Hi this is Steve Nerlich from Cheap Astronomy www.cheapastro.com and this is *How the Sky Works*.

Night time is the astronomers' time, we observe, we record, we collect photons. Debt-ridden astronomers feverishly align their spectrum filtered CCDs to collect every last photon that falls their way, while the rest of us just look – and even stare – in wonder.

But there's always a time limit. Every astronomer knows that every day the Sun will come up and completely obliterate the fabulous wonders of the night sky. Mind you, this has a certain practical importance, as even Cheap Astronomers have to go to work sometimes.

The daytime belongs to the astronomers' nemesis, the man they call Roy G Biv. Those gentle, often Doppler-stretched, photons of the night are hopelessly out-competed by the hyperactive high energy photons of the day, pumped out by a white hot ball of nuclear fusion a mere eight light minutes away. Although the longer wavelength red, orange, yellow and green photons come straight on through, the blue indigo and violet ones get scattered, repeatedly ricocheting off one atmospheric particle to the next, spreading out across the sky from horizon to horizon creating a uniform, detail-less, and very opaque, blue.

Our only comfort, as we trudge off to work, is knowing that those even shorter wavelength cancer-causing photons – in the UV, X and gamma ray wavelengths - just bounce straight back into space. And three cheers for the Earth's magnetosphere that wards off the constant outpouring of sub-atomic particles that will just plain kill you. But what the heck, let's burn another rainforest down.

Anyway, the daytime slowly drifts on by, the end of shift whistle blows, and I want my telescope. As the Sun goes down, the astronomer forgets the intervening drudgery of the day, but not before noticing that the Sun rose over there – and then it set over there. It moves along a line – in the sky!

The path the sun traces through the daytime, the ecliptic, is a key feature of the sky. While, by definition, the path of the Sun, it's also closely followed by the planets – and even the Moon sticks fairly close to it.

If they are visible at all, Venus and Mercury will only be visible for an hour or two – on the ecliptic – either just after sunset, or just before dawn. Being in a closer solar orbit than the Earth, neither seemingly strays far from the Sun. Venus is a very, very bright star-like object, being the brightest object in the sky after the Sun and the Moon, while Mercury will just look a bit bright. The other planets visible to the naked eye, Mars, Jupiter and Saturn, being further out than Earth, can often be seen in the late night sky when they are in those parts of their orbit that are behind Earth.

There's a long tradition of naming the seven days of the week after the seven visible objects that move along the ecliptic. In English we still keep Saturday for Saturn, Sunday for the Sun and Monday for the Moon, but for some reason gave up the other days to a bunch of Norse gods. However, in latin languages, like Spanish, the tradition continues so that Tuesday is Martes (for Mars), Wednesday is Miercoles (for Mercury), Thursday is Jueves (with a J, for

Jupiter) and Friday is Viernes (for Venus). We don't have nine day weeks, because you can't see Uranus or Neptune – we didn't even know they were there until 1781 and 1846 respectively.

Since we live on a spinning planet that is tilted 23.5 degrees to the flat disk of the solar system, the line of the ecliptic, which is the path of the Sun through the sky, shifts with the seasons. In January, in the southern hemisphere's Summer, the ecliptic will be high in the sky (since the Sun will be high in the sky, seeing how it's Summer). However, at the same time, from the perspective of people in the northern hemisphere – it will be low to the south and quite cold because it's their Winter. Around July though, it's their Summer, and the ecliptic will be high in the sky for Northern hemispherites, but low to the north for Southern hemispherites, who, in July, will be shivering through their Winter.

This brings me to another timekeeping story. The sundial was first invented in the northern hemisphere – where, if you put a stick in the ground, its shadow will point vaguely north and, as the Sun moves from east to west, that shadow will arc around from left to right. This is why all clocks are geared to turn in a 'clockwise' direction, it's just a convention that was established with the first sundials. Here in the southern hemisphere, the shadows of our sundials point vaguely south and arc 'anti-clockwise' as the Sun moves from the east to west. Try it, if you ever get down here, unlike the urban myth of water going down the plug hole the wrong way, this really happens. And by the way, to save confusing our northern visitors, we've kept all our clocks going in your direction.

And talking of hemispheres brings us to another key feature of the sky – the celestial poles. If you've ever seen one of those photos where the camera aperture is left open for an hour or more at night, you can see how all the stars trace out great concentric circles, as though the whole sky is turning about a single point. This is indeed exactly how it acts, although it's just another consequence of us living on a spinning planet. If you've never seen one of those photos, go to Cheap Astronomy, www.cheapastro.com and click on Naked Eye Astronomy and then the Southern Celestial Pole to see a fabulous time lapse photo taken by debt-ridden astronomer Ray Suckling.

Any southern hemisphere astronomer, debt-ridden or cheap, can tell you that the Southern Cross points the way to the southern celestial pole. And any northerner can tell you the northern celestial pole is marked by Northern Star Polaris, which sits at the end of the handle of the Little Dipper, also known as the constellation Ursa Minor. Slip on some snow shoes and trudge to the geographic north pole and Polaris will be directly overhead– trudge to south pole and the Southern Celestial Pole will be directly overhead. Start walking north again and that point will slip back down into the southern sky and by the time your reach the equator, it will be down to the horizon. If you keep going north from the equator, it disappears entirely and the Little Dipper begins to appear.

There's marvelous sights that both hemispheres share of course. Anything positioned out midway between the celestial poles will be visible to everyone depending on which bits of the sky Roy G Biv chooses to blue out at different times of year. The wonderfully geometric Orion's belt appears in the sky in the Northern hemisphere's Winter around January. Us southerners also welcome its return, though in T-shirts, because it's Summer, and we call it the Saucepan,

because it’s upside down. Then in July we shiver as we stare up at Scorpius, with its bright red star Antares, which you crazy northerners call a Summer constellation.

And if none of this is making any sense, just try and remember that you live on a planet. And it’s one with an equatorial spin of 1,600 kilometres an hour, tilted at 23.5 degrees, and taking one year to traverse an orbit with a diameter of 300 million kilometres.

When you are looking at stars, it’s because you are temporarily on the side of the earth that faces away from the Sun – staring out into the cold vacuum of space. It’s the warm embrace of our atmosphere that stops you from dying almost immediately. In fact, you get anything from 8 to 12 hours of death-defying viewing time before the Earth spins you back into line with the Sun and the whole sky blues out again.

But the Earth takes a year to travel through its orbit around the Sun, all the while spinning madly on its axis. On one side of its orbit we all get to admire Orion’s belt – and whether summer or winter, it will be in January. Then, come July we are on the other side of the Sun, which is bluing out the other side of the sky that had Orion’s belt, and instead we all get to look at Scorpius – either shivering or sweating.

If you’ve got your head around all that, you pretty much understand how the sky works.

Thanks for listening. This is Steve Nerlich from Cheap Astronomy, www.cheapastro.com. Cheap Astronomy offers an educational website for when you’re lying in the gutter, looking up at the stars. No ads, no profit, just good science. Bye.