UK SPACE AGENCY

esero

esa

MISSION X

TRAIN LIKE AN ASTRONAUT

ACTIVITY GUIDE

Tim Peake, British ESA Astronaut

What does your job involve?

Most astronauts train for a 6-month mission to the International Space Station (ISS). This requires an intimate knowledge and understanding of several space vehicles. The main purpose of the ISS is to conduct scientific research and this also requires a lot of training. Astronauts need to understand the science involved and work the equipment in the different laboratories. They also need to maintain the ISS, which can mean fixing the toilet, performing a spacewalk or repairing a solar array. Astronauts are only a very small part of the huge international team that works round the clock to support the ISS and so astronauts also need to be good at teamwork and communication.

What do you do in a typical day?

There is no such thing as a typical day! Training occurs in 'blocks'. You may travel to Star City near Moscow where you will spend four weeks learning about the spacecraft, and then to Houston for a few weeks training on the Space Station systems and then to Japan for a couple of weeks to learn how to operate the laboratory. Until launch, this cycle continues for about two and a half years once assigned to a mission.

What is the most exciting aspect of your work?

Travel to space provides a constant source of excitement! However, so does having the privilege of meeting so many experienced people in the space industry from flown astronauts, instructors and flight controllers to engineers and technicians. Everyone I work with is highly motivated and focused on a common goal, which creates a very positive work environment. I've found the advanced first aid and human physiology experiments especially fascinating.

Why is what you do important?

Living and working in space is not easy – far from it. Space is an incredibly harsh environment that forces us to overcome many challenges by innovation, experimentation and pushing the boundaries of what we consider possible. By doing this we will further our collective knowledge and be able to use this for the benefit and betterment of everyone back on Earth.

What advice would you give to someone considering a career in space?

Find out what it is that really inspires and excites you, and follow this path. For me, it was an early passion for aviation that led to A-Levels in Physics, Mathematics, Chemistry and then a career as a military pilot. This was prior to becoming a test pilot and gaining a degree in flight dynamics later in life. Often experience and knowledge gained in one sector of industry will also be extremely valuable in another. Keep all options open and explore opportunities when they arise such as Mission X.

UK SPACE AGENCY

Find out about the work of the UK Space Agency, and the companies and people in the UK who are involved in the space sector. For starters head to the Agency's Twitter page (@spacegovuk), website (www.gov.uk/ukspaceagency), Flickr photostream (spacegovuk) and YouTube channel (spacegovuk). Check out the ESERO-UK website too (www.stem.org.uk/esero)

The UK Space Agency is based in Swindon, Wiltshire, but also has offices in London and the UK Space Gateway in Oxfordshire. The UK Space Agency has a number of roles including co-ordinating UK civil space activity, encouraging academic research and supporting UK space industry. It aims to tell the story of the UK space sector, increasing understanding of space science and how we use space in our everyday lives. The Agency helps to inspire the next generation of UK scientists and engineers, through programmes like Mission X: Train Like an Astronaut. It raises the profile of UK space activities and home and abroad, representing the UK space sector at an international level, for example in promoting co-operation in the European Space Programme. The Agency also licences the launch and operation of UK spacecraft.

Cosmic Help at Hand

The mission card headings provide links to more details about each activity. There are lots of organisations who are keen to help you with your missions and provide additional resources, these include:

The UK Space Education Resource Office	www.stem.org.uk/esero
ESAKids	www.esa.int/kids/en/home
The Association of Science and Discover Centres (ASDC)	www.exploreyouruniverse.org
Universe Awareness	www.unawe.org
The Royal Aeronautical Society (RAES)	www.aerosociety.com/Careers-Education/coolaeronautics
ESA Education	www.esa.int/Education
World Space Week	www.worldspaceweek.org
UKSEDS	www.ukseds.org/outreach/
The National Space Centre	www.spacecentre.co.uk
The Royal Observatory Greenwich	www.rmg.co.uk/royal-observatory
The British Interplanetary Society	www.bis-space.com
The Royal Observatory Edinburgh	www.roe.ac.uk
The Royal Astronomical Society	www.ras.org.uk
The Science Museum	www.sciencemuseum.org.uk

There are some great video and photographic resources available on YouTube including:

spacegovuk • ESA • ReelNASA • Chris Hadfield • NASA Edge

Principia www.principia.org.uk **Principia Space Diary** principiaspacediary.org

Social Distancing

Thriving in space requires being able to cope with social distancing and being in quarantine. When you are away not just from Earth but from friends and families for long periods of time. Astronauts have lots of ways of coping and not just surviving but thriving in space. Astronauts recommend:

- Thinking about the bigger picture
- Scheduling eating and sleeping
- Keeping busy with work
- Exercising regularly – even if it is in a confined space
- Eating well
- Helping colleagues
- Taking time to look out of the window and to appreciate the beauty around them
- Learning new skills – making films, performing magic tricks
- Connecting with friends and family
- And having fun – many astronauts have dress down Fridays

BASE STATION WALKBACK!

Mission Challenge

Aim to increase your walking distance to 6.2 miles, or 10 km the equivalent of the NASA Base Station Walk-Back limit. Try skipping, cycling or running instead. How far can you cycle and still comfortably get back to base? How far did you walk, cycle, skip or run?

Space Fact

Astronauts may need to explore the cratered Moon or rocky terrain of Mars. They use vehicles like hi-tech Go-karts (called rovers) to help carry samples and astronauts. NASA sets a limit of 6.2 miles on how far a rover can be driven from its base station. Crew members must be capable of walking the 6.2 miles back to their base station, taking into consideration limits such as oxygen supply.

MISSION ACTIVITY

AGILITY ASTRO COURSE

Mission Challenge

Complete an agility course to improve movement skills, co-ordination, and speed. Record your speed and see if you can get faster with practise.

