Build to Launch
A STEAM Exploration Series

2021
Teacher
Resource
Guide

LEGO® Education is teaming up with NASA to bring students and teachers an out of this world STEAM Learning experience!
LEGO® Education is teaming up with NASA to bring students and teachers an out-of-this-world STEAM Learning series! Build to Launch explores the technology, STEAM concepts, and careers behind the Artemis I mission to the Moon. Join the all-new LEGO® Space Team and their Artemis I Team counterparts for a 10-week interactive digital learning adventure. In each episode, students will find themselves in the shoes of NASA engineers, scientists, and—of course—astronauts. Through open-ended lessons, students will get hands-on experience and solve the same problems the Artemis I Team faces as they build toward launch!

Find more Build to Launch resources online: LEGO Education and NASA's Artemis Mission: Taking STEAM Learning to new heights!

Course Design

The Build to Launch Program is fueled by LEGO Education’s commitment to learning through play and exposing students to all the possibilities their future might hold.

The program is designed to:
- Encourage innovative thinkers and problem solvers
- Connect classrooms to the Artemis I Mission
- Encourage students to connect with the LEGO Education and NASA teams
- Allow students to showcase their design engineering skills and STEAM practices

Each of the three modules will:
- Engage students through a mission briefing that introduces STEAM concepts for students to explore
- Challenge students with 2 open-ended, 45–90 minute lessons that encourage problem-solving
- Encourage creativity and solution diversity via the engineering design process
- Expose students to the diversity of careers and people working at NASA
- Provide inspirational models from LEGO Education with links to the full lesson plans that can be completed prior to starting missions for additional scaffolding
- Include resources from NASA including images, videos, and lessons with links to expand learning further
"Every NASA mission requires people from a wide range of STEM careers, skills, backgrounds, and interests."

- Mike Kincaid,
  Associate Administrator of NASA's Office of STEM Engagement

**Build to Launch Program Overview**

On Tuesday, September 14th, *Build to Launch* will kick off with an exciting mission briefing to spark discussion and get students thinking about the technology, STEAM concepts, and careers behind the Artemis I mission. This 10-week program has three modules: Getting to Space, Testing and Transport, and Working in Space. Each module lasts three weeks. The first week of each module features a mission briefing led by both LEGO® Space Team and NASA team members. The following two weeks feature lesson-based “missions” where students will step into the shoes of NASA experts and take on open-ended prompts. Finally, we’ll highlight student work, review concepts they’ve mastered, and count down to the Artemis I launch slated for later this fall.

**Learning Promise**

In this program, your students will investigate themes and careers related to space exploration and the Artemis I mission. Students will utilize STEAM skills and practices while solving problems based on the challenges the Artemis I Team might face. They will apply engineering design skills as they brainstorm, prototype, iterate, and explain their ideas in preparation for launch.
Module 1
Getting to Space

Mission Briefing
Tuesday, September 14

In this first briefing, students will meet the LEGO® Space team and learn about NASA’s Artemis I Mission. They’ll gain an understanding of how the 10-week digital series will work and get their first set of marching orders should they “choose to accept” their mission.

Autonomous Movements Mission
Tuesday, September 21

Students will explore the importance of autonomous technology in space. Their first mission will be to design and build a prototype vehicle that can move independently and complete specific tasks on the lunar surface.

Working Together Mission
Tuesday, September 28

Students will learn how communication and planning are essential in assembling a spacecraft whose parts are built by many independent groups. A spacewalk also shows students how critical teamwork is to ensure that things go smoothly.

Module 2
Testing and Transport

Mission Briefing
Tuesday, October 5

In this briefing, students will get a unique look at life on the International Space Station and its complexities. We’ll also recap learnings from the “Getting to Space” module and showcase student prototypes from the previous missions. Finally, they’ll receive instructions for their next challenge.

Take Aim Mission
Tuesday, October 12

Students will investigate the need for thorough testing and precision when it comes to space travel. Then, they’ll apply these ideas to design and build a device that can aim and move toward a target.

The Crawler Mission
Tuesday, October 19

Students will discover how NASA moves an entire rocket to the launch pad. Then they’ll design and build a prototype vehicle that can move large, heavy objects easily.

The Moon’s distance from Earth is about 240,000 miles (385,000km).
Module 3
Working in Space

Mission Briefing
Tuesday, October 26

Students will go behind-the-scenes of the upcoming James Webb Space Telescope launch set for later this fall. We'll also review concepts and showcase student prototypes from the “Testing and Transport” module. The episode concludes with the challenges of working in space and a brief for their next missions.

Hazard Alert System Mission
Tuesday, November 2

Students will consider hazards in space, learn how spacecraft and equipment are built to protect against them, and design and build an alert system that ensures a safe mission.

Using Tools in Space Mission
Tuesday, November 9

Students will examine the physical work astronauts do and the unique tools they use, then it will be their turn to design and build a suitable tool for use in space.

