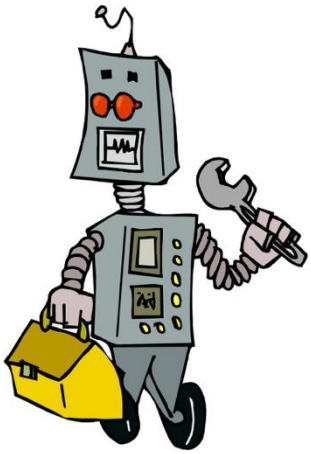
Student Material

A Place for Robots



Have you ever watched a movie or a cartoon in which robots can complete tasks in the place of humans? In the animated movie *WALL-E*, robots help humans after the Earth is considered no longer habitable. Some robots go and take care of the humans on a floating space station, while others stay on Earth and clean up the leftover debris. Another group travels back and forth between Earth and the Space Station looking for signs of life, which would mean that the humans can go back to Earth.

In the real world, NASA (National Aeronautics and Space Administration) has done a great deal of work with robotics. Robotics is the branch of technology that deals with the design, construction, operation, and application of robots. One of NASA's biggest uses of robots is in space exploration. NASA uses robots to travel to and explore places that aren't safe for humans, such as Saturn and Mars.

NASA is preparing for another space exploration mission to Europa, Jupiter's icy moon. It is a high priority to explore because a salty underground ocean is found under the moon's crust. This mission, Clipper Europa, is planned to take place in the 2020s; it will take NASA several years to develop and create the equipment. Once NASA has access to data from Europa, it needs to determine if the moon can sustain life. What makes a planet sustainable?

NASA is still designing the robotic tools necessary for this particular mission. Every mission uses different robots for different purposes. How will robots help us determine if Europa is a habitable moon? Why do companies use robots instead of humans for similar missions? What would it take to design a robot that can collect, preserve, and return evidence of the necessities to sustain life? What would the process of this design and creation look like?

Your challenge will be to create a working model for this mission that can be shared with the education department at NASA, including an argument for why your design is essential to the mission.

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Student Material

A Place for Robots *Rubric*

	Novice	**Apprentice**	**Practitioner**	**Expert**
Design Process Journal: Initial Research (Explore)	includes the purpose of robots and examples of their use in space exploration	includes: ☐ summary of the various uses and purposes of robots ☐ key ideas and details from research ☐ citations for multiple sources	includes: ☐ evidence from informational texts to analyze, reflect, and research space exploration and robotics ☐ relevant information from experiences, print, and digital sources ☐ summary of information in notes ☐ multiple, valid, cited sources to build knowledge about investigation of space exploration and the use of robotics in space	all of *Practitioner* plus: includes an interview with an expert in the field of space exploration or robotics
Design Process Journal: Use of Design Process	documents some of the steps in the Design Process to attempt to create a robotic model	☐ documents all of the steps in the Design Process to create a robotic model ☐ includes both process and reflection notes ☐ states one way to improve design from initial idea	☐ documents, in detail, all steps of the Design Process ☐ provides evidence of reflection and rounding back to earlier stages in the Design Process to improve model ☐ includes relevant information from experiences to provide organized, detailed description of the Design Process in action	all of *Practitioner* plus: provides analysis of errors, and addresses any constraints to the Design Process
Robotic Working Model	reflects design as specified in the Design Journal	☐ functions as specified in the Design Journal ☐ moves based on remote control or programming	☐ functions as specified in the Design Journal ☐ moves based on programming ☐ responds appropriately to obstacles ☐ navigates rough terrain ☐ collects a sample of evidence and preserves the sample for return to Earth	all of *Practitioner* plus: can collect and preserve multiple samples of evidence for sustaining life

