International Space Station Suite

Educator Guide – created by Adrienne Provenzano

Photo credit: NASA

Welcome to International Space Station Suite!

Welcome, educators, to this guide! I hope it provides some inspiration and resources for how you might incorporate my music composition International Space Station Suite into your teaching! You'll find brief descriptions of each of the seven pieces in the suite as well as suggested research and discussion questions and activities for each selection. The composition is an example of program music – music without words that tells a story. At the end of the guide is a list of some suggested resources. Enjoy getting to know the ISS through music and images! The compositions were inspired in part by images and videos taken of and from inside and outside of the International Space Station. Consider what you see, think, and wonder and hear, think, and wonder when using this guide and accompanying PowerPoint as well as the music of International Space Station Suite!

I'd appreciate it if you would please credit me when you use these educator guide materials or the corresponding PowerPoint presentation, including the music audio resources. Also, please let me know how you are using these materials and if you would like to collaborate on creating lesson plans and other resource materials, as well as arrange a virtual visit to your classroom/educational setting so students can learn more about the music composition process! Thank you!

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Fanfare

The ISS circles the Earth every 90 minutes traveling 17,500 miles per hour! A stirring melody by trumpets begins this piece celebrating the amazing human accomplishment known as the International Space Station (ISS). Other instruments join in the adventure – trombone and strings. After a quiet interlude by saxophones, the festive theme returns and fades away, as the ISS fades from view for those who experience it soaring over the Earth.

Suggested research and discussion questions and activities:

Assembly in Low Earth Orbit (LEO) began in 1998 and crews of humans have been arriving and departing regularly since 2000. As you listen to Fanfare, imagine that you are on the ISS orbiting the Earth. What are you doing?

A fanfare is a piece of music that celebrates something. Why do you think the composer wanted to celebrate the International Space Station? What might you compose a fanfare about?

Visit https://spotthestation.nasa.gov and see if you can find a time when the ISS will be flying over your area and check it out! (Be sure to follow safety precautions!)

This piece was written to celebrate the 20th anniversary of the ISS. You can find more information about the history of the ISS at https://www.nasa.gov/station20

Have you ever heard a fanfare? You might look for pieces like Fanfare for the Common Man by Aaron Copland, Fanfares for the Uncommon Woman by Joan Tower, and Olympic Fanfare and Theme by John Williams!

Assembly

The International Space Station was assembled in space. The first two components, Zarya and Unity, were launched into space in 1998. Main assembly was completed in 2011. Additional components are sometimes added or replaced. This piece uses five short motifs (short melodies) to create the sensation of different building blocks of the ISS being connected, piece by piece. The components were designed and built on Earth and then brought to space. The composer decided to use 5 different motifs because 5 different space agencies worked on the ISS: NASA, Roscosmos, ESA, CSA, and JAXA. Each motif uses a different instrument – glockenspiel, clarinet, trumpet, flute, and strings.

Suggested research and discussion questions and activities

Can you design and build a space station? You can find a project to do so in the Space Station Explorers educational guide! See https://www.issnationallab.org/stem/lesson-plans/welcome-to-the-iss-poster/ and https://www.issnationallab.org/stem/educational-programs/space-station-explorers-stem-guide/

What modules do you think a space station needs? Draw a sketch on paper or use a computer program to create a plan and then find materials and construct a model.

Which of the melodies in Assembly would you choose for each of the agencies? If you were writing a song about ISS assembly, what instruments and melodies might you use for each agency?

You can find a video animation of the assembly of the ISS at the NASA Johnson Space Center YouTube page. Listen to Assembly as you watch the video. Can you create your own soundtrack to go along with the video?

You might also enjoy the video of the tour inside the ISS by Astronaut Suni Williams, which can be found at the NASA Johnson Space Center YouTube page!

The ISS is an amazing engineering accomplishment. You can build your engineering skills by learning to be a problem solver! The engineering design process and the music composition process have many similarities, too! Check out NASA BEST Engineering and other engineering challenges and curriculum!

