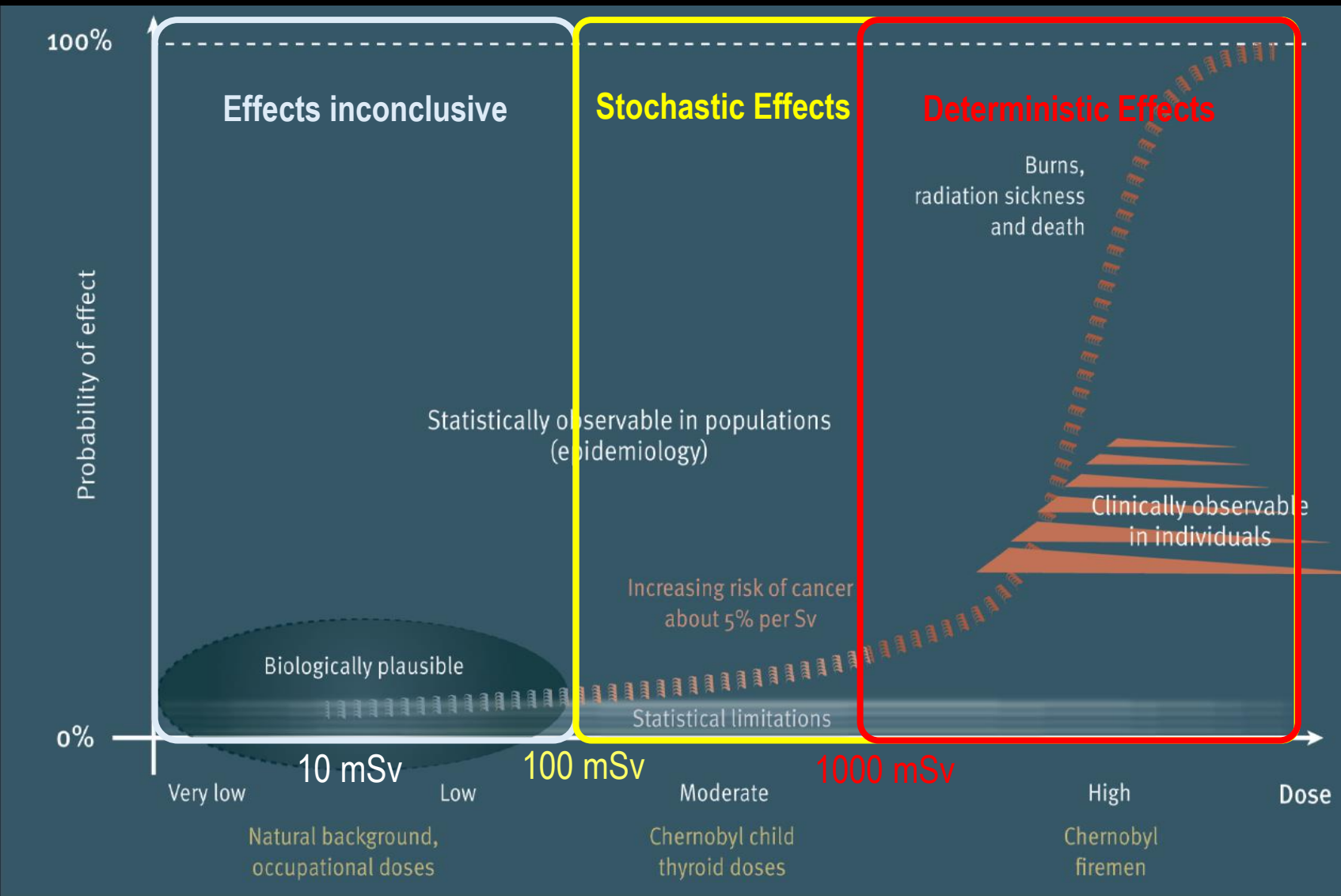
per year, only

~3 mSv

Our body doesn't have or need a sensor for it!



Units for Radiation Dose (Sv & mSv)



It is estimated that the additional chance of dying of cancer due to *radiation exposure above 100 mSv* was about **5% per sievert (Sv)**.