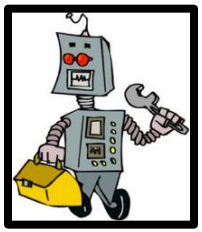
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Final Proposal	☐ introduction of concepts of robotics used in space exploration ☐ some facts and detail ☐ a list of resources used at the end of the proposal	☐ introduction of concepts of robotics used in space exploration as hook ☐ findings presented using the Design Process system view framework ☐ research embedded throughout proposal ☐ sources cited at the end of proposal ☐ opinion is supported with fact and detail to strengthen the argument for the design	☐ introduction with claim supported by research and a logical sequence ☐ integrates information from several texts on robotics or space exploration ☐ cites sources throughout the proposal ☐ includes evidence and direct quotes from multiple credible, timely sources ☐ references using Design Process, showing journey through several attempts at model design ☐ includes words, phrases, and clauses to create cohesion and clarify relationships between claim and evidence ☐ includes concluding statement that supports argument and addresses their audience	all of *Practitioner* plus: includes an online tool, e.g., website to advocate solution beyond the classroom

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A Place for Robots *Scaffold for Learning*

Teacher Material



Benchmark Video and Discussions

- Unit launch — Space Exploration
- Design Process
- Bias

Instructional Activities: Learning

Instructional Activities: Additional

Instructional Texts/Websites	Instructional Videos	How-to Sheets	Practice
• Use the Design Process • Cite sources • Use programming software • Recognize bias (P, SG) • Write a claim • Text evidence (HW) • Robotics (P, SG) • Solar system (P) • Author's claim • Bias (IV) • Clauses	• Use the Design Process • Cite sources • Use programming software • Recognize bias (P, SG) • Write a claim • Text evidence (HW) • Robotics (P, SG) • Solar system (P) • Author's claim • Bias (IV) • Clauses	• Use the Design Process • Cite sources • Use programming software • Recognize bias • Write a claim • Note-taking • Cite • Credible sources	• **Create Design Journal (I, P)** • **Identify valid sources (HW)** • **Note-taking (I HW)** • **Use of clauses (I, P)** • **Read informational texts about robotics (I)** • **Research space exploration and robotics (I, P)**
			Application • **Cite sources (I, P, HW)** • **Write a claim (I)** • **Differentiate reasons and evidence (P, SG)** • **Determine validity of resources (I, P)** • **Categorize text structures (I, P)** • **ID objects in the solar system (SG)**
Interactive Websites	**Learning Centers**	**Small-Group Mini-Lessons**	**Assessment**
• Coding 101 (I, P) • Valid or Not • Name That Space Object (P) • Khan Academy • Solar Systems	• Differentiate reasons and evidence • Understand the Design Process (I, P) • Determine validity of sources (HW) • Identify and use clauses • Categorize text structure (P) • Identify objects in the solar system (P, SG) • Author's claim (IV) • Text structures	• Use the Design Process • Cite sources • Use programming software • Recognize bias • Write a claim • Text evidence • Robotics • Solar system • Author's claim • Bias • Clauses	• **Using rubric, peer edit (P)** • **Peer edit sources (P)** • **Self-assess text structure (I)** • **Self-assess Design Process against rubric (I)** • **Assess solar system knowledge (I, P)**
			Reflection • **What did your group do well? (SG)** • **What "aha" do you have for NASA? (I, P)** • **Can you see yourself contributing to space exploration? How, or why not? (I)**

Key: Individual **(I)**, Pairs **(P)**, Small Groups **(SG)**, Activities suitable for homework **(HW)**, Insights Video **(IV)**

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Teacher Material

A Place for Robots *Content Facilitation Grid (Week 1 Sample)*

Student Name	Names steps of Design Process	Describes which step of the Design Process is being used	Identifies reasons for the claim an author makes	Identifies evidence to support reasons for claim author makes	Connects reasons and evidence	Identifies bias in texts	Identifies valid sources	Describes characteristics of valid sources	Writes claim	Determines important information to record for notes	Identifies clauses in sentences	Appropriately uses clauses in writing	Identifies text structure	Sorts texts based on structures	Names inner and outer planets of the solar system

M – mastery P – peer tutor level HW – needs homework for reinforcement
W – working on it ML – needs a mini-lesson