Arrivals and Departures

Written in a ragtime music style, this jaunty piano piece imagines spacecraft traveling to and from the International Space Station. Chromatic scales played in contrary motion provide a sense of the movements of space vehicles up and down containing crew and cargo. This piece is in a 5 part rondo form – ABACA. The A section repeats three times and the B and C sections are played once. It takes a lot of hard work and collaboration to send people into space as well as all the items they need to live and work there! Many different spacecraft travel to and from the International Space Station bringing people and cargo. Some visitors stay a few days and some for as long as a year!

Suggested research and discussion questions and activities

Can you make up a dance or movements to go along with this music? Does the music help you know when to move fast or slow? When to move up or down?

Can you learn the different types of rockets and space vehicles used to send crew and cargo to the ISS?

Explore how a rocket works! What is propulsion? Can you draw and design a rocket and spacecraft? What do you want to learn about rockets and spacecraft?

Look up the current expedition and crew and learn about their education experiences and career paths. Can you find out how many people have traveled to and from the ISS and from which countries?

Each expedition has its own mission patch. Do some research about expedition mission patches and design your own!

If you were going to the ISS, what would you bring along? Imagine you can bring a shoebox with personal items, what would you put inside?

Spacewalk

Construction of the ISS involved many different spacewalks. Spacewalks still take place for additional station upgrades and maintenance, like changing batteries, cables, and antennas. A spacewalk is also called an EVA – Extravehicular Activity. Usually, two expedition crew members team up on a spacewalk outside of the station. They go slowly to get the job done correctly and efficiently! This music is slow also! To do their work, spacewalkers need special spacesuits! On Earth, they practice many times in a special pool, wearing their spacesuits, to help prepare for working in space. In this piece, the two main melody lines take turns, and there is a mysterious out of this world melody as well! There are 5 counts to each measure – see if you can count them!

Suggested research and discussion questions and activities

Do you hear the two different spacewalkers taking turns as they move? Can you move slowly while listening to the music? What do you think it would be like to go on a spacewalk?

A spacewalk, or EVA (Extravehicular Activity), is a dangerous and exciting part of space exploration. Research spacesuits to learn more about how they provide a special life support system protection for spacewalkers!

Can you draw and design a spacesuit to protect you from the many hazards of space?

With Love from Station

Imagine a bouquet of flowers floating in the International Space Station! Astronaut Scott Kelly grew zinnia flowers when on the ISS and sent a photo of them back to Earth on Valentine's Day. Growing plants like lettuce, chili peppers, and zinnias are just a few of the many science experiments and investigations being done on board. The tune With Love from Station sounds a bit like a melody played on a music box. The instruments are harp and glockenspiel!

Suggested research and discussion questions and activities:

What might you grow on the ISS? Why might it be important to learn to grow food in space?

What message of love, kindness, and caring might you send from the ISS?

Veggie is just one investigation into plant growth on the ISS. Look at the Space Station Explorers site (https://www.issnationallab.org/stem/) for information about the Tomatosphere project where students receive seeds flown on the ISS and seeds kept on earth and then grow and study them!

Scott Kelly wrote about his experience growing zinnias in his autobiography, Endurance. Explorers often write about their travels in journals or logbooks, and scientists also take notes! What sort of journal or logbook might you create?

Inside the International Space Station the crew participates in many different activities – living, working, and even playing! Much of what they do connects with science, technology, engineering, and math (STEM), while other activities have to do with arts and education! How would you spend your time on the ISS?

Solar Song

Do you know the song Twinkle, Twinkle Little Star? That melody is played by the guitar in this piece and two flutes join in a countermelody. This piece is a reminder that solar energy is what powers the ISS! The vast solar array panels collect energy from the sun and store it in batteries to power all sorts of equipment. The Sun in our solar system is a star! The ISS is a star-powered spacecraft!

Suggested research and discussion questions and activities:

Sing along with this piece using the words of Twinkle, Twinkle Little Star. Write some new lyrics about the ISS!

