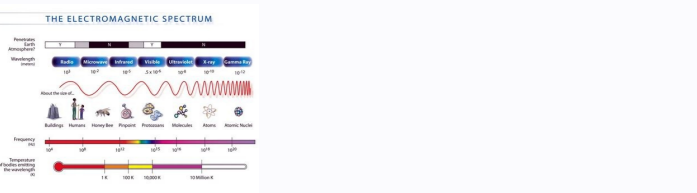
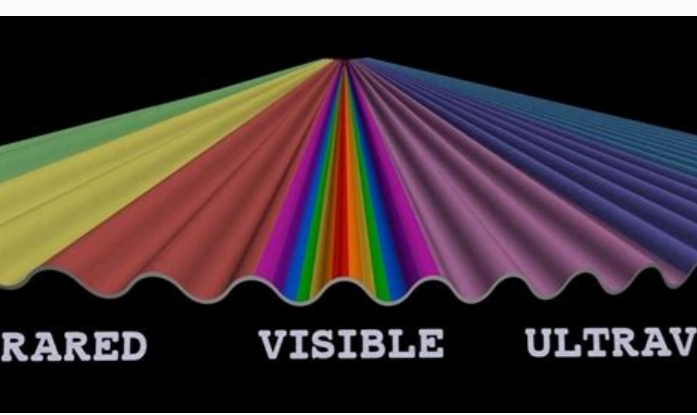
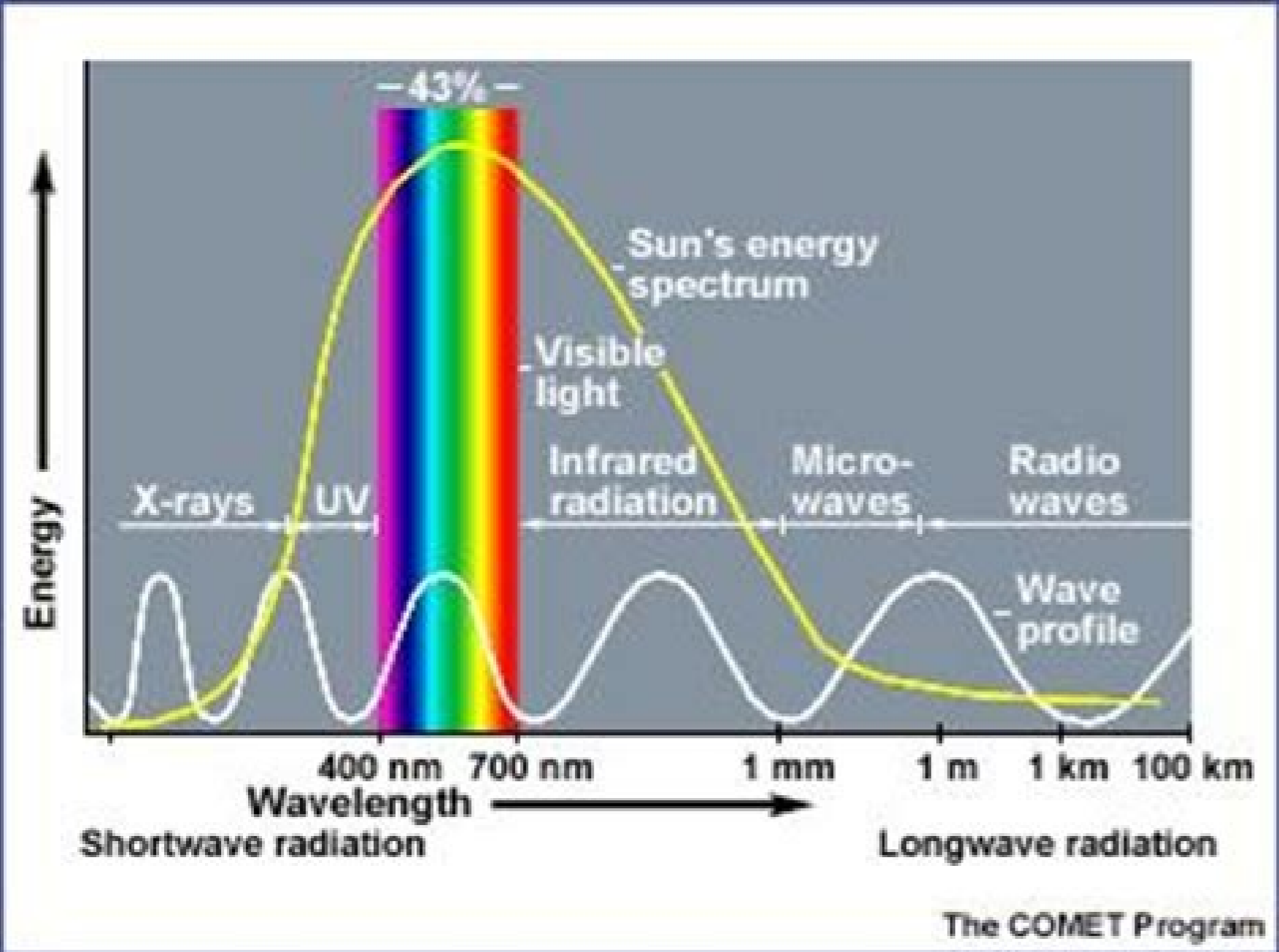
