



national science week 2020

Astronomy When It's Cloudy

Sometimes objects in the sky won't be visible. Cloudy conditions might be the perfect opportunity to catch up on sleep, but they're also wonderful for exploring space from indoors.

What is the Milky Way, how BIG is it and why doesn't it fill up the sky?

Earth is one of eight known planets and many smaller rocky bodies that orbit around our star, Sol. This system of orbiting bodies and star is therefore called the **Solar System**, though most just call our star the Sun. Our Solar System sits inside our home galaxy, called the Milky Way. It does look milky as it stretches across the sky, due to billions of distant stars that each only add a pinpoint of light.

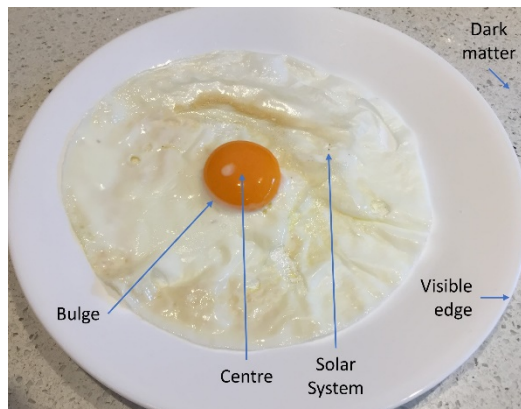
Try this: Find an empty two litre plastic milk carton and its lid. Fill the lid full of **rice grains**, patting them down flat. Pour that rice onto a plate, count how many grains were in the lid and write this number down. Take the empty lid, fill it with water then pour that into the carton. Count the number of lids it takes to fill the carton. With a calculator, multiply those two numbers together to get the number of grains that'd fill the carton. It's a lot!



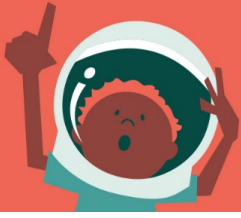
A 50m pool holds 2.5 million litres of water, so it'd take 1.25 million cartons for you to fill the pool. Multiply that number by your calculated grains in just one carton, to give the number of grains that'd fill the pool. It'll be many billions. Our Milky Way has about 400 billion stars inside it. Imagine shrinking each of their solar systems to the size of a rice grain. How many pools are needed to fit the Milky Way? Did your answer confirm that the Milky Way would fill about three pools with rice?

So, the Milky Way is huge, but it's just one galaxy in our Universe of maybe two trillion galaxies. Australia would be buried under two kilometres of rice if each solar system was the size of a grain. That's a lot of rice. And we won't think about how many universes there might be.

Try this: Cook a **fried egg**, sunny side up, so you don't break the yellow yoke but do let the white of the egg stretch out as far as you can. Place the egg on a large plate and add a tiny speck of pepper about one third the way from the yoke to the edge of the plate.



The Milky Way is shaped like two fried eggs slapped back-to-back, so you've only made the top half. A huge number of stars are in the central bulge of the yoke, with a giant black hole in the middle. There are fewer stars in the egg white region. The pepper is where our Solar System is located, though the speck would need to be shrunk 10 000 times to give its real scale. Imagine you've shrunk and are inside the yoke looking around. You see stars in every direction, so your entire



sky would be filled with their light. We don't see that in our night sky. Now imagine you are on the pepper and looking around. If you look towards the yoke, you'll see lots of stars, but only in a narrow band. If you look over your left or right shoulder or away from the yoke across the egg white, you see very few stars. If you look up or down, you'd see few. This is what we see in the night sky. The Milky Way is seen to be a thin band of light with far fewer stars in all other directions.

The View from Orbit

Explore satellite images with your computer or mobile device, and maybe discover the unknown.

