ANHANG 1

Appendix A0

Lernzielkatalog (Physik)

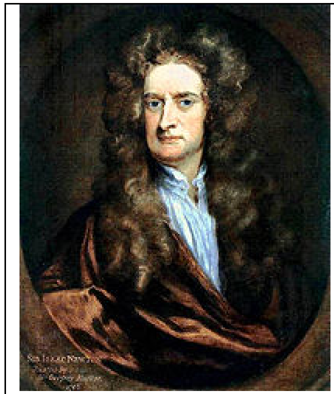
SchülerInnen sollen …

- ... über die Doppelnatur des Lichtes Bescheid wissen
- .... Emission und Absorption von Licht durch Vorgänge auf atomarem Niveau erklären können
- ... über die Stellung von Halbleitern zwischen Leitern und Isolatoren Bescheid wissen
- ... den Aufbau einer Halbleiterdiode kennen
- ... das Funktionsprinzip photovoltaischer Zeller verstehen
- ... die Bedeutung von Halbleitern für die Technik verstehen
- ... einfache Schaltpläne lesen können
- ... einfache Schaltungen bauen können
- ... Fachvokabular in der Fremdsprache erwerben
- ... Zusammenhänge zwischen der Energieversorgung und die Auswirkungen auf die Umwelt kritisch betrachten

Appendix B1

Theories of Light

What do you think, who said what? Match the pictures and the statements!



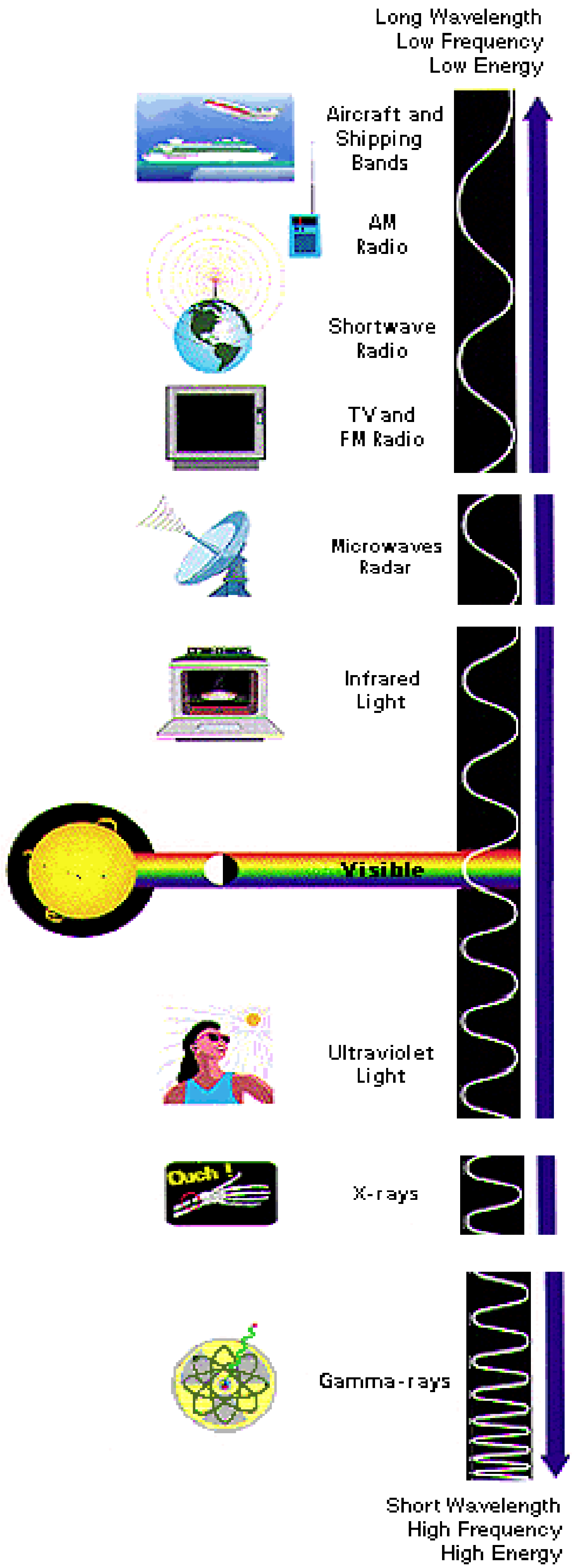
Sir Isaac Newton (1643-1727)

