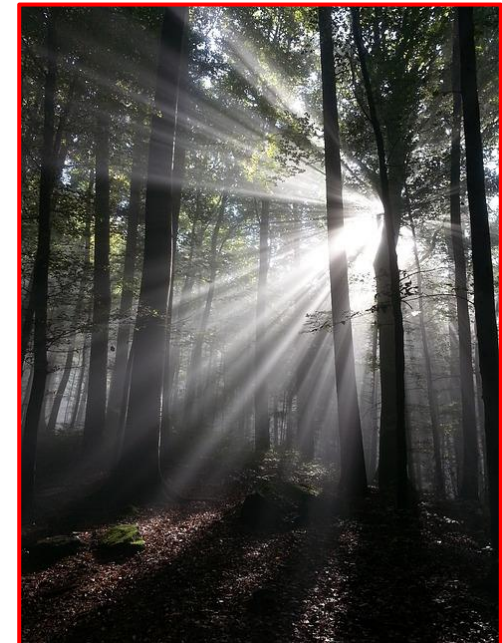
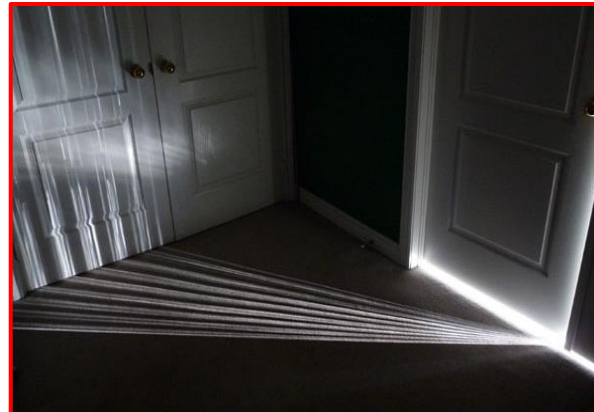
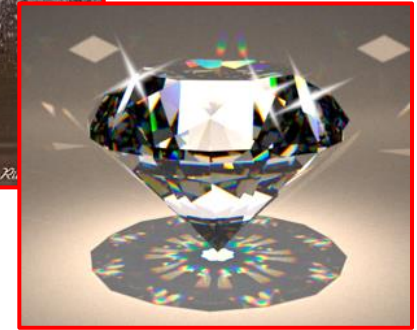


# What Is Light?



# Observed Properties of Light

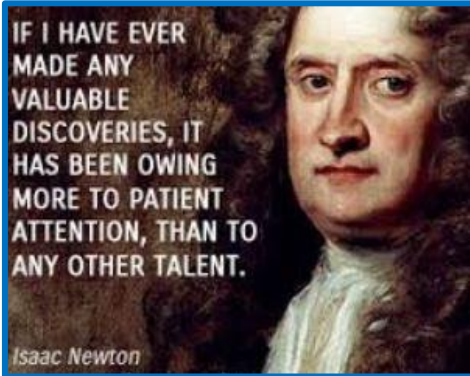
- Light travels in straight lines (*shadows*)
- Light can be bright or dim (*intensity*)
- Light can be different colors (*dispersion*)
- Light can bounce off surfaces (*reflection*)
- Light can, or cannot go through objects/ substances (*transmission/absorption*)
- Light changes its speed/direction when entering different materials (*refraction*)
- Light can bend at an opening or edge (*diffraction*)

... WHAT IS LIGHT ?



# Nature of Light Debate

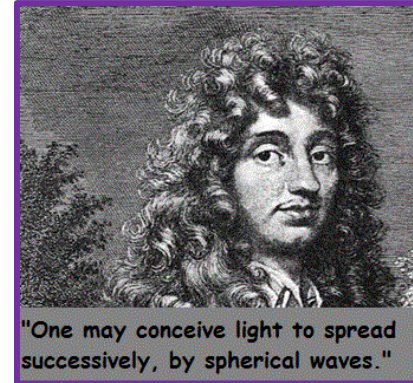
Isaac Newton, 1675:



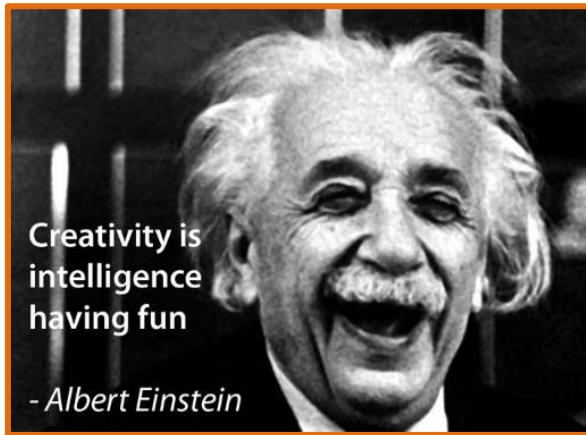
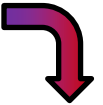
light is made of **particles of energy (corpuscles)**. Explained reflection, shadows, traveling in straight lines.



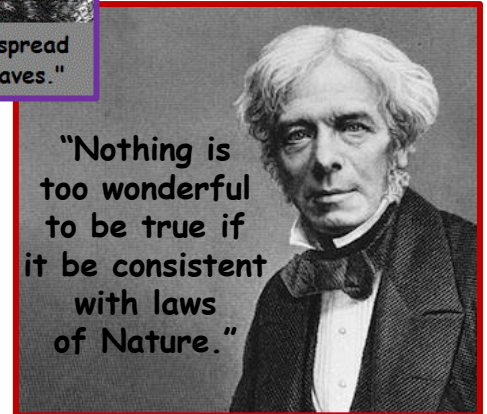
Christiaan Huygens, 1678:



light is made of **waves** in *ether*. Explained diffraction, interference.

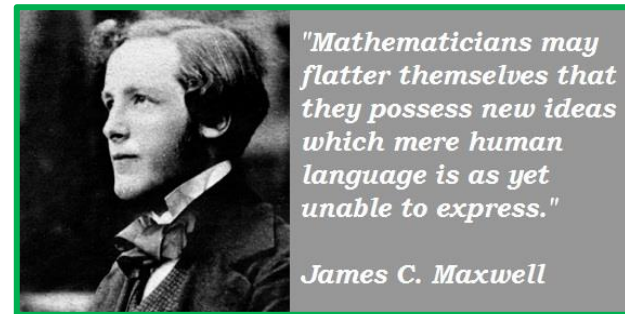
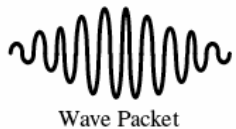


**Michael Faraday, 1847:** light is a **high-frequency electromagnetic vibration**, which could propagate even in the *absence of a medium*.



**Albert Einstein, 1905:**

a beam of light is not a continuous wave propagating through space, but rather a **collection of discrete wave packets, photons**.