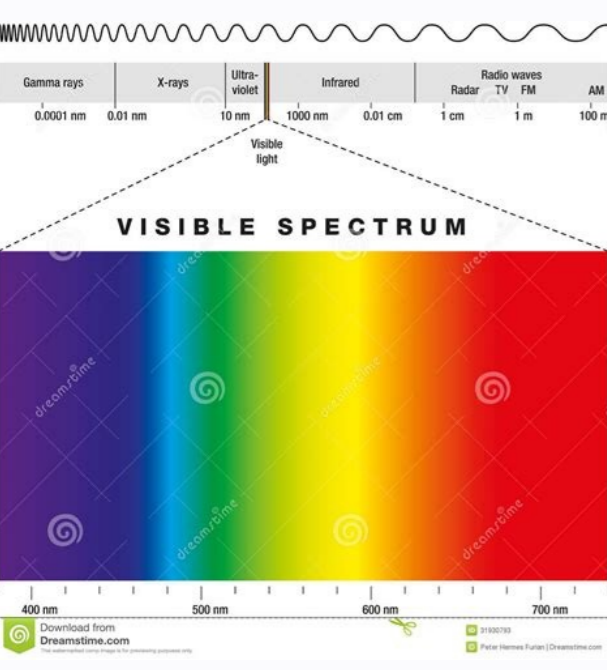
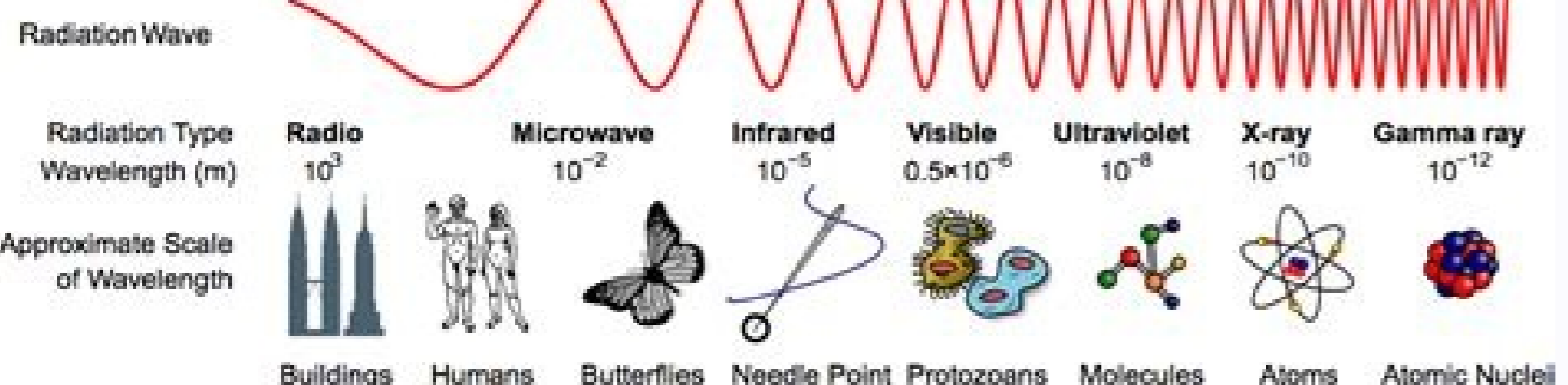


