# Family Space Day Overview - ISS

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 what it is like to live and work aboard the International Space Station, including some of the considerations for eating, drinking, and sleeping in space.
- learn about the microgravity environment of the station and how it affects every-day activities …including play!
- experience the challenges of maneuvering equipment aboard the station.
- learn about the science being conducted in space that helps us on Earth now, and will prepare us for future space missions to the Moon, Mars, and beyond.

## Activities

- Station 1: ISS Posters
  Children and their parents will view 4 posters that provide information on what it is like to live and work in space and about who has been involved in the construction of the International Space Station.

- Station 2: Robotic Arm Challenge
  Children are challenged to perform a variety of tasks using a remotely controlled robotic arm – just like the astronauts have to!

- Station 3: Toys in Space
  Do toys on Earth and toys aboard the International Space Station (yes, the astronauts took some!) behave in the same manner? Children play with toys, make predictions about their behavior in micro-gravity, and learn if their predictions are correct.

- Station 4: Space Drink
  Children make a hands-free drink packet, similar to what the astronauts use.

- Station 5: Space Crystals
  Crystals in space grow without the pull of gravity. Children make their own sugar solution and watch crystals grow.

- Station 6: Veggies in Space
  Hydroponic gardening is explored as children construct their own soil-less gardens.

- Station 7: Coloring Sheets and Games
  Children can relax and color and play simple games related to the International Space Station.

- Station 8: Reading Room
  Children and their parents can browse and read a selection of books about living and working in space (refer to book list for suggested reading).

## Other Materials

- *Facilitator Information* – International Space Station
- *Explore the International Space Station* – Book and Website References
- *All About the International Space Station* – A Space Station Fact Sheet

# Facilitator Information

(All you need to know about the ISS to survive the day)

## Who's building the ISS?

The ISS construction is a collaborative effort between the United States, Russia, Canada, Japan, Belgium, Brazil, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland and the United Kingdom. Space Station assembly will require 45 trips from Earth to carry all of the materials - 36 launches are planned for the United States and nine for Russia. The station is scheduled to be finished in 2010. It is 360 feet across and 290 feet long. It travels at 17,500 miles (28,163 kilometers) per hour, orbiting Earth once every 90 minutes at a distance of only 250 miles (400 kilometers) above the surface!

## Why are we building the ISS?

The mission of the ISS is to enable long-term exploration of space and create a permanent orbiting science institute that provides a laboratory free of the effects of gravity where scientists can conduct long-term research in material, life, and medical science. The low-gravity environment unmasks the basic properties of materials, which will lead to new manufacturing processes and products to benefit mankind. It provides a unique space platform for observing Earth and space, improving our understanding of Earth's environment and the universe. Finally, the ISS provides the foundation for the future exploration and development of space. It allows scientists to study long-term effects of weightlessness on the human body for application to future human space exploration. It will allow technology research in fluids, combustion, life support systems, and radiation environment, which is needed for future human exploration of space.

## What do astronauts do on space stations?

One thing they are doing right now on the International Space Station is building and maintaining the station! As materials and modules are shuttled to the station, the astronauts put them into place and make sure all systems are working. Space stations also are ideal for launch, repair, and retrieving of satellites. The space shuttle was used for several missions to access, repair, and upgrade the Hubble Space Telescope. Astronauts also conduct scientific experiments in space.

In addition to their work, astronauts have their daily routines of eating, sleeping, bathing, and exercising. And astronauts need a little time off to read, e-mail friends and family, play games, or just look out the window.

## What kind of research can be done on a space station?

On Earth, gravity influences the way crystals, plants, and animals grow. In contrast, space stations offer an environment where there is very little gravity. Research is being conducted to understand how weightlessness influences growth and development. In microgravity nearly perfect crystals can be grown; it may be possible to use these to create new and more efficient drugs for cancer, diabetes,

emphysema, and immune system disorders. Research also concentrates on how plants can be grown in space to provide food. Studies are assessing how weightlessness influences calcium and tissue loss in humans — and how this can be prevented. Perhaps the most important reason for living in space is to determine how to keep humans healthy for the length of time that will be required by journeys of exploration to Mars and other planets.

