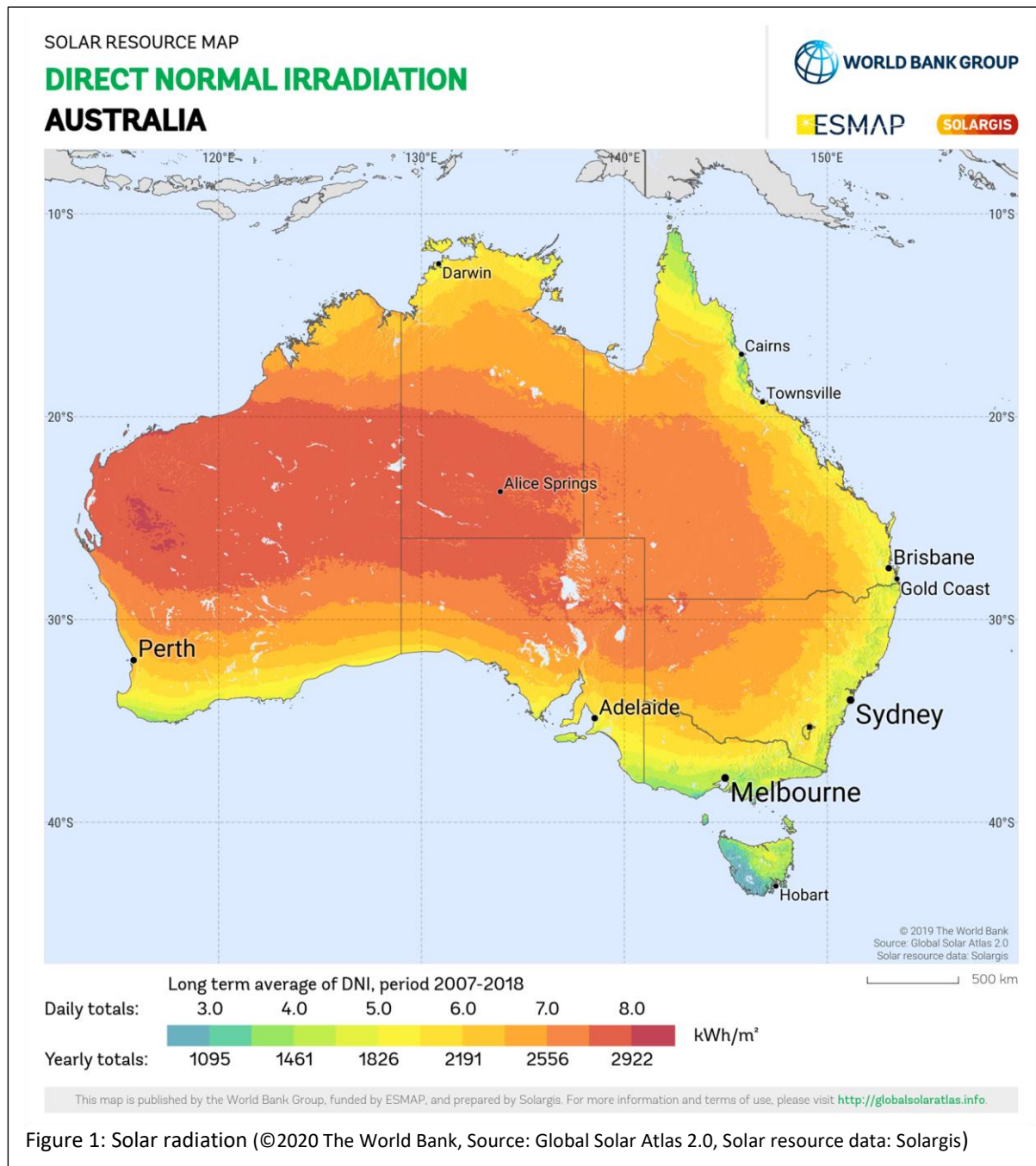




Solar radiation reaching Australia

The amount of solar radiation received in different locations depends upon distance from the equator, time of year, elevation and average cloud cover. Figure 1 presents average solar radiation values for Australia.



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Solar radiation

As shown in Figure 2, the approximate breakdown of the sun's light reaching earth is 7% ultraviolet, 43% visible light and 49% infrared. The most intense radiation is in the visible light range from 380 – 700 nm.

Processes driven by solar radiation

Water cycle

Evaporation is driven mainly by infrared radiation and accelerated by wind. About 25% of solar energy that reaches the surface is absorbed by water and leaves the surface through evaporation. When water vapour condenses to form clouds, the heat is released into the surrounding atmosphere. The water cycle is vital for moving water around the globe where it can be accessed by plants and animals on land.