The Radiation Scale

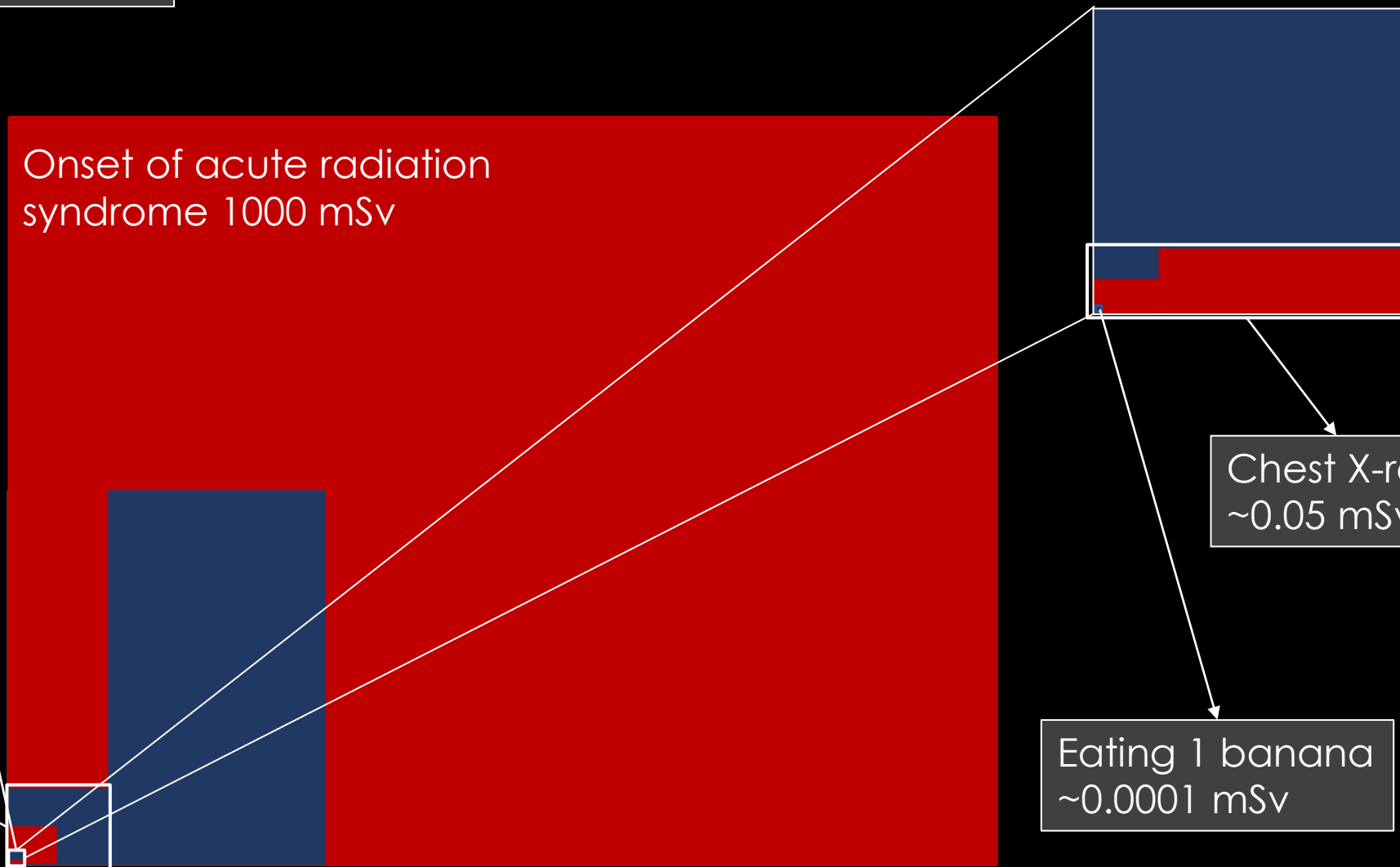
Round Trip Flight Tokyo – New York
~0.2 mSv