Space Fact

Astronauts lose agility while spending time in space because they are floating around and don‘t have to change direction quickly. Astronauts work with NASA’s Astronaut Strength, Conditioning & Rehabilitation (ASCR) specialists, who provide them with one-on-one pre-flight and post-flight conditioning activities. To help astronauts recover their agility after a mission, they run through an agility course that tests their speed, reaction time and hand-eye co-ordination.

Agility is the ability to rapidly change direction without loss of speed, balance or control. Agility training reduces your risk of injury, stops you getting out of breath and gives you the flexibility to deal with a range of physical challenges. Just like an athlete, astronauts must do strength and agility training to perform better in space and on their return to Earth.

MISSION ACTIVITY

JUMP FOR THE MOON

Mission Challenge

Skip on the spot for 60 seconds without stopping. Rest for 30 seconds. Repeat three times. Vary and extend by adding jumping jacks, travelling forward, and by increasing length of time.

Space Fact

On Earth, humans experience the effects of gravity as a constant force pulling on the human body. The constant force is essential for building healthy strong bodies. Bones can be made stronger by weight-bearing activities such as jumping, walking, running or dancing. This is especially important when we are young as this is when our skeletons are most responsive to exercise. Astronauts train to ensure their bones are strong enough for the mission. Once in space, bones in the lower torso and legs are most affected by the reduced gravity. NASA engineers “artificially load” astronauts by providing harnesses for them to wear that strap them to treadmills while they exercise. On Earth, astronauts continue to exercise and eat properly in order to build up their bone strength. They have their bone mineral density (BMD) checked for up to three years after they return.

MISSION ACTIVITY

Peake Liftoff!

Why not add space-style burpees to your astronaut training programmes.

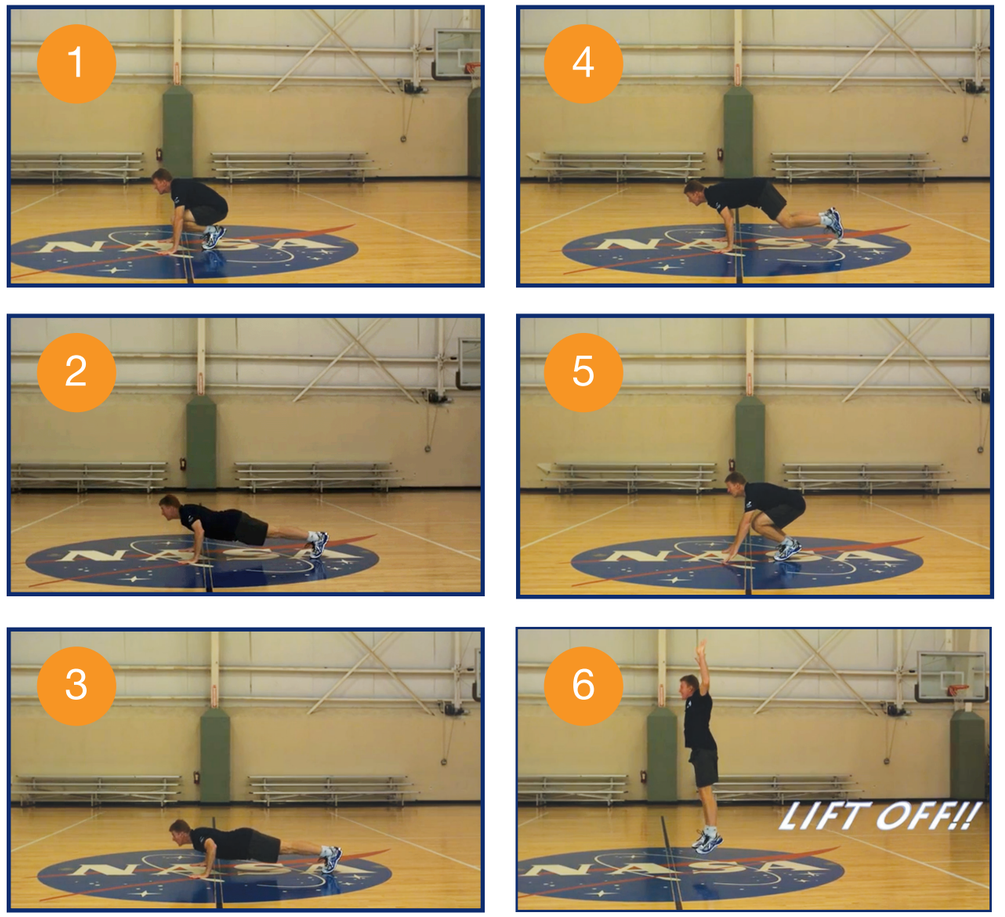
In Peake Liftoff you will perform a burpee. This is an activity that is designed to promote a combination of muscular strength, agility, coordination and endurance. The burpee blends together squats, pushups, and jumping in the air!

Being physically active is an important way to keep your muscles strong and your heart and lungs healthy. To produce the complex motions we need in life, it is important to work many muscles together. As you move during the day, such as to and from class at school, your muscles, heart, and lungs benefit. They get stronger by being worked for long periods of time.

Many movements require a coordinated effort between the brain and different muscles to perform complex actions. Muscle flexibility can help reduce risk of injury and activities such as jumping can help you strengthen your bones.

Put it all together in a Peake Liftoff!

