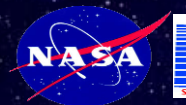


Bristle Bots to the Rescue!

Caitlin Nolby and Marissa Saad
North Dakota Space Grant Consortium



What are solar panels?
How do they help us?

What are rovers?











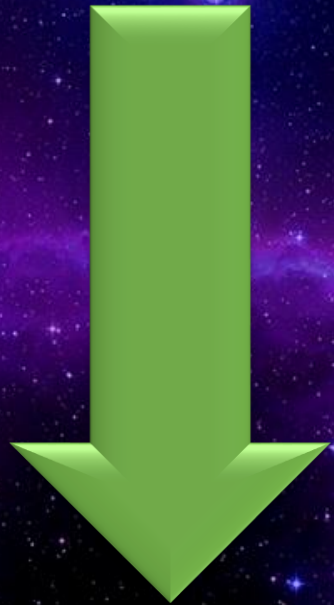
MISSION CONTROL, NASA
JOHNSON SPACE CENTER, HOUSTON, TEXAS

31:27

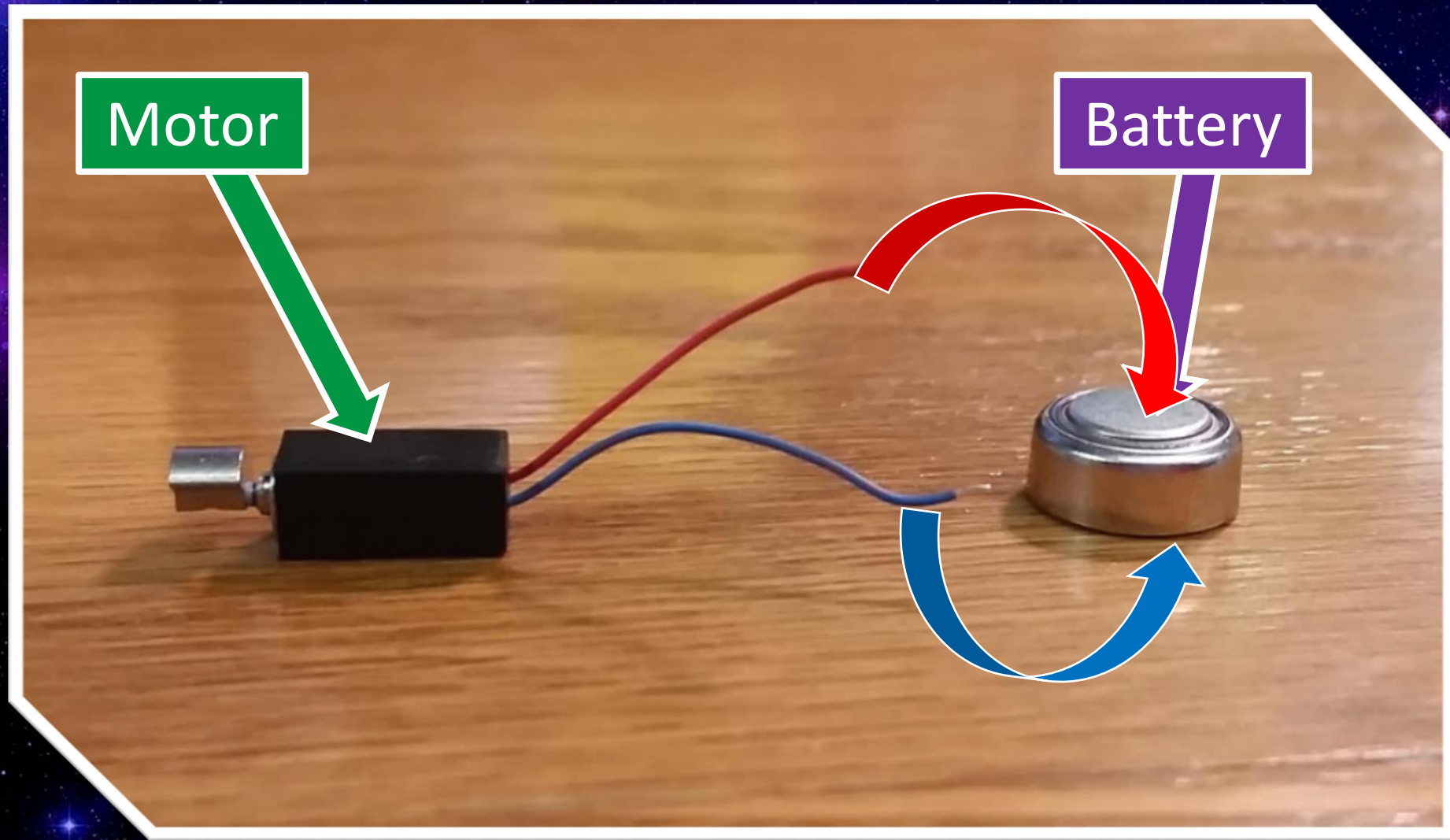
The body of your rover

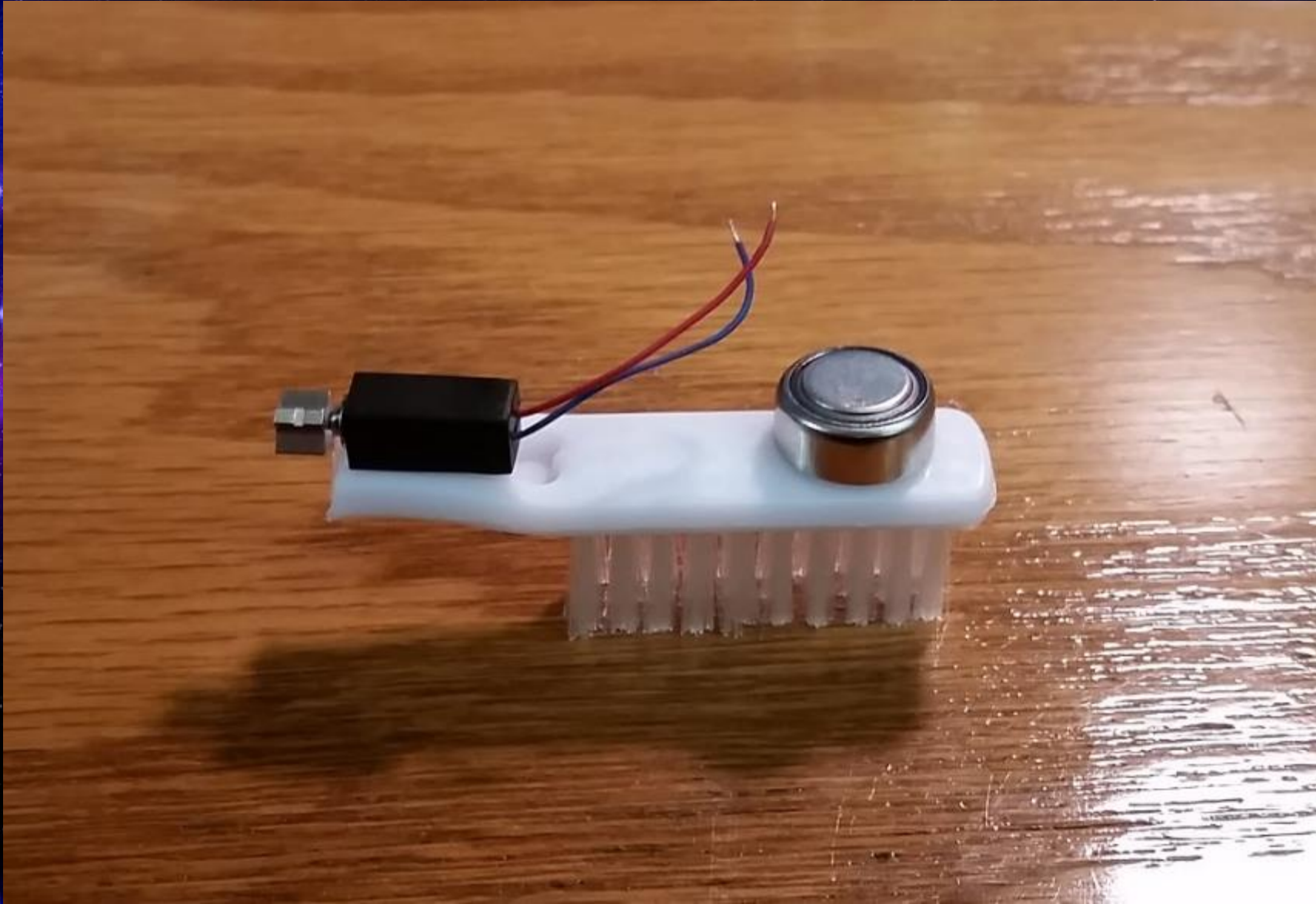


Bristles: Up or Down?



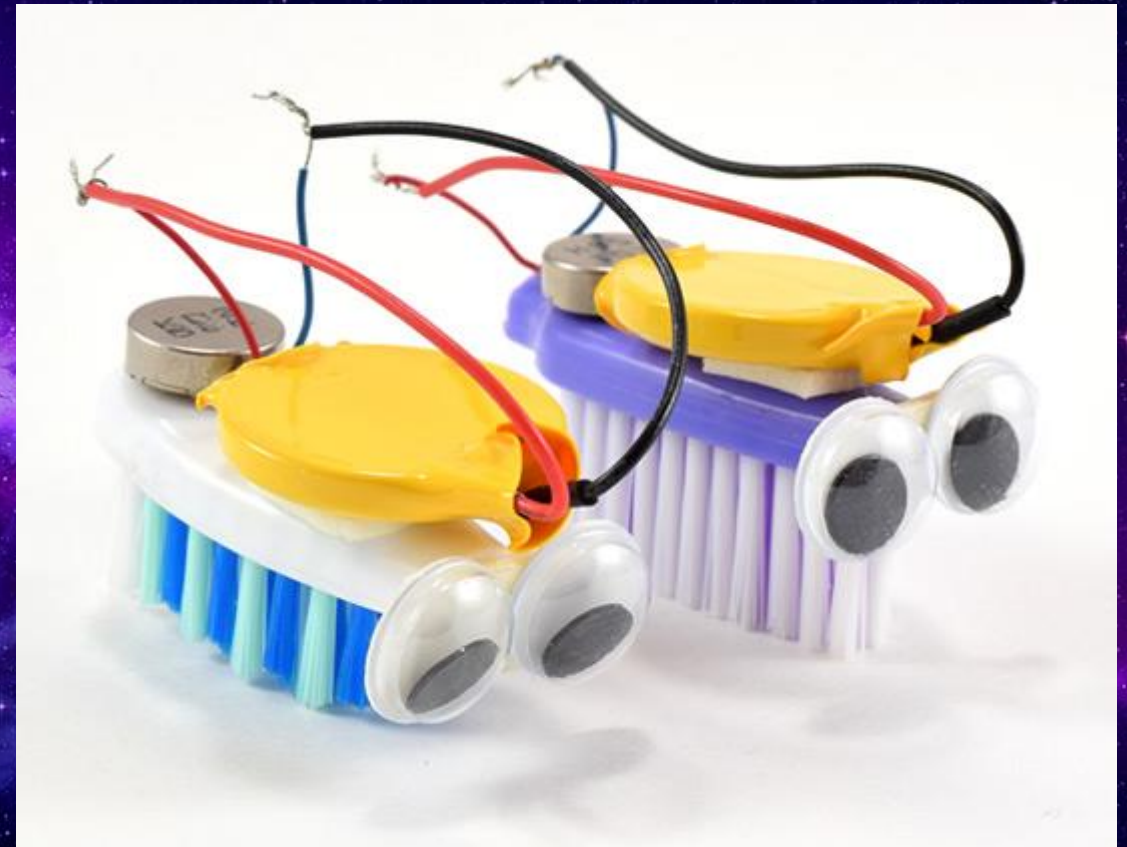
How do you power your rover?