What is solar energy? Can you research and discover how energy is collected and used by the ISS solar arrays?

Heliophysics is the study of the sun! You can find more information at NASA's Science Mission Directorate about research into heliophysics, like the Parker Solar Probe mission. Visit https://science.nasa.gov/heliophysics

Another site for information, games, and activities about the sun and solar system is https://spaceplace.nasa.gov/ This site can also be read in Spanish!

In 2013, Astronaut Dr. Karen Nyberg made a star-themed quilt square while on the ISS and invited people on Earth to also make quilt squares and submit them to the Astronomical Quilt Block Challenge. More than 2400 squares were received and then assembled into 28 quilts! Many quilt patterns involve stars. Can you make a star-themed quilt square out of fabric or paper or other arts and crafts supplies?

Cupola

A musical round is a composition where the same melody is heard played or sung at staggered intervals. This form was chosen to illustrate the orbit of the ISS around and around the Earth every 90 minutes. The International Space Station is in a free-fall orbit around the Earth. When on board in the microgravity environment, the crew members sometimes look out the seven windows of the cupola at the Earth and space. If you were in the cupola, you could look out to the Earth below and see all sorts of landforms, water, auroras, and weather conditions on the planet and beyond Earth see the vastness of space. You might see the moon and sun and other stars, too! In the piece called Cupola, percussion instruments provide a contrast to the gentle melody of the orbit which is played by many different instruments.

Through the cupola windows, crew take photographs and videos, operate the robotic arm, help with arriving and departing spacecraft, and even enjoy some leisure time reading books and playing music instruments.

Suggested research and discussion questions and activities:

What do you imagine when you hear this music?

Can you create a song or poem or artwork about the Earth? Can you design and build a cupola window and imagine you are on the ISS? What do you notice about planet Earth?

Investigate the many astronaut photographs of Earth – you can see them at the Gateway to Astronaut Photography of the Earth, https://eol.jsc.nasa.gov/

The Sally Ride EarthKAM project (https://www.earthkam.org/) provides opportunities for students to have photos taken from the ISS that they can study. Consider signing up for a mission!

Robotics are an important part of the International Space Station. Find out more about the robotics inside and outside the ISS!

You can find videos of astronauts on board the ISS reading books aloud at the Storytime from Space website, https://www.storytimefromspace.com/

Fanfare – Encore!

An encore is when a piece of music is played again! Listen to Fanfare from International Space Station Suite again and think about what you've learned about the International Space Station. The 7 pieces in this suite tell a story of space exploration! Imagine you are part of an expedition to the ISS and write a story, poem, or song about your adventures! Create a play or artwork!

What science experiments might you conduct? What technology might you test? What engineering design challenges can you try to help develop the skills to be a space station explorer? Who is part of the crew? Do you go on any spacewalks? How do you get to and from the space station? How does it feel to arrive at the ISS? How does it feel to return to Earth? What do you want to remember about your trip to space? How might you share your adventures with others?

You can keep learning about the International Space Station and space exploration in many ways! If you can, check out https://eyes.nasa.gov At this site, the Solar System Interactive app features real-time 3D data visualizations about the solar system, including satellites like the ISS and the Eyes on the Earth app features the Earth Science fleet, including the ISS! Perhaps some of the materials in the education resources list will help you with your learning adventures!

Educational Resources: Off the Earth, For the Earth

GENERAL

Main NASA website www.nasa.gov

NASA JPL-CalTech Solar System Ambassadors Calendar of Events and Directory

https://solarsystem.nasa.gov

https://solarsystem.nasa.gov/solar-system-ambassadors/events

https://appliedsciences.nasa.gov

National Air and Space Museum https://airandspace.si.edu

https://starnetlibraries.org

https://nightsky.jpl.nasa.gov/

Astronauts! https://www.nasa.gov/astronauts

NASA and National Parks Service https://www.nps.gov/subjects/technology/nasa-collaboration.htm