Watch Tim demonstrating them in the introductory video for Mission Walk around the Earth:
https://youtu.be/utaBPMerOxA



CREW STRENGTH TRAINING

Mission Challenge

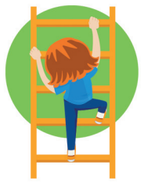
Perform multi-joint weight-bearing exercises such as body-weight squats for lower body strength, and push-ups to develop upper and lower body strength. Push-ups should be done with arms extended (but not locked), and level with the chest. Students who cannot do standard push-ups should begin with bent-knee push-ups (knees on the ground)

Space Fact

NASA researchers are working to lessen hazardous muscle atrophy (muscle wasting) and loss of bone density in astronauts on long space flights. The crew must be in top physical condition to complete its mission. Astronauts also need strong muscles and bones to explore a lunar or Martian surface. They must be able to lift, bend, build, manoeuvre and even exercise. If a crew member trips or falls, muscle and bone strength can make the difference between returning to work, or ending the mission and returning to Earth. On Earth, strong muscles and bones are important to health and physical fitness. Severe muscle atrophy or bone loss in space could mean crew members might fail to recover their pre-flight physical condition when they get back to Earth.

MISSION ACTIVITY

LET'S CLIMB A MARTIAN MOUNTAIN



Mission Challenge

Climb a wall bar, hanging rope, playground equipment or rock wall as high as you can and touch the highest bar. Descend safely. Climb a hill, stairs or use a step machine.

Space Fact

During the basic training, and sometimes in preparation for a space mission, astronauts perform activities aimed at strengthening upper body muscles, whole body stability and balance, flexibility, and agility. Astronauts mostly train on artificial walls. ESA astronaut Paolo Nespoli is keen on rock climbing and he is not the only one. NASA astronaut Scott Parazynski said that 'one of the best ways to prepare for a spacewalk is rock climbing. It takes a lot of strength and endurance'. Similarly in preparation for a space mission, climbing activities require training, a mental focus and physical fitness. Planets of the Solar System feature impressive mountains. Olympus Mons on Mars is the tallest mountain in the Solar System: it is 3 times as tall as Mount Everest!

MISSION ACTIVITY

GET ON YOUR SPACE BIKE

Mission Challenge

Try to cycle as far as you can on static exercise bikes. Cycle to school or in your free time and record the distances.

Space Fact

One exercise that has been used by astronauts on the International Space Station for over 10 years is the cycle ergometer (CEVIS). Russians have a cycle called VELO. Muscle and bones do less work in weightlessness and this causes them to get weaker. Training with a cycle improves leg muscles, cardiovascular fitness and endurance. It also improves co-ordination, posture and balance.

Distance to Space	100 km
Average distance to ISS	400 km
Distance to Moon	384,400 km
Average distance to Mars	225 million km

MISSION ACTIVITY

MEET THE EXERCISE MACHINES

NASA has designed specialised exercise equipment for the ISS, including the Advanced Resistive Exercise Device (ARED) and the Combined Operational Load-Bearing External Resistance Treadmill (COLBERT). Each astronaut has a customised workout on the ARED to exercise the upper and lower body. The COLBERT is a new generation treadmill on the ISS. It is designed to exercise the walking and running muscles that otherwise go unused in space. COLBERT has data collection devices that show how successful exercise on the treadmill is at reducing bone and muscle loss.

Crew members also follow an exercise routine, using a cycle called an ergometer, which is similar to an exercise bike. They also use elastic exercise aids like theraband and theratubing for strength training, similar to lifting weights here on Earth.

FACT CARD

MISSION CONTROL

Mission Challenge

Bounce a tennis ball off a wall while balancing on one foot. How long are you able to balance? Does it get easier as you practice? What organs do you use to help you gain your balance? Why can't astronauts practice their balance in space?

Space Fact

On Earth we use lots of clues to sense the position of our bodies. We use touch and pressure cues such as the weight we exert on our feet when standing and visual cues (such as ceilings and floors). Our sense of being upright is determined by the pull of gravity, sensed by the balance organs of our inner ears. In low gravity the brain must relearn how to use these sensory signals. As astronauts free float there are no pressure cues on the bottoms of their feet and no distinct ceilings or floors The balance organs of the inner ear are no longer subject to the familiar gravitational pull. As they adjust, astronauts may experience disorientation and nausea. When they return to Earth, they must relearn the cues of a higher gravity environment. Driving a car or flying a plane will be off limits until the astronauts sense of balance and spacial awareness readjusts.

MISSION ACTIVITY

EXPLORE AND DISCOVER

Mission Challenge

Pick up mission samples (balls of different weights from six base stations) in a set time.

Space Fact

Exercise is essential for astronauts. They feel weightless, so moving around is effortless and their muscles become weaker. Astronauts also experience decreased bone density, heart and blood vessel changes and shifts in fluids. To counteract these changes, astronauts must perform aerobic and anaerobic exercises in space. The International Space Station (ISS) has exercise equipment adapted to work in a microgravity environment.

Aerobic exercise uses oxygen to produce energy. It includes activity that uses repetitive motion of arms and legs for at least 20 minutes. Aerobic activity reduces stress, increases blood circulation, strengthens the heart and lungs and builds up endurance. It strengthens bones, burns fat, and lowers blood sugar. Anaerobic exercise makes the body produce energy without using oxygen. It builds agility, as well as strengthening and toning muscles.

MISSION ACTIVITY

Speed of Light

Name:

	Light-years Ahead	Lightning Fast	Fast	Better Luck Next Mission
Test 1				
Test 2				
Test 3				
Test 4				

Median | Mode | Mean

SPEED OF LIGHT

Mission Challenge

Hold a ruler or speed of light indicator, test your reaction times by working in pairs with one student holding the ruler at the zero mark between the thumb and forefinger. The first student drops the ruler and the second tries to catch it. Repeat as many times as you can to see if your reaction times improve. See if your performance changes after physical exercise or after squeezing a stress ball.

Space Fact

Astronauts preparing for Extra-Vehicular Activities (EVAs) or robotic arm operations, test their skills in the Virtual Reality Laboratory (VR) at NASA's Johnson Space Centre in a virtual reality microgravity environment. Wearing special gloves, video-display helmets, chest packs, and controllers, astronauts learn how to orient themselves in space, where ideas of up and down are meaningless and even a minor tweak with a thruster can send you spinning into the void. The Jake Garn Training Centre at NASA's Johnson Space Centre is where astronauts prepare for operations using a space station simulator. A motion-based trainer simulates the vibrations, noise and views that the astronauts experience during a launch or landing and pilots test out their reaction times and problem solving skills.