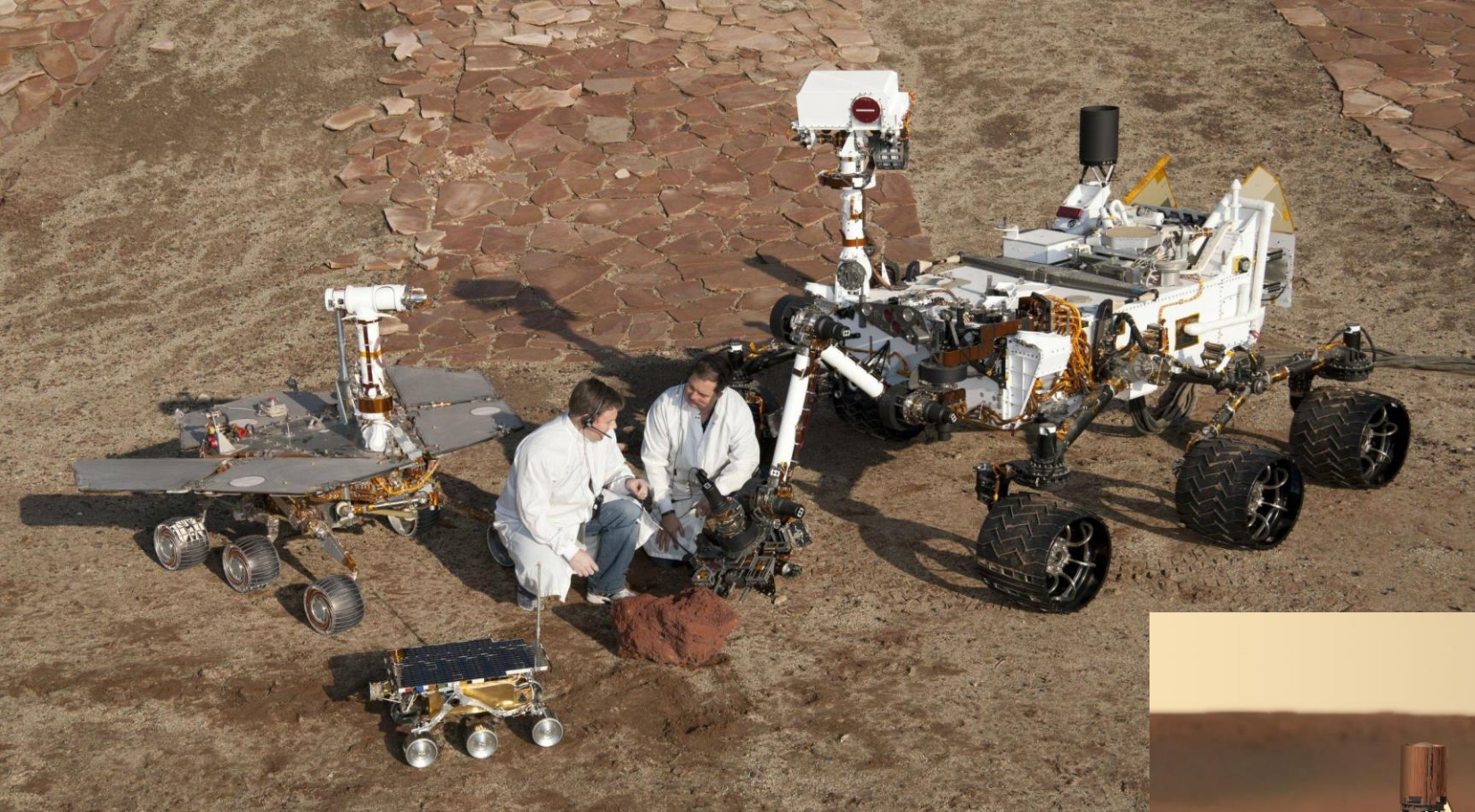




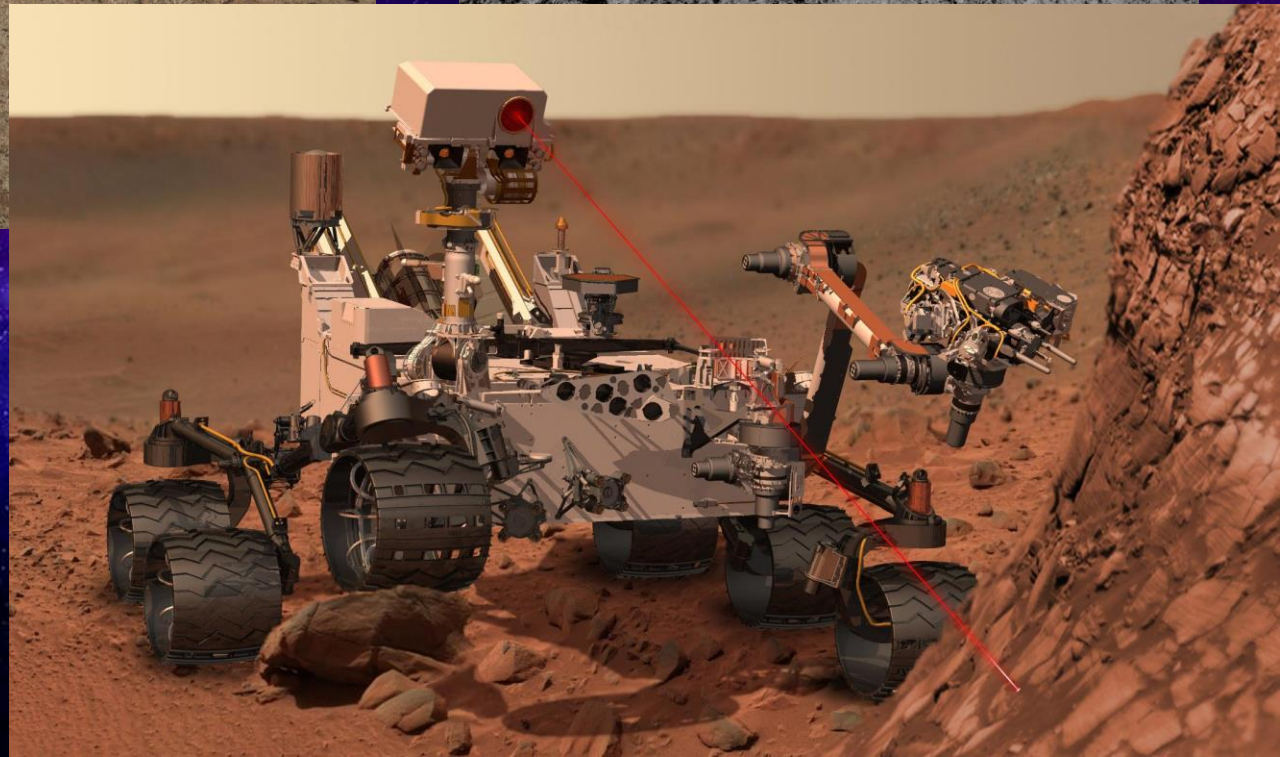
We explored... Now lets explain!

- How does this relate to your electromagnetism unit?
- What else could you integrate with this lesson?
- Any modifications?
- What are some of the more challenging aspects (for elementary school students)?
- Which designs were most successful?
- How might this relate to young students' lives?
- Why solar panels? Can students relate to these?
- What can we improve for next time?
- Any additional materials?