**James Maxwell, 1864:** light is an **electromagnetic wave**.

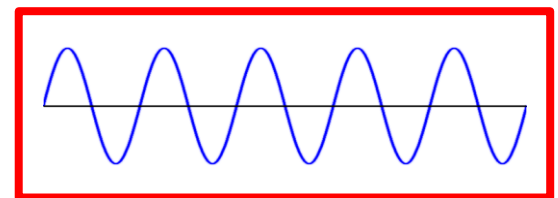


# Can we compare light to...

## ...the waves in the ocean?



***“High-low”  
pattern behind  
the obstacle***

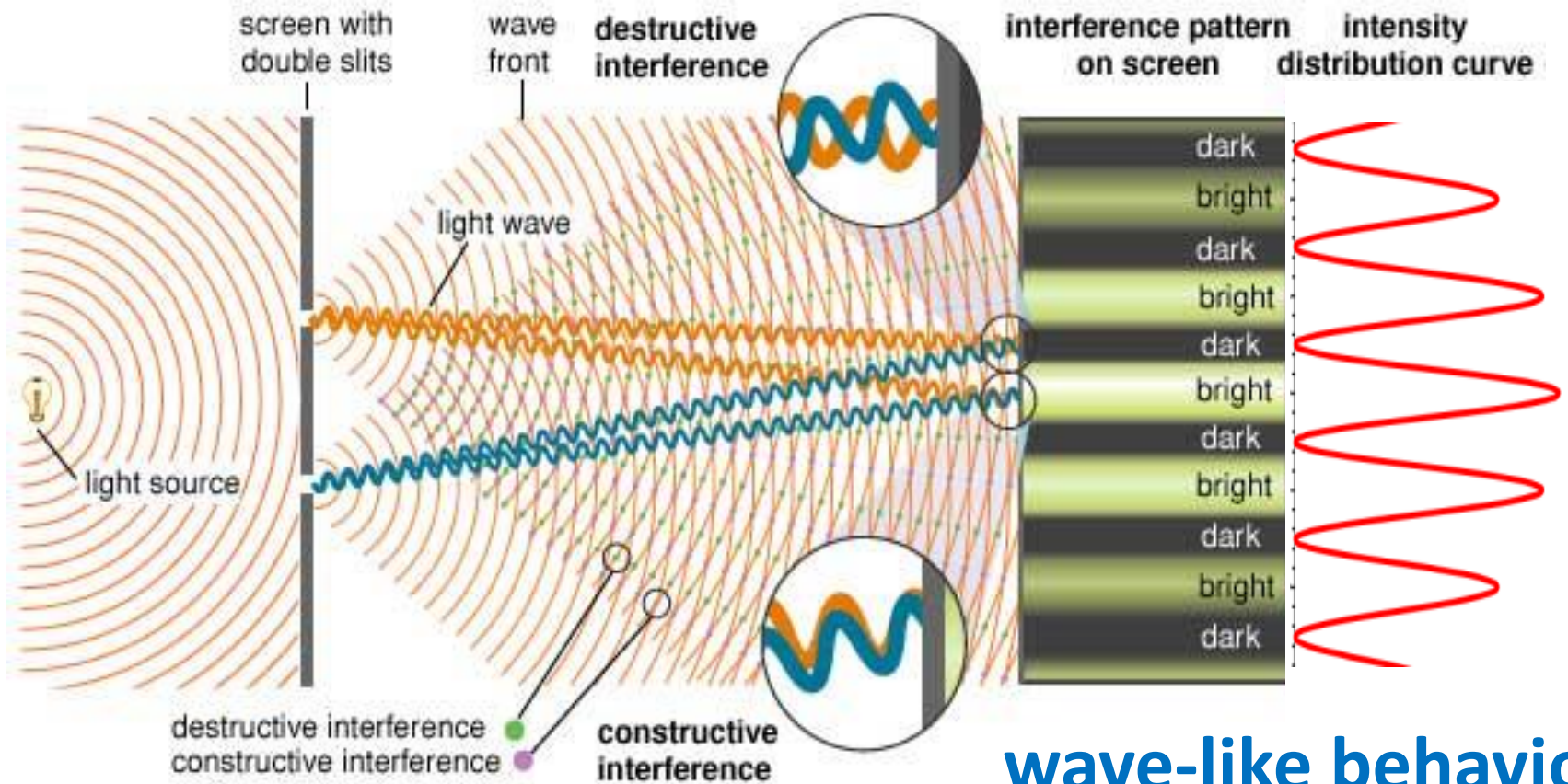




# Double-Slit Experiment

# Thomas Young, 1803

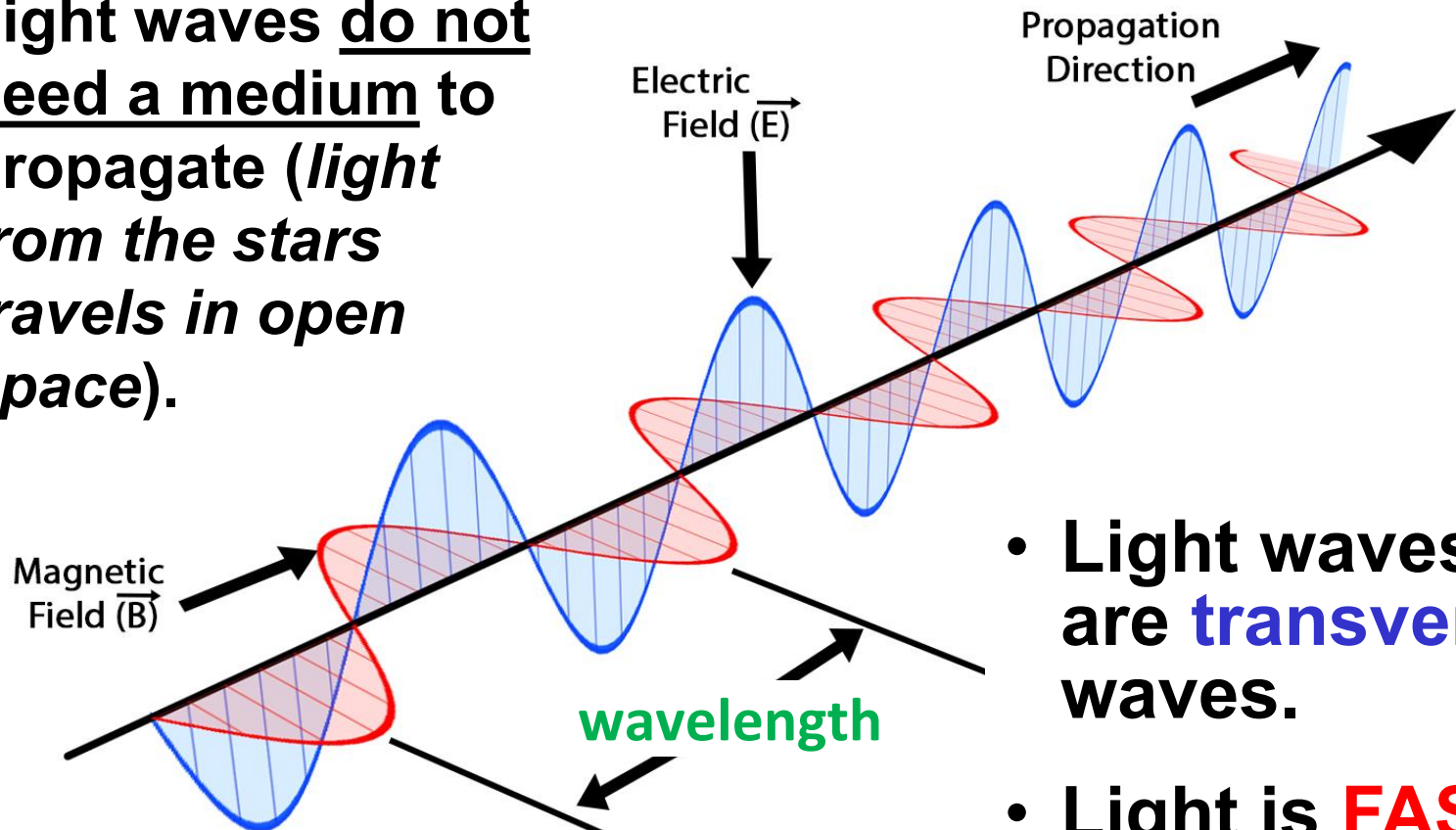
**Light passing through two parallel slits will interfere, producing a *pattern of bright and dark fringes*.**



# Light Waves

Light is an **electromagnetic wave** made of oscillations of *electric and magnetic field*.

- Light waves do not need a medium to propagate (*light from the stars travels in open space*).

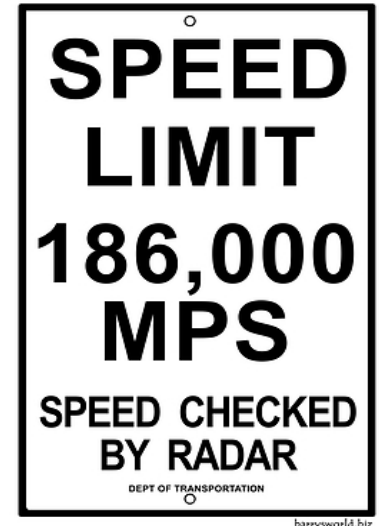


- Light waves are **transverse** waves.
- Light is **FAST!**

# Speed of Light

<https://www.youtube.com/watch?v=kZZ4B8UiEGM&t>

The speed of light in a vacuum, denoted **C**, is **constant** throughout the Universe.



- **C** is the **maximum speed** at which all matter and information in the Universe can travel.
- **C = 299,792,458 meters/second** (approximate value of **~300,000,000 m/s** is commonly used for simple calculations)
- When light travels through matter, its speed can change (inside a *diamond*, light is *slowed down to less than 80,000 mps*), but can **never be larger than C**.

# Speed of Light – How Fast?

- It takes **~8 minutes** for light to travel all the way **from the Sun to the Earth**.
- It takes **~ 4.4 years** for light from the nearest star, **Alpha Centauri**, to reach the Earth.



- It takes **~2.5 million years** for light from the nearest large galaxy, **Andromeda**, to reach our own galaxy, the Milky Way.