MISSION ACTIVITY

SPACE ROCK 'N' ROLL

Mission Challenge

Perform somersaults on a mat. Then perform more advance somersaults through a hula hoop. See how many somersaults you can complete. Remember to do the exercise well rather than fast.

Space Fact

In space, astronauts can perform spectacular rolls. On the International Space Station (ISS), astronauts seem to be floating. The astronauts inside the ISS experience microgravity or weightlessness. There's no up or down for them. Therefore astronauts can easily do acrobatics and they can do a series of somersaults without any particular effort. In order to stop rolling they must reach out to hold onto an object or person. Here on Earth things behave differently. When an acrobat makes a flip, he/she needs to jump high and be quick enough to rotate completely before gravity pulls him/her back to the ground. If you are well trained with somersaults on Earth you are well prepared for amazing flips in space.

MISSION ACTIVITY

CREW ASSEMBLY & SPEED OF LIGHT

Space Fact

To help prepare astronauts for working in a spacesuit and manipulating objects during an EVA, they train in the Neutral Buoyancy Lab (NBL). The NBL is a large pool containing equipment and mock-ups similar to what an astronaut would experience in space. The NBL is 40 feet deep, 202 feet long, 102 feet wide, and contains 6.2 million gallons of water. This watery environment is primarily used to train astronauts for EVAs by simulating microgravity conditions. Suited astronauts are trained by certified divers who show them how to open hatches, use tools, and move in a simulated weightless environment. Dexterity and hand-eye coordination play a major role in performing the training tasks effectively. During NBL training the EVA astronaut wears a training version of the EVA spacesuit designed to be worn underwater. Astronauts only have 6-7 hours of life support during an EVA, so timing, efficiency and teamwork is very important while working in space. As astronauts practice manipulating tools quickly and accurately in their spacesuits they are improving their dexterity and hand-eye coordination for a space mission. One of the selection tasks for Japanese Astronauts is to create 1000's of origami cranes to check their patience, attention to detail and dexterity.

FACT CARD

PLANET YOU GO, GRAVITY YOU FIND

Mission Challenge

Do arm exercises with balls of different weights as if you are in different gravitational conditions. Use medicine balls to strengthen your arms and torso muscles and improve your co-ordination. See how your strength improves over time.

Space Fact

Mass is the amount of matter that makes up an object. It is always the same, but its weight changes depending where, or on which, planet it is.

To be a space explorer of the future you need to be prepared to deal with different gravity environments in our galaxy! Strong abdominal and back muscles, the core muscles, protect your spine, maintain proper posture, and transfer forces through your body for powerful movements such as swinging and throwing. These muscles are engaged as you sit, turn your body, or even just stand still. Strong arm muscles allow you to lift weights easily, without feeling pain and are useful in most sports.

MISSION ACTIVITY

CREW ASSEMBLY

Mission Challenge

Assemble a puzzle as a team under time pressure. Follow instructions to create an origami crane as Japanese astronauts do during selection. Assemble a Lego vehicle or something similar. Attempt these tasks wearing bulky gloves and see how you are able to handle large and small objects. Can you undertake an assembly task underwater?

Space Fact

Astronauts sometimes need to repair large objects in space, such as satellites and solar arrays. This is sometimes carried out during a space walk also known as an Extra-Vehicular Activity (EVA). When assembling or maintaining objects, astronauts must have good dexterity, hand-eye co-ordination and work as a team. They must also be able to manipulate tools and objects while wearing a pressurized spacesuit that includes gloves over their hands. These gloves, worn to protect astronauts from the space environment, can be thick and bulky. They are made so astronauts on an EVA can move their fingers as easily as possible. A piece called a bearing connects the glove to the sleeve allowing the wrist to turn. Astronauts must learn to work with their gloves on to handle both large and small objects.

MISSION ACTIVITY

DO A SPACEWALK

Mission Challenge

Perform “bear crawls” and “crab walks” to strengthen muscles and improve co-ordination

Space Fact

In space, astronauts must perform tasks that require muscle strength and co-ordination, including Extra Vehicular Activities (EVAs) aka spacewalks. On spacewalks, crew members check the outside of their spacecraft or the International Space Station and make repairs or modifications if necessary. They rely on their upper body strength and co-ordination to move around the vehicle.

Although safely tethered to the space vehicle, crew members still have to endure long periods of work and tough conditions. Astronauts must manipulate their fingers inside large, thick gloves, perhaps for hours at a time. A spacewalk also involves co-ordinating arm and leg movements to move around, aka “translate”. Astronauts prepare for EVAs by practising these strenuous tasks underwater, for example in the Neutral Buoyancy Tank at NASA’s Johnson Space Center.

MISSION ACTIVITY

BUILD AN ASTRONAUT CORE

Mission Challenge

Perform “Commander Crunches” (sit-ups) for one minute. Perform “Pilot Planks” (planks). Take one leg and extend to the side. Hold your leg out for 30 seconds. Try this with both legs, one leg at a time. Perform side heel-touches for one minute.

Space Fact

Astronauts must have strong core muscles to control their movement in the microgravity of space. On spacewalks aka EVAs, they may work in their spacesuits for six hours or more, bending, twisting and lifting. Astronauts perform workouts to keep their core muscles strong in space. On Earth, we are always moving against the force of gravity, as our muscles and bones support our bodies. In the microgravity of space, the body does not need the support of muscles and bones. With lack of use the core muscles become weaker. Astronauts who stay on the ISS for several months work out for a minimum of six days a week for at least two hours a day. Core strength powers all your movements. Your abdomen and back muscles work together to support your spine when you sit, stand, bend over, pick things up and exercise.