Fluids, flames, molten metal and other materials are researched on the station so that scientists can create better metal alloys and more perfect materials for applications such as computer chips. Some experiments will take place outside the ISS to study the nature of space - these experiments help spacecraft designers make better and safer spacecraft.

Other research encompasses monitoring our Earth's atmosphere, weather, climate, oceans, land, and resources. The space stations offer “the best seat in the house” to make observations of Earth's environments.

## What challenges are there to living and working in space?

One of the primary challenges to living and working in space is the “weightless” environment. Under reduced gravity conditions, there is very little “load” on bones and muscles, so living organisms lose bone mass, muscle tissue, and fluids. Even the heart — a muscle — loses mass because it does not have to work as hard. Humans in space must exercise about two hours each day to maintain their bone and tissue mass so that they can return to Earth's gravity and function well.

In space there is no protective atmosphere as there is on Earth. Humans must have shielding to protect them from solar radiation, which can damage tissue. The space station offers some protection. While astronauts are working outside the station, they work in the protection of a space suit.

Every-day-stuff can be challenging, too! Most of the food that they eat is frozen or dehydrated; they simply add water and microwave it for a hot space meal. Sleeping has its own challenges — imagine slipping into a sleeping bag that is attached to the wall. Bathing is not routine, either. Instead of a shower, the astronauts take sponge baths to conserve water.

Astronauts have to deal with a tight schedule to get all the work accomplished, and unforeseen issues pop up constantly. The astronauts may get lonely for home on long missions. And living in tight quarters with the same small group of people can get on anyone's nerves! When astronauts are being selected for missions, the mission planners are looking for people who will do well in these conditions. Other mechanisms are implemented as well; leisure time is important and built into the schedule, contact with families and friends is maintained, and there are plenty of the comforts of home, including movies, books, music, and games.



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*http://www.lpi.usra.edu/education/space_days*

# Get On Board the Station
# ISS Informational Posters

You and your child will explore what it is like to live and work on the International Space Station by viewing the informational posters.

## What You Need:

- 4 sheets of poster board in different colors
- Large print-outs of the questions and answers in the below boxes
- Cover sheets for the answers
- Color images related to the content
- Glue or tape to adhere the information to the posters

## What to Do:

Each of the following should be made into a big, bold, colorful poster with related images.

**What Do I Breathe?**
Imagine living and working in space … what would it be like?

There is no atmosphere in space, so astronauts must carry their air with them in their suits or on the Space Station.

**Which Way is Up?**
Astronauts live in microgravity on the Space Station. Everything – including them – "floats."

**Whew … It's Hot! And Cold!**
Our atmosphere helps to keep Earth's temperatures comfortable. Working outside the Space Station where there is no atmosphere could be very hot when you are in the sunlight or very cold when you are in a shadow. Temperatures inside space suits and the Station can be controlled to keep the astronauts comfortable.

**Is There a Target Store Near By?**
Nope! In space, like when you are camping, you need to take everything! Food, water, shelter, air (okay, usually you don't need air when you camp), tools, a good book to read …

**WHY is the Ice Cream DRY?** Food for Thought …
Taking food into space has some special challenges. Can you name some?

In microgravity everything has to be secured in place – what happens if it is not?

Crumbs floating in the International Space Station can cause problems if they get into the wrong place.

Over a long time, food can spoil – just like at home. What do we do to keep food from spoiling?

**What sorts of things are we doing on the International Space Station?**
There are many different scientific experiments aboard the ISS.

**Crystals**
Microgravity offers special opportunities for growing crystals so that scientists can better understand their shape and structure and use their knowledge to help fight diseases and make new medicines.