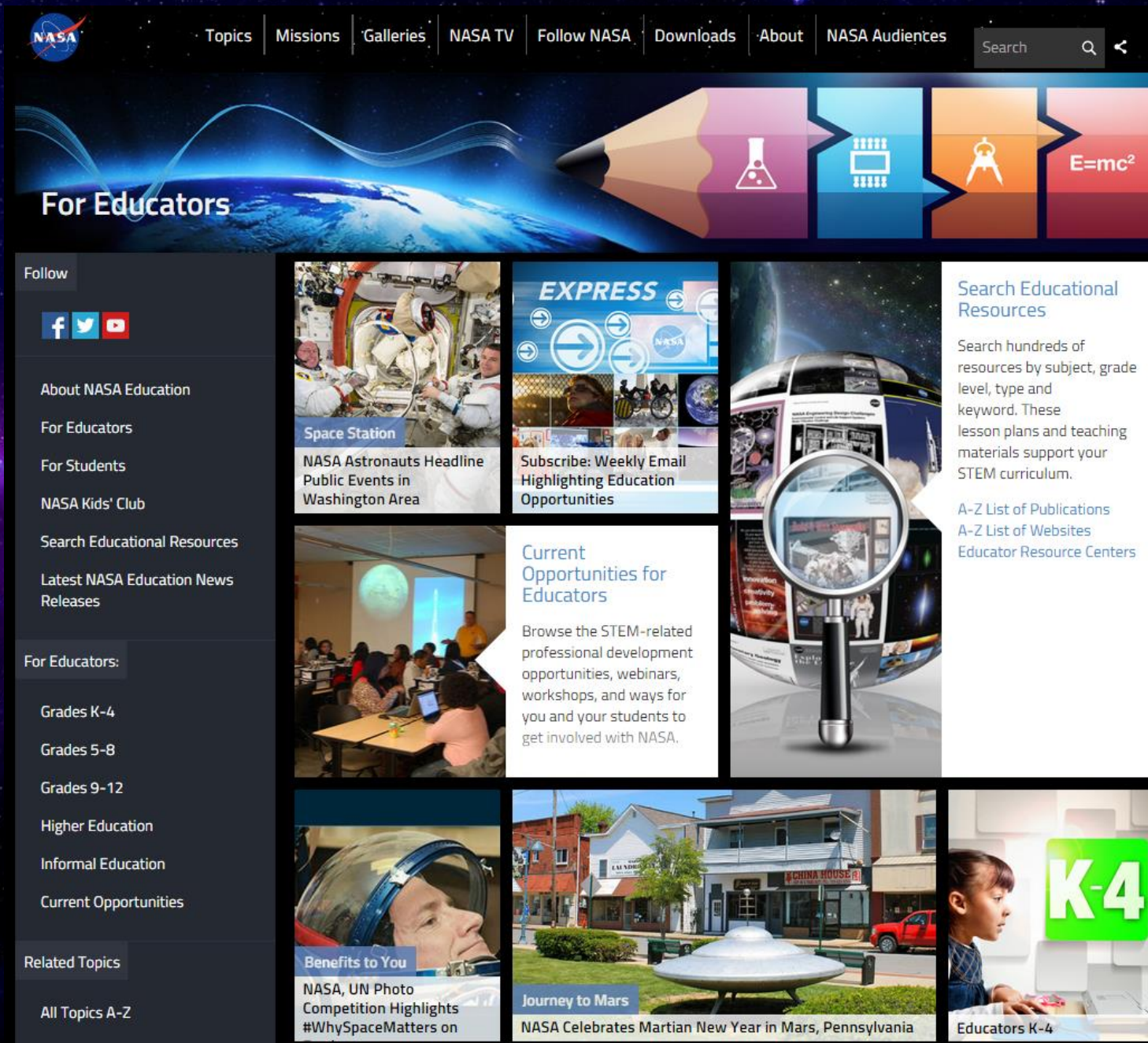




- How can students relate to rovers?
- Mars, Moon, remote RC cars, drones, Roomba, etc.\
- Student designed rover [cleaning demo](#)
- [Mars Rover Test Drive](#): Send Rhett & Link to Mars



NASA Education



The image shows a screenshot of the NASA Education website. At the top, there is a navigation bar with the NASA logo and links for Topics, Missions, Galleries, NASA TV, Follow NASA, Downloads, About, and NASA Audiences. A search bar is located on the right side of the navigation bar. Below the navigation bar is a large banner featuring a stylized pencil with icons for a beaker, a computer monitor, a microscope, and the equation $E=mc^2$. The text "For Educators" is displayed on the left side of the banner. Below the banner is a grid of content blocks. On the left side of the grid is a sidebar with various navigation options. The main content area includes a "Space Station" section with an image of astronauts, an "EXPRESS" section with a magnifying glass over a globe, a "Current Opportunities for Educators" section with an image of a classroom, a "Benefits to You" section with an image of an astronaut's helmet, a "Journey to Mars" section with an image of a Mars rover, and a "K-4" section with an image of a child. A "Search Educational Resources" section is also present on the right side of the grid.

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For Students

NASA Kids' Club

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Latest NASA Education News Releases

For Educators:

- Grades K-4
- Grades 5-8
- Grades 9-12
- Higher Education
- Informal Education
- Current Opportunities

Related Topics

- All Topics A-Z

Space Station
NASA Astronauts Headline Public Events in Washington Area

EXPRESS
Subscribe: Weekly Email Highlighting Education Opportunities

Current Opportunities for Educators
Browse the STEM-related professional development opportunities, webinars, workshops, and ways for you and your students to get involved with NASA.

Search Educational Resources
Search hundreds of resources by subject, grade level, type and keyword. These lesson plans and teaching materials support your STEM curriculum.
A-Z List of Publications
A-Z List of Websites
Educator Resource Centers

Benefits to You
NASA, UN Photo Competition Highlights #WhySpaceMatters on

Journey to Mars
NASA Celebrates Martian New Year in Mars, Pennsylvania

K-4
Educators K-4

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NASA for Students

For Students



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For Students: Grades K-4

[Grades 5-8](#)[Grades 9-12](#)[Higher Education](#)

Related Topics

[All Topics A-Z](#)

Explore This: Planetary Explorer



NASA Kids' Club



Explore This: Technology




Now in Space! Expedition 44

Expedition 44 is part of a special mission. Scott Kelly and Mikhail Kornienko are staying on the space station for one year!

Planet of the Month: Jupiter -- King of the Planets



Space Math at NASA



National Aeronautics and Space Administration
Goddard Space Flight Center

[GO](#)

[Flight Projects](#) | [Sciences and Exploration](#)

Space Math @ NASA

[Home](#) | [Problem Books](#) | [STEM Modules](#) | [Inquiry](#)

[Math by Grade Level](#) | [Math in Science](#) | [Math in Engineering](#) | [Math in Press Releases](#) | [Math by NASA Mission](#) | [Articles](#)

Space Math @ NASA

SpaceMath@NASA introduces students to the use of mathematics in today's scientific discoveries. Through press releases and other articles, we explore how many kinds of mathematics skills come together in exploring the universe.

