

Eyes on Earth Space: Teaching Earth Science from Space

Space Mission Assignment

By Brenda Williams

Title

The ISS and the Robotic Arm

Grade Level

Fourth and Fifth Grade

Length of Lesson

Three 45-minute lessons

Materials

Teacher should prep for each group--1 large strip of corrugated cardboard (cut the length of the strips about 5 x 20 centimeters [2 x 8 inches] along the corrugations (grooves) so the cardboard won't bend easily) with a hole punched in one corner • 1 small strip of corrugated cardboard (cut a large strip in half) with a hole punched a hole in one corner • unbend a paperclip to form a hook, and tape it to the inside of the cup.

Each group will need-- 1 medium (i.e., 1-inch) brass fastener • 1 straw, students will cut into 2.5-centimeter (1-inch) lengths • 100 centimeters (39 inches) of smooth string (e.g., kite string), students will cut string • 1 large paper clip • 1 paper cup (3-ounce) • tape (any kind) • have fishing line available for groups, if needed

Each student will need—a Chromebook (teacher may assign students videos using Google Classroom) • student worksheet-pages 17 and 18 in the following Design Squad pdf

(http://pbskids.org/designsquad/pdf/parentseducators/DSN_NASA_MissionSolarSystem_FullGuide.pdf) • science journal/notebook

Resources/Links & Citations

<https://www.youtube.com/watch?v=SOCixRhRGDw>

<https://eol.jsc.nasa.gov/ESRS/HDEV/>

http://pbskids.org/designsquad/parentseducators/guides/mission_sandeep_yayathi.html

<https://solc.gsfc.nasa.gov/modules/newkz3/index.html>

<https://www.nasa.gov/specials/kidsclub/nowinspace/expedition55/index.html>

<https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-the-iss-k4.html>

<https://www.youtube.com/watch?v=zbwV0fs5-xU>

http://pbskids.org/designsquad/pdf/parentseducators/DSN_NASA_MissionSolarSystem_FullGuide.pdf

<http://pbskids.org/designsquad/build/robo-arm/>

Core State Standards Initiative. (2018a). Retrieved from

<http://www.corestandards.org/ELA-Literacy/>

Core State Standards Initiative. (2018b). Retrieved from

<http://www.corestandards.org/Math/Content/5/NBT/>

NGSS Lead States. (2013). *Next Generation Science Standards: For States, by States*. Washington, DC: The National Academies Press.

Texas Education Agency. (2012). Texas Essential Knowledge and Skills for 4th and 5th Grade.

§111.6. Math. <http://tea.texas.gov>

Texas Education Agency. (2017a). Texas Essential Knowledge and Skills for 4th and 5th Grade.

§110.15. English Language Arts and Reading. <http://tea.texas.gov>

Texas Education Agency. (2017b). Texas Essential Knowledge and Skills for 4th and 5th Grade.

§112.15. Science. <http://tea.texas.gov>

Standards

Science Texas Essential Knowledge and Skills (TEKS)

4.3 and 5.3 Scientific investigation and reasoning. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to: (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student; (D) connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.

4.4 and 5.4 Scientific investigation and reasoning. The student knows how to use a variety of tools, materials, equipment, and models to conduct science inquiry. The student is expected to: (A) collect, record, and analyze information using tools, including calculators, microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, mirrors, spring scales, pan balances, triple beam balances, graduated cylinders, beakers, hot plates, meter sticks, compasses, magnets, collecting nets, and notebooks; timing devices, including clocks and stopwatches; and materials to support observation of habitats of organisms such as terrariums and aquariums.

4.6 Force, motion, and energy. The student knows that energy exists in many forms and can be observed in cycles, patterns, and systems. The student is expected to: (D) design an experiment to test the effect of force on an object such as a push or a pull, gravity, friction, or magnetism.

5.6 Force, motion, and energy. The student knows that energy occurs in many forms and can be observed in cycles, patterns, and systems. The student is expected to: (D) design an experiment that tests the effect of force on an object (Texas Education Agency, (2017b).

Next Generation Science Standards (NGSS)

3-PS2-1 Plan and conduct an investigation to prove evidence of the effects of balanced and unbalanced forces on the motion of an object.

3-PS2-2 Make observations and/or measurements to produce data to serve as the basis for evidence for the explanation of a phenomenon or test a design solution.

3-PS2-3 Ask questions that be investigated based on patterns such as cause and effect relationships.

3-PS2-4 Define a simple problem that can be solved through the development of a new or improved object or tool. (NGSS Lead States, 2013).