Onset of acute radiation
syndrome 1000 mSv

Chest CT scan
~10 mSv

Chest X-ray
~0.05 mSv

Eating 1 banana
~0.0001 mSv



Questions on Ionising Radiation & Radiation Scale

**WHAT ARE THE BENEFITS
OF IONISING RADIATION?**

Heat source

**Gamma-ray
emission**

**Transmutation
/ neutron
activation**

**Change
chemical
structure**

Half-life decay

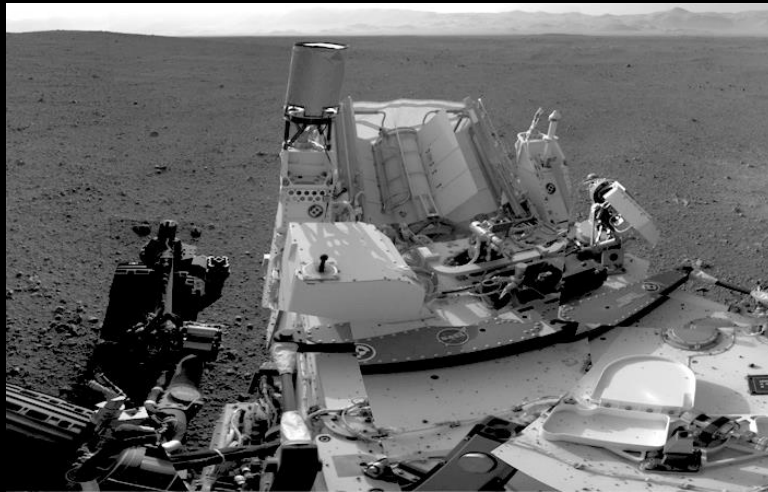
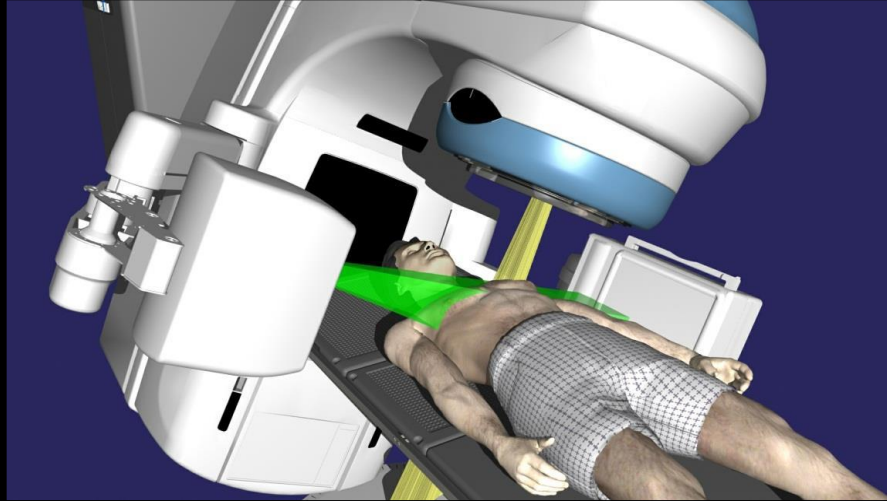
**Cell
destruction**