Kennedy Center for the Performing Arts

https://www.kennedy-center.org/education/

NASA Science Directorate **https://science.nasa.gov**

https://science.nasa.gov/heliophysics/

NASA Best Engineering

https://www.nasa.gov/audience/foreducators/best/edp.html

EARTH OBSERVATIONS and EARTH SCIENCE

Sally Ride EarthKam www.earthkam.org

Curriculum materials, EO Kids, and More! https://earthobservatory.nasa.gov

Gateway to Astronaut Photography of Earth https://eol.jsc.nasa.gov/

https://landsat.gsfc.nasa.gov

Earth as Art NASA eBook and other resources https://science.nasa.gov/get-involved/art-and-science

Earth as Art image collections www.usgs.gov

NASA @ Your Table and more! https://earthdata.nasa.gov

https://climate.nasa.gov

https://climatekids.nasa.gov/

Games, Crafts, and more! https://spaceplace.nasa.gov

Citizen Science https://www.globe.gov/web/elementary-globe

Visualization software https://eyes.nasa.gov/eyes-on-the-earth.html

Solar System Interactive https://eyes.nasa.gov/apps/orrery/#/home

https://mynasadata.larc.nasa.gov

NASA @ Your Table: Food and Drink https://appliedsciences.nasa.gov/our-impact/news/nasa-your-table

https://www.issnationallab.org/stem/educational-programs/windowsonearth/

PROFESSIONAL DEVELOPMENT, LESSON PLANS, CURRICULUM

Webinars and Digital Badges https://www.txstate-epdc.net/

Internships https://intern.nasa.gov/

Curriculum links https://science.nasa.gov/learners/wavelength

NASA STEM Engagement https://www.nasa.gov/stem

NASA eClips ™ http://nasaeclips.arc.nasa.gov/

Lesson plans and more! https://www.jpl.nasa.gov/edu/

Citizen Science and More! https://science.nasa.gov/

Curriculum materials, NASA @Home and more! https://science.nasa.gov/get-involved/nasaathome

Free weekly newsletter with NASA resources! https://www.nasa.gov/stem/express

www.nasa.gov/kidsclub/index.html

INTERNATIONAL SPACE STATION

https://www.nasa.gov/mission_pages/station

https://www.nasa.gov/station/

https://www.nasa.gov/station20

International Space Station Flyover Information https://spotthestation.nasa.gov

Space Station Explorers and more! https://issnationallab.org/stem/

https://issnationallab.org/stem/educational-programs/space-station-explorers-stem-guide/

https://issnationallab.org/stem/lesson-plans/welcome-to-the-iss-poster/

https://www.nasa.gov/audience/foreducators/stem_on_station/index.html

StoryTime from Space https://storytimefromspace.com/

ISS Benefits for Humanity https://www.nasa.gov/mission_pages/station/research/benefits/index.html

Article about International Space Station Suite

https://www.issnationallab.org/iss360/musical-windows-to-the-world/

NASA and 4H – Expeditionary Skills for Life

https://www.nasa.gov/audience/foreducators/stem-on-station/expeditionary-skills-for-life.html

https://www.bioedonline.org/lessons-and-more/resource-collections/experiments-in-space/butterflies-in-space/ (also at bioedonline.org, ants in space, plants in space and spiders in space!)

Imagine You're an Astronaut – Unit of ISS Lessons

https://www.jpl.nasa.gov/edu/learn/project/imagine-youre-an-astronaut/

Spacesuit Curriculum www.nasa.gov/audience/foreducators/spacesuits/eduactivities/index.html

More on spacesuits https://www.nasa.gov/feature/spacewalk-spacesuit-basics/

Suni Williams Video Tour of ISS, see NASA Johnson Space Center YouTube Channel

Space Archaeology https://issarchaeology.org/space-archaeology-for-real/

ISS Paper Model https://www.nasa.gov/stem-ed-resources/build-the-station-simulation.html/

https://www.nasa.gov/pdf/616947main_Build_Station_Simulation.pdf

ISS 3D Model https://solarsystem.nasa.gov/resources/2378/international-space-station-3d-model/