**Humans in Space**
If humans – like YOU – are going to travel in space, we need to do scientific studies to understand what happens to our bodies in microgravity. How do our bones and muscles adapt? How much should we exercise? What special nutrition do we need?

**Food**
We also need to be able to support ourselves living and working in space – and that means growing food! How can we best grow lots of crops? Scientists are experimenting with different seeds and light and types of materials for growing.

There are many other experiments taking place aboard ISS to help make life here on Earth better!!

**What does it take to build the ISS?**
The International Space Station draws upon the scientific resources of 16 nations: Canada, Japan, Russia, 11 nations of the European Space Agency, Brazil, and U.S.A.

Assembly will require 45 trips from Earth to carry all of the materials – 36 launches are planned for the United States and 9 for Russia. The station is scheduled to be finished in 2010.




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# Possible Poster Images

Images can be found at:

Space Suits
http://www.nasa.gov/images/content/145452main_iss012e19194.jpg

Space Food
http://www.nasa.gov/audience/formedia/presskits/spacefood/factsheets.html

Sleeping in Space
http://liftoff.msfc.nasa.gov/academy/astronauts/sleep.html

Space Walk
http://www.nasa.gov/images/content/152964main_s121e07412_hi_res.jpg

ISS
http://www.nasa.gov/mission_pages/shuttle/shuttlemissions/sts116/launch/sts116_summary .html

Canadian Crane
http://liftoff.msfc.nasa.gov/news/2003/news-canadarm.asp

NASA Space Station Gallery
http://spaceflight1.nasa.gov/gallery/images/station/

# Robotic Arm Challenge

On the International Space Station robotic arms are very important extensions of the astronaut's arms! Robotic arms are used to help attach huge modules of the station, put satellites in orbit, provide a platform for astronauts to work on – and move around - the station. Robotic arms helped secure the Hubble Space Telescope so it could be repaired!

Humans pick things up without thinking about the steps involved. In order for a robotic arm to pick up or move something, it needs to perform in several steps—moving the arm, rotating the "wrist," opening and closing the "hand" or "fingers."

This activity will demonstrate the challenge of maneuvering a robotic arm, which is what the astronauts aboard the ISS use when attaching station modules, solar panels, or other new components.

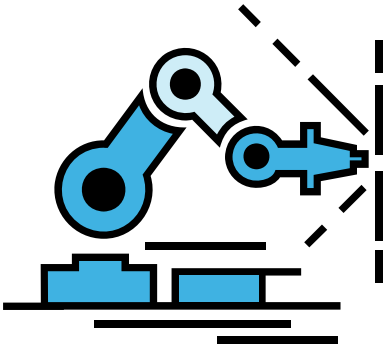
**Note:** this activity was written for the Armatron / Radio Shack Robot Mechanical Arm, which is no longer for sale. Products, such as the Lynx 5 Programmable Robotic Arm Kit by Hobitron (http://www.hobbytron.com/lynx-arm.html?AID=10289758&PID=2224652) or a remotely controlled toy can be used with modifications.

## What You Need:

- A robotic arm
- Closed module
- 2 canisters, 2 cones, 2 spheres
- Flat module

**OR**

- Any items that can be maneuvered with the robotic arm, such as candy or blocks and small cups.

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What to Do:

- Have your child test each of the motions on the Robotic Arms by moving the knobs and sticks, one at a time.

Challenge your child to move the robotic arm so that it performs the following operation:

- Pick up the canisters from the flat module, one at a time, and place them into the module
- Close the lid on the module containing the canisters
- Pick up the 2 cones, one at a time, and place them on top of the canisters
- Pick up the 2 spheres, one at a time, and balance them on top of the 2 cones

**OR**

- Determine a task, such as selecting candy and placing it into a cup or container and undertake the needed operations to make it happen.

