Facilitator Information

(All you need to know about space health to survive the day)

On Earth and in space we must maintain our health to perform our everyday tasks well – from homework to playing ball to mowing the lawn to building a space station. We need to eat well, exercise, stay clean get enough sleep, relax, avoid too much sun, and more! While there are many commonalities for staying healthy shared by children and astronauts, living and working in space puts some unique twists on health issues.

Eat Right!

Eating well-balanced diets contributes to our physical and mental health. According to KidsHealth, each day 9-13 year old girls need:

5 ounce equivalents of grain (for example, 1 cup of cereal); boys need 6 ounces
2 cups of veggies; boys need 2 ½ cups
1 1/2 cups of fruit;
3 cups of milk (or another calcium-rich food);
5 ounce equivalents of meat, beans, fish, and nuts
6 to 8 glasses of water

So is junk food allowed? You bet! You just need to be sure that you are getting a balance of different foods. Astronauts take some special things to eat on board the spacecraft. Favorites include M&Ms, candy bars, and beef jerky.

Astronauts need well-balanced diets as well, but they face some special challenges caused by changes in the way their bodies function in space.

Getting Enough to Eat. Many astronauts find that they are just not as hungry or the food is not as appetizing, or they are too busy to eat when they are in space (sound like familiar Earth-based excuses?!). Most lose about 5% of their weight during a typical Space Station stay of 4 to 6 months. To help ensure appetizing menus, well before blasting off into space, the astronauts taste-test the food and select their personal menus.

Wanted: Calcium. Our bones form the support structure of our bodies. They protect our organs, help us to move around, store minerals, and produce blood cells. Our bone is living material made of cells and organic materials and more than half is made of calcium and phosphorous. Bones are our body's "calcium bank;" calcium is constantly being taken out (resorbed) from the bones to use for other bodily processes. There is a constant balance of osteoblasts, the bone-forming cells, and osteoclasts, the bone resorbing cells, and osteocytes, the bone

maintaining cells. We need to consume lots of calcium to maintain healthy bones, and keep the activity of these three cells in balance.

Under microgravity conditions, calcium becomes even more important because our bodies have no reason to maintain such a robust skeleton; less support is needed when we are not experiencing the pull of Earth's gravity. In space, the lack of gravity signals the osteoclasts to begin breaking down the unnecessary bone and the osteoblasts either don't change or slow their production of new bone. The net result is for a loss of bone mineral.

Astronauts lose 1 to 2% of their bone mass for each month they are in space. This means that they lose 10% of their bone mass in less than a year – on Earth, humans lose 10% of their bone mass after the age of 50 and over a period of 10 years!

Bone mass loss – on Earth or in space - means that bones become weaker, they fracture and break more easily when stressed. To make the challenge to health even more complex, that calcium can be deposited elsewhere in the body and cause problems – like kidney stones. To counter bone mass loss, astronauts eat a diet rich in calcium.

Once the astronauts return to Earth the bone loss stops. Scientists are working to understand if the lost bone is completely replaced and if the new bone is the same strength or weaker than the original. Because space travel has been limited to relatively short visits – the longest has been about 14 months – we are still working to understand the impact on the human body. NASA is testing new exercise equipment and routines, nutrition, medications, and other ways to help to combat the changes to the human body in space.

Vitamin D Dilemma. On Earth our skin uses small amounts of natural ultraviolet radiation to manufacture vitamin D, which – like calcium - is vital to maintaining healthy bones. About 10 minutes of Sun each day allows our skin to make the recommended amount of vitamin D. Going outside to get a little sunshine on their bodies is not a possibility for astronauts! In fact, because they are above Earth's atmosphere, they are exposed to much more dangerous levels of ultraviolet and other radiation from the Sun than we are on Earth's surface. To work outside in the space environment, astronauts have to wear space suits. In addition to providing life support, the suits also serve to cover their bodies and shield them from ultraviolet radiation. Their space helmets are equipped with special visors that filter out ultraviolet radiation and protect their eyes. So, back to the vitamin D issue… because astronauts cannot produce vitamin D naturally from sun exposure, they take supplements to help with this issue. NASA scientists are preparing a study at the South Pole to investigate what amount of supplement is required for individuals spending months without ultraviolet light exposure.

