Family Space Day Overview – Health in Space

Family Space Day is a three hour event. The activities are set up so that children and parents can select the order in which they undertake activities. Parents and children are encouraged to learn, play, and explore *together*.

Objectives of the Day

Children will:

- build an understanding of the unique conditions in space that result in challenges to staying healthy.
- learn about common health challenges astronauts and children face.
- learn strategies for staying healthy.
- explore what it is like to live and work in space.

Activities

- Station 1: Preparing for Space Travel
  Parents and children identify what they have in common with astronauts using interactive posters.

- Station 2: Galley Game
  What could be so different about eating in space? Children learn about the considerations for bringing food into space and the challenges of eating it!

- Station 3: Beans in Space
  In this model, children compare the mass of an object on Earth to the mass of an object in space to understand why our muscles get more of a workout on Earth, and why astronauts experience muscle atrophy.

- Station 4: Bones of Contention
  Children create models to compare bone loss in space to healthy, well exercised bones on Earth. They discover what happens to bones without proper exercise and nutrition!

- Station 5: Measure Up
  In microgravity conditions everything – including body fluids – floats! In a simulation of how fluids shift in astronaut's bodies, parents and children measure each other's ankle widths before and after lying on their backs with their feet and legs propped against a wall.

- Station 6: Sponge Spool Spine
  Children simulate what happens to a human spine in space by making a representation of a human spine on Earth, and then exposing it to "microgravity conditions."

- Station 7: UV Man!
  Children construct UV Man! (or woman!) and equip him with special radiation detectors to investigate the source of ultraviolet radiation – our Sun. They explore how we can protect UV Man! – and ourselves – from being exposed to too much UV radiation.

- Station 8: UV Man in Space
  Children investigate the importance of good nutrition, sleep, exercise, and recreation for astronauts – and themselves! They discover the healthy choice challenges they have in common with astronauts.

- Station 9: The Astronaut in Me
  Children investigate the importance of good nutrition, sleep, exercise, and recreation for astronauts – and themselves! They discover the healthy choice challenges they have in common with astronauts.

- Station 10:Coloring Sheets and Games
  Children can relax and color and play games related to the staying healthy.

- Station 11: Reading Room
  Children and their parents can browse and read a selection of books about living and working in space and staying healthy (refer to book list for suggested reading).

Other Materials

- *Facilitator Information* – Health in Space
- *Explore Human Health in Space* – Book and Website References
- *All About Staying Healthy in Space* – A Health in Space Fact Sheet

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.

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.

Preparing for Space Travel

In this activity, you and your child will learn what happens to the human body when it has been in space for a period of time.

What You Need:

- 8 sheets of poster board in different colors
- Large print-outs of the information below
- Color images related to the different subjects
- Scissors
- Glue or tape to adhere the information to the poster board
- Elastic exercise bands
- One Answer Sheet on cardstock for each child
- Pencil or crayon for each child

What to Do:

Each of the following sets of information should be made into a big, bold, colorful poster with related images. Make sure the answers to the questions are on the posters, but covered by a page labeled "lift me" that hides the answer.

Place tape or a glue stick near posters 3 - 8 for the children to adhere their answers to their Venn Diagrams.

Provide each child with an Answer Sheet. Invite the children and parents to examine the posters and complete the questions by putting the answer in the appropriate area of the diagram.

Floating in Space

Wouldn't it be fun to float in space?

As fun as it is, floating in space is not healthy for the astronauts!

Earth's gravity pulls on us, which keeps us from floating away. Aboard the International Space Station astronauts live and work in *microgravity*.

On Earth, the pull of gravity keeps our muscles working hard. Astronauts' muscles do not have to work very hard in space.

When your muscles don't get a work out, they become weak.

Who needs to exercise to keep their muscles healthy?
You? Astronauts? Both?

Bone Loss

In microgravity astronauts don't need as much bone to support themselves. Their bones get weak. Astronauts have to exercise and eat diets rich in calcium to keep their bones healthy in space.

Even on Earth, bones need calcium and a lot of activity to stay strong.

What helps keep your bones strong …
Soda pop or milk?

What types of activities help keep your bones strong …
Running or watching a movie?

Who needs to exercise and eat food rich in calcium to keep their bones healthy?
You? Astronauts? Both?

