Lunar Habitats and Rover Exploration Missions Teacher Guide

Summary

- Coding skill level: **Intermediate**
- Recommended grade level: **Grades 1-8 (U.S.), Years 2-9 (U.K.)**
- Time required: **50 minutes**
- Number of modules: **1 module**
- Coding Language: **Tynker Blocks**

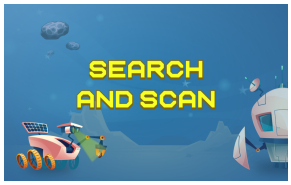
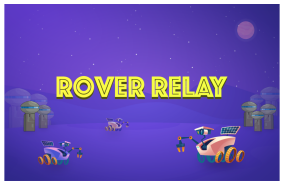
Teacher Guide Outline

Welcome!

In this lesson, students will learn how rovers are used to collect samples from the lunar surface. NASA's Artemis program is a plan to return astronauts to the Moon and establish a lunar base for sustained scientific exploration. Water is key to sustaining a human presence on the Moon. Rich water deposits on the Moon are in the form of ice and located in dark craters. NASA will use robots to collect and analyze samples of water ice, as well as assemble and maintain a lunar base on the surface of the Moon. What we learn on or around the Moon will help NASA take the next giant step--sending astronauts to Mars.

This lesson is intended to be completed in two different parts (as described in the "Getting Started" section of this teacher guide). In Part 1, students are introduced to rovers and will learn the purpose of rovers as they complete a variety of fun activities. There's also an optional "Rover Explorer" assignment, which will allow you to assess your students' understanding. The assignment will also guide your students' thought process before they start coding their Tynker projects. You can find an answer key to the "Rover Explorer" assignment in the "Help" section.

In Part 2, students will combine their coding, innovation, and art skills as they complete one of 4 DIY (do-it-yourself) projects using Tynker:

Lunar Test Drive (Beginner)	Search and Scan (Intermediate)	Rover Relay (Advanced)	Build a Lunar Habitat (Open-ended)
			

The following modules includes a tutorial to help guide your students' creative process, a sample project, ideas on how to expand on their project, and code blocks to help them get started: *Lunar Test Drive, Search and Scan, Rover Relay*. **Note:** *Build a Lunar Habitat* is an open-ended project where students are provided a tutorial, but will need to select their own code blocks. As students complete the DIYs, they'll reinforce coding concepts such as direction and turning, simple loops, simple messaging, advanced events, input/output, simple physics, and more!

How to Prepare

This activity is designed for self-directed learning. Your role will be to help students individually and facilitate as they complete the activities. The best way to prepare is to:

1. **Familiarize yourself with the material.** After selecting your Tynker lesson (e.g., Lunar Habitats and Rover Exploration Missions), read through this teacher guide and complete the activity before assigning it to students. This will allow you to troubleshoot anything in advance and plan for potential questions from your students.
2. **Get students excited about coding.** Inspire students and get them excited for the Hour of Code event. Here is a link to resources such as inspirational videos and posters from the Hour of Code website: https://hourofcode.com/us/promote/resources#videos
3. **OPTIONAL: Sign up for a teacher account.** Although an account is NOT required, creating a free teacher account will allow you to access teacher guides, answer keys, and tons of additional resources. You'll also be able to create free accounts for your students, monitor their progress, and see their projects.
4. **OPTIONAL: Create student accounts.** From your teacher account, you can easily create free student accounts for all your students. This will allow them to save their projects and progress, so they can continue coding when they get home! Again, this is not necessary to complete the Lunar Habitats and Rover Exploration Missions lesson.
5. **OPTIONAL: Print certificates to hand out.** While signed in to your Tynker teacher account, you can print certificates by clicking on a classroom from your teacher dashboard, clicking the "Gradebook" tab, going to "Hour of Code," and clicking the "Print All Certificates" button. This will only print certificates for student accounts assigned to the selected classroom.
6. **Complete this lesson in two different parts.** Please refer to the "Getting Started" section of this teacher guide.