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Healthy Hydration: Water makes up about 2/3 of our weight. Our cells need water to create the chemical reactions that sustain us and water in our blood helps our circulatory system carry nutrients. Water helps to carry toxins out of our bodies. Everyone – including astronauts - loses water when we sweat, go to the bathroom, and even when we breathe. Astronauts, like children on Earth, have to drink lots of water to keep their bodies functioning well. Six to 8 glasses of water are recommended for children each day.

Exercise!

Exercise keeps our heart healthy, makes our muscles and bones stronger, keeps us flexible, and makes us feel better all around. On Earth, gravity pulls against us when we walk, run, and play ball – this makes our muscles work hard – and keeps them strong! It also stresses our bones and tells our bone cells to continue to make more bone. But in space, astronauts float around and don't have to use their muscles nearly as much and they don't need their bones to help support them. Because astronauts don't need as much muscle and bone in space, their body stops maintaining them – their muscles atrophy (even their heart muscles get smaller because the heart does not have to pump as hard in microgravity) and their bones deteriorate. Astronauts have to exercise – almost 2 hours a day! – to make their muscles and bones physically work and stay healthy for their return to Earth.

What kind of exercises do astronauts do? They perform "resistive" exercises; they pull against the exercise machines in various ways – making it seem like they are lifting weights with their arms and legs. They also pedal on a recumbent stationary bicycle and walk and run on a treadmill.

Stay Clean!

Staying clean helps to prevent the spread of germs and diseases – at home or in space. On Earth, this means bathing, washing our hands, brushing our teeth, and wiping dirty surfaces with disinfectant. In space, it means the same thing, only different ways to do so! You cannot have free-flowing water in space; in microgravity, the water does not simply flow down the drain! Astronauts use sanitizing wipes to keep their bodies and hands clean. They use rinse-less shampoo to wash their hair; just rub it in and towel it off! To brush their teeth astronauts can either swallow the toothpaste (yuck) or spit it into a wipe or cloth. Dishes and surfaces are cleaned with sanitized wipes.

Sleep Well!

Getting plenty of sleep helps our bodies to rest and recover from activity and keeps our brains thinking clearly when we are awake. Eight hours is the recommended number of hours of sleep each day for children and for astronauts! However, children often are tucked into their beds and astronauts are *strapped* into theirs. In microgravity astronauts float; their movements need to be restricted so that they do not bump into places they shouldn't. Like on Earth, it can be hard to get a full 8 hours of sleep in space. For starters, it is rather exciting to be in space? Daylight is also an issue; because the Space Station is going around Earth at a high rate of speed, the Sun rises every 90 minutes. This pattern of darkness and sunlight can be disruptive to sleep; astronauts pack sleep masks. Physical changes that the astronauts' bodies go through in space – lengthening of their spines, shifting of their fluids – can cause discomfort that prohibits sleep as well. And finally, sometimes the job underway requires the crew to work shifts; it's hard to sleep when your team mates are banging around and talking! Once the astronauts are back on Earth, their sleep patterns return to normal.

Use Sun Block!

Our Sun provides heat and light – things we need and enjoy on Earth! But it also produces other types of energy, some of which is dangerous to humans and other organisms because it can damage our tissue. Much – not all – of this dangerous radiation is filtered by our atmosphere. Some ultraviolet radiation passes through our atmosphere. While we cannot see or feel this high energy ultraviolet energy, it interacts with our tissue. On the plus side, it helps our skin manufacture vitamin D, a necessary vitamin for bone production and immune system health. However, too much ultraviolet radiation causes our skin to burn. On Earth, we can protect ourselves by wearing clothing, using sun block, and staying out of the Sun.

Astronauts work above Earth's protective atmosphere and are exposed to high levels of ultraviolet radiation and other radiation such as high energy X-rays, and gamma-rays and even more dangerous cosmic rays. Ultraviolet radiation is not as much of a concern; they work in spacecraft that have special shielding, wear special suits when they work outside of the spaceship, and even have special visors to protect their eyes. This equipment has been coated with special UV-blockers. However, some high energy radiation can still pass through the shielding. Astronauts receive 10x the amount of radiation exposure as we do on Earth. Such high exposure can damage the immune system, causing astronauts to be susceptible to infection while in space. Long-term exposure can damage cells and DNA, leading to cataracts and cancers. Astronauts wear instruments, called dosimeters, that monitor how much radiation each of them has received. Once they reach certain levels, they do not continue to work in space.

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