Muscle Loss

In space, lifting weights is easy … the weights are weightless!

Astronauts perform "resistive" exercises; they pull against exercise machines in various ways – making it seem like they are lifting weights with their arms and legs.

Try the resistance bands to see what kind of work out you get!
How hard is it?

How long do astronauts need to exercise every day?
During commercial breaks of their favorite TV show or almost 2 hours?

Who needs to exercise to keep their muscles strong?
You? Astronauts? Both?

Fluid Distribution

The pull of Earth's gravity keeps the fluids in your body from floating up but in microgravity in space fluids float! Astronauts get "puffy faces" and "chicken legs" in space!

What do you think some of the symptoms of a "puffy face" would be?
"Puffy faces" causes stuffy noses and headaches, but don't worry, the symptoms go away after a few days in space.

Who has fluids float to their heads?
You? Astronauts? Both?

Sleep

Astronauts have to get plenty of rest so that their brains are sharp. But astronauts don't want to be floating around while they sleep, so they strap themselves into sleeping bags attached to the walls of the International Space Station.

Why do astronauts need to stay alert?
So that they can get to the next level of their Playstation game or because their work is very difficult and they need to be able to focus completely

Who needs to get plenty of rest to stay alert?
You? Astronauts? Both?

Staying Clean

Astronauts live and work in tight places with other astronauts. They have to keep themselves clean to make sure they stay healthy.

Taking a bath and brushing your teeth are a challenge in space. Astronauts take sponge baths and wash their hair with a vacuum! They also swallow their toothpaste!

Who needs to stay clean to keep their bodies healthy?
You? Astronauts? Both?

Eating Healthy

Making healthy meal choices is very important for astronauts. They have to consume just the right foods so that they are stay strong and energized.

Which food choice is the healthiest?
French fries or a grilled chicken sandwich?

Which foods contain the most nutrients, minerals, and vitamins?
Spinach or ice cream

Don't worry – astronauts get to have snacks in addition to a well-balanced meal!

Who needs to eat well to keep their bodies healthy?
You? Astronauts? Both?

Radiation

Our Sun gives us light, but it also gives out other types of radiation, like ultraviolet – UV – radiation that causes sunburn. Earth's atmosphere helps to protect us from much of the UV and other types of dangerous radiation, but we still need to take precautions!

Above Earth's atmosphere astronauts have their space suits and the Space Station to *help* protect them from the radiation. NASA is studying many different types of radiation shielding to find ways to protect astronauts.

What measures can you take to protect yourself further from UV radiation on earth?
Never go outside or wear sunblock?

What is one effect of too much UV radiation?
A sunburn or wrinkled clothes

Who needs to protect themselves from sunburn?
You? Astronauts? Both?

Possible Images for Posters

The following links provide nice images for the posters.

NASA Explores – Floating in Space
http://www.nasaexplores.com/show2_articlea.php?id=04-010

MSN Health and Fitness – Osteoporitic Bone
http://health.msn.com/PopUp.aspx?cp-documentid=100063529

NASA – Osteoporitic Vertebrae
http://science.nasa.gov/headlines/y2001/ast01oct_1.htm

Exploration NASA – Exercise in Space
http://exploration.nasa.gov/articles/pumpingiron_lite.html

NASA Human Space Flight – Fluid Distribution
http://spaceflight.nasa.gov/gallery/images/station/crew-11/html/iss011e10309.html

NASA Human Space Flight – Radiation
http://spaceflight.nasa.gov/gallery/images/shuttle/sts-88/html/s88e5056.html

PBS Living in Space – Sleeping in Space
http://www.pbs.org/spacestation/gallery/8_sleep.htm

NASA – Hygiene in Space
http://history.nasa.gov/SP-4225/nasa4/photo/nasa4-photo-34.htm

NASA – Food in Space Gallery
http://www.nasa.gov/audience/formedia/presskits/spacefood/gallery_food.html

	You	Astronaut	Both!
Who needs to exercise to keep their muscles healthy?			
Who needs to exercise and eat food rich in calcium to keep their bones healthy?			
Who needs to exercise to keep their muscles strong?			
Who has fluids float to their heads?			
Who needs to protect themselves from sunburn?			
Who needs to get plenty of rest to stay alert?			
Who needs to eat well to keep their bodies healthy?			
Who needs to stay clean to keep their bodies healthy?			