**Penetrating
power**

Nuclear fission

USEFUL PROPERTIES OF IONISING RADIATION

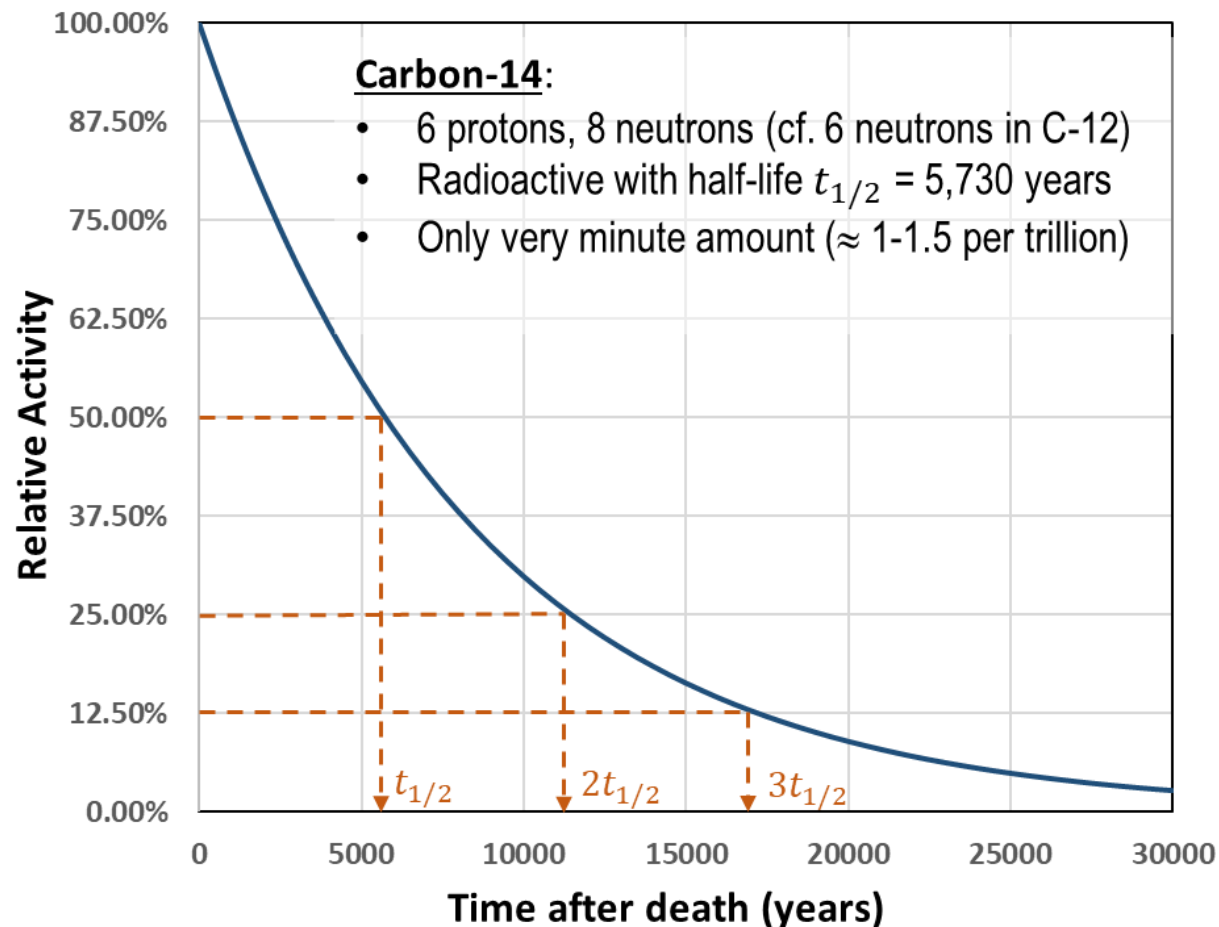
Interesting applications



Medical purposes

- <https://youtu.be/zEihqK-jhBM>

Dating of rocks, artefacts




- Measure amount of radioisotope in sample
- Compare to decay curve
- Find the age of sample and even age of Earth!



Carbon dating: 200 BC to 68 AD.

Dating of rocks, artefacts



Argon-argon dating used to date the extinction of dinosaur : 66.0 million years ago!

- Measure amount of radioisotope in sample
- Compare to decay curve
- Find the age of sample and even age of Earth!