Activity

Overview

Objectives

Students will...

- Apply coding concepts such as direction and turning, simple loops, simple messaging, advanced events, input/output, and simple physics
- Use code blocks to create "Lunar Habitats and Rover Exploration Missions" projects

Materials

- **For web:** Computers, laptops, or Chromebooks (1 per student)

- **For mobile:** iPads or Android tablets (1 per student)

Vocabulary

- **Code:** The language that tells a computer what to do
- **Actor:** A Tynker character or object that can talk and interact with others
- **Stage:** The background of the project where the Actors are placed
- **Sequence:** The order in which steps or events happen
- **Command:** A specific action or instruction that tells the computer to do something
- **Loop:** An action that repeats one or more commands over and over
- **Infinite loop:** A loop that repeats forever and does not end until the program stops

U.S. Standards

- **CCSS-ELA:** RI.1.7, RF.1.4, RF.1.4.A, SL.1.1, RI.2.7, RF.2.4, RF.2.4.A, SL.2.1, RI.3.7, RF.3.4, RF.3.4.A, SL.3.1, RF.4.4.A, RF.1.4.A, RF.4.4, SL.4.1, RF.5.4.A, RF.5.4, SL.5.1, RI.6.4, RI.6.7, SL.6.1, SL.7.1, SL.8.1
- **CCSS-Math:** MP.1
- **K12CS:** P1.1, P1.3, P2.1, P2.3-2.4, P3.2-3.3, P4.4, P5.1-5.2, P6.1-6.3, P7.2-7.3
- **CSTA:** 1A-AP-09, 1A-AP-10, 1A-AP-11, 1A-AP-12, 1A-AP-13, 1B-AP-11, 1B-AP-12, 1B-AP-14, 2-AP-13, 2-AP-16, 2-AP-17
- **CS CA:** K-2.AP.12, K-2.AP.13, K-2.AP.14, K-2.AP.15, K-2.AP.16, 3-5.AP.10, 3-5.AP.13, 3-5.AP.14, 3-5.AP.17, 6-8.AP.13, 6-8.AP.16, 6-8.AP.17
- **Illinois CS:** K-2.AP.09, K-2.AP.10, K-2.AP.11, K-2.AP.12, K-2.AP.13, K-2.AP.14, 3-5.AP.11, 3-5.AP.12, 3-5.AP.14, 6-8.AP.11, 6-8.AP.14, 6-8.AP.17, 6-8.AP.18
- **ISTE**: 1.c, 1.d, 4.d, 5.c, 5.d, 6.b

U.K. Standards

National Curriculum in England (computing):

- **Key Stage 1 (Year 2)**
    - Understand what algorithms are, how they are implemented as programs on digital devices, and that programs execute by following precise and unambiguous instructions
    - Create and debug simple programs
    - Use logical reasoning to predict the behaviour of simple programs
    - Use technology purposefully to create, organise, store, manipulate and retrieve digital content
    - Recognise common uses of information technology beyond school
    - Use technology safely and respectfully, keeping personal information private; identify where to go for help and support when they have

concerns about content or contact on the internet or other online technologies

- **Key Stage 2 (Years 3-6)**
  - Use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs
  - Understand computer networks, including the internet; how they can provide multiple services, such as the World Wide Web, and the opportunities they offer for communication and collaboration
  - Use technology safely, respectfully and responsibly; recognise acceptable/unacceptable behaviour; identify a range of ways to report concerns about content and contact
- **Key Stage 3 (Years 7-9)**
  - Create, reuse, revise and repurpose digital artefacts for a given audience, with attention to trustworthiness, design and usability
  - Understand a range of ways to use technology safely, respectfully, responsibly and securely, including protecting their online identity and privacy; recognise inappropriate content, contact and conduct, and know how to report concerns

Getting Started (20 minutes)

The lesson is intended to be completed in two different parts:

Part 1:

Introduce students to NASA rovers by completing the following activities:

- Play this short video about NASA's new VIPER rover that will help us map water ice locations on the Moon: https://www.youtube.com/watch?v=ROWPoRXLvo4
- Try out the NASA Forward to the Moon with Artemis Explorer Activities: http://nasa.gov/exploreractivities
- Students can learn more about Artemis by exploring these websites: https://www.nasa.gov/what-is-artemis https://www.nasa.gov/artemis/videos
- Tell students that they're going to use Tynker in an upcoming activity to create their own projects where they will create a "Lunar Habitats and Rover Exploration Missions" project about rovers. *Optional:* Before students start coding, ask them to complete "Rover Explorer" assignment for homework or as an in-class activity:

Hour of Code
Lunar Habitats and Rover Exploration Missions

Name _____
Date _____

Rover Explorer

Directions: Answer the questions below, then create an outline for your "Lunar Habitats and Rover Exploration Missions" Tynker project.

Questions:

1. List 3-5 examples of how robots can be used in the Artemis program:

   _____

   _____

   _____

   _____

   _____

   _____

2. Why do you think NASA is sending VIPER to search for water ice on the moon?

   _____

   _____

   _____

3. Bonus: How is exploring the Moon a stepping stone to reaching Mars?

   _____

   _____

4. Imagine you are part of a NASA team that needs to use rovers to explore the Moon. What is the goal of the mission? What tasks does the rover need to perform? Below are questions to prompt ideas:

Guiding Questions
What is the rovers' mission: Do the rovers need to search for ice in dark craters? Do they need to collect rock/water samples? What photographs do they need to take? Do they need to deliver supplies?
How many rovers do you need to complete the mission?
Do the rovers need to travel to a certain location?

Note: You **do not** need to answer the "Guiding Questions." The purpose of this chart is to guide your creativity/inspiration for the project.

Optional: Use the space below to sketch Actors or brainstorm ideas.

Part 2:

Remind students that they're going to use Tynker to create their own "Lunar Habitats and Rover Exploration Missions" projects. Now that they know more about rovers and their purpose, they're ready to move on to the DIY module.

DIY Module (30 minutes)

This lesson has 4 DIY (do-it-yourself) modules that your students can choose from. Note that the DIYs range in level of difficulty from beginner to advanced. Facilitate as students complete the modules on their own:

Lunar Habitats and Rover Exploration Missions

- Below are the 4 different modules:

DIY module	Recommended Level	Description
Lunar Test Drive	Beginner	Students will reinforce coding concepts as they program a rover that travels to a location of their choice. Additionally, they'll learn why robots are crucial for space exploration. Coding activities include building a lunar base, giving instructions using "say" blocks, programming Actors to react when touched by other Actors, using Physics code blocks, and programming the rover to navigate the terrain.
Search and Scan	Intermediate	In this coding adventure, students will code their own challenge for a virtual rover that will search for samples on the moon's surface. Coding activities include designing a lunar base for the rover to navigate through, using Physics code blocks to make obstacles active (to block the rover) or static (obstacles don't move), adding/drawing Actors, customizing Actors, adding a "win" condition, and programming rovers to move/turn.
Rover Relay	Advanced	Students will need to program multiple rovers to work together to complete a task. The provided example shows rovers scanning and collecting ice samples, but students are encouraged to design their own lunar rover challenge. Coding activities

		include customizing a lunar base, applying Physics code blocks to obstacles, adding/drawing Actors, customizing the Flag Actor, programming the project to display a victory message when a condition is met, programming the rovers to move, and using messages to make the rovers communicate with each other.
Build a Lunar Habitat	Varies (open-ended)	In this open-ended project, students begin with a blank canvas where they can bring their ideas to life through code! Coding activities include choosing a background, tiles, Actors, props, and coding Actors such as rovers. **Note:** Students will need to add their own images and code blocks.