MISSION ACTIVITY

ASTRO CROPS

Mission Challenge

In this Space mission themed activity, pupils will observe how seeds grow into mature plants by tracking the development of three unknown seeds. Pupils will also learn to make scientific observations and record data to track the growth of these plants over time before being given the opportunity to interpret and present their results, drawing important conclusions. This activities requires pupils to follow the development of plants for 12 weeks, so a long period of time will need to be allocated.

Space Fact

Six hundred thousand school children planted rocket seeds and compared their growth with rocket seeds flown and grown in space by Tim Peake. The results show that seeds that have been in space grow almost as well as those that have stayed on Earth. It suggests vibrations during launch, temperature fluctuations, cosmic rays and microgravity do not prevent seeds from germinating and growing.

MISSION ACTIVITY

ASTRO FARMER

Mission Challenge

In this set of six activities, pupils will investigate which factors affect plant growth, and relate these factors to growing plants in space. They will learn that plants need air, light, water, nutrients and a stable temperature to grow. Children will also observe what happens to plants when they vary some of these factors. These 6 activities can be done individually or as a set.

Space Fact

Space farms - green houses that use artificial light and hydroponics may grow the crops that future explorers eat. The most likely foods to be grown in space are lettuce, rice, soybeans, peanuts, spinach, and cabbage.

MISSION ACTIVITY

ASTRO FOOD

Mission Challenge

In this set of activities, students will learn about the different components of plants. They will learn which parts of well-known plants are edible and learn the difference between a vegetable, a fruit and a seed. The students will have to imagine and draw the plant associated with the fruit/vegetable/ seed they are observing. They will also learn that different plants require different growth conditions and will give different yields. Based on this they will consider which plants are suitable for growing in space as a good source of nutrition for astronauts.

Space Fact

It's not always obvious what the difference between fruits and vegetable are. Usually fruit contains a seed or seeds and they come from plants. Good examples are strawberries, apples, oranges, melons, and tomatoes. Vegetable typically have leaves, stems, roots, flowers, bulbs and seeds. These include potatoes, peas, beans, cauliflower, garlic, peas.

MISSION ACTIVITY

REDUCED GRAVITY, LOW FAT

Mission Challenge

Find out the hidden fat, sugar and salt content of a cheeseburger and chips. Use the nutrition labels to help you weigh out the amount of fat, sugar and salt in this meal. Alternatively you can mix up the meal with water to create a burger meal soup. Heat the mixture and then cool it down so that you can measure the fat layer.

Space Fact

As astronauts travel to the Moon, Mars, and beyond, the need for nutritionally balanced meals becomes even more important. Dietitians and food scientists analyse the amount of fat inside food packaged for spaceflight and monitor astronaut's consumption of fat while their in space.

MISSION ACTIVITY

Food Fit for Spaceflight

The Energy of an Astronaut

mission fact HOW YOU EAT

Spaceflight food is very different today from the food on the first space missions. The early Mercury programme (1961-1963) included food packaged in bite-sized cubes, freeze-dried powders and semi-liquid foods in aluminium tubes. The menu today is composed mainly of packaged foods that are freeze-dried and thermostabilised (heated and canned), with very little fresh food. However, crew members do plan their own menus with the assistance of a dietitian to include all the nutrients needed for working in space. Spacecraft are equipped with refrigerators and a food warmer for warming up food in pouches or tins.

Astronauts use special trays in space because of the micro-gravity environment. These trays are designed to hold everything in place while food is prepared and eaten. The trays have straps on the back so astronauts can attach them to either the wall or their legs. They also use Velcro to attach food and drink packages. Utensils (including knife, fork, spoon and sometimes most importantly scissors) are held in place using magnets or Velcro straps. The food trays have compartments to hold bowls which snap into place.

mission fact ENERGY OF AN ASTRONAUT

Astronauts must consume sufficient energy (calories) in space to work effectively and maintain good health. Calcium and vitamin D are vital with their beneficial effect on bone, as a low-gravity environment can lead to poor bone health. Many astronauts simply do not consume enough calories because of lack of time, unappetising choices, adverse reactions, or difficulties with actually eating and digesting the food available. A varied, tasty and healthy menu has been shown to decrease stress during space missions, leading to a healthier and better-performing crew.

Nutrition is essential to maintain hydration, bodily functions, and skeletal and muscle condition, especially on long missions. However, food storage space is limited on a spacecraft and the weight of food supplies must be kept low to save launch costs.

mission fact MENUS OF AN ASTRONAUT

Astronauts help to plan their menus by participating in food tasting panels on Earth before their missions. This helps the food scientists learn about the astronaut's preferences while planning balanced menus. One of the most popular food items on an astronaut's menu is the flour tortilla. Tortillas contain large amounts of the carbohydrates our bodies need to function. Tortillas are easily stored and do not produce crumbs. Dried crumbs can get into the ISS's equipment or experiments. Crumbs can even be dangerous if they float into an astronaut's eyes, nose, or mouth. Another popular food is dried fruit similar to the fruit you can find in breakfast cereal.

Astronaut menus are available for each crew member who travels into space. The calories in each menu need to be carefully considered. If astronauts eat more calories than they need, these may be stored as fat. If they don't eat enough calories, they might feel tired, weak or dizzy.

Go to the crew profiles section of this NASA page to find menus.
www.nasa.gov/mission_pages/shuttle/shuttlemissions/sts131/index.html

The Eatwell Plate

Plan and draw a meal for an astronaut, including foods from each food group but minimising foods that are high in fat or sugar.