7 types of radiation in the electromagnetic spectrum

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List the 7 types of radiation in the electromagnetic spectrum in the correct order. What are the 7 types of electromagnetic spectrum. 7 types of radiation in the electromagnetic spectrum in order. What are 7 types of electromagnetic radiation.

Bernie's Basics What have radios, warm hugs and nuclear blasts got in common? Practically everything! By Bernie Hobbs You can change the radio station you're listening to with the flick of a dial. But imagine if your radio let you tune into any frequency you want, no matter how high. You wouldn't be stuck with the cricket or Kyle Sandilands, you could tune into anything from TV shows to sunshine and gamma-ray bursts. Radio, microwaves, UV, visible light and gamma rays have completely different effects, but they're all exactly the same kind of thing: electromagnetic radiation (EMR). They're just waves of energy travelling through space — or through things. The only difference between gamma-rays from nuclear bombs and the waves that let our TVs and microwaves do their thing is how much energy those waves have got. Radio waves have got the lowest energy on the electromagnetic spectrum. But if you could crank up the energy in radio waves a bit, you'd turn them into microwaves and you could zap your dinner with them. Keep increasing the energy and you'd be able to use those waves as a torch (visible light) before they started shining right through things (x-rays) and eventually, when they're at the other end of the energy spectrum, they'd be deadly gamma-rays. (That's quite a lot of cranking — gamma radiation has got more than a million million times as much energy as radio waves.)

Energy, wavelength and frequency Electromagnetic radiation is just waves of moving energy, but when we tune into radio or TV stations, we don't talk about their energy — it's all about frequency. Your microwave oven has got a particular frequency too (it's on the label on the back). And if you've got a pet X-ray machine, it'll operate at certain frequencies as well. Frequency is just how often something happens. In the case of EMR, it's how often you'd get hit by a wave of radiation if you stood in its way. Right now you're probably being pummeled by radio waves and visible light. You'll get hit by way more visible light waves than radio waves each second because visible light is higher energy, and higher energy radiation has a higher frequency. And that's because of two things: High energy radiation makes very skinny waves (short wavelength). All radiation travels at the same speed — the speed of light (a magnificent 300,000 km/second.). That combination of different wavelengths travelling at the same speed means you'll squeeze a lot more skinny waves into one second's worth of radiation than you will fatter waves. Radio waves have got the longest wavelengths, ranging from a few metres to waves that are kilometres long. And for every wavelength there's a corresponding frequency. It's that range of wavelength and frequency that means we can fit lots of different radio and tv stations in. If only we could get enough good stuff to see and hear on them.