Galley Game

In this activity, you and your child will think about the food that astronauts eat in space and determine the correct answers to the questions.

What You Need:

- Questions and answers on cardstock
- Pencils or crayons
- Toothpicks for dehydrated ice cream
- Samples of space food
- Slice of bread
- Tortilla
- Glass of water
- Drink pouch (sample of drink pouch from ISS or Capri-Sun pouch)
- Dehydrated ice cream
- Ice cream (use mashed potatoes for the ice cream – it won't melt!)
- Powdered milk
- Plate or bowl to put food in or on

What to Do:

- Copy the 6 questions below onto cardstock
- Copy the Parent Answers sheet on the back of the cardstock
- Break up the dehydrated ice cream
- Place food samples on table for children to see
- Give the children the questions and have them look at the food samples to answer the questions.

So, you think you know food in space? Let's see!

1. **Why might astronauts eat tortillas instead of bread?**
   A. Tex-Mex food tastes better
   B. Tortillas make great space Frisbees
   C. Tortillas don't crumble

2. **Most space food is dried - dehydrated - and is sealed in packages. What must be added to make it ready to eat?**
   A. Kool-aid
   B. Water
   C. A McDonald's hamburger and French fries

3. **Why shouldn't you have an open glass of water on the Space Station?**
   A. Someone might spill it
   B. In microgravity the water will float out and get into equipment
   C. Space ducks like to swim in open glasses of water – and you do <u>not</u> want to attract space ducks

4. **What is one reason astronauts attach drink bags to their suits?**
   A. So that they can drink upside down
   B. So that they can work and still drink without using their hands (how cool is this?!)
   C. Because astronauts are very forgetful and would misplace their drinks otherwise

5. **Why are some space foods – like ice cream – dried?**
   A. Astronauts do not know that fresh ice cream tastes better
   B. Regular ice cream takes up space and energy to stay frozen and it would melt and be a floating mess!
   C. Because the ice cream has been on the Space Station soooooo long it has dried out!

6. **Why might astronauts drink powdered milk?**
   A. Astronauts *like* powdered milk!
   B. Because their mothers tell them to – and mom knows best!
   C. It weighs less, takes up less space, and does not spoil like fresh milk

Goodies in Space

Astronauts get to take their own goodie bag – a few special things they like to eat. What would be in your goodie bag? Remember, what you take as to fit into a small area, can't spoil, and can't cause a mess

Parent Answers
To Help You Impress Your Child With Your Knowledge!

1. Why might astronauts eat tortillas instead of bread?
   - **A. Tex-Mex food tastes better**
   - **B. Tortillas make great space Frisbees**
   - **C. Tortillas don't crumble - Tortillas make far fewer crumbs than bread. Bread crumbs are bad because they can potentially float around and get stuck in filters or computers or an astronaut's eye.**

2. Most space food is dried - dehydrated - and is sealed in packages. What must be added to make it ready to eat?
   - **A. Kool-aid**
   - **B. Water**
   - **C. A McDonald's hamburger and French fries**

3. Why shouldn't you have an open glass of water on the Space Station?
   - **A. Someone might spill it**
   - **B. In microgravity the water will float out and get into equipment**
   - **C. Space ducks like to swim in open glasses of water – and you do not want to attract space ducks**

4. What is one reason astronauts attach drink bags to their suits?
   - **A. So that they can drink upside down**
   - **B. So that they can work and still drink without using their hands (how cool is this?!)**
   - **C. Because astronauts are very forgetful and would misplace their drinks otherwise**

5. Taste the freeze dried ice cream. Yum! **Which do you like more – "space ice cream" or what you get at home? Why?**

Why are some space foods – like ice cream – dried?
   - **A. Astronauts do not know that fresh ice cream tastes better**
   - **B. Regular ice cream takes up space and energy to stay frozen and it would melt and be a floating mess!**
   - **C. Because the ice cream has been on the Space Station soooooo long it has dried out!**

6. Why might astronauts drink powdered milk?
   - **A. Astronauts *like* powdered milk!**
   - **B. Because their mothers tell them to – and mom knows best!**
   - **C. It weighs less, takes up less space, and does not spoil like fresh milk**

Beans in Space

What's it like to work out in space? Earth's gravity makes your muscles work harder because it is constantly pulling on your muscles. But on the International Space Station there is no gravity to pull on your muscles so they don't work as hard. This can cause "muscle atrophy" – or weaker muscles. Astronauts have to work out almost 2 hours every day on special machines to keep their muscles in shape so that they are strong when they return to Earth's gravity.