TASTE IN SPACE

MISSION ACTIVITY

Mission Challenge

Do a food tasting with your eyes blindfolded and with your nose pinched. Write down a description of the food e.g. sweet, sour, spicy, salty or bitter foods and its texture. Repeat but this time noting the sight, taste and smell with your eyes open. Foods such as coffee, apple sauce, yoghurt, lemon juice, ginger biscuits, tortilla, marmalade, crackers, orange juice, curry powder, salsa, horseradish sauce, chutney could be included in the tasting. Check first to see if anyone has allergies.

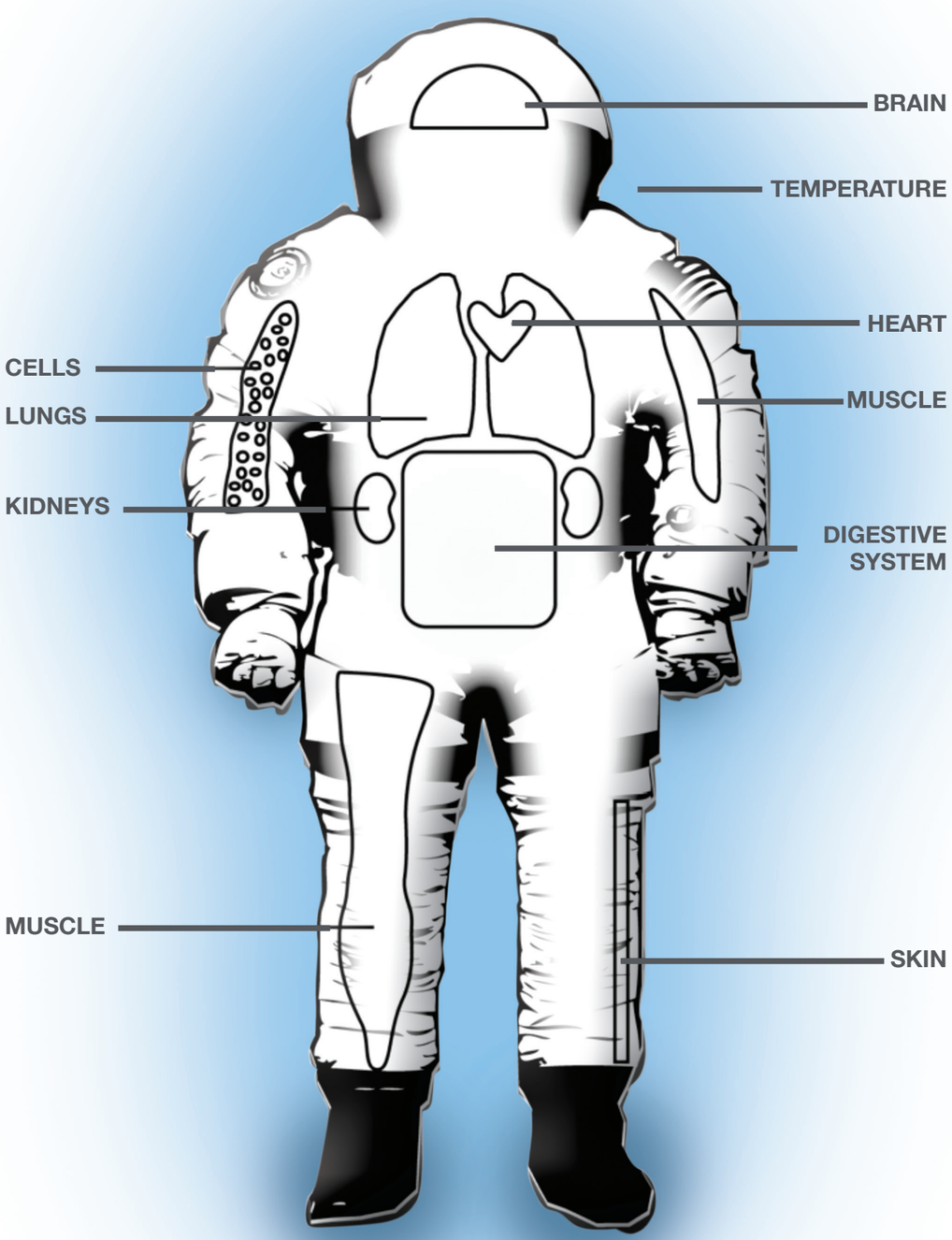
Astronaut Fact

Astronauts taste a variety of foods and drinks and sometimes have special meals designed for them. Tim Peake will be eating food prepared by Heston Blumenthal based on ideas from British school children. Fluid shifts mean that astronauts have a 'stuffy head' and feel like they have a cold. This means that food tastes blander in space. Tim asked for foods which have more seasoning and which will remind him of home. You can find out more about taste in space in this collection of resources prepared as part of the Great British Space dinner competition. http://www.nationalstemcentre.org.uk/elibrary/collection/1937/the-great-british-space-dinner