Agriculture

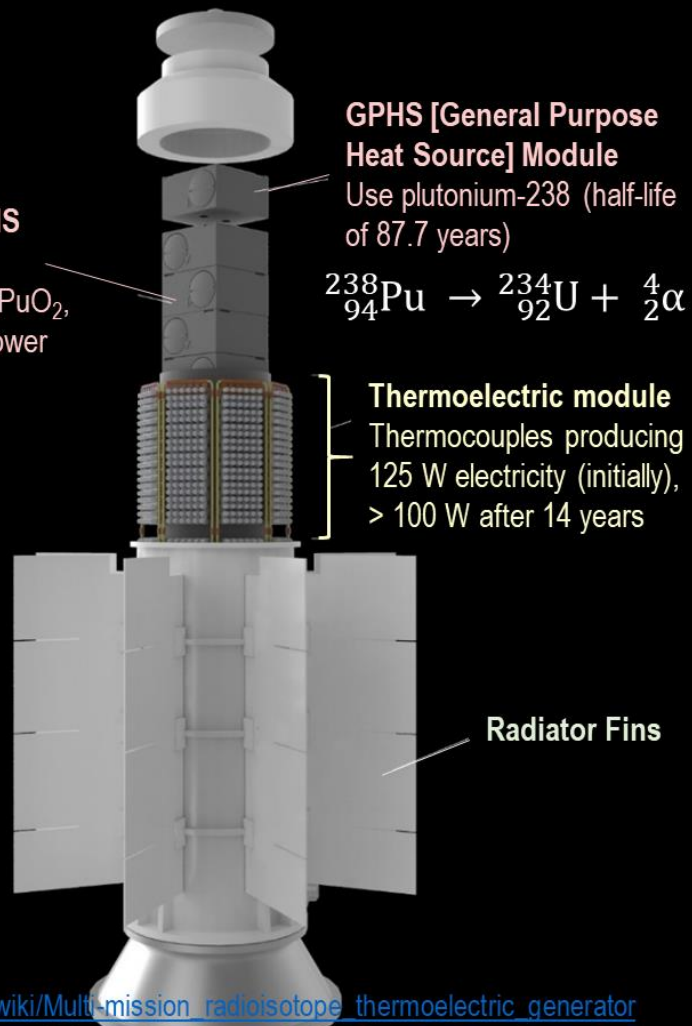
- <https://youtu.be/go9dNfDhkys>

Heat and power

**Multi-Mission
Radioisotope
Thermoelectric
Generator**
(expanded view)

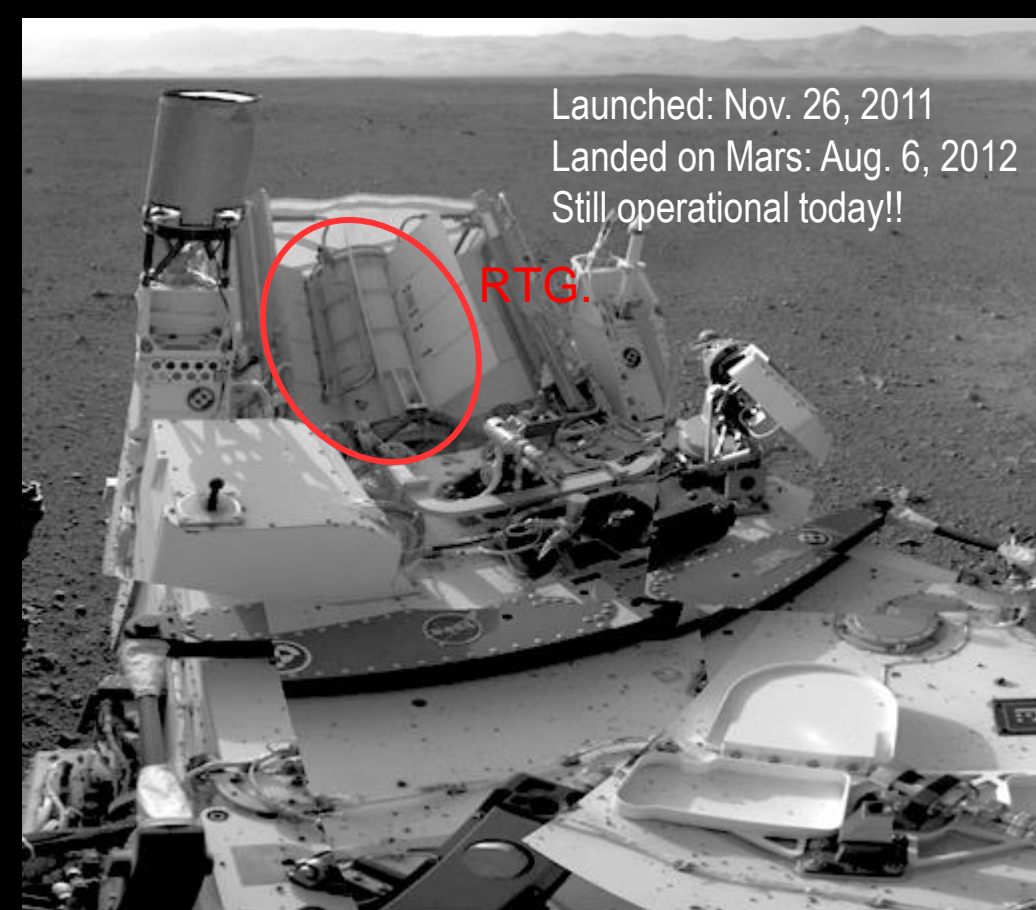
**Stack of 8 GPHS
modules**

About 4.8 kg of PuO_2 ,
2 kW thermal power
(initially)



- Missions in space: unmanned, no power stations!
- Radiation from radioactive isotopes can produce heat and electricity for space crafts or rovers – missions can last for years

Heat and power



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The Mars Science Laboratory rover, Curiosity

Questions on Applications of Ionising Radiation

DEMONSTRATION TIME!