Countdown to Launch
Tuesday, November 16

In this final mission debrief, we'll recap the learning outcomes from the entire series, highlight more student work, and explore final preparations for the Artemis I launch.
Engineering Design Approach

The lessons included in the *Build to Launch* program are created for students to stretch their design engineering skills. The lessons do not specify an engineering design process to follow, but ideally students will follow a predetermined series of steps when creating their solutions. If you do not have such a process in place, consider providing your students with this helpful guide below.

01 Define and Understand the Problem
Ask students to restate the problem in the lesson and discuss it as a group to ensure they understand the problem and how to approach it.

02 Generate Ideas
As a whole or in small groups, have students brainstorm ideas for models to solve the problem. Ask students to think about what the problem is and different ways they could solve it. Encourage students to share all ideas. No idea is too silly in this phase. Help students understand what constraints or requirements exist for their solution.

03 Prototype
Students should consider their ideas and the constraints of the problem to select the best idea to move forward with. Consider having students create sketches of their idea and then build a prototype model.

04 Test and Redesign
Students should test and iterate on their design. Allow students time to test their model in order to see if it works as expected. If not, encourage students to change one element at a time (i.e. one part of the model or piece of a program). Students should analyze their idea and modify their prototype to make improvements as needed to reach the desired solution. Remind students to check their constraints to ensure their idea stays focused on the right outcome.

05 Explain
Encourage students to “think aloud” sharing how they approached finding their final solution. Ask students where they had difficulties, what they iterated on, and how they met the constraints.

The Moon’s entire surface is cratered and pitted from impacts.
## Engineering Design Rubric

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<thead>
<tr>
<th>Indicator</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
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<tbody>
<tr>
<td>Identify or Define Problem</td>
<td>Student clearly identifies the problem to solve.</td>
<td></td>
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<tr>
<td>Generate Ideas</td>
<td>Student provides several ideas. Ideas are reasonable to meet the need.</td>
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<tr>
<td>Identify best idea based on constraints</td>
<td>Student selects the idea to model that best fits the problem and provided constraints.</td>
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<tr>
<td>Design and Build a prototype</td>
<td>Student builds a prototype that meets a need and can be tested.</td>
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<tr>
<td>Testing Prototype</td>
<td>Student conducts tests of the model to evaluate if it meets needs and records findings.</td>
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<tr>
<td>Evaluating Tests</td>
<td>Student uses test results to identify best characteristics for final solution.</td>
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<tr>
<td>Iterating and Redesigning</td>
<td>Student modifies the prototype model based on information from tests.</td>
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<tr>
<td>Explaining results</td>
<td>Student presents a final solution with clear explanation of how it meets the need and explains process to get to final model.</td>
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### Resources

**Engineering Design Notebook:** Have students keep an engineering design notebook throughout the program where they can record their ideas, challenges, iterations, and final solutions. A LEGO® Education branded engineering design notebook will be available for download from the LEGO Education website in August. You have the option to use this notebook or take inspiration from it for students to create their own.

**Professional Development Support:** Access the LEGO Education Professional Development Platform at [https://pd.legoeducation.com/](https://pd.legoeducation.com/) to check out excellent resources for teaching to the open-ended project approach you’ll find in *Build to Launch* as well as product training if you’re using LEGO Education solutions.

**LEGO Education Community:** Connect with other *Build to Launch* participants and educators who use LEGO Education materials to teach a wide variety of open-ended projects at [community.legoeducation.com](http://community.legoeducation.com). In this forum, LEGO Education Master Educators will jumpstart a weekly discussion around each mission. Join that conversation on the #BuildtoLaunch Mission Control page, see how other educators are solving the open prompts, or leave a question for the LEGO Education team.

**LEGO Education Lesson Plans:** To continue learning with LEGO Education content, access our full library of lessons at [www.legoeducation.com/lessons](http://www.legoeducation.com/lessons). You’ll also find resources for guided lessons that are useful for getting students started before they try open-ended lessons.

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Earth’s Moon is the only place beyond Earth where humans have set foot.
Differentiating

The Build to Launch program was designed with students in upper elementary and middle school in mind. However, we encourage teachers from all grade levels to utilize this program to expose students to engineering design, the Artemis I mission, and various careers at NASA. Each lesson will provide tips for differentiating learning for all age groups.

Celebrating Student Work

Celebrate your innovative thinkers by sharing their work with LEGO® Education using #BuildtoLaunch on Instagram and Twitter. Work can also be shared in the LEGO Education Community on the #BuildtoLaunch Mission Control page. Selected work will then be reshared on the LEGO Education social channels, highlighted in the LEGO Education community, and even featured in the Build to Launch episodes released weekly on YouTube. If chosen, LEGO Education will reach out directly with instructions for completing a release form required for any images or videos containing people (adults and/or children).

Connecting with the Team

Please take advantage of this unique and exciting opportunity to connect your students with the NASA or LEGO Education teams! Submit questions for them via the LEGO Education Community #BuildtoLaunch Mission Control page or on Twitter using the hashtag #BuildtoLaunch. Then watch in suspense to see if the NASA or LEGO teams answer your students’ questions during the weekly episodes.

—Esben Stærk,
President of LEGO Education

Earth’s Moon is the fifth largest of the 200+ moons orbiting planets in our solar system.