In this model, you and your child will compare the mass of an object on Earth to the mass of an object in space to understand why our muscles get more of a work out on Earth, and why astronauts experience muscle atrophy.

What You Need:

- 2 opaque non-breakable containers (coffee cans work well)
- Tape (to seal the containers)
- 3 cups of beans (for the Earth can only)
- Paper or foam to stuff inside the Earth can so that the beans don't rattle
- Labels for each can

How to Construct Earth and Space Containers:

- Cover containers with white contact paper.
- Pour 3 cups of beans in one container and label it "Earth".
- Put paper or foam in other container and place a few beans on top and label it "Space".
- Replace lids on containers and tape shut.

What to Do:

- Ask your child to hold the Earth can in one hand and the Space can in the other hand. Have them pretend the can of beans on the Space Station weighs what it would if they were actually on the Space Station.
- Ask your child if 1,559 beans weigh the same in space as 1,559 beans weighs on Earth. Nope! In microgravity on the Space Station stuff floats – it doesn't weigh anything at all! So, 1,559 beans on Earth weigh more than 1,559 beans in space.
- Ask your child if the mass – the amount of stuff – is the same on Earth as it is in Space. Yup! A can of beans or a toothbrush or a human has the same mass in space – the same amount of stuff - but none of these things weighs anything on the Space Station! Mass remains constant no matter where you are – Earth, Space, Moon.
- What might cause the same amount of stuff to have a different weight on Earth versus in space? Gravity! Earth's gravity "pulls" on objects, giving them weight. On the Space Station (because it and everything on it is in constant free fall together) objects do not weigh anything. There is no

(apparent) gravity pulling on objects to give them weight. What does your child weigh on Earth? On the Moon his/her weight would be 1/6 because the Moon is smaller and has less mass so it has a smaller gravitational pull.

Now invite your child to lift the cans up and down 20 times. Which can gave his/her muscles more of a workout?

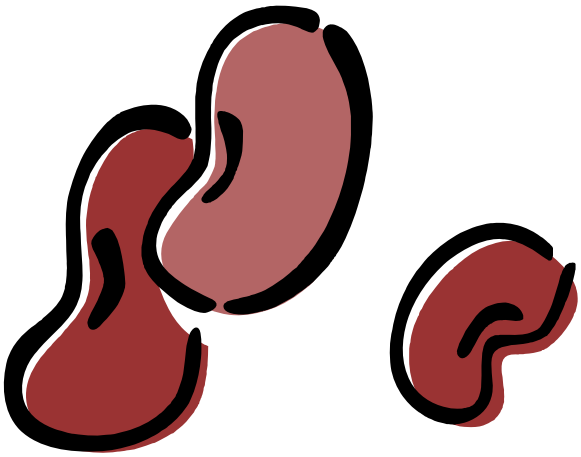
Parent Prompts:

If your muscles aren't having to do any work (to fight the force of gravity), will they become weaker or stronger?

Why do astronauts have to work out in space?

How much work is it to lift a weightless weight?

What can you do to keep your muscles strong and healthy?



Bones of Contention

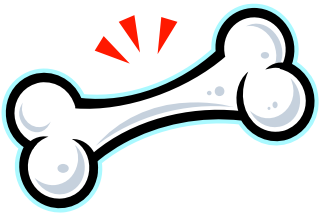
Our bones support our bodies when we stand, sit, run, or anything else. They also protect our organs inside, store minerals (like calcium), and produce blood cells. Our bones are **alive** – and constantly being broken down and reformed.

In microgravity you don't need much effort to move around or do things or hold your body upright. Because we don't need bones in space, our body stops trying to maintain them and we slowly lose bone mass. Too much bone loss causes a disease - osteoporosis - where our bones become weak enough to break or fracture easily. In space, astronauts have to exercise a lot – physical activity helps bones stay strong – and they have to eat meals rich in calcium – just like you! Even with all this work, astronauts still suffer some bone loss. NASA scientists are exploring ways to help prevent bone loss.