HYDRATION STATION

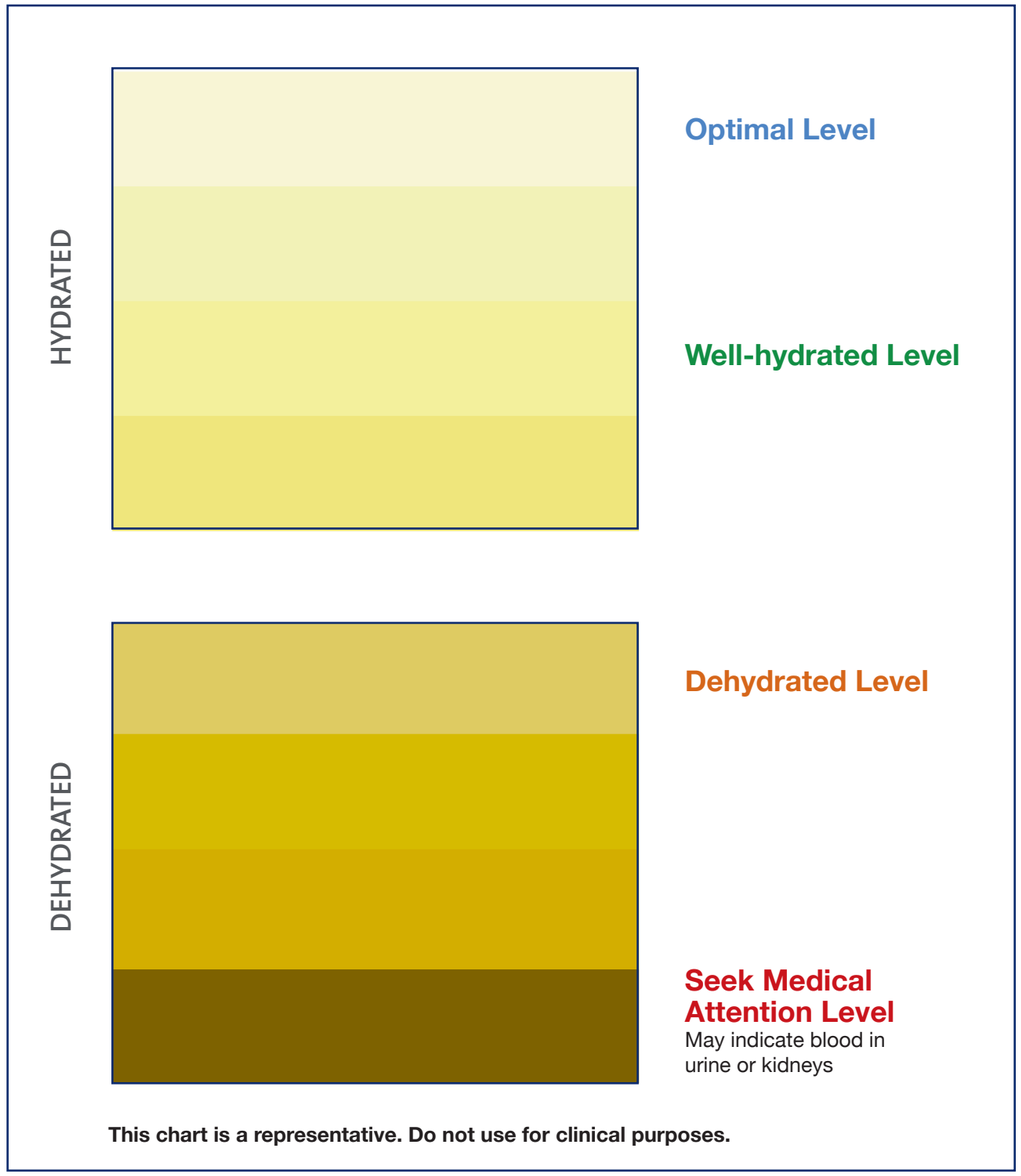
Mission Challenge

What effect does dehydration have on the parts of this astronaut?



Mission Challenge

Using water, apple juice, cranberry juice, food colouring, coffee or tea, create 'samples' of urine that reflect four different hydration levels.



This chart is a representative. Do not use for clinical purposes.

Space Facts – Hydration

As astronauts reach orbit they experience a shift of fluids. The body senses the extra fluid and begins to get rid of what it thinks is excess. This sudden loss of fluids can result in dehydration. Dehydration is a lack of water that can be extremely dangerous. Astronauts' bodies cannot function properly without water. Therefore, when they first enter orbit, astronauts must drink a sufficient amount of water.

Why is hydration important?

The body depends on water for survival. Water makes up more than half the body weight. Every cell, tissue, and organ in your body needs water to function correctly.

Best for hydrating

- Water
- Eat plenty of fruit and vegetables

HYDRATION

Tips for staying hydrated

- Keep a water bottle filled with water
- Drink water before, during and after exercise.
- Start and end your day with a glass of water.
- When feeling hungry, drink water.
- Drink water at a restaurant.
- Add lemon or lime to your water.

Prevent dehydration

Drink adequate amounts of water. The young and elderly are most at risk. During heat waves, attempts should be made to drink plenty of water.

Dehydration

Excessive loss of body fluid. The body does not have enough fluids to function normally.

Causes of dehydration

Diarrhoea
Vomiting
Sweat
Diabetes
Burns
Inability to drink
Fluid shift

Symptoms of dehydration

- Dry mouth
- Sweating may stop
- Eyes reduce tear production
- Muscle cramps
- Nausea and vomiting
- Heart palpitations
- Lightheadedness
- Poor levels of concentration.

12 Hour Hydration Diary

Track your liquid intake for 12 hours. Use your urine colour test chart to categorize your urine. Complete the log in private. Do not bring urine samples into the classroom!

Mission Challenge					
Bathroom Time (hr)	Urine Colour	Urine Category	What I drank	How much I drank	Physical Activity (None, Low, Moderate, High)

Home Food Diary

Day	Date		
Time	Meal	Food/drink description & preparation	Portion size
8am	*Breakfast*	*Unsweetened orange juice* *Cornflakes* *Milk (semi-skimmed)* *Toast* *Banana*	*1 glass* *1 medium bowl* *200ml* *1 slice* *1 piece*

LIVING BONES AND STRONG BONES

Mission Challenge

Draw a diagram of the inside and outside of two bones – one healthy and one unhealthy. You can use pictures or bone samples to help you out. Now make a bone model using only paper, card, sticky tape.

You can add gravel, beads, or straw if you wish to add additional strength. Test the strength of your model bone by loading with weights or textbooks. Identify ways in which you and astronauts can make bones stronger.