Where does it all come from? Whether it ends up as microwaves, X-rays or sunlight, the energy that travels as electromagnetic radiation is always produced in the same way. It all comes from electrons suddenly losing energy. Light is produced when electrons drop to a lower energy level in an atom. Electrons suddenly hitting a metal surface give off energy as X-rays. And electrons vibrating in radio transmitters give off the low energy radiation we tune into. But it's not just radio towers, X-ray machines and light bulbs that produce electromagnetic radiation; every bit of matter in the universe emits radiation, including you. Warm things like us give off body heat, and that heat energy travels as infrared radiation. So you're actually emitting higher energy radiation right now than your remote control or microwave oven. But don't get too cocky; we might make higher energy radiation than our appliances, but we don't pump out nearly enough of the stuff to do anything more useful than hug with it. Just ask anyone who's tried to boil an egg in their armpit. Thanks to Prof David Jamieson from the School of Physics at The University of Melbourne. Tags: astronomy-space, energy, physics, nuclear-energy

Light The most common form of radiation we are all familiar with is visible light. Light is energy that originates from a source and travels through space at the speed of ... light! It has a particular wavelength and frequency that defines its energy. We can detect this radiation with our eyes. The only difference between various colors of light, red, yellow, green, blue, and purple is in their wavelength or frequency, or in other words in their energy. Red light, for example, has less energy than purple light. There is a wide range of electromagnetic radiation in nature. The visible part of the spectrum is only a tiny part of this wide range of energies. As we move down in frequency from red light, there are other familiar forms of electromagnetic radiation: Infrared Microwaves Signals from our cell phones Radio waves These are all forms of radiation that are invisible to our eyes and that have less energy than visible light. As we move up in frequency from purple light, there are Ultraviolet (UV) radiation X-rays Gamma rays These are all forms of radiation with energies much higher than visible light. X-rays and gamma rays have enough energy that during interaction with atoms, they can remove electrons and cause the atom to become charged or ionized. That's why we refer to these as ionizing radiation. When most people talk about radiation, they are referring to ionizing radiation. For more information on ionizing radiation, click here Ionization is a unique property that other forms of radiation at lower frequencies, such as those from our cell phones, do not have. For more information on non-ionizing radiation, click here To learn more about what happens to an ionized atom, click here Study Astronomy Online at Swinburne University All material is © Swinburne University of Technology except where indicated. EM radiation is classified into types according to the frequency of the wave: these types include, in order of increasing frequency, radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, X-rays and gamma rays. Table 11.1 lists the wavelength and frequency ranges of the divisions of the electromagnetic spectrum.

| Category | Range of Wavelengths (nm) | Range of Frequencies (Hz) |
|-------------------|---------------------------|--|
| gamma rays | $< 10^{-10}$ | $> 3 \times 10^{17}$ |
| X-rays | 10^{-10} to 10^{-8} | 3×10^{16} to 3×10^{18} |
| ultraviolet light | 10^{-8} to 400 | 3×10^{14} to 3×10^{16} |
| visible light | 400 to 700 | 4.3×10^{14} to 7.5×10^{14} |
| infrared | 700 to 10^5 | 3×10^{12} to 3×10^{14} |
| microwave | 10^2 to 10^3 | 3×10^8 to 3×10^{10} |
| radio waves | $> 10^3$ | $< 3 \times 10^8$ |

Examples of some uses of electromagnetic waves are shown in Table 11.2. Category Uses gamma rays used to kill the bacteria in marshmallows and to sterilise medical equipment X-rays used to image bone structures ultraviolet light bees can see into the ultraviolet because flowers stand out more clearly at this frequency visible light used by humans to observe the world infrared night vision, heat sensors, laser metal cutting microwaves microwave ovens, radar radio waves radio, television broadcasts