- Remind students to use their "Rover Explorer" assignment as a reference.
- Ask students to add a background and Actors to their project. They can draw their own artwork or select images from the Media Library.
- Are students struggling to draw their own Actors?
    - Ask students to watch the Tynker support video on how to draw their own Actor: https://www.tynker.com/support/videos.
- Do students need help locating additional code blocks? Ask them to click this icon:

- Are students on the code blocks tab, and want to return to the tutorial? Ask them to click this icon:

- *Optional:* Direct your students to this link, which includes helpful video tutorials: https://www.tynker.com/support/videos

Extended Activities (10 minutes each)

Show and Tell

Encourage students to share their projects with the class:

- Use your projector to display their unique projects. What obstacles and successes did they experience? *Optional:* Encourage students to practice saying coding terms (e.g., command, sequence) as they describe their projects.

Unplugged Activity: Design Your Own Rover

Below is a NASA link to a teacher guide that challenges students to think like an engineer as they build a rubber-band powered rover:
https://www.jpl.nasa.gov/edu/teach/activity/roving-on-the-moon/

Going Beyond an Hour

If your students enjoyed an Hour of Code, they're sure to enjoy the rest of what Tynker has to offer! Tynker offers a complete premium solution for schools to teach computer science. Over 400 hours of lessons are available to take K-8 students from block coding to advanced text coding. We offer tons of resources for teachers, including comprehensive guides, free webinars, and a forum to connect with other educators.

More Hour of Code Activities

Tynker offers many other tutorials for the Hour of Code, including STEM Hour of Code lessons that you can integrate into the subjects you already teach. Check out the main Tynker Hour of Code page to see all the tutorials!

Do More with Tynker

With Tynker, kids don't just acquire programming skills--they explore the world of possibilities that coding opens up. Tynker has several interest-driven learning paths that make coding fun, both inside and outside the classroom:

- **Coding and Game Design:** Your students can use Tynker Workshop, a powerful tool for crafting original programs to make games, stories, animations, and other projects. They can even share their work with other kids in the Tynker Community.
- **Drones and Robotics:** Tynker integrates with connected toys, including Parrot drones and Lego WeDo robotics kits, so kids can see their code come to life.
- **Minecraft:** Tynker integrates with Minecraft so your students can learn coding through a game they love. Tynker offers skin and texture editing, as well as a custom Mod Workshop that lets kids try their original code in Minecraft.

Tynker for Schools

Used in over 90,000 schools, our award-winning platform has flexible plans to meet your classroom, school, or district needs. All solutions include:

- Grade-specific courses that teach visual coding, JavaScript, Python, robotics and drones
- A library of NGSS and Common Core compliant STEM courses that are great for project-based learning
- Automatic assessment and mastery charts for whole schools and individual classes and students
- Easy classroom management with Google Classroom and Clever integration
- Professional training, free webinars and other teacher training resources

Need help getting Tynker started at your school? Contact us to learn more about teaching programming at your school with Tynker!

Help

Need help? Below you'll find answers to frequently asked questions about the Lunar Habitats and Rover Exploration Missions lesson.

What is Hour of Code?

The Hour of Code is a global learning event in which schools and other organizations set aside an hour to teach coding. No prior coding experience from you or your students is needed! The event is held every December during Computer Science Education Week. You can also organize an Hour of Code year-round. The goal of the Hour of Code is to expand access to computer science education for people of all backgrounds. Learning computer science helps students develop logic and creativity, and prepares them for the changing demands of the 21st century. Tynker has been a leading provider of lessons for the Hour of Code since the event began in 2013. Since then, over 100 million students from 180 countries have finished an Hour of Code.

How do I prepare for Hour of Code?

1. **Familiarize yourself with the material.** After selecting your Hour of Code lesson (e.g., Lunar Habitats and Rover Exploration Missions), read through the teacher guide and complete the activity before assigning it to students. This will allow you to troubleshoot anything in advance and plan for potential questions from your students.