Parent Prompts:

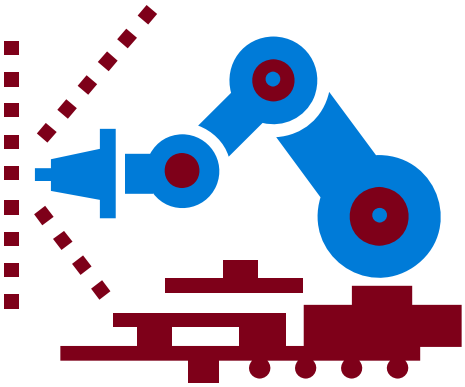
How many steps did it take you to pick up and move the object to the closed module?

Would it be easier or more difficult to pick up a larger object? Why?

If you practiced a lot with this robotic arm, do you think you would be able to do it faster?

How easy or difficult would it be to use a robotic arm to unscrew a screw, or to tie something together?

Why might astronauts or scientists use a robotic arm in space?



# Toys in Space

Astronauts aboard the ISS perform several experiments in order to benefit humans on Earth and to prepare humans for long-term exploration into the solar system – from growing crystals for new medicines to testing new exercises to keep their bones and muscles strong. However, sometimes they just want to have a little fun with their experiments! The astronauts wanted to find out if microgravity affects the way toys work and operate in space! Earth's gravity pulls on you as you leap to slam dunk a basketball into a hoop. It also keeps your toy racecars on the track. What would happen to those toys and others if they were in space? That's what we want you and your child to discover along with the scientists in this activity.

In this activity, your child will predict how certain toys react in zero gravity compared to the way they behave on Earth.

## What You Need:

- Toys in Space video (Can be ordered from NASA: http://catalog.core.nasa.gov/core.nsf/5f9c4a5adae3d29e8625670d004edb64/c4be9dec2fc10f2d86256e4400550766?OpenDocument, or viewed online at Lift Off to Learning: http://quest.nasa.gov/space/teachers/liftoff/toys.html)
- Gyroscope
- Ball and cup
- Small ball and hoop

## What to Do:

- Ask your child to play and experiment with the ball and cup at station "A".
- Have your child make observations about the way the toy operates and why it operates in that manner.
- Ask your child to think about how that toy would work in space. Would it work the same or differently?
- After your child makes his/her observations and predictions, have him/her watch the video to learn how microgravity affected the toy.
- What happened? Were they surprised?
- Repeat these steps for stations "B" (Gyroscope) and "C" (small ball and hoop).
- Ask your child how might other toys be affected by the microgravity in space?

## Why *Do* Things Float in Space?

Gravity is the attraction between two masses, such as between the Earth and Moon, or between the Earth and you. The farther away from the mass you are, and the smaller or less dense it is, the less it pulls on you. Many people think there is no gravity once you get as far away from Earth as its atmosphere. But Earth's gravity field extends beyond the atmosphere, and beyond the Space Station and beyond satellites and even beyond the Moon. In fact, Earth's pull is only 1/10$^{th}$ smaller on the Space Station than it is on Earth's surface.

If Earth's gravity still "pulls" on the Space Station, why don't people and things fall toward Earth? Why do they float? The Space Station – and everything in it - *is* constantly falling toward Earth, but it is also moving forward very fast – at 17,500 miles per hour. This combination keeps the Space Station in orbit around Earth. It is in constant "free fall." And everything on the Space Station is falling together – the astronauts, their equipment, pencils, and clipboards. Because they are all falling together at the same rate, they appear to float relative to each other.

# Space Drink

How is a space drink different from an Earth drink? In space we recycle! The water is created as a byproduct of the electrical power system. The water is consumed from small drink bags using a straw (sippy cups in space!). This activity will give your child the opportunity to drink water just like the astronauts do on the International Space Station! When the astronauts float in space to do repairs on the ISS – often for many hours at a time - they use drink bags inserted into their space suits so that they can stay hydrated 'hands free'.

