

Chapter 15.

The electromagnetic spectrum

New Words

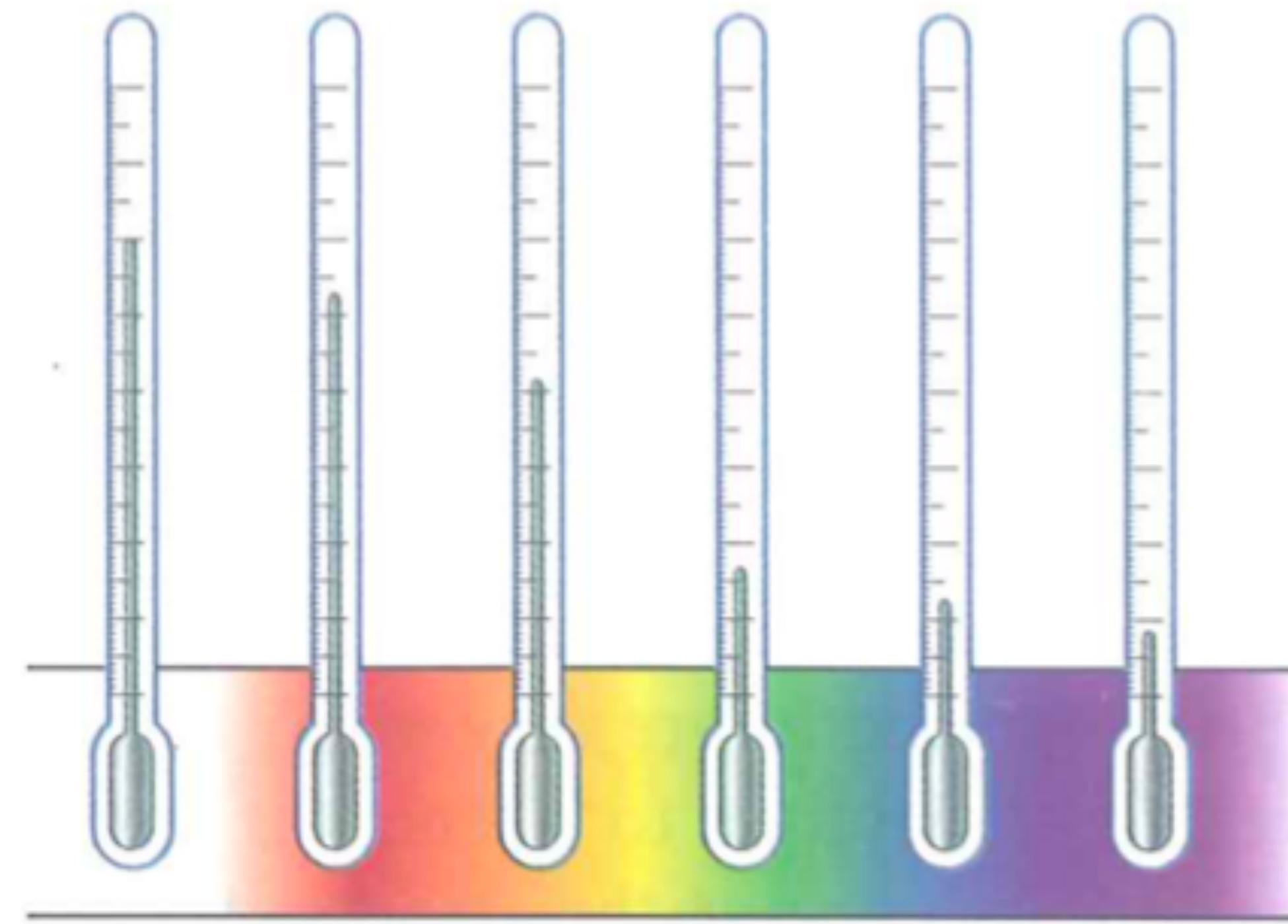
spectrum, prism, infra, ultra, aerial, sterilize,
intruder, hazard, grill, toaster, endoscope

Electromagnetic waves

1. Who discovered infrared light and how?

Electromagnetic waves

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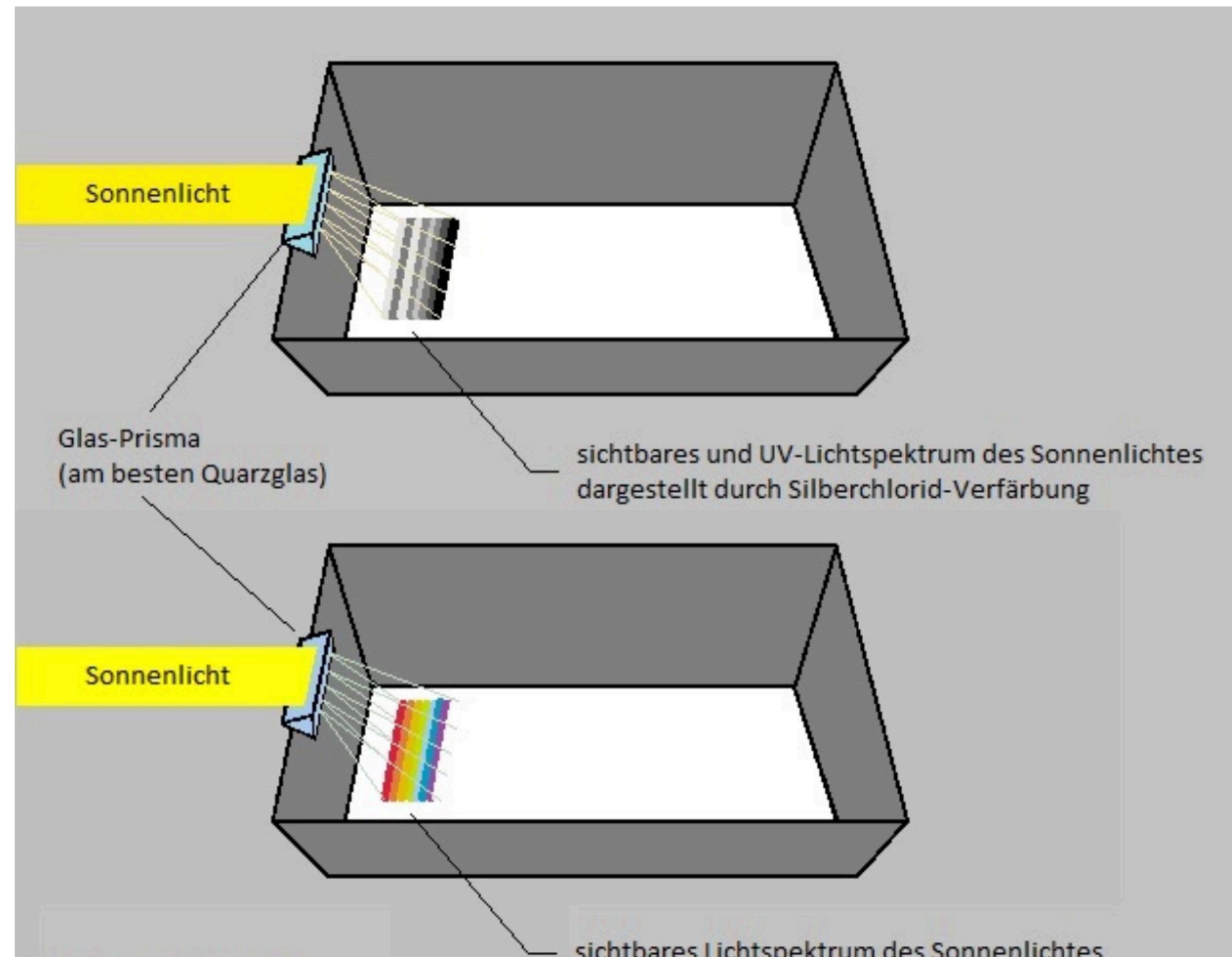