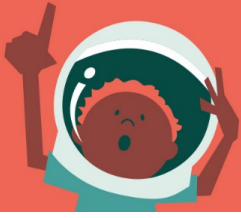
Try this: Run **Google Earth**. Search for famous outback meteorite craters and visit them in *Street View* mode to experience a 360-degree ground panorama. Find Wolfe Creek crater, Henbury crater and Gosses Bluff near Uluru. Then Parkes Observatory, Siding Spring Observatory, Mount Stromlo



Observatory and Tidbinbilla Deep Space Tracking station. You can also try some hard-to-reach and secretive sites. Some countries hide theirs from Google. Have a look for Pine Gap, Woomera, ANSTO in Lucas Heights, and Casey Station in Antarctica. Can you see Scott-Amundsen Base at the South Pole? Where did it go?

Try this: Have some astronaut **docking practice** of your spacecraft with the International Space Station (ISS) in low Earth orbit, using the very realistic SpaceX simulator. Try to impress the crew with your flying skills. It takes a steady hand, a sure eye, and it's not easy.

Try this: Visit **Cloud Free Night** to get the latest weather predictions and satellite images near to you. It's written by volunteer astronomers, is tailored for observers, and uses the detailed Australian ACCESS model by the Bureau of Meteorology. This is more accurate than the coarser global GFS one used by many phone weather apps. Go to the *Meteogram* tab for accurate predictions of when the cloud and rain will clear and see the difference between the two models.



The View from the Backyard with your instrument – your eyes

Try this: Stare at a blank white wall or a blank sky. Did you notice tiny shaped distortions, hairs or blobs in what you see, and they tend to drift downwards while you're staring? These **floaters** are moving tissue in the gel of your eyeball and are normal.



Observers should be aware of staring at something for too long as they can distract your concentration. If you get a sudden big increase in floaters or flashes of light, do be sure to visit your doctor or optometrist.

Try this: Your eye has two types of light sensitive receptors; **cones and rods**. The cones allow you to see colours and details quickly in bright light and are useful during the day. At night, the rods come into play slowly for seeing faint light but without seeing colour. Move from a bright room into a very dark room and you won't see anything for a few minutes until your rods kick in. Look at objects of different colours. Do you notice you can't see the colour? As you sit in darkness, your eyes "dark adapt" over 15 minutes before you can see the faintest of objects. If you then read something under a white light, such as on your phone or TV, you lose this night vision.

Put a pirate's patch on one eye and wait to become dark adapted. Walk into a bright room then back into the dark room. Your uncovered eye will be blinded initially, but if you remove the eyepatch your other eye will immediately be able to see. Pirates didn't all have bad eyesight, but rather knew this trick for going safely between a deck in daylight and the darkness below-deck.

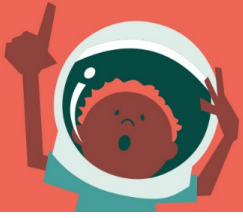
Try this: Look at something in the dark that is barely visible to you. Then look slightly above it or to one side of it but keep concentrating on the thing. It's easily seen. This is known as **averted vision** and allows you to see fainter objects because your eye has an interfering blindspot if you look directly at something. Another technique is to scan your eyes left and right, rather than using a fixed stare at a faint object. This keeps it fresh in your vision.

Remember to breathe normally because many people, without realising it, will hold their breath when trying to see a faint object, and the reduced oxygen will interfere or even cause you to faint.

Food has been tried for seeing at night. Carrots were first reported for this during World War 2. Try eating some to see if it is a myth. Many astronomers like chocolate; for better night vision of course.

Citizen Science

There are many science projects where researchers seek the help of the public, usually doing tasks in a web browser using remote programs or using your computer's spare time with downloaded software and data. A famous one is SETI@Home that allows you to search for signs of extraterrestrial intelligence in signals received by radio telescopes. Many others exist in all sciences. Generally, some caution is needed for IT bugs, you must always keep your malware protection up-to-date, have a backup of your computer files just in case, and expect to use more electricity and data usage in a month than normal. But it can be great fun.



Resources

Google Earth: www.google.com/earth/ in a web browser or use their app.

Restricted sites: www.traveller.com.au/off-limits-10-places-you-will-never-go-in-australia-20dqi/

ISS docking simulator: <https://iss-sim.spacex.com/>

Cloud Free Night: www.cloudfreenight.com

Citizen Science: www.zooniverse.org and www.scienceunited.org