You and your child will create models to compare bone loss in space to healthy, well exercised bones on Earth. You will discover what happens to bones without proper exercise and nutrition!

What You Need:

- 2 Tall Styrofoam cups
- Slightly sharpened pencil
- Colored markers



What to Do:

Share with your child that maintaining healthy bones – like healthy muscles – means exercising! By not exercising, we lose bone material and our bones become brittle and can break.

Because astronauts live in reduced gravity, their muscles and bones don't have to work as hard as ours do on Earth – so their muscles and bones break down.

Invite your child to create a model of a healthy, exercised Earth bone and an astronaut's bone (or a bone that does not get enough exercise and healthy calcium!)

- Get two cups and Label one cup "Earth Bone" and one "Bone in Space"
- Poke 5 holes in the "Earth Bone"
- Poke several (~25) holes in the "Bone in Space"
- Place your hand on top of the "Normal Bone" cup and push down
- Place your hand on top of the "Bone in Space" cup and push down with the same force as you used on the "Normal Bone."

Parent Prompts:

Which cup collapsed under your hand more easily?

Why do you think it collapsed so easily?

Why might astronaut's bones become weak?

What can astronauts do to build strong bones?

What can you do to build strong bones?

Measure Up!

Astronauts on the International Space Station have puffy faces! Why? It's all about the pull of gravity – or lack of it!

Our bodies are made of 60% water, most of which is in our cells and circulatory system. We're well adapted to dealing with Earth's gravity - our hearts pump our blood and keep it from pooling in our feet. But in microgravity on the Space Station everything floats – even the fluids in our bodies! As soon as they get into space, fluids in the astronauts' bodies shift, causing puffy faces and shrunken legs – what they call "chicken leg syndrome!"

This shift does not harm the astronauts; they may get headaches and stuffy noses. The symptoms go away within a few days after they return to Earth.

In microgravity conditions everything – including body fluids – floats! In a simulation of how fluids shift in astronaut's bodies, you and your child will measure each other's ankle widths before and after lying on your backs with your feet in the air.

What You Need:

- Magic marker
- 18 inch string that will not stretch and a ruler or a flexible (cloth) measuring tape
- A writing utensil and paper for the measurements
- Timer or watch or clock

What to Do:

- Using the string and ruler, help your child measure and note the width of his/her ankles – you can mark the position on the string with the marker.
- Ask your child to lie on the floor with his/her legs resting vertically against the wall. Remain in this position for 1 minute
- After 1 minute, measure and note the size of your child's ankles while they are still propped up.
- Now it's your turn! (optional!)

Parent Prompts:

Were your ankles bigger or smaller after propping them up against the wall?

What do you think caused the difference in size?

Where did the fluids go?

What do you observe about pictures of astronauts in space – why are their faces so puffy?

Sponge Spool Spine

Our bones form the support structure of our bodies. And a primary component is our spine – the 33 vertebrae that extend from our skulls to our pelvis. The bones are separated by thin pads of tough fiber (inter-vertebral discs). This inter-layering of bone and disk allows our spines to be flexible – letting us bend and twist, but still protecting the important nerves in our spinal cord. Our bodies are adapted to Earth's gravity. This gravitational force squeezes our spines; we do not sense the squeezing because we are used to it. But in microgravity settings like on the Space Station, our spines stretch! Astronauts actually grow 2 to 3 inches taller when they are in space!

You and your child will simulate what happens to a human spine in space by making a representation of a human spine on Earth, and then exposing it to "microgravity conditions."

What You Need:

- A tall, *clear* container, such as a water jug or 2 liter bottle with the top cut off, filled ¾ full with water
- A ruler
- 1 pencil (slightly sharpened)
- Scratch paper and writing utensil
- 1 pipe cleaner
- 3 small wooden spools
- 3 sponge pieces, about the size of a dime, each with a hole in the center

What to Do:

Invite your child to make a model of a spine. Do they have a spine? Where? What does it do for them?