Electromagnetic waves

2. Who discovered ultra-violet light and how?

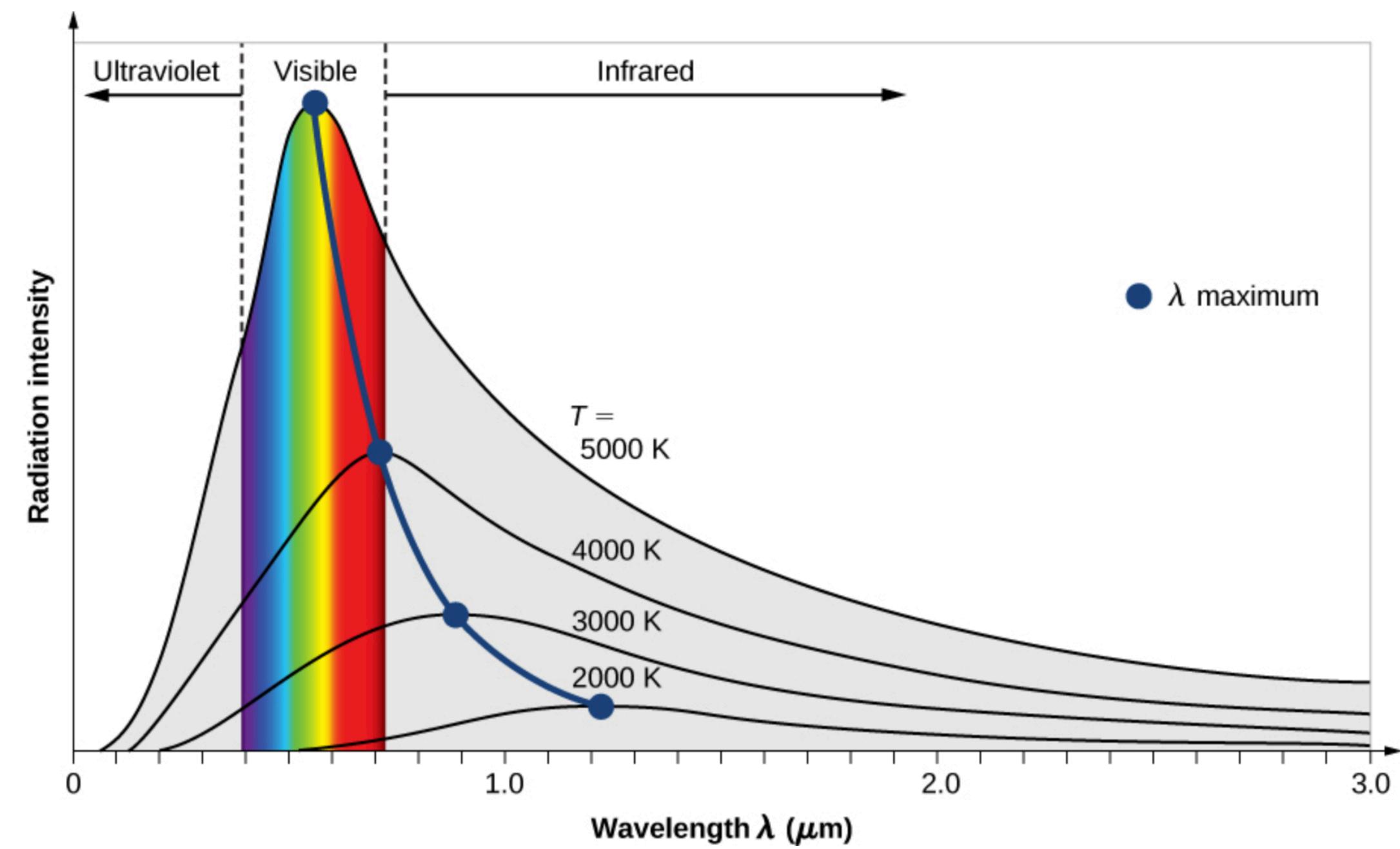
Electromagnetic waves

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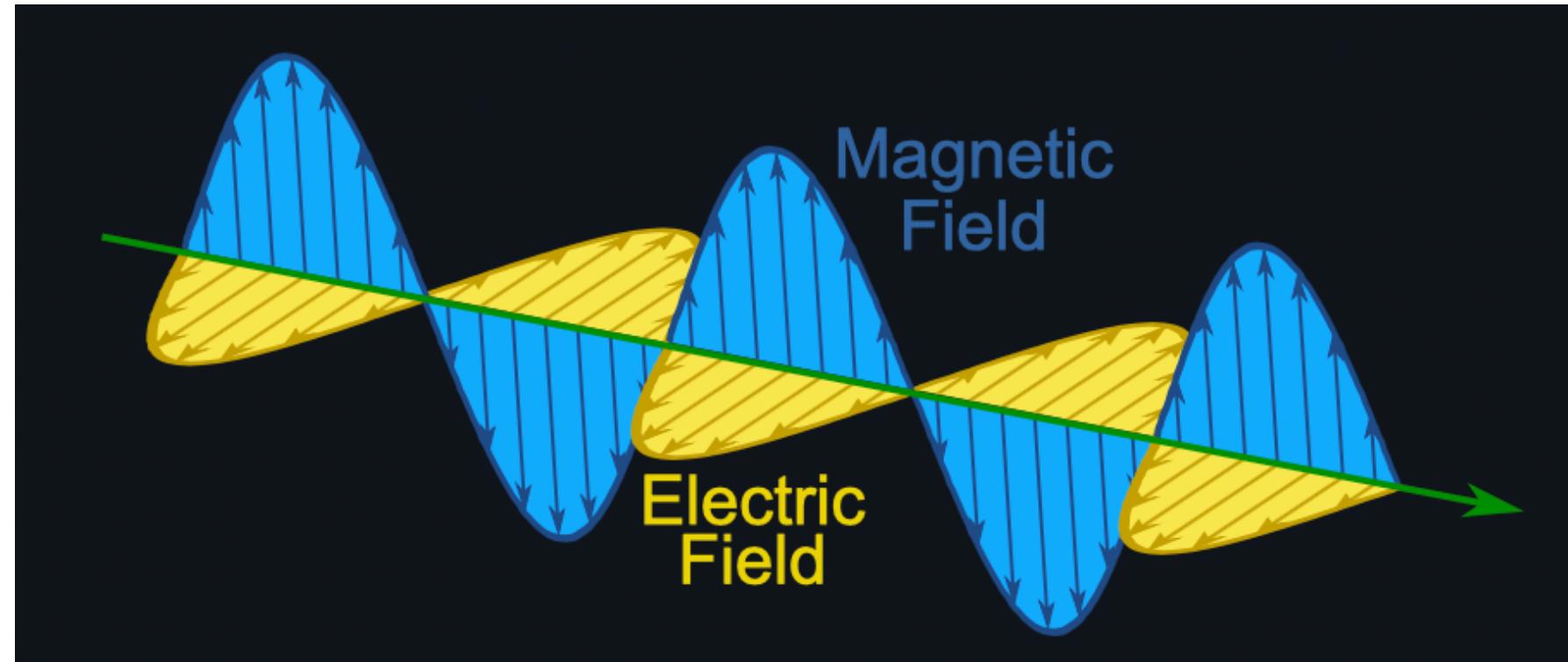
Electromagnetic waves