Table 11.2: Uses of EM waves

Textbook Exercise 11.1 Arrange the following types of EM radiation in order of increasing frequency: infrared, X-rays, ultraviolet, visible, gamma. Solution not yet available Calculate the frequency of an EM wave with a wavelength of 400 nm . Solution not yet available Give an example of the use of each type of EM radiation, i.e. gamma rays, X-rays, ultraviolet light, visible light, infrared, microwave and radio and TV waves. Solution not yet available Figure 11.2: The electromagnetic spectrum as a function of frequency. The different types according to wavelength are shown as well as everyday comparisons. EM radiation in the visible part of the spectrum is scattered off all of the objects around us. This EM radiation provides the information to our eyes that allows us to see. The frequencies of radiation the human eye is sensitive to constitute only a very small part of all possible frequencies of EM radiation. The full set of EM radiation is called the electromagnetic spectrum. To simplify things the EM spectrum divided into sections (such as radio, microwave, infrared, visible, ultraviolet, X-rays and gamma-rays). The EM spectrum is continuous (has no gaps) and infinite. Due to technological limitations, we can only use electromagnetic radiation with wavelengths between 10^{-14} m and 10^{15} m . Home Science Physics Matter & Energy The Electromagnetic Spectrum The electromagnetic spectrum is the distribution of electromagnetic radiation according to energy (or equivalently, by virtue of the relations in the previous section, according to frequency or wavelength). Regions of the Electromagnetic Spectrum The following table gives approximate wavelengths, frequencies, and energies for selected regions of the electromagnetic spectrum.

| Region | Wavelength (Angstroms) | Wavelength (centimeters) | Frequency (Hz) | Energy (eV) |
|-------------|------------------------|---|---|-----------------------|
| Radio | $> 10^9$ | > 10 | $< 3 \times 10^9$ | $< 10^{-5}$ |
| Microwave | 10^9 - 10^6 | 10^2 - 10^1 | 3×10^8 - 3×10^{10} | 10^{-5} - 10^{-3} |
| Infrared | 10^6 - 7000 | 0.01 - 10^2 | 3×10^{12} - 3×10^{14} | 10^{-3} - 10^{-1} |
| Visible | 7000 - 4000 | 7×10^{-5} - 4×10^{-5} | 4.3×10^{14} - 7.5×10^{14} | 2 - 3 |
| Ultraviolet | 4000 - 10^4 | 4×10^{-5} - 10^{-4} | 7.5×10^{14} - 3×10^{17} | 3 - 10^3 |
| X-Rays | 10^4 - 0.1 | 10^{-7} - 10^{-9} | 3×10^{17} - 3×10^{19} | 10^3 - 10^5 |
| Gamma Rays | < 0.1 | $< 10^{-9}$ | $> 3 \times 10^{19}$ | $> 10^5$ |

The notation "eV" stands for electron-volts, a common unit of energy measure in atomic physics. A graphical representation of the electromagnetic spectrum is shown in the figure below. The electromagnetic spectrum Thus we see that visible light and gamma rays and microwaves are really the same things. They are all electromagnetic radiation; they just differ in their wavelengths. The Spectrum of Visible Light In the same way that we sense frequency of sound as pitch, we sense the frequency of light as color. Notice how small the visible spectrum is over the full range of the electromagnetic spectrum. The visible part of the spectrum may be subdivided according to color, with red at the long wavelength end and violet at the short wavelength end, as illustrated (schematically) in the following figure. The visible spectrum How Roy G. Biv Lost a Vowel The sequence of colors red, orange, yellow, green, blue, and violet may be remembered by memorizing the name of that fine fellow "ROY G. BIV". This was originally "ROY G. BIV", because it used to be common to call the region between blue and violet "indigo". In modern usage, indigo is not usually distinguished as a separate color in the visible spectrum; thus Roy no longer has any vowels in his last name. Infrared Radiation Beyond the red end of the visible spectrum is infrared radiation. This ranges from 700nm down to 0.1cm. We feel such radiation from a heat lamp but we cannot see this radiation. Radio Waves We are familiar with radio waves from UHF, VHF, FM and AM transmissions. They have very long wavelengths. AM radio waves have the longest wavelengths in this group, and thus the smallest frequencies. UV, X-ray, Gamma-Rays These shorter wavelength, higher energy rays are largely blocked out by the Earth's atmosphere. (We will later see more about why particular wavelengths are blocked compared to others. (see next slide). Thus Superman's "X-ray vision" is basically useless on Earth.

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