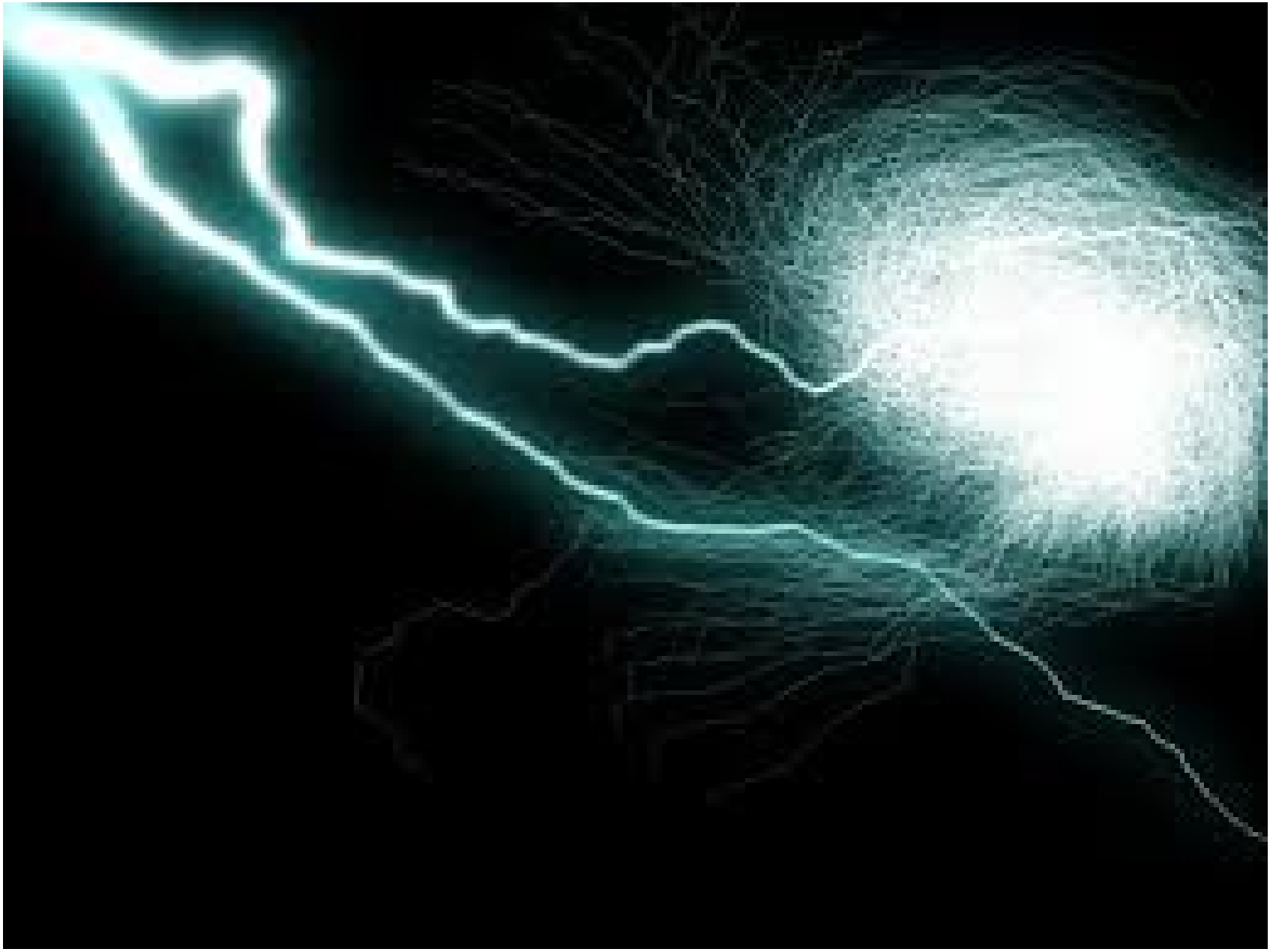
Electric Lighting



Incandescent Bulbs – 2 percent efficient

Invented in 1879 by Thomas Edison 1847 – 1931.