Radiation spectrum from the Sun and black body radiation



Electromagnetic waves

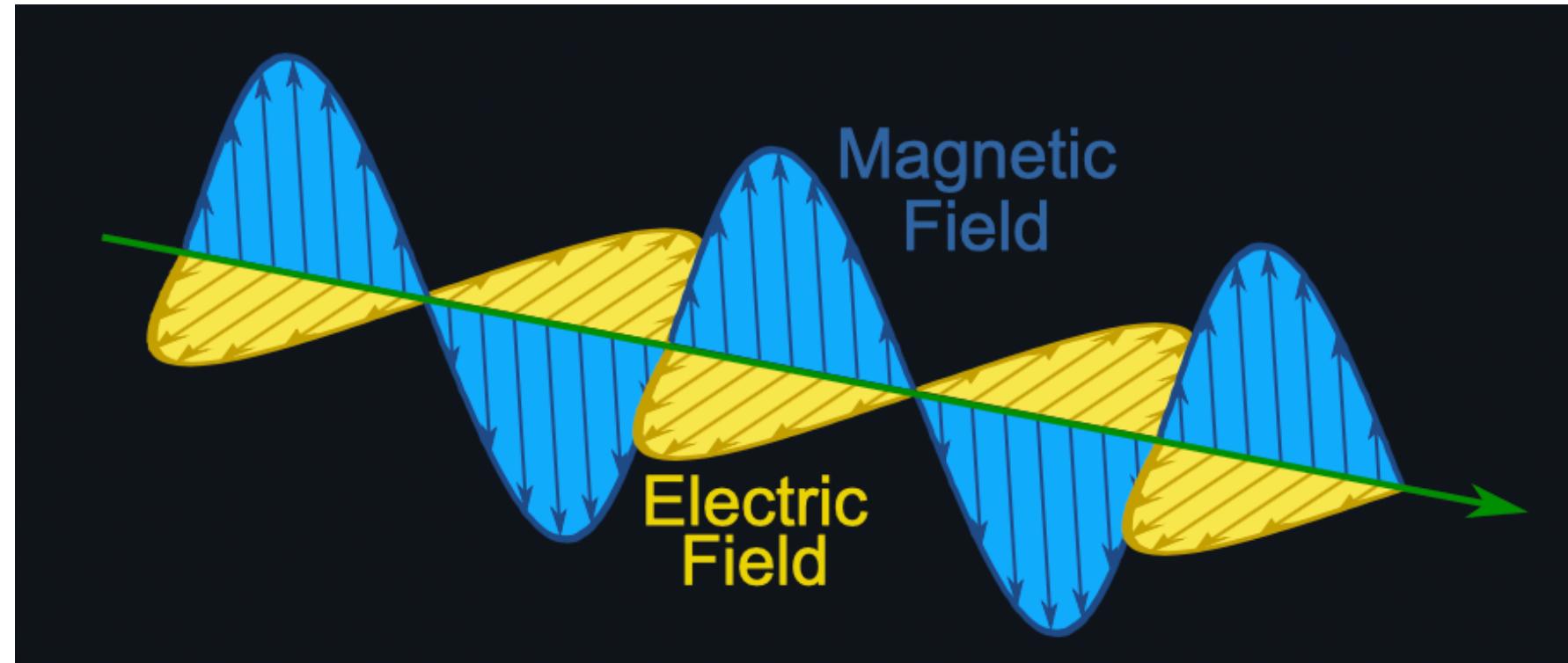
EM Wave model of light – James Clerk Maxwell



Light is a
transverse
wave!!!

Electromagnetic waves

EM Wave model of light – James Clerk Maxwell

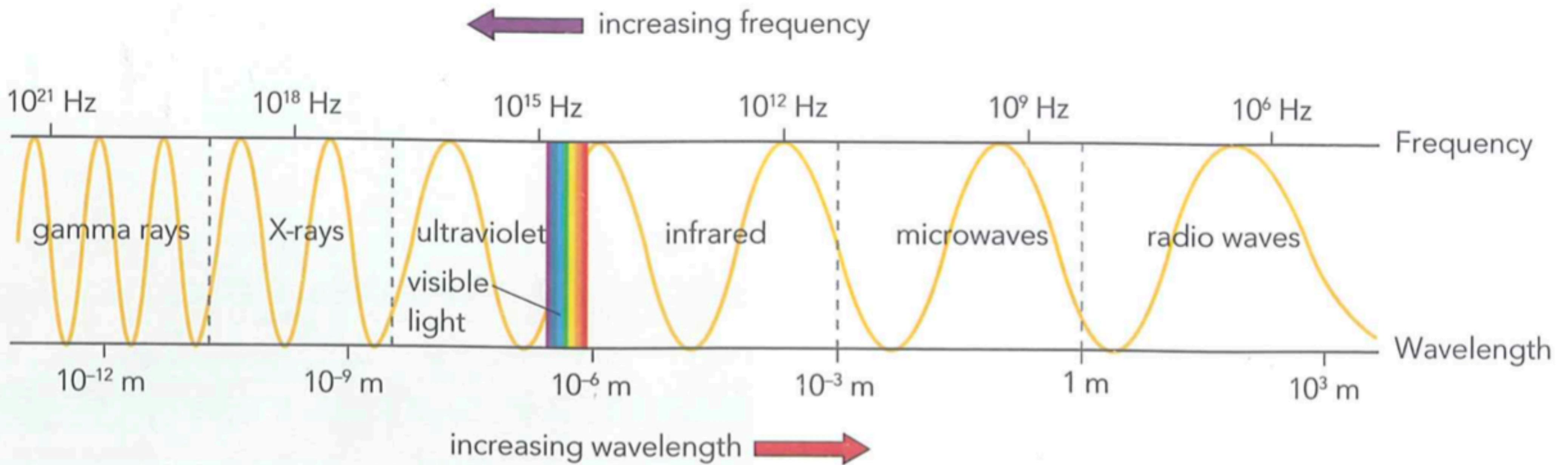


Light is a
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Prediction of Maxwell's EM wave model:

1. EM wave speed in vacuum = speed of light in vacuum;
2. Continuous frequency

EM Spectrum

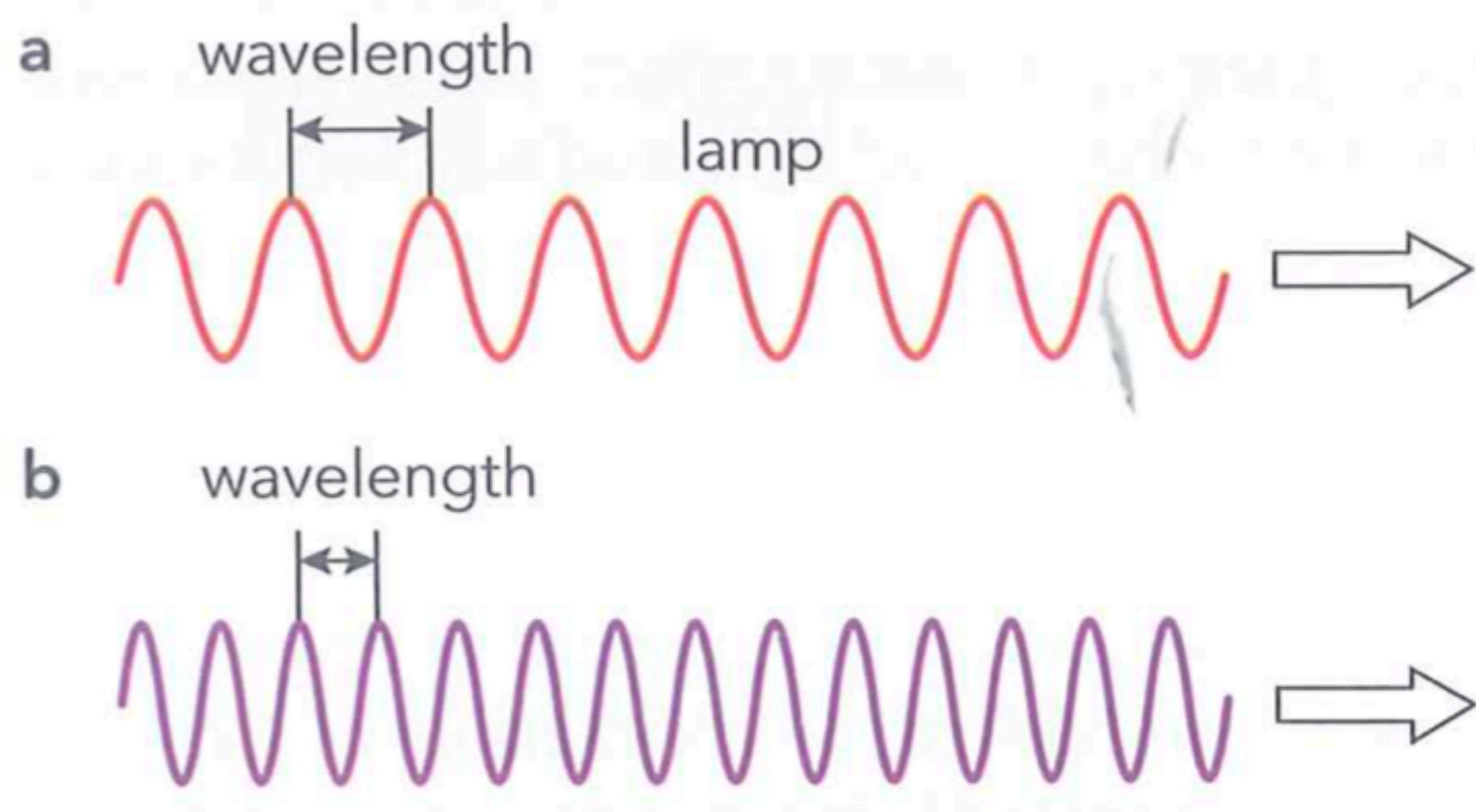


Exercise

Draw and label two waves to show the difference between **red** light and **violet** light.

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Exercise

Describe and explain what happens when monochromatic green light of wavelength 540 nm passes through a prism. And calculate the frequency of the green light.

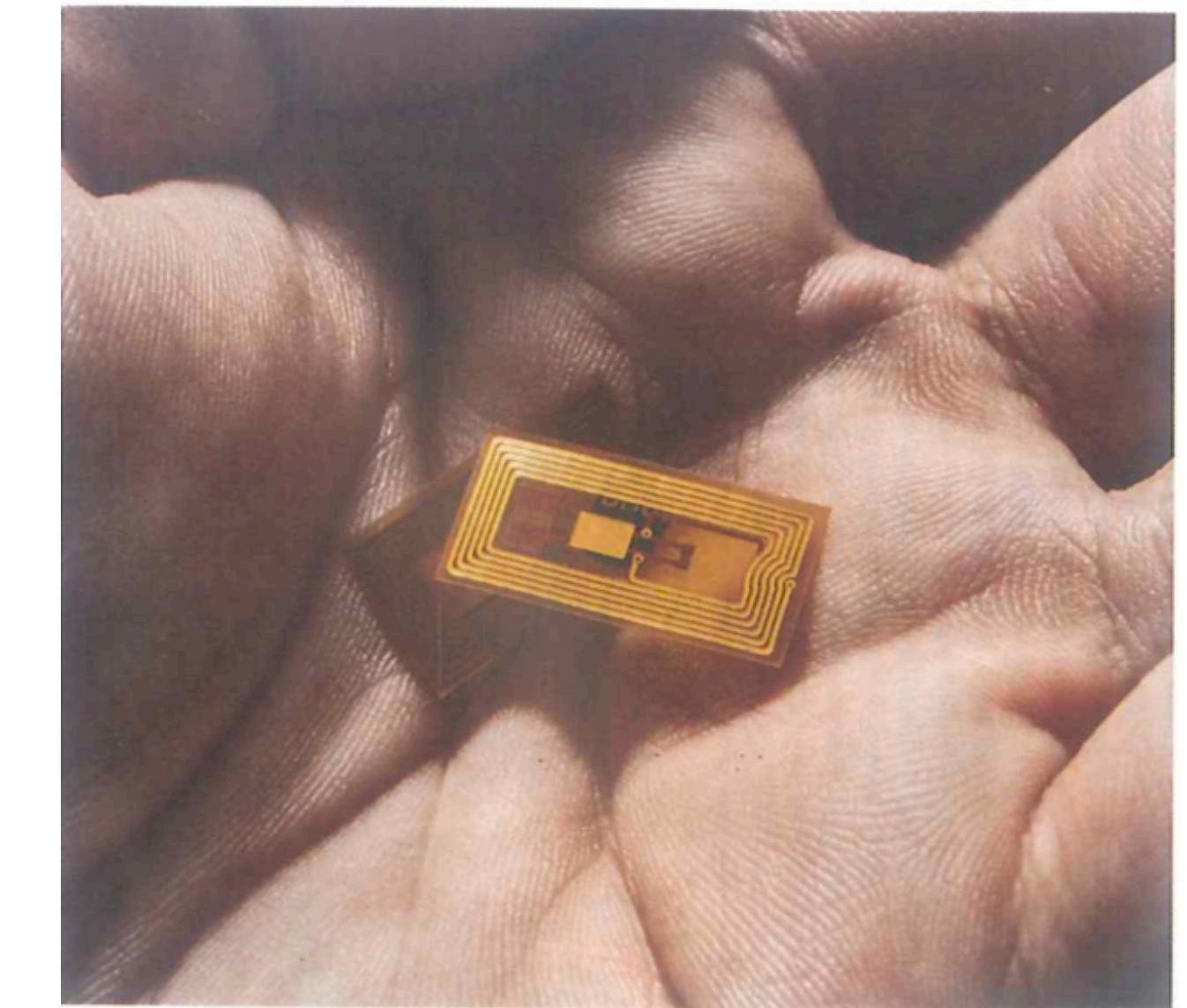
Different types of EM waves and their uses

1. Radio waves (long wavelength, transfer in long distance)

	Frequency / Hz
Broadcast	AM: 500 – 1600 K FM: 80 – 110 M
TV	10-1000 M
Mobile phone	1000 - 3000 M