2. **Get students excited about coding.** Inspire students and get them excited for the Hour of Code event. Here is a link to resources such as inspirational videos and posters from the Hour of Code website: https://hourofcode.com/us/promote/resources#videos
3. **OPTIONAL: Sign Up for a teacher account.** Although an account is NOT required, creating a free teacher account will allow you to access teacher guides, answer keys, and tons of additional resources. You'll also be able to create free accounts for your students, monitor their progress, and see their projects.
4. **OPTIONAL: Create student accounts.** From your teacher account, you can easily create free student accounts for all your students. This will allow them to save their projects and progress, so they can continue coding when they get home! Again, this is not necessary to complete an Hour of Code.
5. **OPTIONAL: Print certificates to hand out.** While signed in to your Tynker teacher account, you can print certificates by clicking on a classroom from your teacher dashboard, clicking the "Gradebook" tab, going to "Hour of Code," and clicking the "Print All Certificates" button. This will only print certificates for student accounts assigned to the selected classroom.

How can Tynker help me manage my Hour of Code?

Tynker has several free features for registered teachers that will help you manage your Hour of Code. If you set your students up with a Tynker classroom, you will be able to track their progress and print Hour of Code completion certificates for them to keep.

How do I open the DIY modules?

Have your students go to this URL: tynker.com/hour-of-code. Next, direct them to the activity you want them to complete (e.g., *Lunar Test Drive, Rover Relay, Search and Scan*).

Who is this activity for?

Design a Mission Patch is intended for students in grades 1-8 (U.S.) and years 2-9 (U.K.) with some coding experience.

Do I need to create Tynker accounts for my students?

No, you do not need to create Tynker accounts for your students.

What devices do I need?

- **For web:** Computers, laptops, or Chromebooks (1 per student) with an internet connection
- **For mobile:** iPads or Android tablets (1 per student) with an internet connection

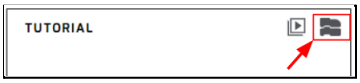
- If not enough devices are available, students can work in pairs on the same device

What will my students learn?

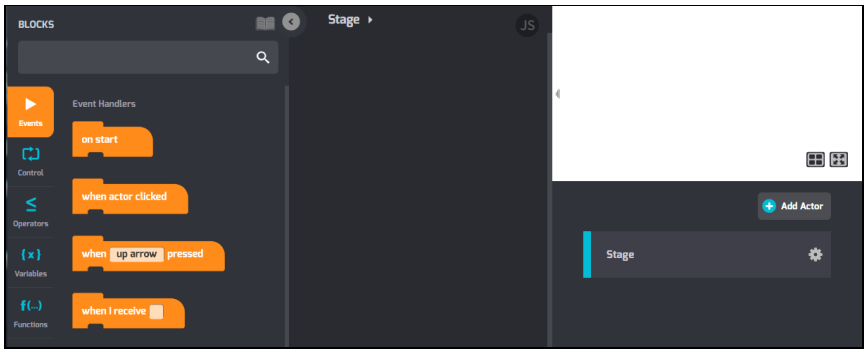
Students will learn about the meaning behind NASA's rovers and human spaceflight plans for sending humans to the Moon and on to Mars. They will also use Tynker to create rover-themed projects. Additionally, students will reinforce coding concepts as they complete 3 different coding activities and experiment with code blocks. In this process, students will develop debugging and logical reasoning skills.

How do my students code their Actors?

The DIY modules includes a workspace for students to code their project. The section on the left is a tutorial tab that provides code blocks and suggestions on what to create. Students can access a variety of different code blocks by clicking this icon:



Once students have the code blocks tab open, they should see something similar to the image below. Ask students to click the different categories (e.g., events, control, motion, etc.) to find the code blocks they want to use.



What are some helpful websites I can refer to?