The light works by a thin wire called a “filament” being heated by the electric power to glow white hot. The filament reaches a temperature of about 2400 C (Celsius).

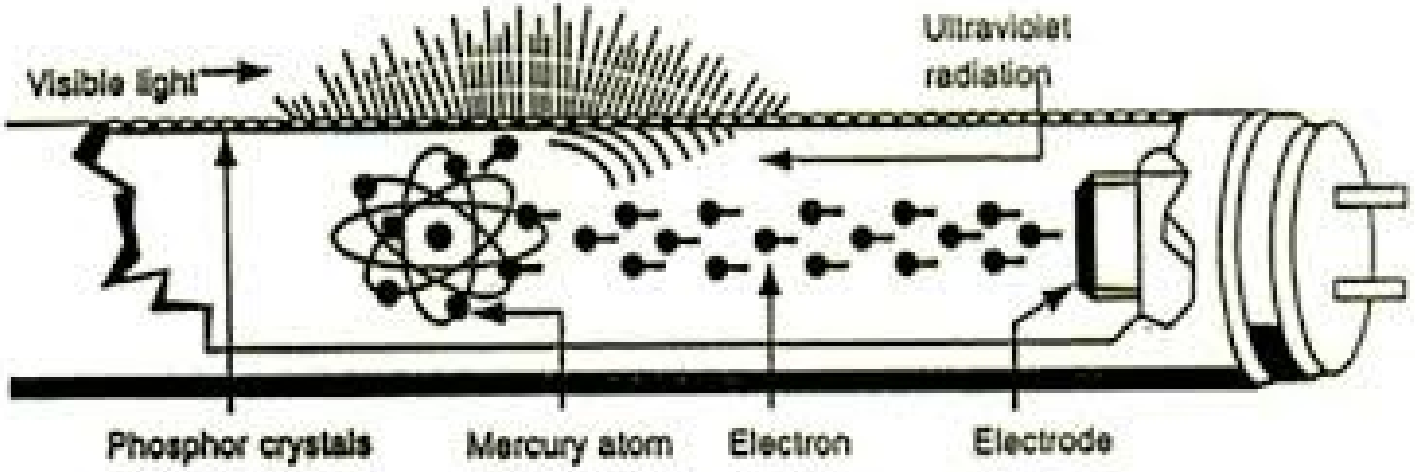
The filament is made of the metal and element Tungsten, having the highest metal melting point of 3422 C. The glass bulb contains gases such as Argon. No Oxygen is present so the filament cannot burn.

Dumet wire is a metal alloy (a mixture of metals) that easily bonds to glass to form an airtight seal in order to get electric power to connect from outside to inside the bulb.

These bulbs are very inefficient but can be recycled fairly easily:

Fluorescent Bulbs – 10 percent efficient

Invented in approx 1930 by Edmund Germer 1901 - 1987



Unlike a filament light, fluorescent lights do not get hot.

The glass bulb or tube contains Mercury vapour gas. Mercury is a metal element that is very toxic. Mercury is a unique metal that is a liquid at room temperature.