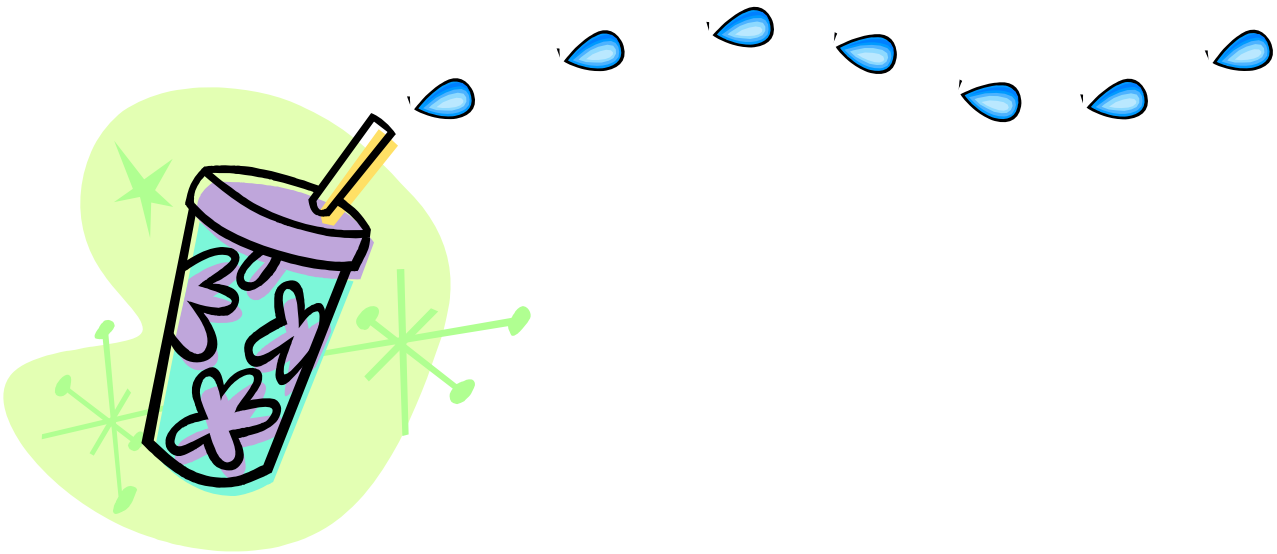
In this activity, you and your child will make a drink container that resembles the ones that the astronauts use onboard the International Space Station.

## What You Need:

- Zip-Lock or similar sandwich bag
- 1 cup water or other drink (be forewarned of sticky messes!)
- Straw
- Large size masking tape

## What to Do:

- Fill the bag with 1 cup of water or other drink.
- Place the straw into the bag allowing one end to stay outside the open end of the bag.
- Seal the bag leaving the straw protruding from the bag.
- Using the masking tape, attach the pouch to your clothing
- Give it a taste!



# Space Crystals

It's easy to grow your own crystals! A crystal called “Zeolite” has been grown on several shuttle missions since 1992. By growing the crystals in space, scientists are trying to grow larger more perfect crystals to better understand the structure of the crystal. Scientists are hoping one day to possibly use Zeolite crystals to store hydrogen for cars that run on fuel cells with no pollution! You can grow beautiful clear sugar crystals with sugar and water or you can add food coloring to get colored crystals. Boiling water is required to dissolve the sugar, so adult supervision is recommended for this activity.

In this activity, your child will grow sugar crystals that resemble the Zeolite crystals that the astronauts are growing on the ISS.

## What You Need:

- 1 cup water
- 2 1/2 cups table sugar
- clean glass jar or cup
- pencil or popsicle stick
- String - *crystals will form on a cotton or wool string or yarn, but not on a nylon line. If you use a nylon line, tie something to it to stimulate crystal growth.*
- Pan or bowl for boiling water and making solution

## What to Do:

Hint: You may wish to grow a seed crystal, a small crystal to weight your string and provide a surface for larger crystals to grow onto. A seed crystal is not necessary as long as you are using a rough string or yarn.