Below are websites you might find helpful:

- **Explore Moon to Mars:** https://www.nasa.gov/topics/moon-to-mars
- **What is the Artemis Program for Grades K-4 and Grades 5-8:**
  - **Grades K-4:** https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-the-artemis-program-k4.html

  - **Grades 5-8:** https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-the-artemis-program-k4.html

- **Moon's South Pole in NASA's Landing Sites:** https://www.nasa.gov/feature/moon-s-south-pole-in-nasa-s-landing-sites
- **Lunar surface in-situ resource utilization (ISRU):** https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20190032062.pdf
- **Report on surface buildup scenarios and outpost architectures of lunar exploration:** https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20090012432.pdf
- **NASA Forward to the Moon with Artemis Explorer Activities:** http://nasa.gov/exploreractivities
- **Different NASA Mars rovers:** https://spaceplace.nasa.gov/mars-rovers/en/
- **Learn about the lunar surface in-situ resource utilization (ISRU) capabilities:** https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20190032062.pdf
- **Report on surface buildup scenarios and outpost architectures of lunar exploration:** https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20090012432.pdf

Do you have an answer key?

Yes, below are suggested answers to "Rover Explorer" assignment:

- **Question 1:** List 3-5 examples of how robots can be used in the Artemis program.
  - **Suggested answer:** Robots can be used to search for ice in dark craters, collect rock/water samples, take photographs, deliver supplies, conduct experiments, and more!
- **Question 2:** Why do you think NASA is sending VIPER to search for water ice on the moon?
  - **Suggested answer:** Water is a necessary resource because of its many uses. For example, astronauts could use the Moon's water to make rocket fuel, for drinking, and breathing as they live/work on the Moon.

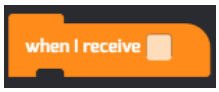
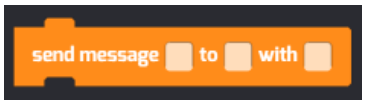
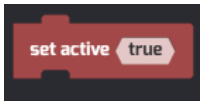
- **Helpful websites:**
  https://www.youtube.com/watch?time_continue=69&v=ROWPoRXLvo4&feature=emb_logo
  https://www.nasa.gov/feature/moon-s-south-pole-in-nasa-s-landing-sites

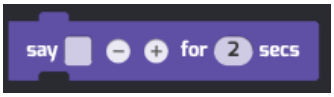
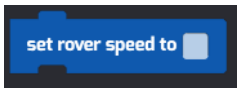
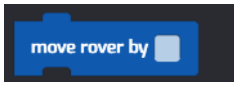
- **Question 3:** How is exploring the Moon a stepping stone to reaching Mars?
  - **Suggested answer:** NASA is sending astronauts and rovers to the Moon to explore new areas, run tests, take samples, search for the Moon's water, and learn how humans can live and work in an environment beyond Earth. Ultimately, what we learn from this mission will help us get closer to one day exploring Mars!
  - **Helpful website:**
    https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-the-artemis-program-k4.html

What do the code blocks do?

Below is a description of the provided tutorial code blocks.

Tutorial code blocks:

Code Blocks	What They Do
	Run the code attached to this block when the Play button is clicked.
	React when the specified parameter is detected.
	Listen for a message or broadcast from other scripts before activating.
	Send a message to an Actor, with the specified parameters.
	Set whether the Actor uses physics and can affect other Actors that use physics.
	Set whether the Actor (if active) is unaffected by gravity or collisions. An Actor that is not static will fall due to gravity, while an Actor that is static will not.

	Pause the program for a specific number of seconds.
	Show a message for a specified amount of seconds.
	Prepare the rover to work with the rover code blocks.
	Set the rover to the specified speed.
	Make the rover point at the specified degree.
	Move the rover a specific number of units.

Note: Students are encouraged to explore and use additional code blocks from the Tynker commands library. For information on how to access the code blocks, please refer to the "How Do My Students Code Their Actors?" question in this teacher guide.

How can I contact the Tynker support team?

If you have any issues or questions, send us an email at support@tynker.com.