- Place a small loop at one end of the pipe cleaner
- Thread the pipe cleaner through the center of the sponges alternating them with the wooden spools. Push them down toward the loop.
- Measure the length of all of the sponges and spools together
- Ask your child what they think will happen when the "spine" is dipped into the water. Will it grow? Shrink? Stay the same?
- Holding the end without the loop, dip the pipe cleaner with the sponges and wooden spools into the container of water
- Measure the sponges and spools again – did the length of the "spine" change?

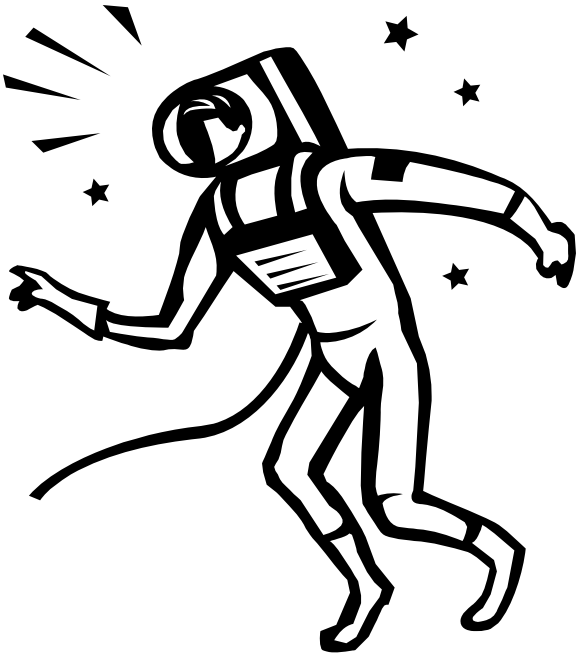
Parent Prompts:

What do the pipe cleaner, sponges, and wooden spools represent? (The spools represent the solid bone and the sponges are the flexible discs)

What happened to the sponges?

Why did the sponges expand?

The same thing happens to astronauts' spines – but not because they are dipped in water! Why do astronauts' spines s-t-r-e-t-c-h?



UV Man!
(or girl or dog or…)

Humans need UV radiation because our skin uses it to manufacture vitamin D – vital for maintaining healthy bones. About 10 minutes of Sun each day allows our skin to make the recommended amount. However, too much UV exposure causes the skin to burn and leads to wrinkled and patchy skin, skin cancer, and cataracts.

On Earth, we are protected by our atmosphere from most UV radiation coming from the Sun. The Ozone layer absorbs much of the UV, but some still gets through. We can protect ourselves by covering with clothing and using sun block.

In space there is no atmosphere to protect astronauts from ultraviolet radiation. Astronauts have to provide their own protection in the form of space suits, helmets with protective visors, and space stations. While these measures work very well for protecting against UV radiation, the higher energy radiation is not completely blocked. Even with protective shielding, astronauts aboard the International Space Station receive a daily dosage of radiation about equal to 8 chest X-rays! Astronauts wear special radiation detectors – dosimeters – that help determine how much exposure they have to radiation.

The UV-sensitive beads used in this activity serve as UV radiation detectors. They change color when exposed to ultraviolet radiation from the Sun or from UV lights. The brightness of the color corresponds to the intensity of the UV radiation. When shielded from UV sources, or when exposed to light that does not contain UV radiation - such as indoor light bulbs - the beads remain white.

You and your child will construct UV Man! (or woman!) and equip him with special radiation detectors to investigate the source of ultraviolet radiation – our Sun. Your child will explore how he/she can protect UV Man! – and themselves – from being exposed to too much UV radiation.

What You Need:

- 3 UV beads
- 2 *non*-UV beads
- 2 pipe cleaners
- Scissors
- Various materials that will "protect" UV Man from ultraviolet radiation, for example: construction paper of different colors, foil, plastic wrap (of various colors), sunscreen, masking tape, paper, cloth, etc.

What to Do:

Ask your child what happens if they stay outside in the Sun too long. Do they get a sunburn? The Sun's rays are good for us in small amounts, but can be dangerous if we get too much.

Invite them to explore how the Sun's ultraviolet radiation affects them by creating UV Man – or any figure they wish - and equipping him with radiation detectors (UV beads) that are made from a special pigment that is very sensitive and turns colors when exposed to the ultraviolet rays.