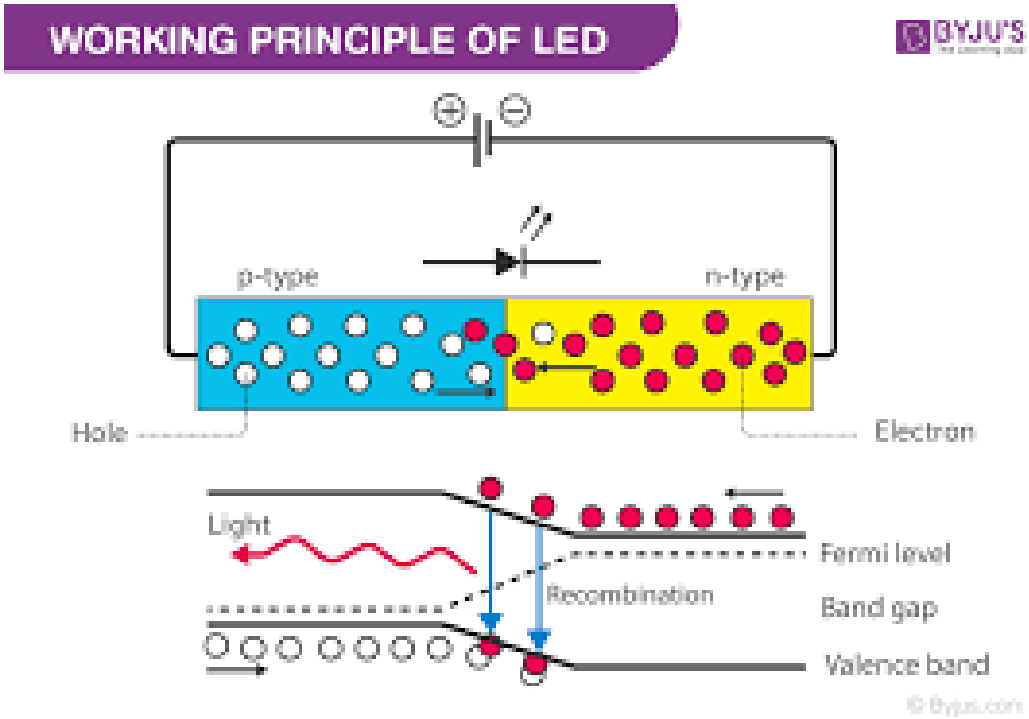
Electricity causes the Mercury vapour to emit ultraviolet light – invisible to the human eye.

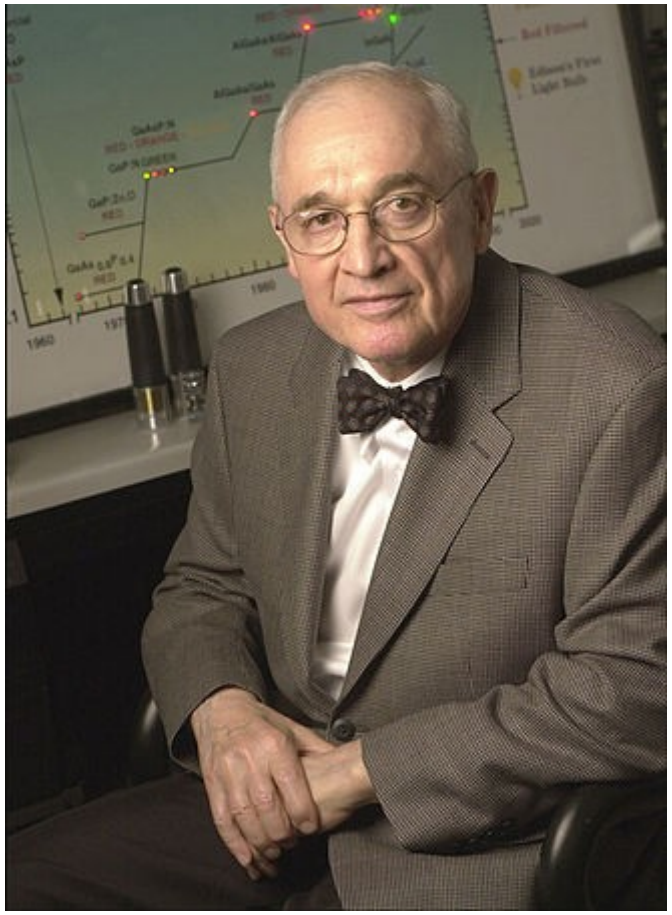
The inside wall of the glass is coated with a white powder known as Phosphor.
The Phosphor absorbs the ultraviolet light and re-emits visible light.

Fluorescent light bulbs must be recycled very carefully due to their toxic contents.

Light Emitting Diodes (LEDs) – 95 percent efficient

Invented in 1962 by Nick Holonyak 1928 - 2022





LEDs work by electroluminescence.

