Why is the sky blue?

This year, we have been engaging in a lot of travel of the mind rather than physical travel. Children do this all the time. 'Why does it rain?', 'Why do I have to go to school?' and the classic, 'Why is the sky blue?' If you have ever struggled for an answer to the last question beyond 'Because it is', spoiler alert, here it is: 'Because of **Rayleigh scattering**!'[1] That should deter a percentage of your questioners, but as it may not satisfy all, this article has you covered. Feel free to expand your response based on the knowledge I am about to impart.

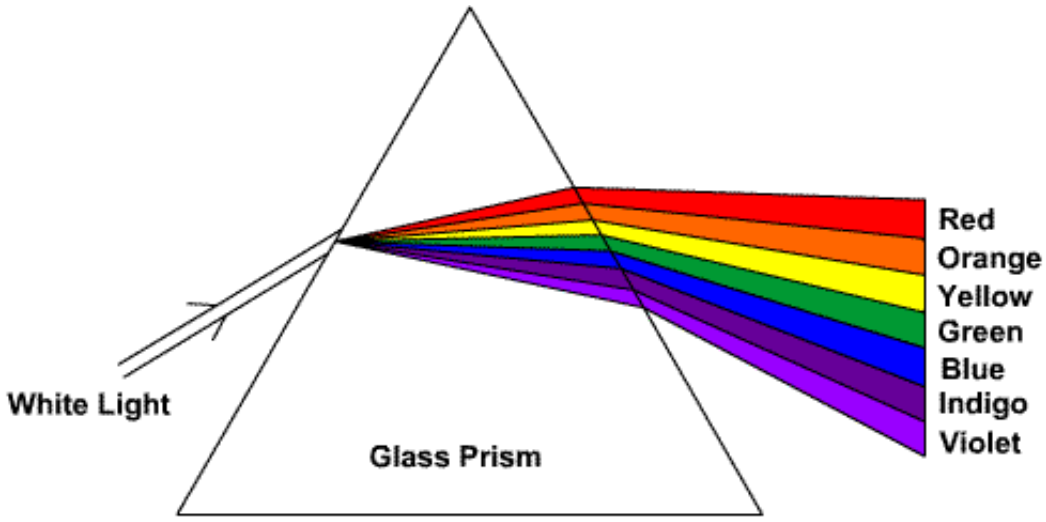
One pre-COVID-19 day, in the times when we were travelling rather than dreaming of it, I was on a tiny commuter plane from Munich to Cluj-Napoca (Transylvania, Romania), feeling tired, when the air hostess shouted down the cabin aisle at us, 'Why is the sky blue?!' And I don't know what form of Pavlovian conditioning came over me, but I shouted back, 'Because of Rayleigh scattering!' Quickly realising that this was a rhetorical question, and mortified, I wanted to hide under my seat, but there was really nothing I could do other than pretend to be part of the aircraft fuselage. The air hostess later explained to me that she and the pilot had been arguing over why the sky was blue, and she wanted to embarrass the pilot by asking the question of the entire cabin of passengers. She had not expected an answer, but was happy that I blurted one out, and was interested to know more about the theory. I kind of felt like one of the nerds from *The Big Bang Theory*.

So then, *why is the sky blue?*

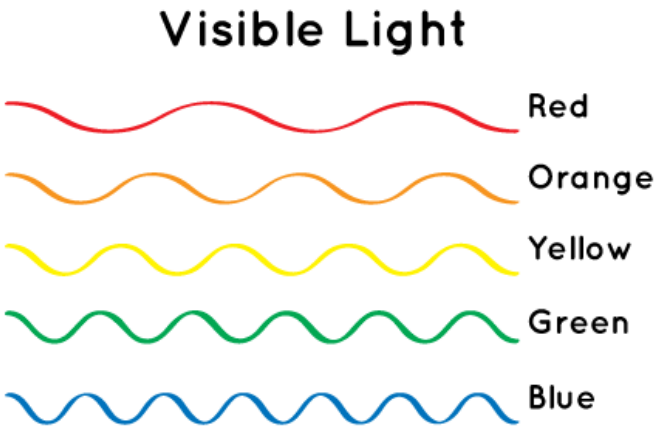
Simply put, it is blue because the contents (gases, particles, etc.) of the Earth's atmosphere are sufficiently dense to scatter all the light from the electromagnetic spectrum that is able to reach the spectrum's blue levels. Other colours are scattered, but not to the same extent as blue. 'But what is the electromagnetic spectrum?' your juvenile interrogator might say. Well, if you have ever played with a prism or seen a rainbow, then you know that light is made up of different colours. The mnemonic ROY G. BIV helps us remember these colours: **r**ed, **o**range, **y**ellow, **g**reen, **b**lue, **i**ndigo and **v**iolet.

So in the sky, red light comes through the atmosphere with minimal scattering, the same for orange light and so on, but blue light is scattered all over the sky. How? Well, a photon of blue light, or anything with a shorter wavelength than blue light, as it comes through the atmosphere hits a particle of dust or a molecule of gas, and is scattered in a random direction. This occurs for all photons of blue light and it's from all of the different

scatterings that the blue light goes through that we end up seeing the entire sky as blue, because eventually, this blue light is scattered back into our eyes.



It is a process of light absorption and re-emission, but in a lot of ways, it's like throwing ping pong balls into a room with a lot of different things that they can ricochet off. If you use a combination of tiny and regular ping pong balls, the physics of these objects means that the tiny ping pong balls are more likely to get straight through and the regular ones are likely to get ricocheted. Now imagine that the larger ping pong balls represent the photons with the shortest wavelengths and frequencies, and the smaller ones represent light with longer wavelengths and frequencies. Blue light with its shorter wavelength is more likely to scatter or 'ricochet' off particles in the atmosphere and thus be visible to us.



So the next time you are on a plane, which could be as soon as the end of year celebrations, and you, or your child or the child next to you, look out the window at the blue sky, you may just recall Rayleigh scattering and the explanation as to why the sky is blue: because the gases and particles in the atmosphere scatter the blue part of sunlight like a bunch of ping pong balls trying to get through a crowded room full of chairs, letting all the other ones just pass through.

Should you get more questions along these lines from your children, or maybe you have some quirky one of your own, please feel free to write to me (z.szabo@oie.int) and I will try to help out.

We wish to thank our colleague Zoltan Szabo for writing this article for the OIE *In-house Times.*

[1] Rayleigh scattering (/ˈreɪli/ RAY-lee) was named after the nineteenth-century British physicist Lord Rayleigh, John William Strutt, 3rd Baron Rayleigh. Wikipedia.