- Cut both pipe cleaners in half. Wrap one of the pipe cleaner pieces around the middle of another one of the pieces to form UN Man's legs and body.
- Thread the pipe cleaner that makes UV Man's torso through the UV beads alternating UV with non-UV beads. Slide all the beads towards UV Man's legs. What color are the beads? (White; there is no UV radiation coming from the inside lights.)

- Use another piece of pipe cleaner to form UV Man's arms, and the last piece to form his head.
- Cover UV Man and take him outside to a shady spot. Ask your child to predict whether UV Man is protected from UV rays in the shade.
- Uncover UV Man – Was his/her prediction correct? (Typically a little ultraviolet radiation reaches our skin even in the shade.)
- Put UV Man in the sun – What happens? Are there any changes? (The beads will darken; they are detecting ultraviolet radiation, the radiation that causes sun burn.)
- Take UV Man inside and invite your child to think about how he/she might protect UV Man from ultraviolet radiation. Have them choose some materials to cover UV Man (make a shirt, cover with tissue paper, use sunscreen, etc.)
- Cover UV Man with the materials you selected
- Take UV Man into the sun and observe how well his protective gear worked

Parent Prompts:

Were your child's predictions correct?

Do the Sun's rays ever turn you colors?
How are the astronauts protected from UV radiation?

What can you do to protect yourself from too much UV radiation?

UV Man in Space!

Now that you have created UV Man and protected him from radiation on Earth, it's time to build a space ship for him. An astronaut's spacesuit, spacecraft, and the International Space Station help to protect him or her from dangerous radiation. Even with all this protection, some high energy radiation does reach the astronauts. NASA monitors the astronauts carefully to ensure they stay within healthy limits.

You and your child will build a spaceship that will help protect your UV Man from radiation!

What You Need:

- Various craft materials such as paper towel tubes, tissue paper, foil, glitter, yarn, markers, paint
- Glue
- Scissors

What to Do:

- Using the various craft items, build a spaceship that will help protect UV Man from radiation.
- Put UV Man in his spacecraft.

The Astronaut in Me!

Do you know that you have a lot in common with astronauts? They do! Astronauts have to make sure that they are healthy while they are on Earth, but also while they are in space. Space has a different effect on the astronaut's bodies than Earth does. Eating well, getting plenty of sleep, exercising to maintain their bones and muscles, staying protected from harmful radiation, and playing and relaxing are all important to the health of an astronaut. How would you feel if you didn't sleep very well during the night? What if you didn't eat a well balanced breakfast to start your day? Making healthy choices keeps you strong just like the astronauts. Use this activity to determine what you need to stay healthy.

You and your child will explore the importance of good nutrition, sleep, exercise, and recreation for astronauts – and you! Your child will revisit the healthy choice challenges they have in common with astronauts.

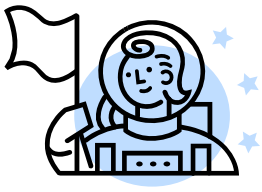
What You Need:

- Butcher paper about 1' longer than your child is tall
- Colored markers

What to Do:

- Have your child lie down on the butcher paper
- Trace the outline of your child
- Invite your child to decorate the image – put their face on it, add a space suit, etc.
- Help your child determine what he or she needs to stay healthy and indicate this information on the poster (draw an arrow to the leg and write "to keep strong bones, I need plenty of calcium and exercise" or "to keep my brain sharp, I need 8 hours of sleep")

Parent Prompts:



What do you do to keep your bones healthy?

What do you do to keep your brain sharp?

What protects you from getting sunburned?

What different things keep your muscles strong?

Coloring Sheets

The following are links to coloring sheets.

NASA – Living in Space Coloring Book
http://www1.jsc.nasa.gov/er/seh/color.html#LIVING

NASA – Space Station
http://www.nasa.gov/audience/forkids/activities/cp_space_station.html

Edu Pics – Space Shuttle
http://www.edupics.com/coloring-pictures-pages-book-03---building-the-space-station-1587.htm

Explore Health in Space!