Electroluminescence is an optical and electrical phenomenon where a material emits light in response to an electric current passed through it.

LEDs contain no toxic material and can be recycled.

Appendix 1

Measuring temperature

We can use the Celsius scale “C”. Named after Anders Celsius, Swedish Astronomer 1701 - 1744

0 is the temperature that water freezes. 100 is the temperature that water boils.

Scientists also use the Kelvin scale “K”. Named after Lord Kelvin, British Mathematician 1824 – 1907

0 is the lowest possible temperature! The intervals are the same as the Celsius scale.

0 K = -273.15 C

Copper Clad Nickel-Iron Alloy (Dumet)

Dumet is a copper clad nickel-iron alloy widely used to obtain hermetic seals in soft glass.

This is possible because the thermal expansion of Dumet closely matches that of glass, and the material “wets” well, affecting the bond with the glass.

Other relative advantages include solderability, weldability, ductility and the ability to be supplied electroplated with gold, tin, or solder. Dumet conforms to ASTM F29-63T.

Typical Chemical Composition

Nickel – 41-42.5%
Manganese – .75-1.25%
Silicon – .3% max
Carbon – .08% max
Sulphur – .02% max
Phosphorus – .02% max
Residuals – 1% max
Iron – balance

Copper Cladding

Copper – 99.99% min
Oxygen – 0%

Colour Temperature

Colour temperature is the temperature that you would have to heat a black solid object for it to glow at the desired colour.

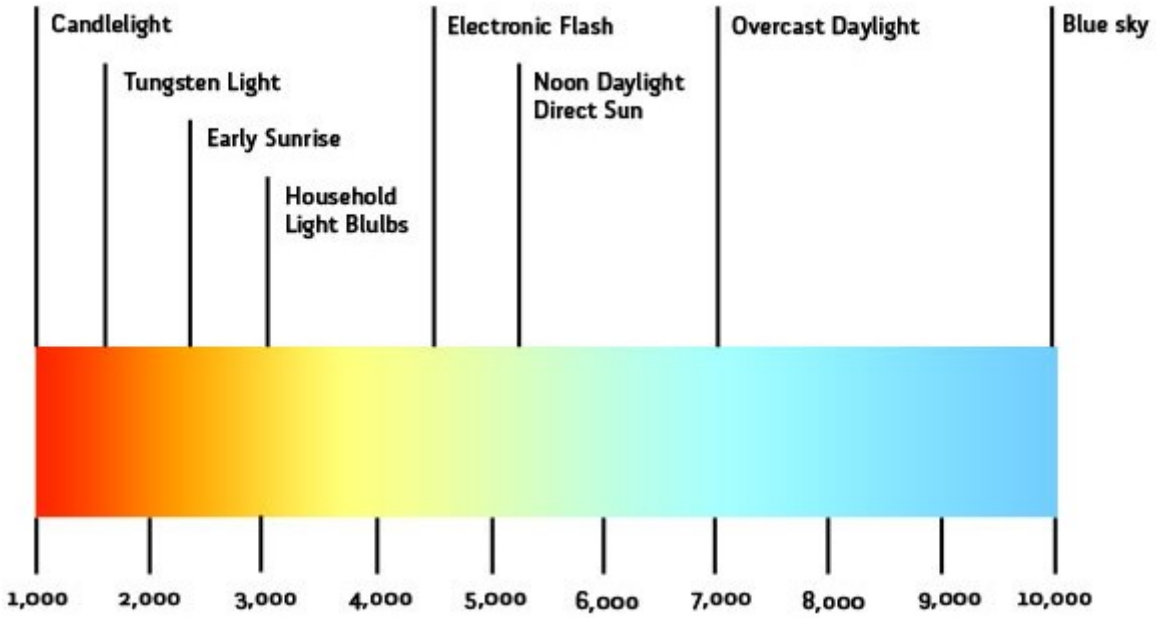
Colour temperature works the opposite way to what our human instinct tells us:

A bonfire has yellow flames and looks warm – it has a warm colour.