The [Karl G. Jansky Very Large Array](#), a radio [interferometer](#) in [New Mexico, United States](#)



a. Radio, television and microphone transmission

b. Radio astronomy

c. RFID

Different types of EM waves and their uses

2. Microwave (slightly shorter wavelength)



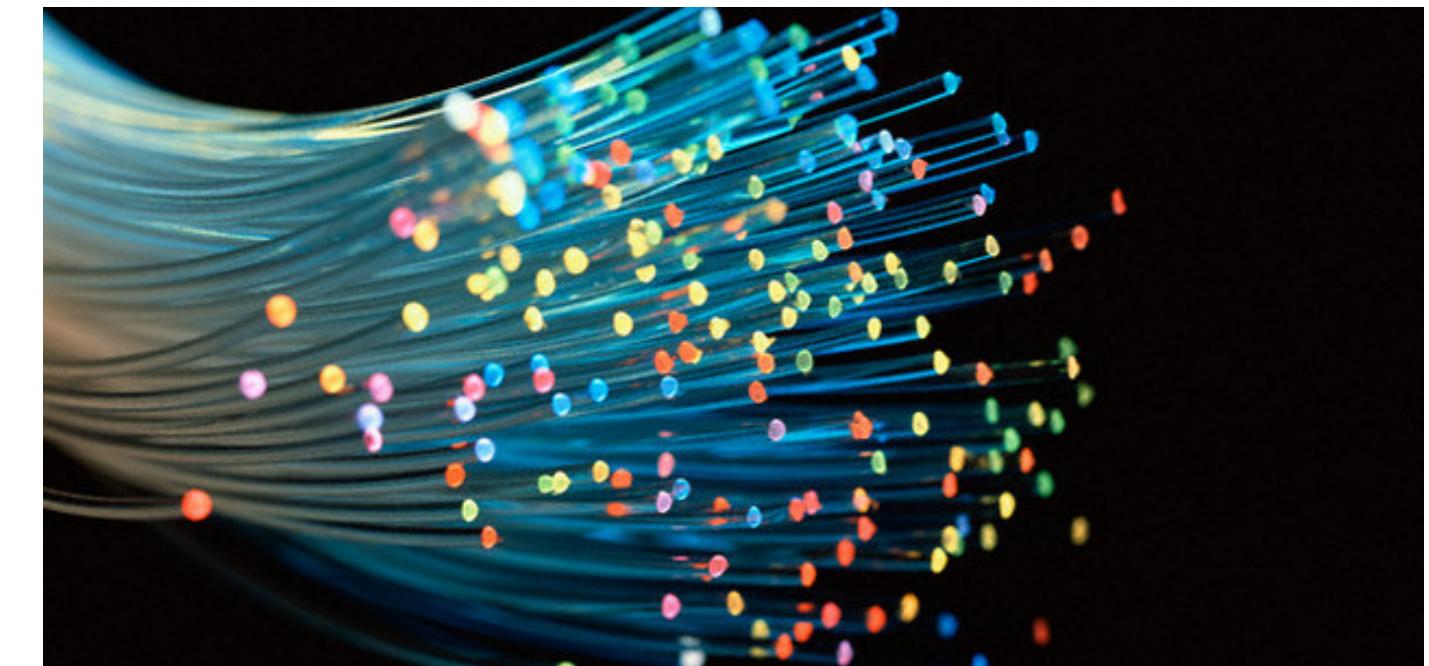
a. Satellite TV

b. Transfer mobile phone signal between masts

c. microwave oven

Different types of EM waves and their uses

3. Infrared radiation



a. Remote controller

b. Grills or toasters

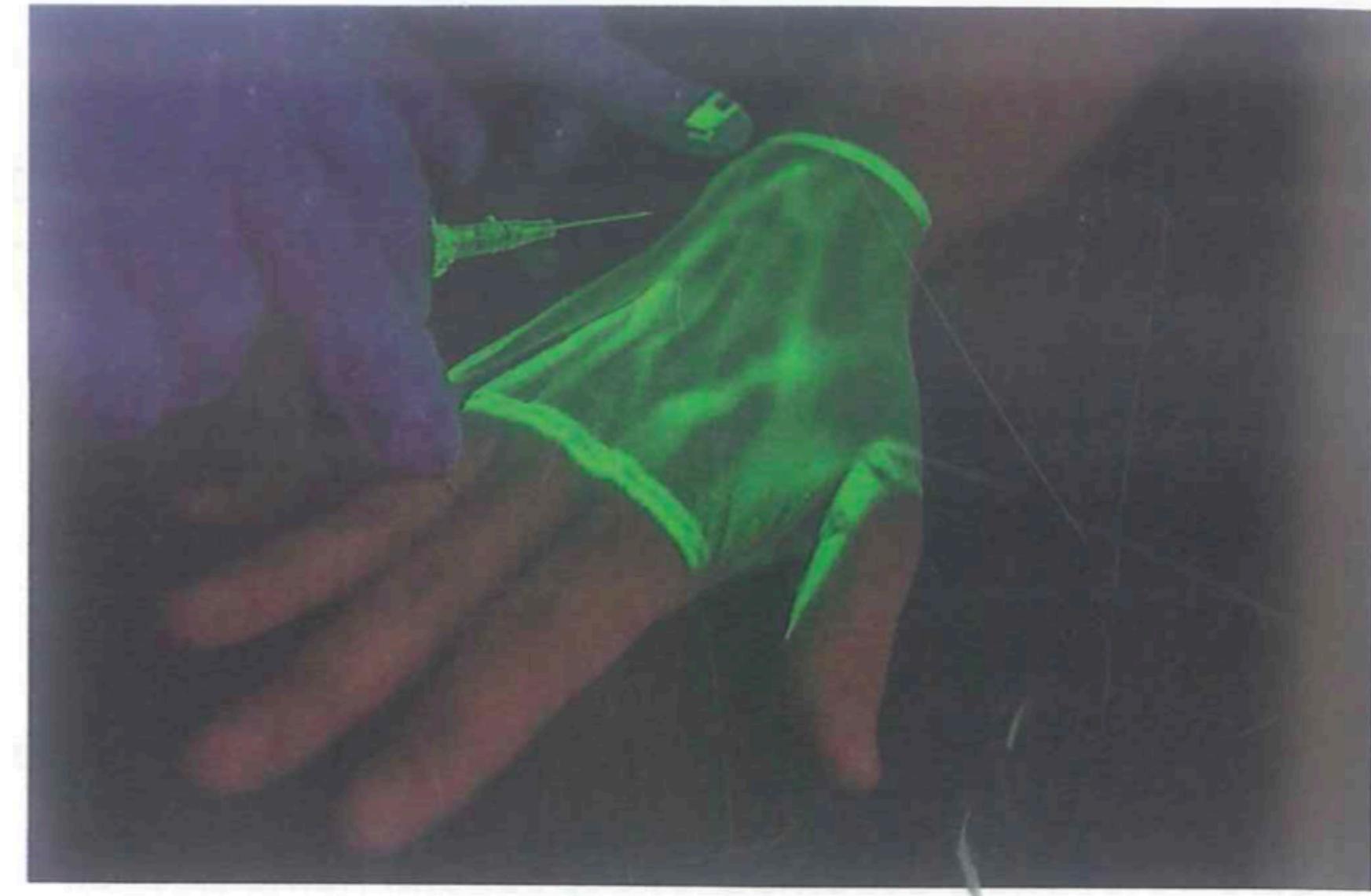
c. Optical fibre

Different types of EM waves and their uses

3. Infrared radiation



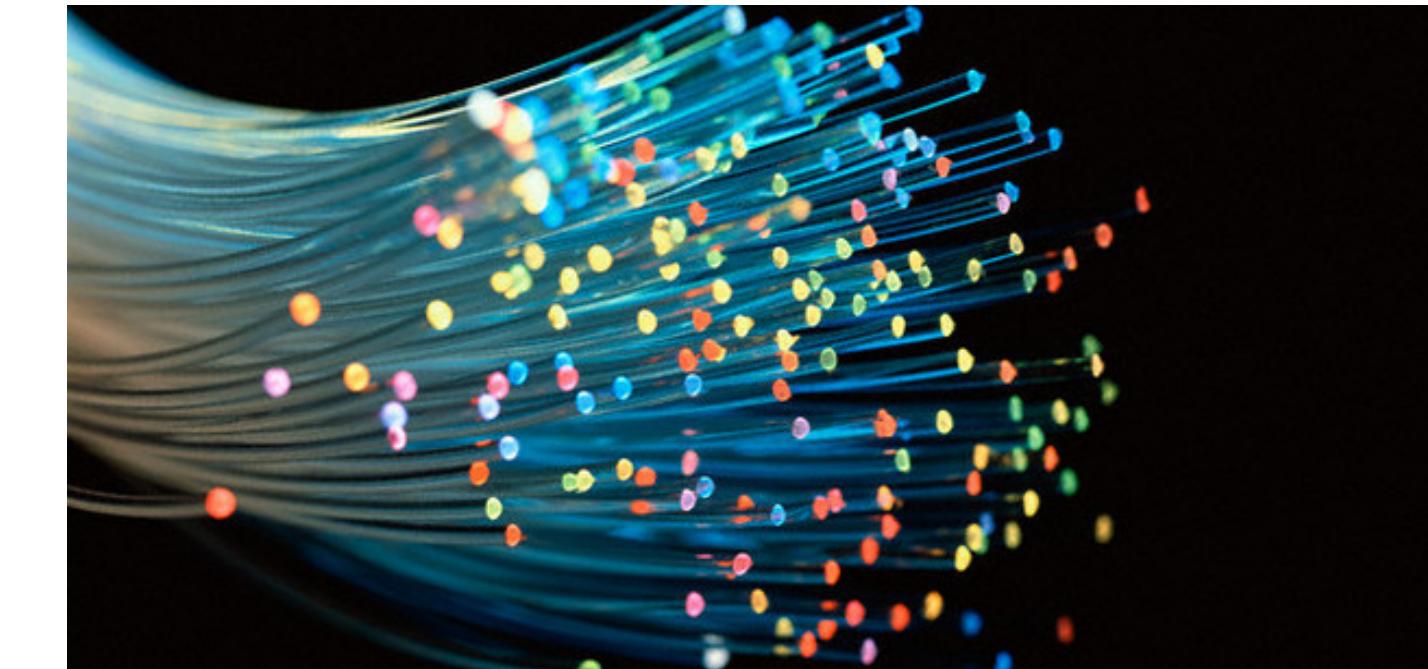
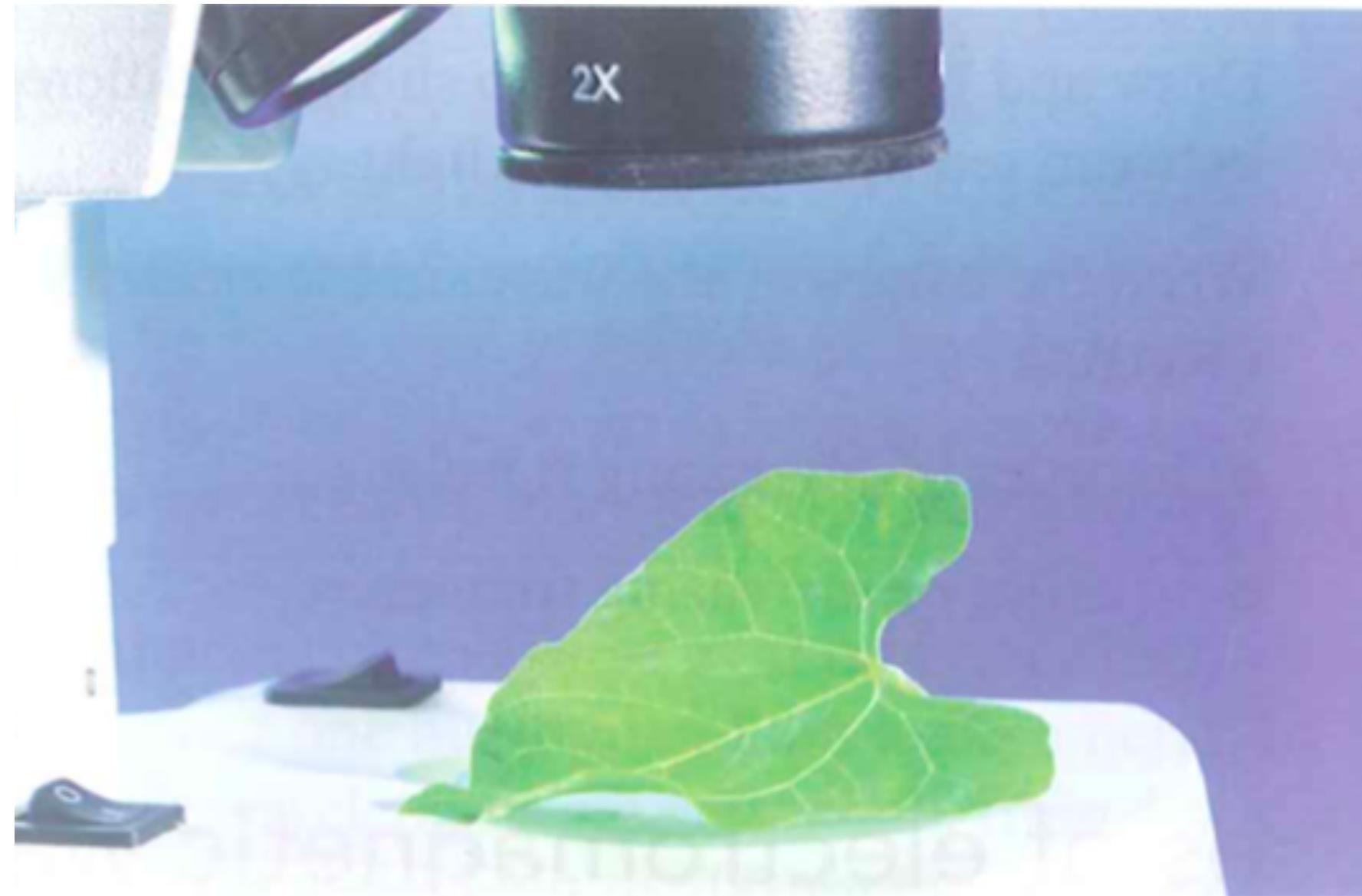
d. Intruder alarm



e. Infrared scanner

Different types of EM waves and their uses

4. Visible light



- a. vision b. illumination c. photography d. photosynthesis e. Optical fibre

Different types of EM waves and their uses

5. Ultraviolet(UV) light



a. Security marking/detecting fake banknote

b. Sterilising water

Different types of EM waves and their uses

X-rays



a. Medical scanning



b. Security scanners

Different types of EM waves and their uses

Gamma rays



a. Sterilising food and medical equipment

b. Detection of cancer and its treatment

Exercise

Name **two** types of electromagnetic radiation that are used to **cook food**

Exercise

Name **three** types of electromagnetic radiation that have **medical** uses

Exercise

A girl phones her friend on her mobile phone while watching TV by a log fire. Explain how infrared radiation, microwave, visible light and radio waves are involved in this.