Websites

http://edspace.nasa.gov/livespace/ - NASA's EdSpace page, for ages 6 and up, includes pages on life and science in space, food in space, hygiene and fashion in space, facts, video clips, links and more.

http://whyfiles.org/124space_station/2.html - This site for 5 to 6 year olds and up explores space sickness, bodily effects, osteoporosis, radiation effects, breathing in space and more.

http://www.pbs.org/spacestation/station/living.htm - PBS's Space Station site provides in-depth features on sanitation in orbit, recreation and sleeping, eating in space, life in microgravity and more. Appropriate for ages 8 and up.

http://www.kidshealth.org/kid/stay_healthy/index.html - Kidshealth discusses a ton of different topics regarding staying healthy. Kids can learn how to be fit, how to eat nutritiously, and lots of other stuff. This site is appropriate for ages 8 and up.

http://spaceflight.nasa.gov/living/index.html - a great site for children ages 8-13 that presents short, illustrated pages about what it is like to eat, sleep, play, and work in space.

http://hacd.jsc.nasa.gov/resources/kid_zone.cfm
Download some terrific space nutrition newsletters and experiments designed for children ages 8 to 13. Newsletters present current research, games, activities, fun facts, and more. Experiments investigate how what we eat influences our bodies and health – on Earth and in space!

Explore Health in Space!

Books

Living in Space. Katie Daynes, Education Development Corporation, 2002, ISBN 0794503012.
Children ages 4–6 can explore what it would be like to travel to and live in space.

Living on a Space Shuttle. Carmen Bredeson, Children's Press, 2003, ISBN 0516269550.
Children ages 4 to 8 will enjoy this exploration of how astronauts eat, drink, and sleep.

Astronaut: Living in Space. Kate Hayden, DK Children, 2000, ISBN 0789454211.
A female astronaut describes her training for a space shuttle flight and, once she is space-bound, what it is like to float, eat, exercise, and work in space. Lots of pictures! For children ages 5 to 8.

Radiation. Mark Pettigrew, Stargazer Books, 2004, ISBN 1932799214.
Children ages 4 -8 discover that radiation is all around us-in the earth, in the air, and in space. This book looks at the many different types of radiation. Find out where radiation comes from, why it is important, and how it can be extremely dangerous.

Cosmic Science: Over 40 Gravity-Defying, Earth-Orbiting, Space-Cruising Activities for Kids. Jim Wiese, John Wiley & Sons, 1997, ISBN 0471158526.
Demonstrations and activities for ages 8–10 explore the structure of our universe and space travel, along with some of the underlying physical principles.

All About Staying Healthy in Space

- A major health risk for astronauts in space is the exposure to high-energy radiation – radiation that can damage human tissue, cells, and even DNA. In space, there is no atmosphere to protect astronauts from UV radiation – or from dangerous X-rays, gamma-rays, and cosmic-rays.
- Space suits and the Space Station have special shielding that helps to protect astronauts from harmful radiation. On the station, sensors inside the crew areas monitor radiation levels. NASA is researching new ways to protect astronauts.
- Because we don't need as much muscle to do stuff in microgravity (everything is weightless), our body does not work as hard to maintain our muscles and they get weaker. Astronauts have to exercise almost 2 hours a day on special exercise equipment to make their muscles work and stay healthy for their return to Earth.
- Even on Earth, with gravity pulling against us as we move around, we need to exercise to maintain healthy and strong muscles. If you stay in bed for a long time – a month or more – when you finally get out, your muscles will be very weak and you will tire quickly. So stay active!
- Healthy bones need exercise, too! The physical stress of exercises like walking and jogging helps to maintain our bones.
- Most of our bone growth occurs until we are about 18-20 – so drink lots of milk, eat stuff with calcium, and get lots of physical activity! If you don't build healthy bones by the time you are 15-20, you won't be able to make it up later in life.
- On Earth, humans over 50 lose about 10% of their bone mass over a period of 10 years.
- Astronauts lose approximately 1 to 2% of their bone mass for *each month* they are in space. This means *they lose 10% of their bone mass in less than a year*.
- In microgravity, fluids naturally "float" upward into our face and head, causing them to swell. This gives astronauts 'puffy face syndrome'.
- Astronauts need to stay clean! Astronauts take sponge baths daily, using two washcloths, one for washing and one for rinsing, and use rinseless shampoo to wash their hair.
- Even though they do not want to because there is so much to do in space, astronauts need to get plenty of rest so that they stay alert and sharp! Astronauts strap themselves into sleeping bags and get their 8 hours of sleep a night!