Math or ELA Connections

Math TEKS:

4.1 and 5.1 Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to: (A) apply mathematics to problems arising in everyday life, society, and the workplace; (B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution; (C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems.

4.6 Geometry and measurement. The student applies mathematical process standards to analyze geometric attributes in order to develop generalizations about their properties. The student is expected to: (A) identify points, lines, line segments, rays, angles, and perpendicular and parallel lines.

4.8 Geometry and measurement. The student applies mathematical process standards to select appropriate customary and metric units, strategies, and tools to solve problems involving measurement. The student is expected to: (A) identify relative sizes of measurement units within the customary and metric systems; (C) solve problems that deal with measurements of length, intervals of time, liquid volumes, mass, and money using addition, subtraction, multiplication, or division as appropriate. (Texas Education Agency, 2012).

ELAR TEKS:

4.7 and 5.7 Reading/Comprehension of Literary Text/Literary Nonfiction. Students understand, make inferences and draw conclusions about the varied structural patterns and features of literary nonfiction and provide evidence from text to support their understanding. Students are expected to identify similarities and differences between the events and characters' experiences in a fictional work and the actual events and experiences described in an author's biography or autobiography.

4.26 Research/Organizing and Presenting Ideas. Students organize and present their ideas and information according to the purpose of the research and their audience. Students are expected to draw conclusions through a brief written explanation and create a works-cited page from notes, including the author, title, publisher, and publication year for each source used.

4.27 Listening and Speaking/Listening. Students use comprehension skills to listen attentively to others in formal and informal settings. Students continue to apply earlier standards with greater complexity. Students are expected to: (A) listen attentively to speakers, ask relevant questions, and make pertinent comments; and (B) follow, restate, and give oral instructions that involve a series of related sequences of action.

4.28 and 5.28 Listening and Speaking. Students speak clearly and to the point, using the conventions of language. Students continue to apply earlier standards with greater complexity. Students are expected to express an opinion supported by accurate information, employing eye contact, speaking rate, volume, and enunciation, and the conventions of language to communicate ideas effectively.

4.29 Listening and Speaking/Teamwork. Students work productively with others in teams. Students continue to apply earlier standards with greater complexity. Students are expected to participate in teacher- and student-led discussions by posing and answering questions with appropriate detail and by providing suggestions that build upon the ideas of others.

5.26 Research/Organizing and Presenting Ideas. Students organize and present their ideas and information according to the purpose of the research and their audience. Students are expected to synthesize the research into a written or an oral presentation that: (A) compiles important information from multiple sources; (B) develops a topic sentence, summarizes findings, and uses evidence to support conclusions; and (C) presents the findings in a consistent format.

5.27 Listening and Speaking/Listening. Students use comprehension skills to listen attentively to others in formal and informal settings. Students continue to apply earlier standards with greater complexity. Students are expected to: (A) listen to and interpret a speaker's messages (both verbal and nonverbal) and ask questions to clarify the speaker's purpose or perspective; and (C) determine both main and supporting ideas in the speaker's message.

5.29 Listening and Speaking/Teamwork. Students work productively with others in teams. Students continue to apply earlier standards with greater complexity. Students are expected to participate in student-led discussions by eliciting and considering suggestions from other group members and by identifying points of agreement and disagreement (Texas Education Agency, 2017a).

ELA and Math Common Core Standards:

CCSS.ELA-Literacy.RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.

CCSS.ELA-Literacy.RI.4.2/5.2 Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.

CCSS.ELA-Literacy.RI.5.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and time/effect.

CCSS.ELA-Literacy.W.4.1.B Provide reasons that are supported by facts and details.

CCSS.ELA-Literacy.W.5.2.E Provide a concluding statement or section related to the information or explanation presented (Core State Standards Initiative, 2018a).

CCSS.Math.Conent.4.MD.A.1 Solve problems involving measurement and conversion of measurements (Core State Standards Initiative, 2018b).

Student Experiences

***Engage (15 minutes)**

1. What is the International Space Station?

Students will view the following video- <https://www.youtube.com/watch?v=SOCixRhRGDw>

2. Where is the International Space Station currently?

Students will use the High Definition Earth-Viewing System to currently track the ISS.

<https://eol.jsc.nasa.gov/ESRS/HDEV/>

3. Formative Assessment Discussion Questions:

*What do astronauts do on the ISS?

*How do astronauts get to the ISS?

*Where does the ISS get the energy it needs to move and provide electricity to power lights and computers?

*What is a robotic arm used for on the ISS?

*What do you think can scientists learn about Earth by using the High Definition Earth-Viewing System (HDEV)?