Partnering NASA Missions

Astrophysics:

- Chandra - [Click here](#)
- Kepler - [Click here](#)
- James Webb ST - [Click here](#)

Earth Science:

- SAGE-III - [Under development](#)

Heliophysics:

- Hinode - [Click here](#)
- IMAGE - [Click here](#)
- MMS - [Click here](#)
- RBSP - [Click here](#)
- THEMIS - [Click here](#)

Planetary:

- Cassini - [Click here](#)
- Dawn - [Mission Math](#)
- EPOXI - [Click here](#)
- InSight - [Click here](#)
- Juno - [Click here](#)

Partnering NASA Programs

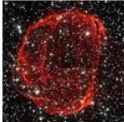
- Eyes on the Solar System - [Click here](#)

SpaceMath@NASA News Updates


March: NASA [Press Release](#) about SpaceMath@NASA- [[Read Press Release](#)]
July: New math guide to [Mars Exploration](#) and the Curiosity Rover - [[Click Here](#)]
August: Expanded and updated math guide on [Black Holes](#) posted- [[Click Here](#)]
November: SpaceMath@NASA served 6,000,000th math problem at the website!
December: New multi-media Grade 6 [Math Modules](#) added- [[Click Here](#)]
February: New multi-media Grade 8 [Math Modules](#) added- [[Click Here](#)]
April: The 7 millionth Space Math problem is downloaded

Math in the News

A behind-the-scenes look at the math in NASA press releases

 **Problem 517: A Distant Supernova Remnant Discovered**
Students explore the size and speed of a distant supernova remnant nebula and compare it to the speed of the International Space Station. (PDF)


 **Problem 516: Hinode Observes Solar Eclipse from Space**
Students use the geometry of a solar eclipse to estimate the distance to the sun using simple proportional reasoning. (PDF)

 **Problem 515: Telling Time on Mars**
Students learn about the difference in time between a martian day and an Earth day, and use this to explore how work schedules change for scientists working with the Curiosity rover on Mars. (PDF)

 **Problem 514: Solar Flares and the Stormy Sun**
Students use simple averaging to explore the sunspot cycle and our sun's changing activity levels in 2012 and 2013. (PDF)

[\(More problems from 2012-2013\)](#)

Multi-Media Math Modules



Grades 6, 7 and 8: Standards-based, multi-media math resources featuring NASA eClips video segments, readings from NASA press releases, online interactive resources, and of course math problems!
[\[click here\]](#)

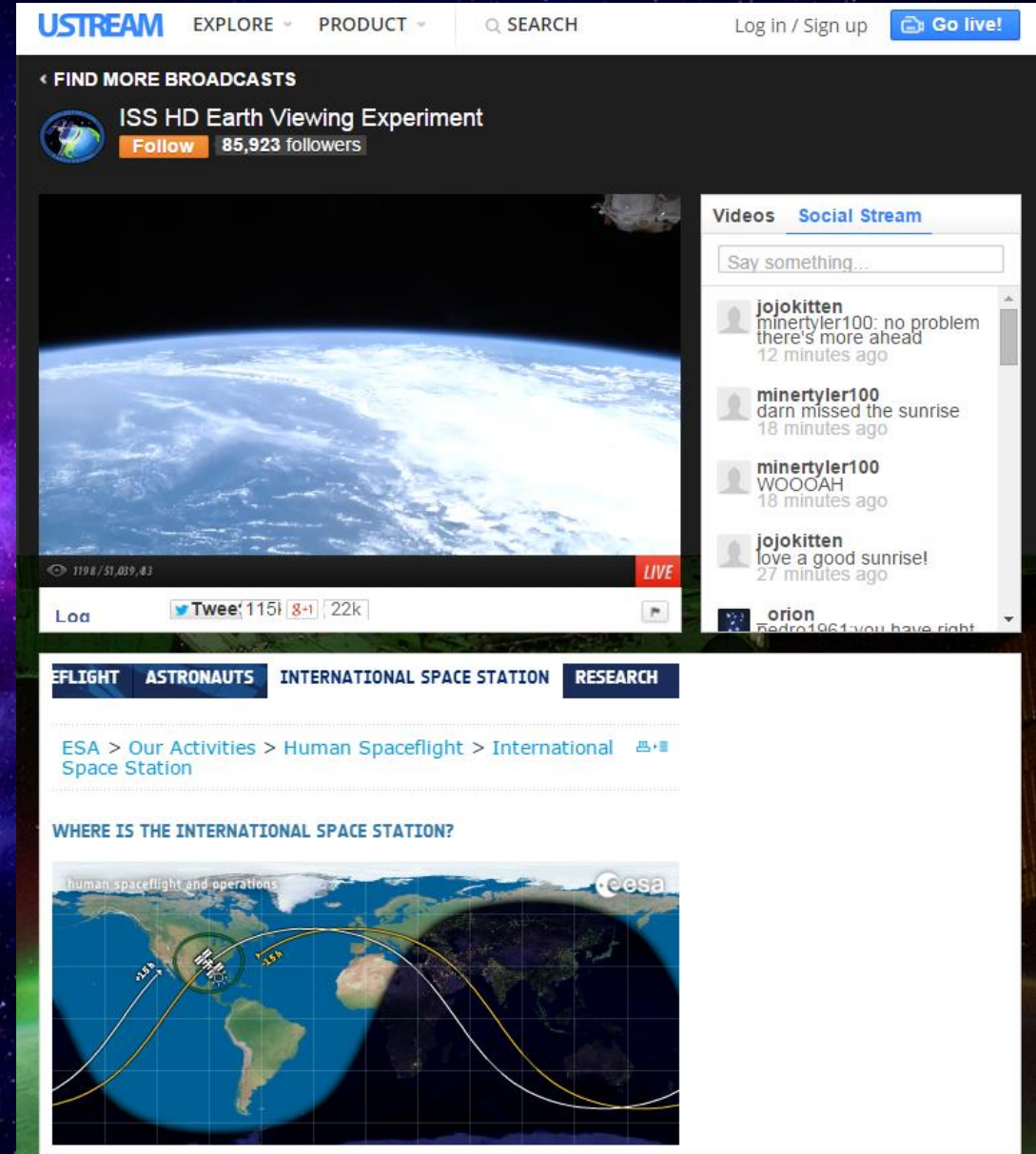
Problem Archives

- I - Problems 1 to 38
- II - Problems 39 to 64
- III - Problems 65 to 101
- IV - Problems 102 to 148
- V - Problems 149 to 233
- VI - Problems 234 to 342
- VII - Problems 343 to 428
- VIII - Problems 429 to 478
- IX - Problems 479 to Current

International Space Station - Live!



