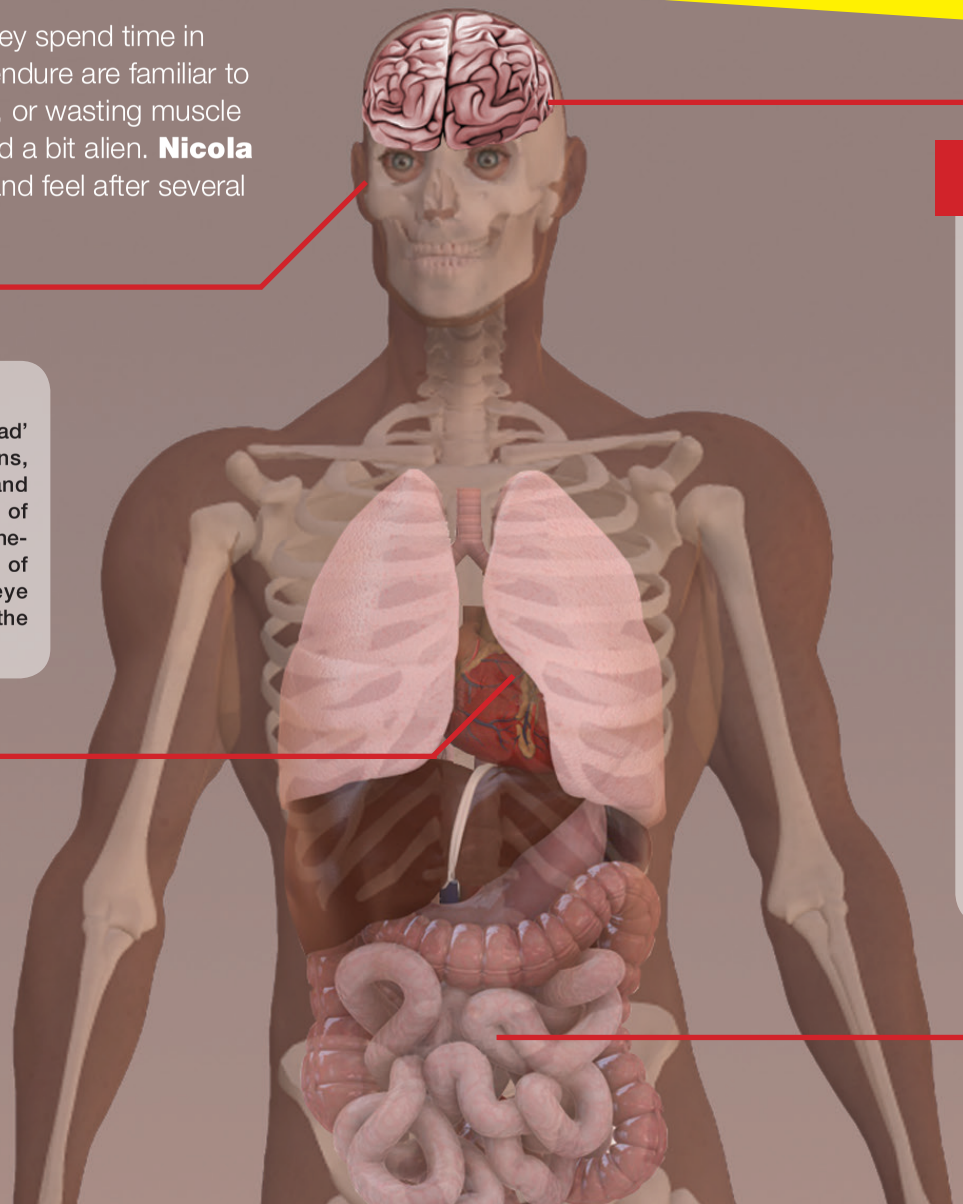
ONE TICKET TO SPACE:

Side effects may include . . .

What happens to an astronaut when they spend time in space? Some of the physical effects they endure are familiar to us – such as motion sickness, congestion, or wasting muscle – but others are completely unexpected and a bit alien. **Nicola Guttridge** explores how you might look and feel after several months in orbit.



EYES

The same fluid shifts around the body that cause 'puffy head' have unexpected and widespread effects in other organs, including the eye. Microgravity subtly changes its shape and redistributes the fluid within it. This results in degradation of both distant and near clarity of vision in approximately one-third of astronauts on short-term missions and two-thirds of those on longer-term missions, along with changes to eye shape and nerves. Some of these alterations remain after the astronauts return to Earth.