Growing plants https://www.nasa.gov/content/growing-plants-in-space/

Astronomical Quilt Project (on and off ISS)

https://podcasts.la.utexas.edu/american-rhapsody/podcast/episode-9-astronomical-quilts-quilting-among-the-stars/

Search Astronomical Quilts! At this site:

https://legacy.lib.utexas.edu/taro/utcah/03932/cah-03932.html/

Music on the ISS

https://science.nasa.gov/science-news/science-at-nasa/2003/04Sep_music/

https://www.nasa.gov/feature/space-station-20th-music-on-iss/

Music in Space concert, 5/2/14 https://youtube.com/watch?v=P_eBWWlYgV8

Also, see YouTube for videos of Chris Hadfield performing David Bowie's "Space Oddity" on the ISS, Cady Coleman performing the first space-Earth flute duet when she was on the ISS, Kjell Lindgren playing the bagpipes on the ISS and many more music performances from the ISS!

Humans in Space Home Page https://www.nasa.gov/topics/humans-in-space

Research and Technology https://www.nasa.gov/iss-science

ISS Experiments, Facilities, and Results https://go.nasa.gov/researchexplorer

STEM on Station https://www.nasa.gov/stemonstation

Media Resources https://www.nasa.gov/stationresearchresources

Additional Media Resources (such as free downloadable posters and infographics): https://www.nasa.gov/mission_pages/station/research/additional_media_resources.html

Amateur Radio on ISS https://www.ariss.org

Get to Know ISS https://www.nasa.gov/audience/foreducators/stem-onstation/know_station

Get Involved with ISS https://www.nasa.gov/audience/foreducators/stem-on-station/getinvolved

Video and animation – NASA Johnson Space Center YouTube Site, including Assembly of ISS and Suni Williams Tour of the ISS

https://www.youtube.com/user/ReelNASA/videos (search International Space Station Assembly)

Assembly Video Animation **https://www.youtube.com/watch?v=yRqUPjl3tTQ**

Equity, Diversity, Inclusion, Accessibility

Accessibility: Space Science is for Everyone: Lessons from the Field (NP 2008-04-512HQ)

https://www.nasa.gov/pdf/259240main_Space_Science_Is_for_Everyone.pdf

Diversity https://www.nasa.gov/about/people

https://www.nasa.gov/women

Spanish language resources

https://spaceplace.nasa.gov/sp/search/Spanish/

https://ciencia.nasa.gov/

Some Space Themed Arts, Humanities, and Music Resources

Spacesuit Art Project, https://spaceforartfoundation.org/spacesuit-art-project

Space School Musical (https://jpl.nasa.gov/edu/teach/activity/space-school-musical)

Rocket Recorder (see West Music or JW Pepper)

Science Songs by Astrocapella

Ballads for the Age of Science

Voyager mission music project – The Golden Record

Gustav Holst's Symphonic Suite, The Planets

The International Space Station, by Franklyn M. Branley, Illustrated by True Kelley(HarperTrophy)

Endurance: My Year in Space and How I Got There, by Scott Kelly's book – Young Readers Edition (Crown Books)

Becoming a Spacewalker: My Journey to the Stars, by Jerry L. Ross with Susan G. Gunderson (Purdue University Press)

Space Station Science: Life in Free Fall, by Marianne J. Dyson, (Scholastic)

Max goes to the Space Station: A Science Adventure with Max the Dog, by Jeffrey Bennett, Illustrated by Michael Carroll (BigKidScience)

Beautiful Planet (National Geographic)

A View from Above: An Astronaut Photographs the World by Terry Virts (National Geographic)

Mission to Cataria, by Travis Bossard and Mick Szydlowski, illustrated by Alexander Novoseltsev (Oskar & Klaus Publishing)

Human Space Flight: Mission Patch Handbook (2014, AeroGraphics, Inc)

There are MANY, MANY more resources about the ISS available – DVD's, websites, books, apps and more! Keep exploring and learning!