- Tie the string to a pencil or popsicle stick. If you have made a seed crystal, tie it to the bottom of the string.
- Set the pencil or popsicle stick across the top of the glass jar and make sure that the string hangs into the jar without touching its sides or bottom. Have the bottom of the string be just above the bottom of the glass jar.
- Boil the water. If you boil your water in the microwave, be very careful removing it to avoid getting splashed!
- Stir 2 cups of sugar into the boiling water, a teaspoonful at a time. Remove from heat. Keep adding the remaining ½ cup of sugar until it starts to accumulate at the bottom of the container and won't dissolve even with more stirring. *(If you want colored crystals, stir in a few drops of food coloring).*
- Pour your solution into the clear glass jar or cup. (*If you have undissolved sugar at the bottom of your pan, avoid adding it to the jar).*
- Place the pencil or object over the jar and allow the string to dangle into the liquid. Cover with plastic wrap or paper.

- Set the jar somewhere where it can remain undisturbed.
- Check on your crystals after a day. You should be able to see the beginnings of crystal growth on the string or seed crystal. It will take a few days to a week for the crystals to grow.
- Let the crystals grow until they have reached the desired size or have stopped growing. At this point, you can pull out the string and allow the crystal to dry. You can eat them or keep them. Have fun!

# Veggies in Space

Someday, astronauts may grow food efficiently in space and use plants to clean spaceship air. The current International Space Station mission is studying a weed in the cabbage and mustard family, to see if its roots grow more readily toward red or blue light. They are also studying how lack of gravity affects plants and how crop yields could be increased for missions that could last many months or even years. After astronauts return the space-grown plant samples from the experiment to Earth, scientists will examine the plants' genes to learn how the space environment has affected plant growth. Understanding how plants grow in space could lead to better agricultural production on Earth. In space, astronauts need to use more efficient agriculture techniques than those used on Earth. Hydroponics provides one approach. Even though hydroponics does not require soil and takes up less space than normal methods, plants grown hydroponically are often larger and healthier than plants grown normally. The following activity is one example of growing plants hydroponically.

In this activity, you and your child will grow plants in a way that is similar to how they are grown aboard the International Space Station.

## What You Need:

- 6-8 seeds
- Zip lock baggy
- Permanent marker
- 2 different sized paper or Styrofoam cups
- ½ cup perlite or sponge (cut up)
- Water
- Spray bottle, water

## What to Do:

- Ask your child if they think it is possible to grow plants without soil? What else do plants need? (Sunlight, food, water). Invite them to create a hydroponic garden – a garden without soil – similar to the way plants are being grown aboard the Space Station.
- Label a Zip lock baggy with your name and the date.
- Poke small holes in the bottom and lower sides of the smaller cup.
- Put about one inch of bottled water (or other good quality water) into the bottom of the larger cup.
- Add ½ cup perlite or sponge pieces to the smaller cup.
- Place six to eight seeds inside smaller paper cup on top of the perlite.

## What to Do (Cont'd):

- Place the smaller cup with seeds into the larger cup and gently push down into the water. Water will flow into holes in the small cup and dampen the perlite. The perlite should be moist at the top where the seeds are located; the seeds should not be standing in water.
- Place the cups into the zip lock baggy.
- Place the baggy in a warm, well-lit area (window sill).
- Watch for plant growth. Add water as needed.

## Parent Prompts:

Are there other substrates that might work for plant growth?
Invite your child to experiment!

What would your child like to see grown aboard the station?

Are there any vegetables that they do not want to have grown aboard the station?