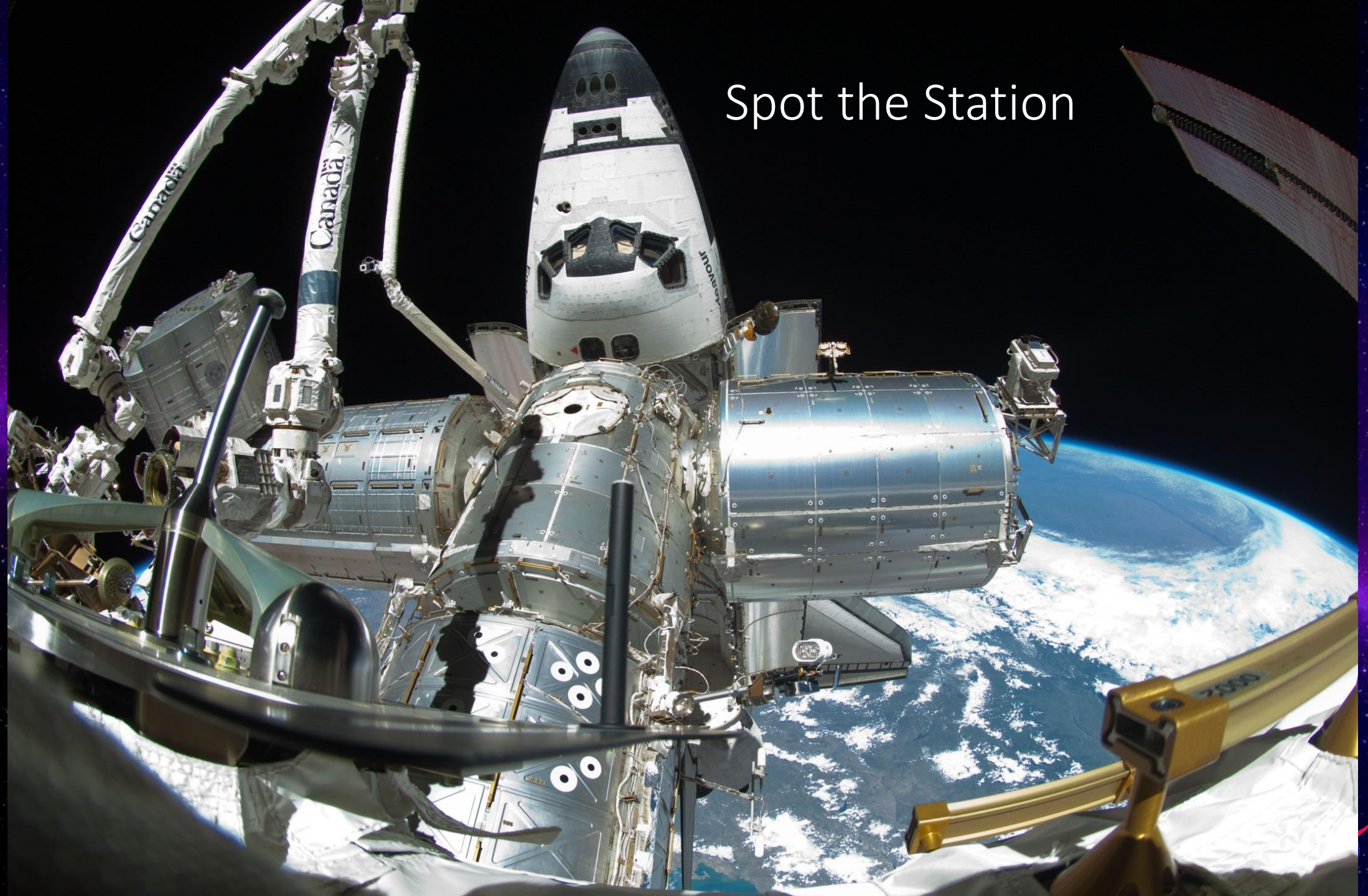
The NASA website features a top navigation bar with links for Topics, Missions, Galleries, NASA TV, Follow NASA, Downloads, About, and NASA Audiences. A search bar is located on the right. The main header displays the International Space Station in orbit. Below this, a secondary navigation bar includes Space Station, Overview, Images, Videos, and Media Resources. A left sidebar lists various topics such as Research and Technology, Crews and Expeditions, and Launches. The main content area is divided into several sections: 'Space Station Updates' with an image of a launch, 'Station Time in Orbit' showing a digital clock at 6058:10:19:10, a 'Tweets' section featuring a tweet from Scott Kelly, 'Commercial Resupply' with an image of a rocket launch, and 'Who's on the Space Station Now?' featuring photos of the Expedition 44 crew: Commander Gennady Padalka, Scott Kelly, and Mikhail Kornienko. A 'One-Year Mission' section is also visible.



The Ustream interface shows the 'ISS HD Earth Viewing Experiment' live broadcast. The top navigation includes 'EXPLORE', 'PRODUCT', and a search bar. A 'Go live!' button is in the top right. The main video player displays a view of Earth from space. To the right, a 'Social Stream' shows user comments, including 'jojkitten' and 'minertyler100'. Below the video, there are engagement metrics like '115' tweets and '22k' views. A bottom navigation bar includes 'EFLIGHT', 'ASTRONAUTS', 'INTERNATIONAL SPACE STATION', and 'RESEARCH'. The 'INTERNATIONAL SPACE STATION' section contains a breadcrumb trail: 'ESA > Our Activities > Human Spaceflight > International Space Station'. Below this is a map titled 'WHERE IS THE INTERNATIONAL SPACE STATION?' showing the station's orbit around Earth, with a 'cesas' logo in the top right corner of the map area.



Spot the Station



Mars Curiosity Rover

NASA Jet Propulsion Laboratory
California Institute of Technology

JPL HOME EARTH SOLAR SYSTEM STARS & GALAXIES SCIENCE & TECHNOLOGY
BRING THE UNIVERSE TO YOU: JPL Email News | RSS | Mobile | Video

Mars Science Laboratory
Curiosity Rover

HOME MISSION NEWS MULTIMEDIA PARTICIPATE! SEARCH ALL MARS

FOLLOW YOUR CURIOSITY

Mars Missions to Pause Commanding in June, Due to Sun

Read More >>

More on Solar Conjunction >>

1 / 5

What's New? Recent Videos Fun Ask Dr. C Curiosity

FAVORITES

Raw Images SEND A POSTCARD TO CURIOSITY

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Government Made Easy

NASA NORTH DAKOTA SPACE GRANT CONSORTIUM

NASA – Lunar Reconnaissance Orbiter

NASA National Aeronautics and Space Administration
Goddard Space Flight Center

Search

Flight Projects | Sciences and Exploration

LUNAR RECONNAISSANCE ORBITER

Home The LRO Mission Images and Multimedia Science and Data Education and Outreach

LRO KIDS!

Get animations, streaming video, cartoon characters, audio narration, interactive games!

NASA | Wall-E Learns About Proportions

Moon Concentration
How Good is Your Memory?

Moon Quiz
Is it a big hunk of cheese? Take quiz and find out!

Moon Cookies
Make these tasty cookies (no baking required)

Unscramble
Take the Challenge!
Unscramble Moon-related graphics

Wordsearch
Help Us Find Our Lost Lunar Words

Moon Calculator
How much would you weigh you lived on the Moon?

Crossword Puzzles
Answer clues and solve the puzzle

Ask Dr. Marc
Dr. Marc answers questions asked by visitors about the moon and other topics.

