Hi this is Steve Nerlich from Cheap Astronomy www.cheapastro.com and this is *A Day on the ISS.*

First – a quick preamble. Here at Cheap Astronomy we acknowledge that people go to the toilet in space and we acknowledge that there is some clever infrastructure which allows that to take place. That's really all that needs to be said on the subject - thank you.

Now sleeping in space - that's interesting. A day on the International Space Station generally involves 16 sun rises, but is nonetheless timed to fit a 24 hour cycle of work and rest since this time period seems to be hard-wired into the average human brain – and it makes life easier for ground control. So, the ISS crew aim to sleep for 8 hours out of every 24 hours, using sleeping bags to stop their arms and legs flailing about, the sleeping bag being attached to a hook on the wall to stop the astronauts being suctioned up to one of the air conditioning inlet ducts. And when I say a hook on the wall… the wall, floor and ceiling are just arbitrary surfaces when you are in microgravity – in the same way that the directions up and down are really just arbitrary.

What is important is that you position your face near an air conditioning outlet duct. Warm air rises on Earth because its lower density means it is quickly displaced upwards by colder denser air being compressed downwards by gravity. However, in microgravity warm air just occupies whatever space it occupies. So, you need to sleep in front of a fan to avoid becoming immersed in a bubble of your own exhaled carbon dioxide.

When you awake after an eight hour sleep, washing and brushing your teeth are also a little problematic. Astronauts can wash with soap and water, but what they can't do is rinse. Splashing fresh water onto their face just puts more water onto their face, since there's no gravity to make it fall back down into a basin. The solution is two wash cloths, one to put the soap and water on and another one to rinse them off again. Astronauts can also clean their teeth in space but the last thing they want to do is spit out, since this will just leave an unsightly glob of fluoridated saliva hanging in the air. The solution is either suction or swallow.

Without needing to dwell on its various sources, as much fluid as possible is recycled on the station. However, standard distillation techniques involving heating fluid to extract purified steam, leaving the remaining detritus behind – also doesn't work in microgravity. If you heat water in microgravity it will turn into steam, but the steam won't rise. It will just hang around, mixed in with all the same stuff it was mixed in with when it was in a fluid state. The solution is to spin the distiller fast enough so that all the denser, heavier yucky stuff is flung to the sides, while the purified steam accumulates in the centre where it can be extracted by suction and filtration.

Water is such an important resource on the station because, as well as being used for drinking and washing, water (also known as H_2O) is an important source of breathable oxygen on the station. Using electricity supplied by the station's huge solar arrays, water can be electrolysed into hydrogen and oxygen. The hydrogen is just vented into space while the oxygen is added to the station's internal atmosphere.

The station's internal atmosphere is maintained at the atmospheric pressure of Earth at sea level, which also known as one atmosphere. The air mix also approximates that of Earth's being 78% nitrogen and 21% oxygen. There is little need to humidify the air that the astronauts breathe, since in microgravity there is nothing to drain fluid away from an astronaut's head and the excess of fluid in the linings of their sinuses effectively humidifies the air they breathe – although this does leave the astronauts with the feeling of a constant head cold.

In between the 8 hour sleep periods, an astronaut's working day is 16 hours long with meal breaks and maybe an hour's recreation time – but at least they don't have to commute to work. Two hours of exercise a day is also required, which is not exactly recreation time, but they can at least listen to some music… or some cheap podcasts maybe.

Exercise in microgravity is all about working against resistance, as a way of simulating the effect of gravity on muscles and bones. For example, astronauts may run on a treadmill wearing a compression harness which offers a degree of resistance for them to push against. In the absence of such exertions, the conservative metabolism of the human body is likely to start reclaiming calcium from bones, leading to a type of osteoporosis – and the absence of exercise will also tend to make unused muscle diminish in size, strength and flexibility.

Now, if you are you into extreme sports, few things can match an EVA, an extra vehicular activity, which is often inappropriately named a *space walk*, since something astronauts almost never do in space is walk – indeed the things they find almost immediately unnecessary in space are their legs.

Of course, when they do an EVA, they need a space suit. One of the key purposes of a space suit is to prevent your blood from boiling, not because of any temperature change, but because it's atmospheric pressure that is keeping gases dissolved in your blood, dissolved in your blood. Remove that pressure, and those gases will return to a gaseous state forming obstructive bubbles in your circulatory system – which will, after a short but excruciatingly painful period, kill you.

However, if you try to do an EVA with one atmosphere of pressure in your space suit you will be floating around like a Michelin Man, struggling to bend a knee, an elbow or even a finger joint. The solution is to adapt to breathing an atmosphere of 100% oxygen, since the only part of our atmosphere that we need to stay alive is that 21% oxygen, so by filling your suit only with oxygen you can stay alive at a much lower pressure – and also move more effectively in your space suit.

The pressure maintained in the space suits used by ISS astronauts is about 30% of one atmosphere – which is about the same air pressure that you would experience on the top of Mt Everest. But astronauts do have to be very careful in moving from the ISS' standard pressure of one atmosphere into a space suit with a pressure of 30% of one atmosphere. Essentially, the astronaut has to do the reverse of what scuba divers do – they have to decompress *before* getting into their space suit, otherwise the nitrogen in their blood will quickly bubble out and give them the bends.

If the need is urgent, this decompression process can be carried out within about two and a half hours – by moving an astronaut into an airlock and putting them through graduated decompression steps, while they breathe an atmosphere of 100% oxygen and slowly breathe off that nitrogen that's dissolved in their blood. Alternatively, if there's more time to play with, astronauts will generally just 'camp out' in the airlock the night before their EVA giving them much more time to breathe off nitrogen in a more relaxed fashion.

And perhaps it's just as well that the astronauts are breathing 100% oxygen, because doing an EVA is a *very* aerobic exercise. Conducting complex mechanical tasks during an EVA has been likened to trying to change a tyre while on roller-skates, wearing two pairs of ski gloves and a backpack. However, with the assistance of the Canadarm to get them around the station, various mechanical assist devices and even a few simple robots the workload of an EVA is made – if not easier – at least, more efficient.

And of course, after such a busy day, the ISS astronauts look forward to nothing so much as hooking themselves up to the wall again for a well deserved rest.

Thanks for listening. This is Steve Nerlich from Cheap Astronomy, www.cheapastro.com. Cheap Astronomy offers an educational website helping you conserve more than just your angular momentum. No ads, no profit, just good science. Bye.