# Coloring Sheets and Games

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

Coloring-Page – Space Coloring Pages
http://www.coloring-page.net/space.html

Boeing – International Space Station
http://www.boeing.com/companyoffices/aboutus/kids/color/spstation.html

NASA – ISS Word Search
http://observe.arc.nasa.gov/nasa/fun/wordsearch/ISS_search/ISS_search.html

NASA – ISS Game Booklet
http://www.jsc.nasa.gov/news/factsheets/iss_activity_sheet_4pgformat.pdf

# *Explore the International Space Station!*

## Websites

http://science.howstuffworks.com/space-station.htm
How the International Space Station works is explored in a site designed for older children and young adults. Visitors are led through an introduction to the station, its components, and the research being conducted.

http://virtualastronaut.jsc.nasa.gov/
The Virtual Astronaut Program is an interactive 3-D Web site that allows children to explore the recent findings in physical sciences, space sciences, space medicine, biomedical research, and living in space. This site has great visuals and easily digested text, and is designed for classroom use.

http://spaceflight.nasa.gov/living/index.html
NASA Living In Space Web site explains how astronauts breathe in space and where they get water. This is a great site for all ages.

http://spaceflight.nasa.gov/realdata/tracking/index.html
Track the International Space Station in real time on this interactive site for children and adults.

http://www.nasa.gov/mission_pages/shuttle/main/index.html
All the latest International Space Station (ISS) and space shuttle news is presented on this site, along with a history of the ISS and shuttle, and other information about NASA's ISS program.

http://spaceflight.nasa.gov/spacenews/factsheets/index.html
This Web site explores the assembly of the International Space Station from human space walks to robotic aspects.

# *Explore the International Space Station!*

## 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.

Space Spinners. Suse MacDonald, Dial Books for Young Readers, 1991, ASIN 0803710089
Based on true events, but from the viewpoint of two spiders, this book for children ages 5–8 traces the story of spiders taken onboard the space shuttle to observe how they constructed webs in microgravity.

A Day in Space. Suzanne Lord and Jolie Epstein, Scholastic Paperbacks, 1986, ASIN 0590410997
This book for children ages 4–8 follows NASA astronauts to find out what it takes to prepare for a mission, and the practical sides of life on the space shuttle. *A Day in Space* also explores some of the common experiments in space (mixing oil and water).

The International Space Station (Let's-Read-and-Find-Out Science 2). Franklyn M. Branley and True Kelley, HarperTrophy, 2000, ISBN 0064452093
Children ages 5-8 learn the history and background of the station as well as descriptions of life in space. Also included is an activity guide for growing your own crystals and a web link that provides the location of the ISS.

# All About the International Space Station

- The ISS construction is a collaborative effort between the United States, Russia, Canada, Japan, Belgium, Brazil, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland and the United Kingdom.
- The Space Station is the largest human occupied object ever sent into space. It includes living and working space that is about the equivalent of two Boeing 747's.
- Space Station assembly will require 45 trips from Earth – some from the United States and some from Russia - to carry all of the materials. The station is scheduled to be finished in 2010.
- About 90% of people on Earth will be able to see the Space Station in the sky without a telescope once construction is complete.
- The Space Station circles the Earth every 90 minutes (it travels 17,500 miles per hour!).
- Humans in space don't require as much sleep as humans on Earth because it doesn't take as much effort to perform tasks in space such as lifting heavy objects. Less effort requires less sleep.
- The majority of an astronaut's time on the Space Station is spent building and maintaining the station, with time also devoted to science experiments. They work in pairs as many of the experiments require teamwork.
- The crew members of the ISS will study protein crystals which will aid in the development of new drugs and treatments for cancer, diabetes, emphysema and immune system disorders.
- Experiments and studies aboard the ISS will also include life in low gravity which causes weakening muscles, changes in how the heart, arteries and veins work, and the loss of bone density. These studies are necessary to prepare for future long-term human exploration of the solar system.
- Fluids, flames, molten metal and other materials will be researched on the station so that scientists can create better metal alloys and more perfect materials for applications such as computer chips.
- Some experiments will take place outside the ISS to study the nature of space. These experiments will help spacecraft designers design better and safer spacecraft in the future.
- These exterior studies may also lead to down-to-Earth developments such as clocks that are a thousand times more accurate than today's atomic clocks; better weather forecasting; and stronger materials.

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