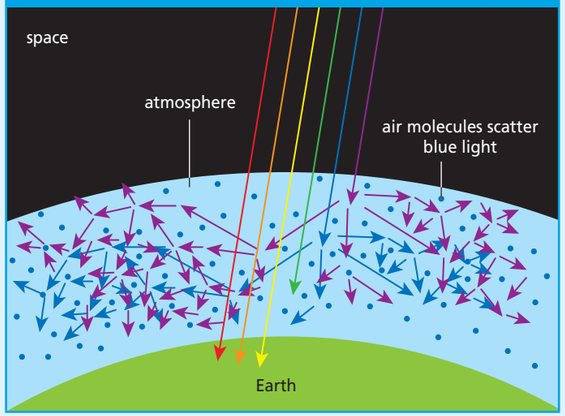
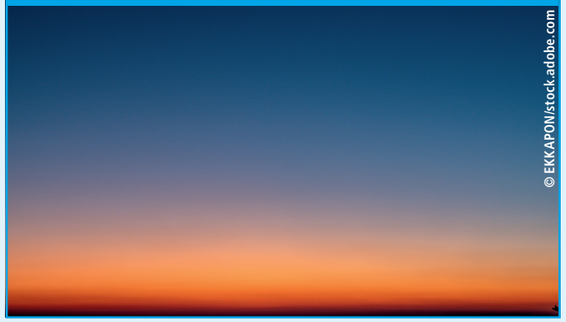
Colours of the sky

1 Blue light is about 10 times more likely to be scattered by Earth's atmosphere than red light



2 The blue of the sky is paler towards the horizon

3 Rayleigh scattering causes the blue colour of the daytime sky and the reddening of the Sun at sunset



4 Water droplets in clouds scatter all colours of sunlight equally in a process called Mei scattering. More light is scattered out of the tops or sides than out of the bases of clouds

About 99% of Earth's atmosphere comprises nitrogen and oxygen molecules, which are much smaller than the wavelengths of visible light. This property results in Rayleigh scattering, in which sunlight is scattered elastically, with photons of shorter, blue wavelengths much more likely to be scattered than photons of longer, red wavelengths.

As blue light is scattered in many different directions by the atmosphere it reaches our eyes from all directions, and is the colour that our eyes predominantly see in the sky (1). (Violet light is scattered even more than blue light, but there is much less of it in sunlight and our eyes are more sensitive to blue.)

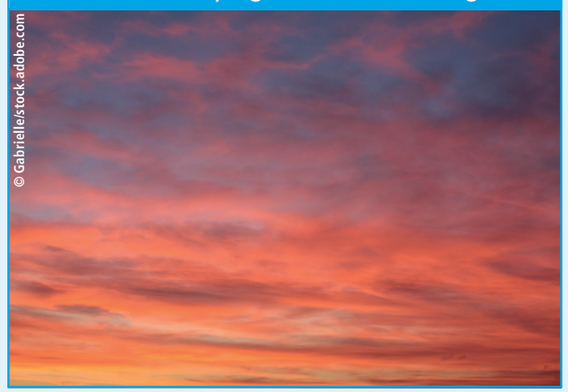
You may have noticed that the sky is not uniformly blue – it tends to be a darker blue overhead that fades to pale blue towards the horizon. This is because light from towards the horizon must travel further through the air to reach your eyes, making it more likely that blue light is re-scattered in a different direction. Light from this direction is also affected significantly by reflecting and scattering off Earth's surface, so that blue light from this direction is less dominant (2).

At sunrise and sunset direct light from the Sun passes through much more of the atmosphere than when the Sun is overhead. Photons of red light from the sunlight are much less likely to be scattered than photons of blue light, and light from the direction of the Sun is dominated by red (3).

Clouds form when invisible water vapour condenses into tiny water droplets, or ice particles, that are small enough to remain suspended in the atmosphere. The water droplets are large enough to scatter all colours of sunlight roughly equally,

5 Water droplets in rain clouds are larger than those in other clouds and scatter light more strongly. Less light escapes out of the base of a rain cloud

6 Red or orange clouds are caused by a combination of Rayleigh and Mei scattering



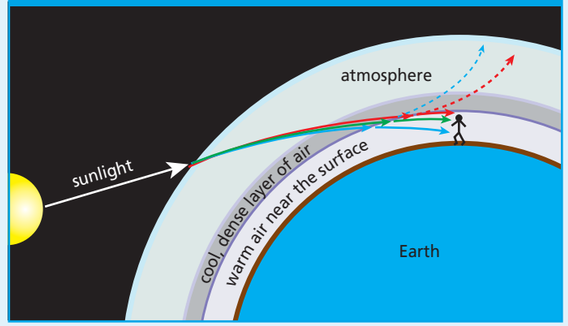
in a process called Mei scattering. The result is that the sunlight reaching us through clouds is a mixture of all colours of sunlight, which combine to give white light (4).

Mei scattering can also cause the base of clouds to appear grey, especially when they are rain clouds. Most of the sunlight scattered in a cloud usually exits upwards, or out to the sides of the cloud, making the top and sides of the cloud whiter than the base, which receives less light. The larger size of water droplets in rain clouds increases the amount of light they scatter, giving them their foreboding steely-grey appearance (5).

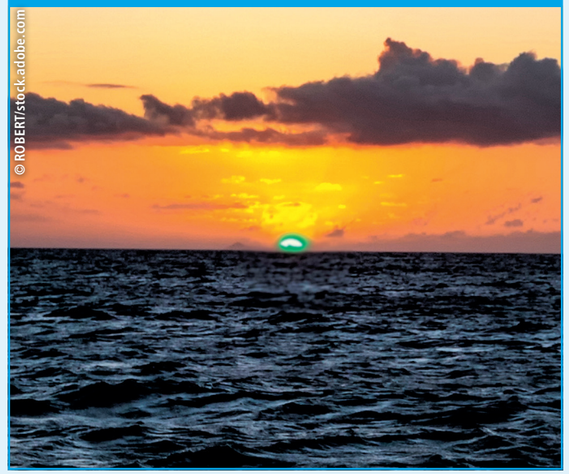
At sunrise or sunset clouds can appear vivid red or orange – a combination of both Rayleigh and Mei scattering (6).

Looking west at sunset towards the Sun dipping below a distant horizon, you may be lucky enough to see a green flash. This is caused by the refraction of light passing through the atmosphere, which causes spectral colours to disperse (7). For an instant, when the upper rim of the Sun is just visible above

7 Observing a green flash*, looking west



8 A green flash seen from the coast of California, USA



the horizon, you may see a brief flash of green light (8). Good places to see the green flash are from westward-facing beaches, or from the tops of mountains or tall buildings – so long as it is a clear day with no haze and there is a distant horizon visible to the west.

SAFETY NOTE

To avoid damaging your eyes, never use optical instruments to look towards the Sun, and only look directly towards it with your naked eyes when it is almost entirely below the horizon, and when you can do so without being dazzled.

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