Photosynthesis

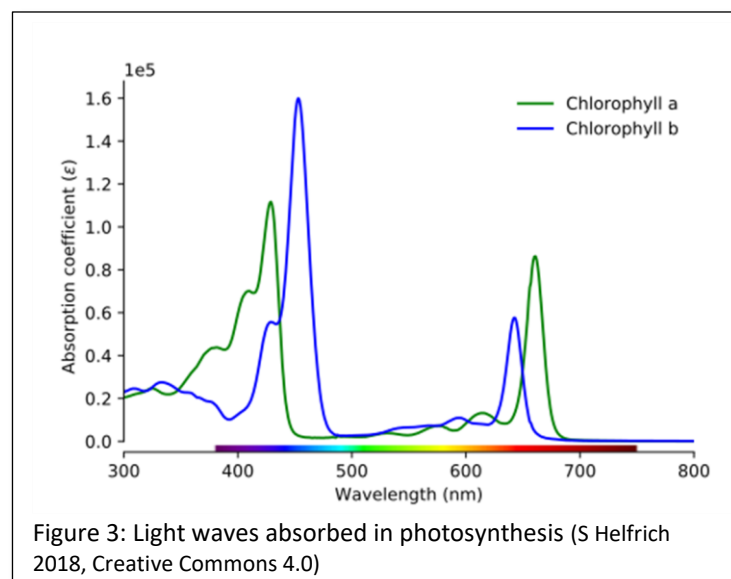
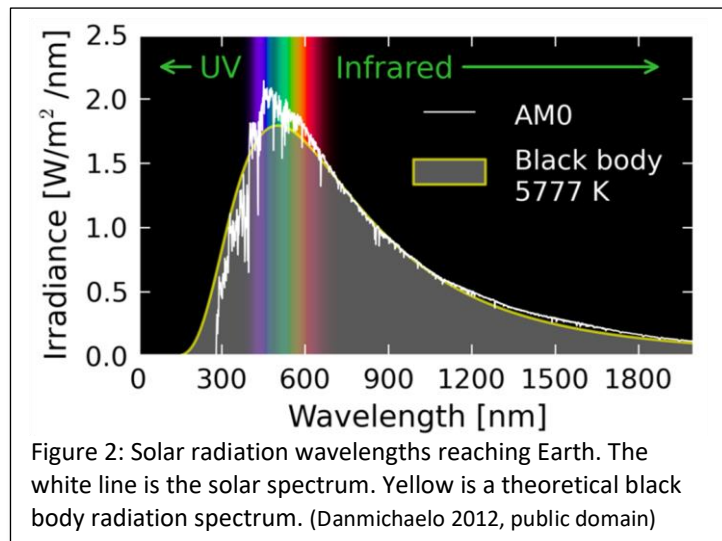
Light from the Sun powers surface ecosystems through the process of photosynthesis. Chlorophyll pigments absorb visible light energy and convert it to chemical potential energy in the form of glucose.

Ultraviolet light is too energetic and can destroy DNA. Some plants attempt to use UV-A for photosynthesis, but it is inefficient. Infrared light does not have enough energy for photosynthesis and is converted to heat, instead.

Human use of solar energy

The human eye has evolved to detect the most plentiful wavelengths from the Sun, which is why these are known as the visible light spectrum. Our skin can detect UV-A light exposure when it causes sunburn. We also detect infrared radiation as heat.

Solar photovoltaic panels use wavelengths of 380 – 750 nm to generate electricity. Solar panels have an efficiency of about 20% when converting solar radiation to electricity. Solar water heaters use a much wider range of wavelengths, from 300 nm – 2 mm, and their efficiency is up to 80%.





Questions

1. How much solar radiation does your house receive? (include units!) _____
2. If 25% of solar energy is absorbed by water and leads to evaporation, how much solar radiation causes evaporation of water near your home? _____
3. What wavelengths are most efficiently absorbed by chlorophyll (Figure 3)? _____
4. Light that is not absorbed is reflected. We see reflected visible light as colours. Explain how we can use Figure 3 to tell what colour(s) plants appear to be. _____

5. Your family is deciding whether to install a solar water heater or photovoltaic panels. Use the information above to justify your choice. What other information might affect your choice? _____

References:

Fondriest Environmental (2014). "Solar Radiation and Photosynthetically Active Radiation." Fundamentals of Environmental Measurements. <https://www.fondriest.com/environmental-measurements/parameters/weather/photosynthetically-active-radiation/>

NASA Earth Observatory (2009). Surface energy budget. <https://earthobservatory.nasa.gov/features/EnergyBalance/page5.php>

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