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Teacher Material

A Place for Robots *Content Facilitation Questions*

COMPREHENSION *Ask questions that ensure students understand content and skills needed to solve the problem.*	• What is a claim? • What is a robot? • What do you need to write an argumentative piece? • What is the difference between reasons and evidence? • What is the Design Process? • What is NASA? • What are the planets in our solar system?
APPLICATION *Ask questions that ensure the ability of students to apply learning to new situations.*	• Why should you support your claim with evidence? • What is the impact of robotics on this generation? • What is the importance of learning about scientific discoveries? • How do you use the Design Process? • How are clauses helpful in writing? • Why is it important to have valid sources of information? • Why is Pluto no longer considered a planet? • Why is our moon not considered a planet?
CONNECTION *Ask questions that ensure the ability of students to apply learning to their lives.*	• How would you use a robot in your own life? • What type of evidence would you ask of someone if he/she were trying to convince you to believe something?
SYNTHESIS *Ask questions that encourage students to create new information from existing data.*	• In what other areas could you use the Design Process? • How do you decide which valid sources are relevant to your proposal? • How do you see the role of NASA evolving in the future? • What will be the potential use of robots in the future? • How could you make an existing claim stronger? • What modifications would you need to make to your robot to explore an environment unlike Europa?
METACOGNITION *Ask questions that prompt students to think about their own thinking process.*	• What do you find is the most challenging in either giving or receiving feedback? • How was the Design Process reflected throughout your work? • What suggestions would you make to design teams based off your experience?

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Student Material

A Place for Robots *Transfer Task*

You've used the Design Process to create a robot that will be able to explore Europa, Jupiter's icy moon, and collect samples from its surface. What if the scientists at NASA wanted to explore a different object in our solar system, like Titan? Titan is one of Saturn's moons and the only object in our solar system other than Earth that has liquid on its surface. Using the Design Process, determine how you would need to modify your current robot to optimize its exploration of Titan. Then write a short proposal to convince a reader that your robot is the best for a mission to Titan!

Remember to include the following:

- Steps in the Design Process that helped modify your robot
- Two or more valid sources of information with accurate citations
- Two reasons with supporting evidence for why your robot is the best to explore Titan

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A Place for Robots *Teacher Notes*

Teacher Material

Unit Overview

In this task, students will create a working model for a mission that can be shared with the education department at NASA, including an argument for why their design is essential to the mission.

Standards Addressed

Common Core Math Practice Standards:
CCSS.MATH.PRACTICE.MP1, CCSS.MATH.PRACTICE.MP3, CCSS.MATH.PRACTICE.MP6

Common Core Literacy Standards:
CCSS.ELA-LITERACY.RI.5.1, CCSS.ELA-LITERACY.RI.5.2, CCSS.ELA-LITERACY.RI.5.4, CCSS.ELA-LITERACY.RI.5.7, CCSS.ELA-LITERACY.RI.5.8, CCSS.ELA-LITERACY.RI.5.9, CCSS.ELA-LITERACY.RF.5.4, CCSS.ELA-LITERACY.W.5.1, CCSS.ELA-LITERACY.W.5.4, CCSS.ELA-LITERACY.W.5.5, CCSS.ELA-LITERACY.W.5.6, CCSS.ELA-LITERACY.W.5.8, CCSS.ELA-LITERACY.W.5.9, CCSS.ELA-LITERACY.SL.5.1

Next Generation Science Standards:
3-5-ETS1-1, 3-5-ETS1-3

Enduring Understandings	Essential Questions
• Reading expands our knowledge of the world and beyond. • People rely on various resources and media to obtain information. • As people gain more information, ideas and stances may change. • There is purpose behind writing. • The Design Process is used to solve problems that don't yet have solutions.	• Why is it important to share what we write? • Why should we reflect on our learning process? • Why should we ask a variety of questions? • Why do we use an engineering design process?

21st Century Skills Addressed

Core Content and Interdisciplinary Themes
- Subject-Area Mastery

Learning and Innovation
- Critical Thinking and Problem Solving
- Creativity and Innovation
- Communication and Collaboration

Information and Media Literacy
- Information Literacy
- Information and Communication Technology

Life and Career
- Flexibility and adaptability
- Productivity and Accountability
- Leadership and Responsibility
- Initiative and Self-Direction

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