Electromagnetic hazards

Shorter wavelength, more dangerous

Microwaves: internal heating of body cells

Infrared: skin burns

Ultraviolet: damage to surface cells and eyes

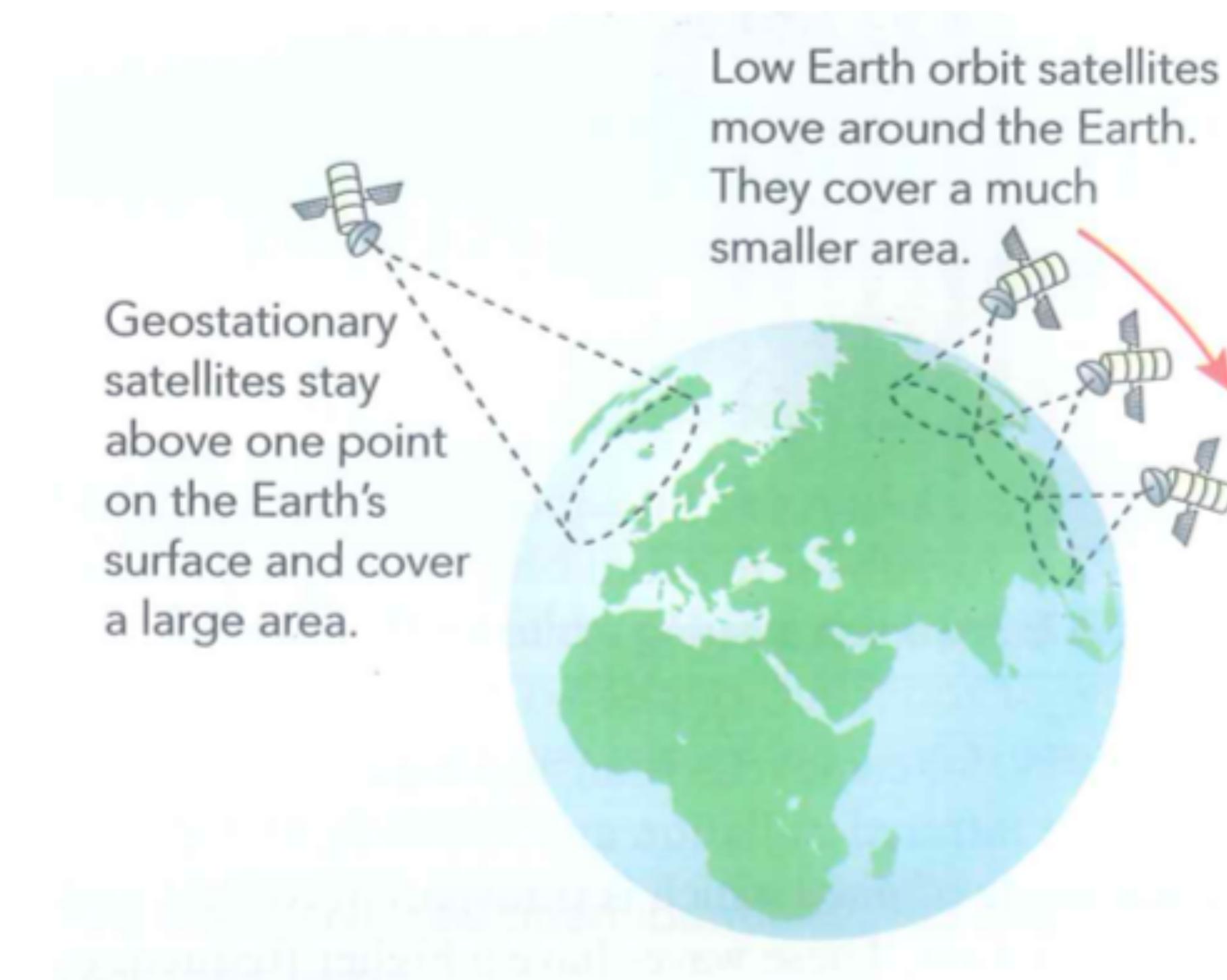
X-ray and gamma ray: mutation/damage to cells



Artificial satellite

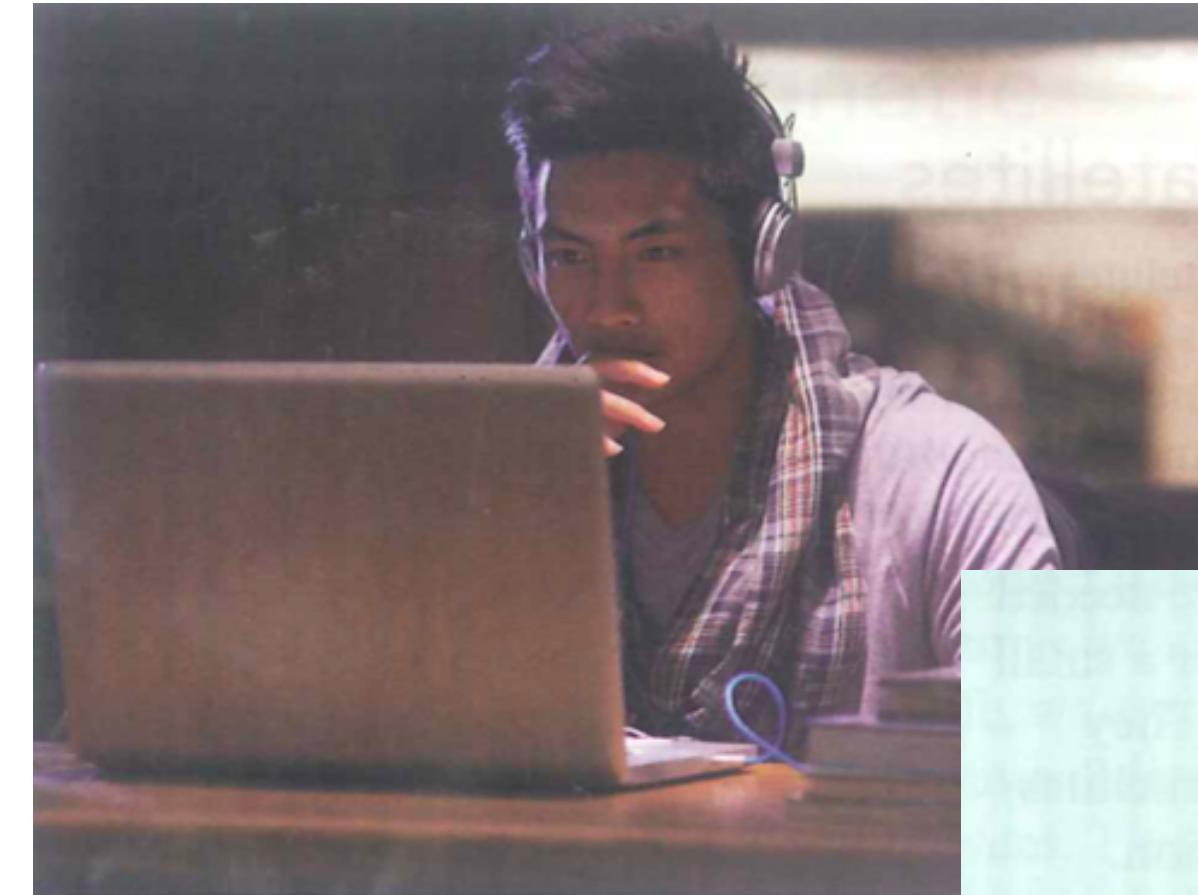
Geostationary satellite: satellite TV/phones => slight delay