Christian Huygens (1629-1695)

- ☐ *Waves moving through the same region of space are added and the result of this superposition (interference) is the wave-front we observe.*
- ☐ *Light is sent out by shining substances in all directions.*
- ☐ *Refraction of light: Waves travel more slowly in denser media. The superposition of these "slower waves" causes a change in the direction of the wave-front we observe.*
- ☐ *Refraction of light: A denser medium attracts light particles more. Therefore the light particles move faster. That's why the particle's path bends.*
- ☐ *Each point on a wave behaves as a point source for waves in the direction of motion.*
- ☐ *Light is made up of small particles.*
- ☐ *Light is spread by waves.*
- ☐ *Reflection of light: Elastic collision of light particles and a surface.*
- ☐ *Light particles travel with constant velocity and in straight lines (sharp shadows).*
- ☐ *Light is emitted in all directions as a series of waves in a medium called the "luminiferous ether"(keyhole – no sharp shadow but spreading out of light)*
- ☐ *The superposition principle explains why we don't see the circular waves.*

Can you find statements describing the behaviour of light in contradicting ways?
What do you think, which statement is correct?

Appendix B2



Radiowaves: for the transmission of radio TV siganls

Microwaves: cooking, radar, sending signals to satellites

Infrared: heat radiated
Visible: part that our ey-es see

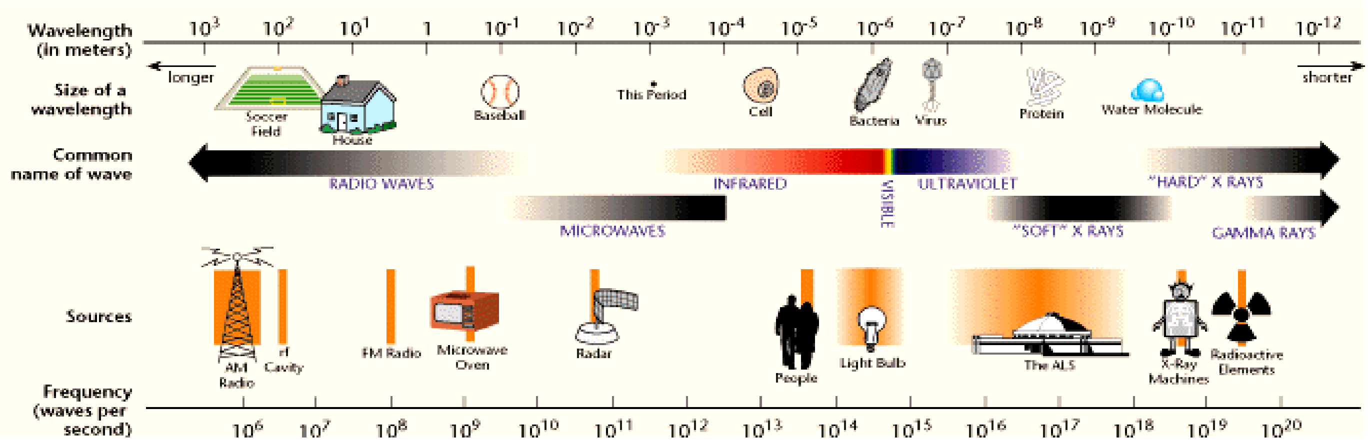
Ultraviolet: the Sun is a source of UV rays that cause our skin to burn.

X-rays: used in medicine to look at your bones or teeth

Gamma-rays: radioactive materials can emit gam-ma-rays.