HEART AND CIRCULATION

'Puffy head' is actually a by-product of the cardiovascular system. On Earth, the heart works hard to pump blood from our feet and extremities, fighting gravity. In space blood begins to shift upwards, but our heart continues to drag it up from our lower body as on Earth. This means that fluid pools in the upper parts of the body, alongside a rise in heart rate and blood pressure. Gravitational changes also affect the shape of individual red blood cells. They become more spherical, meaning that fewer of them can fit in

HEAD

The predominant factor affecting the human body during spaceflight is weightlessness. The sudden sloshing of body fluid up into the upper body results in a congested and swollen – or 'puffy' – head, which also affects the senses of smell and taste. As a result, travellers often lose their appetites or cannot taste food as strongly. The journey up into orbit has effects that add to this, causing motion sickness and affecting concentration.

Both the journey to and time spent in orbit constantly flip our perception of balance, altering where our horizon appears to be. Astronauts often comment that they do not feel as if they are falling, although orbital spaceflight is a constant state of free-fall. Our ears contain organs colloquially referred to as 'gravity receptors', which sense motion and are sensitive to acceleration. Changes in which way is 'up' affect these, and remove the idea that head is 'up', and feet are 'down'. This can lead to the sensation of being upside down, or rapid flips in orientation.

INTERNAL ORGANS

the same blood volume.

These effects cause there to be a higher density of red blood cells in our vessels and the body stops producing them. As a result, astronauts return with a form of anaemia, even if they have only been in space for a matter of days.

MUSCLE

Problems such as muscle atrophy and bone wasting have led to the symptoms of microgravity spaceflight being likened to the effects of aging. Limbs and muscles that are in use constantly on Earth are barely used at all in spaceflight, causing them to waste and weaken. To combat this, astronauts are advised to exercise for several hours per day. However, this in itself becomes an issue; they need to be awkwardly strapped into bikes or treadmills, and often spacecraft do not carry enough water to allow their passengers to shower regularly, adding to an astronaut's discomfort.

BONE

Astronauts come back to Earth having lost both muscle and bone. Studies have shown that astronauts lose bone mass at a rate of approximately one percent each month for the duration of their trip. This loss of bone can have serious consequences; it increases the amount of calcium in the blood, which in turn increases the risk of kidney stones.

Microgravity does not compress the spine, causing it to stretch out and grow taller by a couple of inches as our tendons and ligaments relax. While this may initially sound ideal for those who would wish to gain some height, it causes an incredibly sore back that returns when the astronaut has returned to normal gravity. Along with kidney stones, loss and weakening of bone can lead to fractures and frailty, particularly around the pelvis, similar to osteoporosis on Earth. Women are more susceptible to bone loss than men; while some suggest all-female crews may alleviate social and emotional tensions, they may suffer more physically.

▲ AN graphic by Greg Smye–Rumsby.

Perhaps the most embarrassing of the effects begins on the launch pad. Laid backwards with your feet above your head, liquids begin to shift and your brain registers an abundance of fluid in the body. It therefore signals the need to urinate; astronauts wear an absorbent nappy when they take off as they can lose a litre or so of urine, even if they attempt to dehydrate themselves the day before.

When in space, our hormone levels and interactions become altered by these sudden physical changes, meaning that mechanisms such as kidney filtration skyrocket. All the organs experience weightlessness individually and feel as if they are moving upwards within the body. The ribcage and chest expand outwards as our muscles relax, enhancing this effect.

Changed lighting levels and work schedules disrupt 'normal' sleeping patterns, as do heightened levels of stress and anxiety. This all adds up to cause a weakened immune system in astronauts, which is quickly remedied when they return to Earth.

LEGS AND FEET

The same mechanism that causes 'puffy head' conversely causes thinner 'bird legs' to develop. This is exacerbated by muscle and bone wasting.

Similar to the 'gravity receptors' in the ear, we have equivalents in our skin, particularly on the soles of our feet, or other areas that rely on contact with external stimuli to help us gauge our surroundings. The pressure felt by these receptors helps us to establish balance and keep ourselves from being disorientated, which in turn helps to alleviate sickness and vomiting. With this removed, astronauts are often aware of their stomach and experience nausea.

Nicola Guttridge studied astrophysics and is now a freelance writer based in London.