Low Earth satellite: satellite phone => need more



The right wave for the job

Mobile phone/wireless internet: microwave



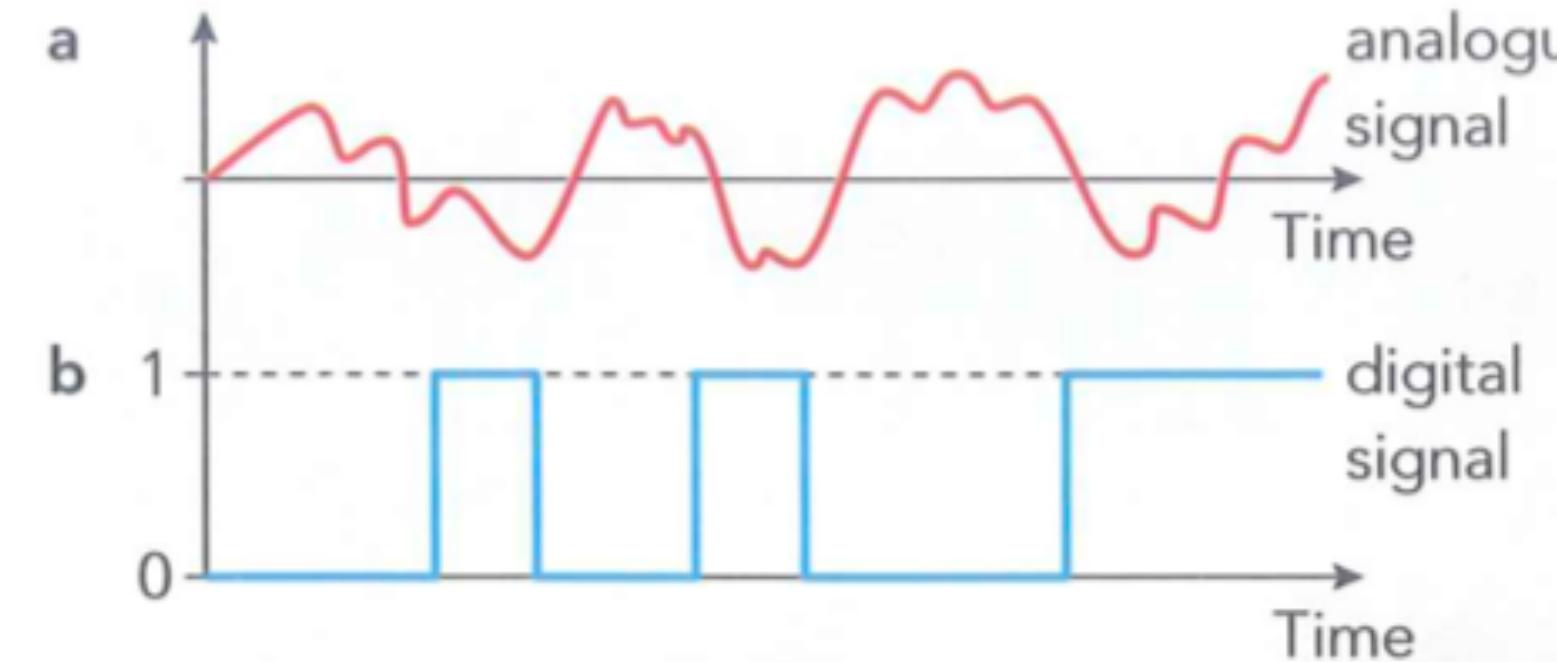
Bluetooth: radiowave



Optical fibre: optical/infrared => transparent to glass & carry more data



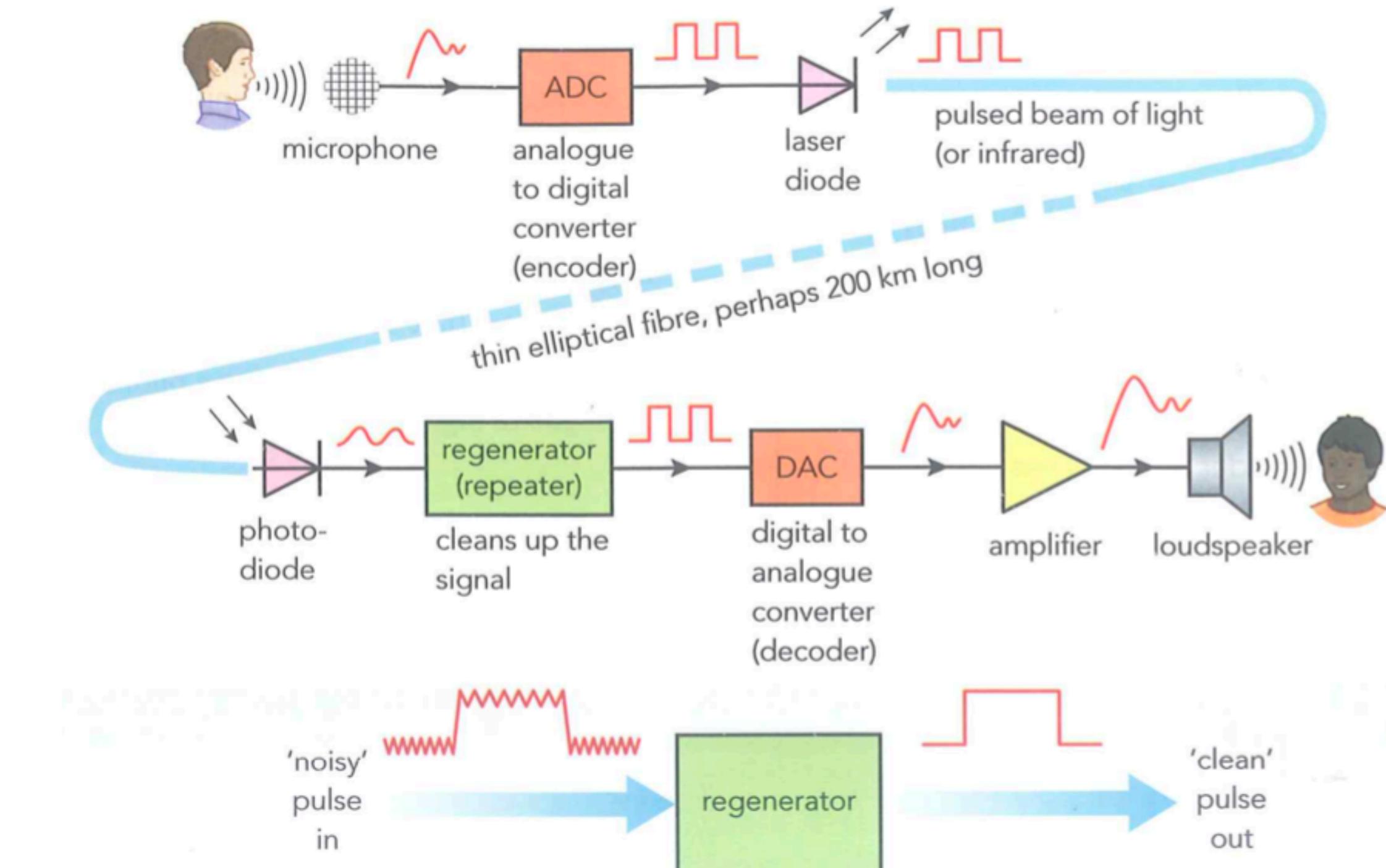
Analogue and digital signals



Varies continuously

Contains a series of pulses

Making a digital phone call



Benefits of digital signaling

fast data transmission rate

Signals can be regenerated=> increased range

Can communicate directly with computers