LIVING BONES

Astronaut Fact

Astronauts need to be able to walk long distances to explore the Moon or Mars surface, especially if their rover breaks down. This long distance is called a 10 km walk-back (6.2 miles). Astronauts need to keep their bones strong and healthy to perform essential tasks such as this. Bone, a living organ, is broken down and built back up again by special cells inside the bones. It takes 10 years for your entire skeleton to be replaced with new bone! There are two ways to keep your bones healthy: proper diet and resistive exercise. To be most effective, you need to use both methods.

You require calcium and vitamin D to build healthy bones. Calcium is found in milk, cheese and yoghurt, as well as leafy green vegetables. Vitamin D is called the “sunshine vitamin” because regular exposure to sunlight gives your body the vitamin D it needs. Vitamin D is also added to foods such as milk and orange juice.

Gravity pulling on your body, or “loading”, is essential to bone health. Exercise that “loads” your bones is called resistive exercise, for example push-ups, skipping, or pushing against a surface. Astronauts need resistive exercise to keep their bones strong and healthy.

FACT CARD

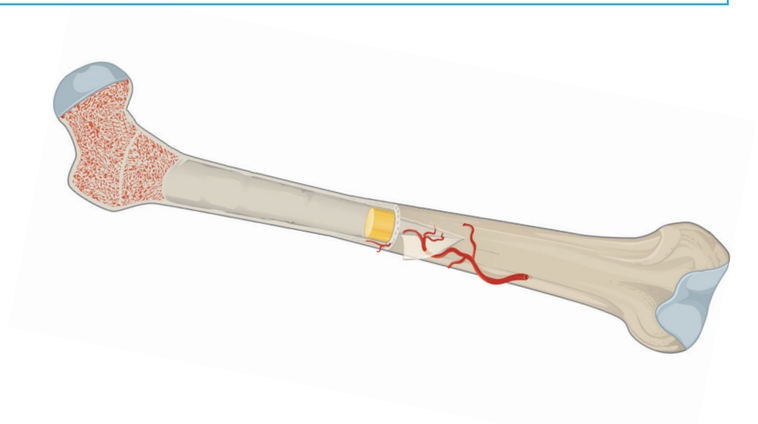
Astro Bones Activity

What features make strong bones?

We predict our bone design will be able to hold:

This is how we prove our prediction:

This is our evidence:



BUGS IN SPACE

Mission Challenge

Create your own microbial box using a sealed bag. Place into the bag items that you think will change over time e.g. bread and items that may not change e.g. coffee beans. Check you are meeting your school health and safety regulations. Think about what microbes are good and how they are used in digestion, medicine and agriculture. Think about in what ways microbes are bad and how they present a danger to health on an off world.

Space Fact

Microbes can also be found aboard the International Space Station (ISS). NASA scientists have reported that some germs on the ISS can increase to a higher number than they do on Earth. Therefore, cleanliness and proper disposal of garbage is an important part of living on the ISS. Astronauts need to clean the International Space Station every Saturday. You can see a link here. Astronauts spend time in quarantine before they go up to the Space Station so they try to minimize the amount of germs they bring into space. Scientists who study microbes are called microbiologists and microbiology is the study of microorganisms or microbes.

MISSION ACTIVITY

SPACE HYGIENE

Space Fact

Keeping clean in space is really important. Saturday mornings are usually set aside for spacecraft cleaning. Keeping their bodies clean is a challenge for astronauts as they don't have running water. Astronauts use dry shampoo, wet wipes, detergent and vacuums to make sure their personal space is as germ free as it can be. Before going into space, astronauts ensure that they are in excellent health. They self-isolate to ensure that they are not exposed to germs and viruses that they could bring into the space station. Put some chocolate powder on your hands. See how carefully you need to clean them with a wet wipe, soap and water or antibacterial gel to get all the powder off your hands. It should take you as long as it takes to sing Happy Birthday twice.

FACT CARD

BIONIC HAND

Mission Challenge

In this activity, pupils will build a bionic hand made out of cardboard, strings, straws and rubber bands. They will relate the bionic hand to their own hand to understand the function of the fingers and the importance of the thumb, to grab or hold objects with different shapes and forms. Pupils will also learn that it would not be possible to move the human hand if it was only composed of bones. The pupils will understand how bones, muscles, tendons and ligaments work, by comparing them with the materials used on the bionic hand to move the fingers.

Space Fact

When humans are working in space, or in environments such as the surface of Mars, they must wear pressurized space suits. This means that it requires more force for them to grasp objects, as they are working against the pressure in the suit. The development of bionic hands that can be remotely operated can help to complete tasks which would be difficult or tiring for a human.

MISSION ACTIVITY

ROBOTIC ARM

Mission Challenge

Try holding a book in your hand straight in front of you and not moving them for one or two minutes? Imagine how hard it is if you had to hold your hand steady for days in a row or lift something really heavy. This is why scientists have designed and used robotic arms in space. Using materials such as lolly sticks, string, chopsticks, and plastic cups can you design and create a robotic arm and end effector that can be used to pick up ping pong balls and rubbers?

Space Fact

Robotic arms are important machines that help people work on Earth as well as in space.The main space station Mobile Servicing System component is known as Canadarm2. This large robotic arm has 7 joints and can move up to 116,000 kg (256,000 pounds) worth of space station equipment. This arm moves equipment around and astronauts can even be connected to the end of the arms to move them around to different parts of the station. Tim Peake floated about 400 km (250 miles) above the Earth and was being moved around by a robotic arm.

MISSION ACTIVITY

NOTES

NOTES

UK SPACE AGENCY

esero

esa

MISSION X

TRAIN LIKE AN ASTRONAUT

Mission X takes place from January to May each year with countries from around the world taking part. To register please visit www.stem.org.uk/missionx/how-sign. Mission X is aimed at students aged 8-12 of all abilities but the activities can be adapted for younger and older children. The programme can be run by individual teachers or as a partnership between science, technology and PE departments. It is especially suitable for delivering cross-curriculum learning.

www.stem.org.uk/missionx

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