Lunar Cryptograms
Decode these important messages

LRO CRAFTS

Discover our scientific, cultural, and personal understanding of Earth

Welcome to the Space Operations Learning Center (SOLC) [Back to Home](#)

SOUND

SPACE OPERATIONS LEARNING CENTER

BEGINNER

← Kids Zone 2 Earth Science Kids Zone 3 Space Station Kids Zone 4 The Moon Kids Zone 5 The Sun Kids Zone 6 Comets Meteors and Asteroids →

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Launch & Deployment Space Communication Flight Dynamics Information Processing Mission Operations Spacecraft Disposal

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LUNAR AND PLANETARY INSTITUTE

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EDUCATION *and* public outreach

TEACHERS AND FACULTY OTHER SCIENCE EDUCATORS PUBLIC ABOUT US

Teachers and Faculty

LPI K-12 Teacher Workshops, Institutes, and Field Trips

Exploration of the Moon and Asteroids by Secondary Students

LPI Summer Intern Program

Humans in Space Youth Art Competition

Educator Resources

Education Newsletter

LPI Higher-Education Faculty Programs



Find upcoming LPI teacher trainings in Earth and space science topics, and connect to resources from past workshops and field trips.

Explore!

NEW AND UPCOMING



Cosmic Explorations: A Speaker Series
The Universe is Out to Get Us and What We Can (or Can't) Do About It



Solar System Exploration Pre-Service Teacher Institute
June 23-27, 2014
Application deadline: June 2



Mars Through Time Workshop
July 8-11, 2014
at the University of New Mexico

SciGirls Activities



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[en español](#)
[Groups](#)
[Learn](#)
[Program Resources](#)
[Forum](#)
[Photos](#)

Activities

SciGirls has made a commitment to providing quality, gender-equitable, inquiry-based STEM activities that are fun for all! Check out the activities under the following topic areas:

- Earth & Space
- Engineering
- Health
- Life & Environmental
- Physics & Chemistry
- Technology

Download the complete guides from Season Three:



SciGirls Participate: Citizen Science Adventures
 Public participation in scientific research, also known as citizen science, engages ordinary people (kids and adults) in the collection of data for use by research scientists. The activities in this book support and prepare your girls for participation in citizen science.

Download the complete guides from Season Two:

Welcome to SciGirls CONNECT

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SciGirls on Facebook

Like

SciGirls on Twitter

Tweets

Follow

PBS LearningMedia @PBSLmMedia 8h
 What kind of stuff is preserved in a bog? @SciGirls activity/video describes functions of unique wetland environment.

Activity 4 Star Power

CREATE A STAR SHOW AND LEARN HOW YOU CAN PREVENT LIGHT POLLUTION.

The stars in the night sky have fascinated humans since we first walked the Earth. But today, electric outdoor lighting threatens our ability to see the stars. Light pollution is a real problem, and not just for astronomers. Animals become disoriented from the excess lights, which can disrupt their mating, migration, and predation behaviors. For example, sea turtle hatchlings follow light from the moon to find their way to the ocean, but coastline lighting can lure them toward roads and predators.

You'll Need:

- room that can be darkened
- desk lamp with lamp shade removed

Part 1 (for each small group):

- shoe box (the narrower, slinky kind is best) or rectangular tissue box and extra paperboard (e.g., cereal box)
- 3"x5" index card
- tape (duct or masking)
- scissors
- pushpin
- LED keychain flashlight
- optional: alcohol, construction paper, glue, construction paper, construction paper, markers, crayons, colored pencils

Part 2 (for each small group):

- aluminum foil
- paperboard (e.g., cereal box)
- tape (duct or masking)
- scissors

2 hours

Activity 2 Insulation Station

DETERMINE THE BEST INSULATION TO KEEP ICE CUBES FROM MELTING

Insulation in the home is used for different purposes in different parts of the country. In warmer climates, insulation keeps the cool air in and the hot air out; in cooler climates it has the opposite effect. The purpose of insulation is to slow down the conduction of heat from one side of a wall to the other.

You'll Need:

- large pitcher
- water
- several insulating materials (shredded paper, bubble wrap, cardboard packing scraps or fabric)

For each small group:

- 2 ice cubes
- 1 91 radiused cylinder (50 mL or larger)
- plastic wrap
- 2 large paper cups
- scissors
- rubber
- tape (masking or clear)
- paper and pencil
- 1 incandescent light bulb, 130 watt
- 1 work light with clamp (or desk lamp capable of holding a 120 watt bulb)
- 1 stopwatch or clock

1 hour

SMART START:

Prepare one paper cup testing station to display by cutting off the top (approximately 1 cm) of a paper cup and filling with one of the test materials. Use the plastic wrap to cover and keep the "insulation panel" inside the cup. Place whole cup (testing cup) inside the top of a second cup. When the test material and insulation are in place, remove the test material and insulation.

Fill a large pitcher with water and allow it to reach room temperature.

Here's how:

- Question.** Divide the girls into small groups, and introduce the idea of insulation. Have them brainstorm different materials that might provide good insulation for different needs (insulating clothing, food storage, etc.). Deliver the SciGirls Challenge: How can you keep ice cubes in a cup from melting?
- Design the experiment.** Show your example paper cup testing station and ask your girls to choose one material to test. Explain to the girls

www.go.to/scigirlsconnect.org/

Activity 5 Deep Sea Diver

THINK LIKE AN OCEAN ENGINEER AND DESIGN YOUR OWN MODEL DEEP SEA DIVER.

Buoyancy is the ability to float. When you put an object in water, it pushes water out of the way to make room for itself. An object floats when it weighs less than the water it displaces; it sinks when it weighs more than the water it displaces.

You'll Need:

- Items to adjust buoyancy (assorted metal washers, pennies, paper clips, binder rings, Styrofoam packing peanuts, small balloons)
- Items for the body of the diver (Styrofoam ball, plastic beverage drinking straw, craft sticks, wooden skewers, plastic eggs, balloon, pipe caps, sponge, craft foam)
- Items to hold the diver together (rubber bands, duct tape, or a hot glue gun)
- optional: objects that sink or float (marbles, metal paper, Ping Pong balls, sponges, plastic spoon, pieces of fruit)

For each small group:

- sturdy clear container at least 6 in. x 6 in. that can hold water
- water
- scissors
- paper and pencil

45 min

SMART START:

Here's one way to start this activity. Get your girls thinking about buoyancy. Show them a group of objects and ask them to predict which will sink and which will float. Then, test their ideas using a plastic container filled with water. Do the girls' predictions match the results?

Here's how:

- Explore buoyancy.** Can you think of things that don't float on the water and don't sink to the bottom (scuba diver, submarine, fish)? This is called "neutral buoyancy." Discuss what it means for an object to be neutrally buoyant. What are some situations where neutral buoyancy might be useful (swimming, using a submersible to study underwater creatures, taking measurements at different depths in the ocean)?
- Design and build.** Engineers will often build models before they design full scale. The models help them understand the factors that may be key to the success of the design. Deliver the SciGirls Challenge: Build a small diver (no larger than 3 in. by 3 in.) that is neutrally buoyant. In small groups, have girls brainstorm what materials they'd like to use, then design and build their diver.