The sky is blue and looks cool – it has a cool colour.

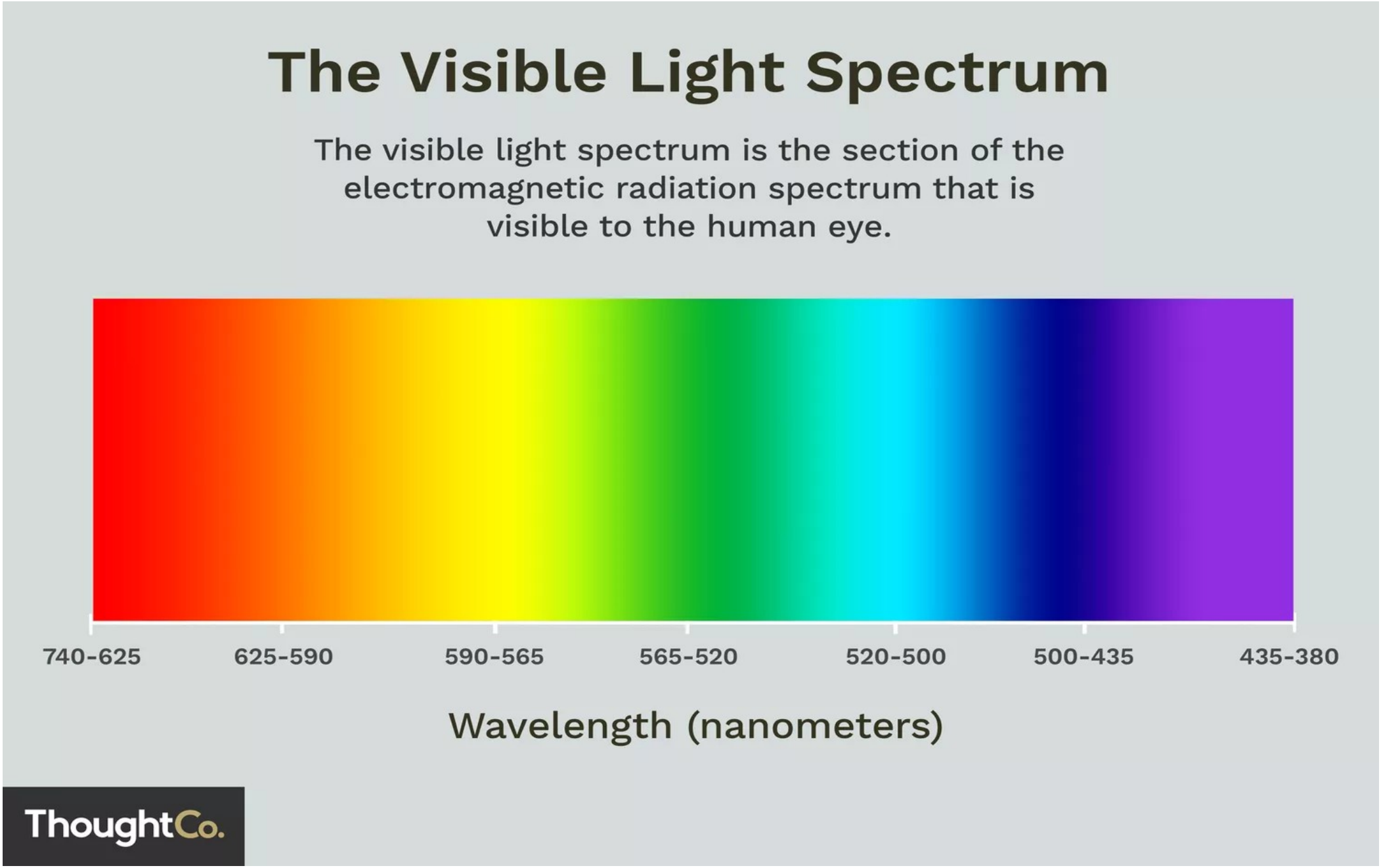
But:

Warm colours have a lower colour temperature than hot colours!