Appendix B3

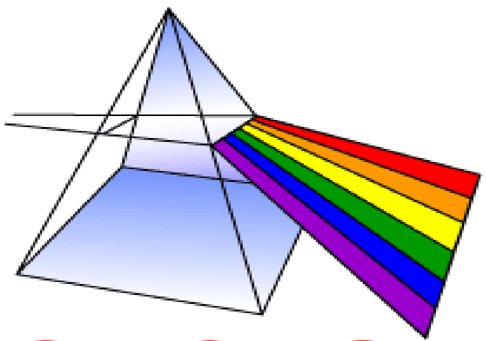
Electromagnetic Waves

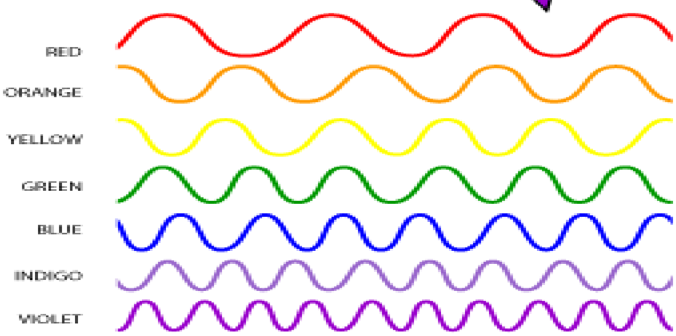


Light is a member of a whole family of waves called the ELECTROMAGNETIC SPECTRUM. These waves have several things in common:

- in contrast to mechanical waves they can travel through ____________
- they travel through __________________ at the same speed (________) km/s
- they are electric and _____________ ripples mostly given off by electrons and molecules as they vibrate or "lose" energy.

<u>DISPERSION:</u> When white light shines through a prism, the white light is broken apart into the colors of the visible light spectrum (rainbow):





Each color in a rainbow corresponds to a different wavelength of electromagnetic spectrum.

Appendix B4

The wave-particle duality of light.
Electromagnetic radiation (a beam of light) can be pictured in two ways: as a wave, or as a stream of individual packets of energy called photons.

ter) could not be explained by invoking the wave nature of light; the photon concept was necessary. We have a confusing situation! Is light a wave or is it a particle? The answer to this is couched in the term the dual nature of light, which simply means that

light sometimes must be described as a wave and sometimes as a particle to explain phenomena (● Fig. 9.10 on page 224).

be explained by the photon (particle) concept? On the other hand, the photoelectric effect (and other newly found phenomena in which light interacts with mat-

Planck's relationship ($E = hf$), with the frequency f being the frequency of the light. That is, a quantum, or photon, of light contains a discrete amount of energy, E, equal to Planck's constant, h, times the frequency, f, of the light. The higher the frequency of the light, the greater the energy of its photons. For example, photons of blue light have more energy than do photons of red light, which have lower frequencies.

In 1905 Albert Einstein (● Fig. 9.8) used Planck's hypothesis to describe light in terms of particles, or quanta (plural of *quantum*), rather than waves. Applying Planck's hypothesis, Einstein assumed that

But how can light be composed of photons (discrete packets of energy) when it shows wave phenomena such as diffraction, interference, and polarization (Section 7.3)—behavior that is explained very well by assuming the wave nature of light, but which *cannot*

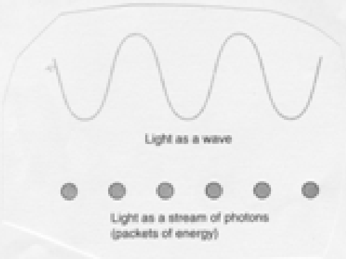
Wave and quantum analogy.
A wave supplies a continuous flow of energy, somewhat analogous to a stream of water. It would take a stream of water an appreciable time to fill a bucket. A quantum supplies energy all at once in a packet or bundle, analogous to a bucket of water. Dumping the water from the bucket fills the other bucket almost instantaneously, and this is analogous to a quantum supplying the energy in the photoelectric effect.

a particular type of experiment, light shows the characteristics of only one model at a time. Thus, in a given experiment, scientists (renowned for being pragmatic) use whichever model of light works—sometimes the wave model, sometimes the particle

model. Perhaps someday we will have a better model of light, but the concept of the dual nature of light has been around for almost a century now and actually does an excellent job of explaining known and newly discovered phenomena and of making valid predictions that have served as the basis of new technologies.

Our macroscopic idea that something must be *either* a wave *or* a particle breaks down here. That is, light does not always behave like a wave, nor does it always behave like a particle; it has characteristics of both, and we simply have no good, single, macroscopic analogy that fits the combination. However, in

light (and, in fact, all electromagnetic radiation) is quantized and consists of "particles," or "packets," of energy. He coined the term **photon** to refer to such a quantum of electromagnetic radiation. He used



/örter: 0 Deutsch (Österreich)