Watch the SciGirls test a neutrally buoyant underwater robot on the SciGirls Invent DVD (Select Aquatics: Test and Redesign 1.)

Use caution when working with hot glue.

www.go.to/scigirlsconnect.org/



NASA Summer of Innovation

What to Consider When Selecting Content

Themed Units



Life Science



Physical Science



Earth & Space Science



Engineering

Grades 4-6

Life Science

- Body
- Food
- Life Out There?
- Plants
- Survival

Physical Science

- Aeronautics
- Force and Motion
- Gravity
- Properties of Matter
- Waves and Optics

Grades 7-9

Earth and Space Science

- Climate and Seasons
- Destination Mars
- Earth Moon Systems

Engineering

- Aeronautics
- Challenges
- Design Process

Themed Camp Guides



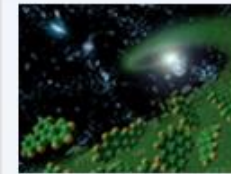
Aeronautics Camp

This camp centers on the mathematical and design principles of flight design.



Designing for Space Camp

This camp centers on developing an appropriate learning progression that focuses on the concepts necessary to learn about engineering.



Life Science Camp

This camp centers on the characteristics of living things, astrobiology, exoplanets and adaptations to the space environment.

NASA Discovery Program

Discovery Program

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- Missions
- News
- Education
- Multimedia
- Small Worlds

Upcoming Mission Events

Dawn Orbit Insertion



ART & THE COSMIC CONNECTION



Mission Milestone Interactive



Discovery & New Frontiers Newsletter Archives

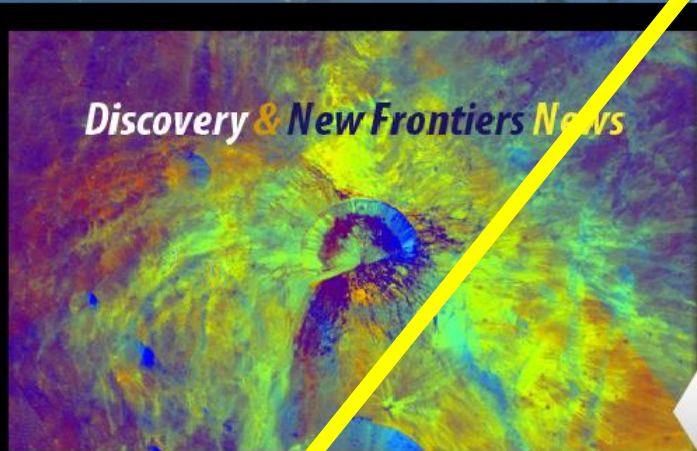


Space Thrills POSTER

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Discovery & New Frontiers News

- Cosmic Art in Action!
New Activity Blends Science and Art, Spurs Creative Thought Processes
- Onward to Ceres
Ion Propulsion Powers Dawn Through the Asteroid Belt
- Looking Back at Us
MESSENGER Takes Image of the Earth
- MESSENGER to Snap Earth
Mercury Orbiter Will Take Images of Earth and Moon
- Read All about It!
Latest Discovery and New Frontiers Newsletter Now Online



Space School Musical
The solar system comes alive!



Exo's Discovery
Take the controls and explore with Exo!

Image Impact
View the images and captions.

Space School Musical

Hannah is trying to finish her science project - a model of the solar system. But there's a problem: it's due tomorrow, she's not finished yet, and it's past her bedtime. How will she get it done? With a little help from her friends - the most talented troupe in the Milky Way!

SONGS
WATCH VIDEOS & SING ALONG

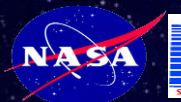
ACTIVITIES
CROSS-CURRICULAR & FUN

GALLERY
PHOTOS & VIDEOS

PRODUCE
YOUR OWN MUSICAL



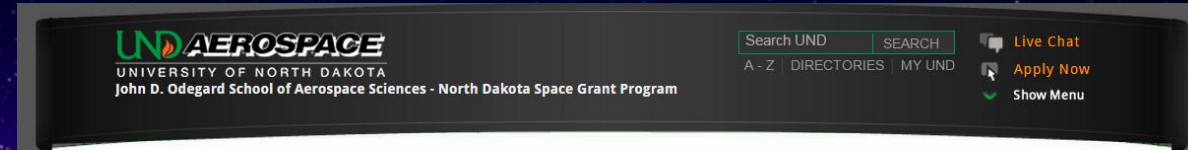
Join Hannah on a trip through the solar system in this ultra-cool edu-tainment "hip-opera" that is out of this world! Move and groove along with the planets, moons, meteors, comets, asteroids and even some rockin' scientists as they sing, dance and serve up the freshest facts in the galaxy. *Space is definitely one cool place.*



North Dakota Space Grant



Facebook page for the North Dakota Space Grant Consortium. The page features a cover photo of a satellite launch and a profile picture with the consortium's logo. The navigation bar includes 'Page', 'Messages', 'Notifications', 'Insights', and 'Publishing Tools'. The main content area shows a post from June 18 at 4:11pm in Grand Forks, ND, titled 'Rockets for 200 kids at Grand Forks Public Library! We survived!'. The post includes a collage of photos showing children and adults participating in a rocket launch event. The left sidebar contains engagement statistics (178 likes, 1 was here, 133 post reach) and promotional options for the page and website.

UND AEROSPACE
UNIVERSITY OF NORTH DAKOTA
John D. Odegard School of Aerospace Sciences - North Dakota Space Grant Program

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ND Space Grant Program

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- Home
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- Scholarships
- Fellowships

Welcome to the North Dakota NASA Space Grant Website
Congratulations MPCG Science Geeks!



MayPort CG team members pictured are: Lance Johnson, Andrew Fugleberg, Marcus Dale, Gracy Leland, Sterling Minkler, and Joshua Weaver.



Twitter profile for NASA ND Space Grant (@NDSGC). The profile picture is the North Dakota Space Grant Consortium logo. The bio reads: 'Part of NASA Space Grant program promoting STEM education and research throughout North Dakota through K-12 and college programs and public outreach efforts.' The location is listed as North Dakota, and the website is ndspacegrant.und.edu. The profile shows 64 tweets, 3 photos/videos, 366 following, 123 followers, and 6 favorites. A recent tweet from June 6 says: '2mrw we're launching sensors 2 the #thermosphere! JK-it's a balloon not a spaceship! #spacejoke #cyaninthe stratosphere'. Below the tweet is a photo of a white balloon with a string of red sensors attached, floating in a clear sky.



NDSGC K-12 Educator Email Listserv

- Workshop opportunities
- New STEM education resources for the classroom
- NASA student contests/team competitions
- Professional Development opportunities
- Emails ~once a week