Candlelight
Tungsten Light
Early Sunrise
Household Light Blulbs
Electronic Flash
Noon Daylight Direct Sun
Overcast Daylight
Blue sky
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000

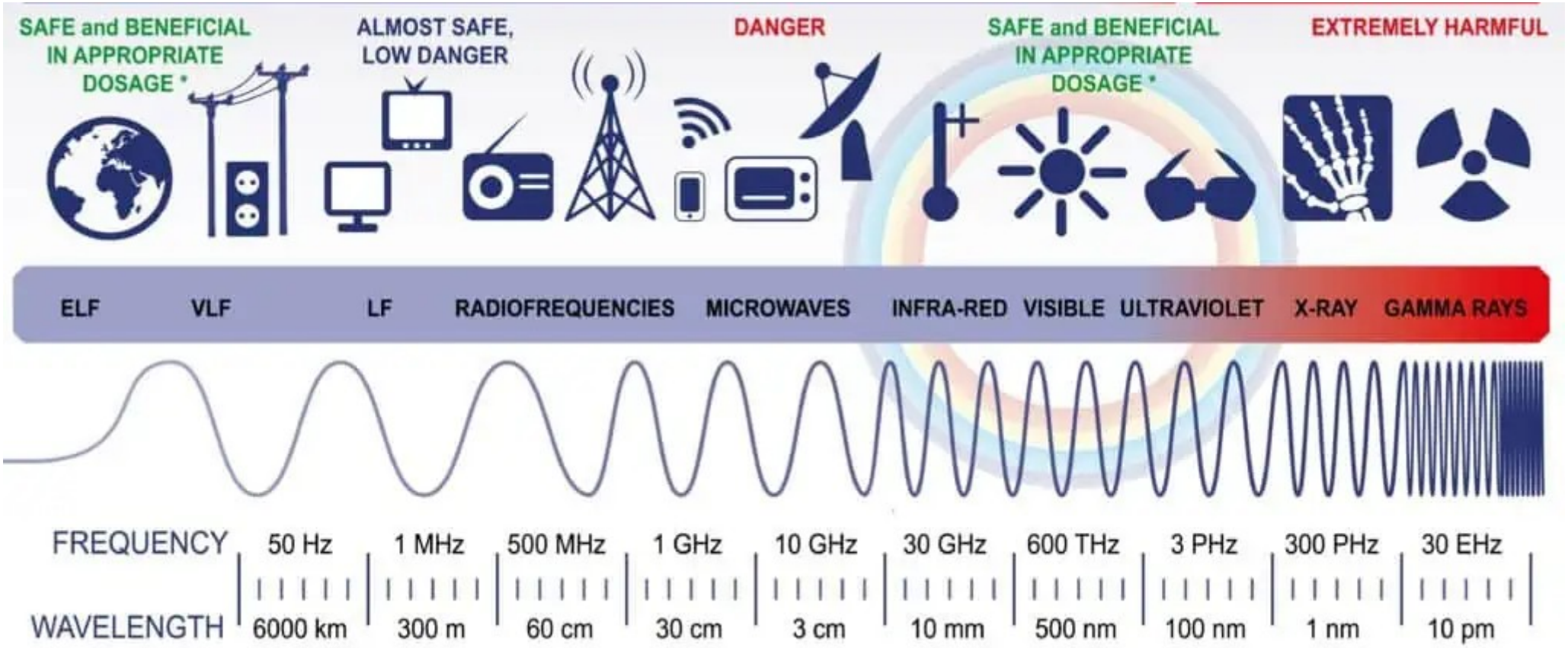

2000K
2700K
3000K
3500K
4000K
5000K
6000K
6500K
8000K
10000K

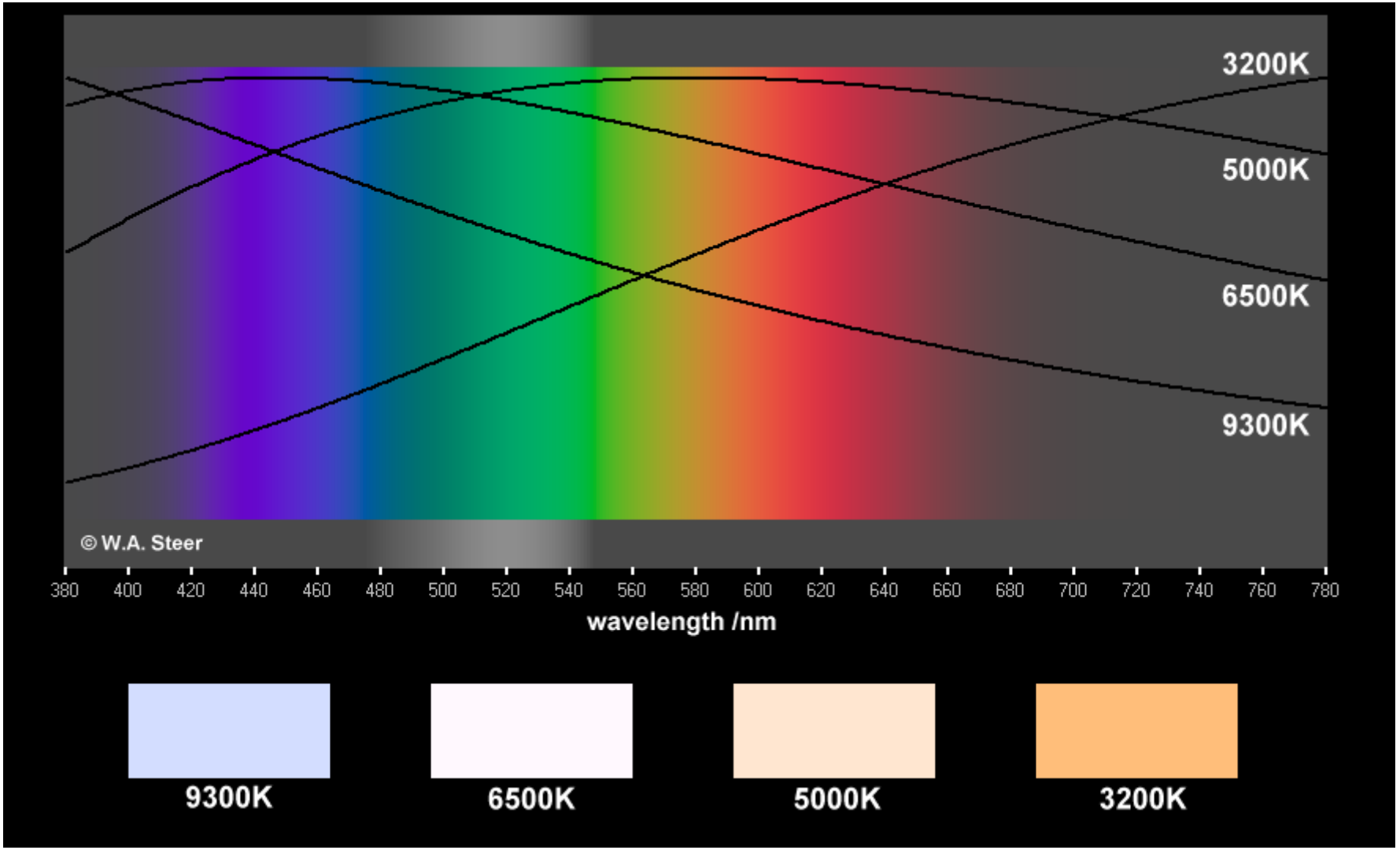

1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000 K



Newton	Red	Orange	Yellow	Green	Blue	Indigo	Violet
Modern	Red	Orange	Yellow	Green	Cyan	Blue	Violet

The Electromagnetic Spectrum




3200K
5000K
6500K
9300K
© W.A. Steer
380 400 420 440 460 480 500 520 540 560 580 600 620 640 660 680 700 720 740 760 780
wavelength /nm
9300K
6500K
5000K
3200K