***Explore (30 minutes)**

1. Using the following web site, <https://solc.gsfc.nasa.gov/modules/newkz3/index.html>, students will independently explore the ISS; what has been done on the ISS; what does the ISS do; living on the ISS; and who's involved with the ISS. Students may explore the educational games on the web site.

2. Using the following web site, <https://www.nasa.gov/specials/kidsclub/nowinspace/expedition55/index.html>, students will learn who recently lived and worked on the International Space Station 55.

3. Using the following video, students will learn how robots can work alongside astronauts on the ISS—

http://pbskids.org/designsquad/parentseducators/guides/mission_sandeep_yayathi.html

4. Formative Assessment Discussion Questions:

*What are some purposes of the ISS?

*What is some data that has been collected from the ISS?

*How large is the ISS?

*Where was most of the ISS constructed?

*What are some parts of the ISS and what are their functions?

*How many astronauts live on the ISS and where are they from?

*How is the arm of humanoid robot, Robonaut2, useful on the ISS?

***Explain (30 minutes)**

1. Students will read the following article about the ISS <https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-the-iss-k4.html>

2. Using the following video, <https://www.youtube.com/watch?v=zbwV0fs5-xU>, students will learn about a robotic arm on the ISS.

3. Formative Assessment Discussion Questions:

- *How old is the ISS?
- *What countries have science labs on the ISS?
- *How do astronauts control the ISS robotic arm?
- *What type of simple machine(s) are used on the ISS robotic arm?
- *Explain how potential and kinetic energy are related to the ISS robotic arm.

4. Using a science journal/notebook, students will answer the following questions. Students may share and discuss responses with a partner or in small groups.

- *Why is the Space Station important?
- *How is the ISS robotic arm like the arm of Robonaut2? How is the ISS robotic arm different than Robonaut2's arm?
- *How would you use the robotic arm on the ISS?
- *How would you use Robotnaut2 on the ISS?

***Elaborate** (15 minutes)

1. Review the Engineering Design Process.
2. Introduce the Design Squad Challenge--(see Challenge 2, page 14, 15, and 16 in http://pbskids.org/designsquad/pdf/parentseducators/DSN_NASA_MissionSolarSystem_FullGuide.pdf)
3. Hand out the student worksheet-(see pages 17 and 18 in http://pbskids.org/designsquad/pdf/parentseducators/DSN_NASA_MissionSolarSystem_FullGuide.pdf)
4. Students will identify the problem—building a robotic arm to play a table top game of Kick the Cup or picking up a cup.

Show the Design Squad video and discuss the steps of the project as a class—see <http://pbskids.org/designsquad/build/robo-arm/>

***Engineer** (45 minutes)

In groups of three or four, students will work through the engineering design process to complete a robotic arm capable of playing Kick the Cup or picking up a cup—for complete directions, see pages 4 and 14-18 in http://pbskids.org/designsquad/pdf/parentseducators/DSN_NASA_MissionSolarSystem_FullGuide.pdf

Each group will present their robotic arm to the class. Students are expected to produce an oral presentation that: (A) compiles important information from multiple sources; (B) develops a topic sentence, summarizes findings, and uses evidence to support conclusions; and (C) presents the findings in a consistent format (Texas Education Agency, 2017a).

The class may ask questions regarding each group's robotic arm.

***Evaluate**

The following rubric will be used to assess the students during the engineering design project. See next page.

Engineering Design Process Rubric

***Individual Progress Report**

Name _____

Date

Project _____

Grade

Criteria	4-5 Points	2-3 Points	0-1 Points	Points
Identifying the problem and brainstorming solutions	Showed a clear understanding of the problem(s) to solve. Independently brainstormed solutions.	Needed some teacher direction to define the problem(s) and brainstorm possible solutions.	Needed lots of teacher direction to define the problem(s). Little if any independent brainstorming.	
Working as a team member	Worked well with team members. Participated and stayed on task.	Was occasionally off task.	Was often off task and not cooperating or participating fully	
Using the	Assisted team	Was	Brainstormed	

engineering design process	in brainstorming many design ideas. Actively participated in testing and improving the design.	occasionally off task instead of assisting team in brainstorming ideas, testing, and improving design.	few design ideas and did little testing or redesigning.	
Processing the science and engineering during group presentation	Assisted team in strong presentation of its solution to the challenge. Showed clear understanding of the science concepts and design process.	Was occasionally off task during presentation. Showed less than adequate understanding of the science concepts and design process.	Did not participate in presentation. Showed little understanding of the science concepts and design process.	
				Total Points