Introduction

LEGO® Education is pleased to bring you the LEGO MINDSTORMS® Education EV3 Space Challenge Set and Activity Pack - a fun, structured learning program that will help you meet your science, technology, engineering, and math (STEM) teaching goals.

Who Is It For?

The Space Challenge is for all educators who want to teach STEM through hands-on problem solving. Whether this is your first experience using LEGO MINDSTORMS or robotics, or you are an experienced user, this learning program has been developed to support you with materials that are suitable for your teaching environment.

What Is It For?

This series of classroom-tested and easily implemented lessons will help you teach STEM concepts. The Space Challenge allows students to take responsibility for their own learning. They will work as young scientists and engineers, immersing themselves in motivating STEM activities that prompt creative problem solving, communication, and teamwork.

What Is in the Pack?

The set consists of three Learning Mats, one Challenge Mat, Dual Lock tape, and a large number of LEGO elements for building the Challenge models. Using the Learning Mats, students test their academic skills by solving the specific tasks described in the Learning Missions. As they develop solutions to the Space Challenge, students work with their models on the Challenge Mat, an engaging and motivating platform for creatively applying STEM knowledge and further developing problem-solving skills.

The LEGO MINDSTORMS Education EV3 Space Challenge is designed for use with the 45544 LEGO MINDSTORMS Education EV3 Core Set and LEGO MINDSTORMS Education EV3 Software.

Learning with the Space Challenge Set

The Space Challenge Set includes seven Challenge Missions, nine Learning Missions, and one Basics of Gears Project, along with student and teacher materials in a multimedia-content environment.

Each Mission and Project presents a fun STEM learning opportunity. The LEGO® MINDSTORMS® Content Editor features all of the tools the students need for documenting and presenting their findings and results as they progress through the material.

Three Research Projects, co-developed with NASA engineers, provide rich opportunities for students to explore and create innovative solutions to current space-exploration topics. The Research Projects are built on three key problems that researchers around the world are trying to solve – how to ensure that humans survive in space, how humans can create energy in space, and how robots can help humans explore space.

Comprehensive Teacher Notes

Throughout the detailed Teacher Notes you will find everything you need to minimize the amount of time you need to prepare for class. The Teacher Notes include key learning areas, explanations, hints, programs, and ideas for differentiation.

The Space Challenge consists of the following main categories:

Basics of Gears

Students learn the basics of gears, so they can build effective robots by applying their knowledge of physical science and mathematics principles.

Learning Missions

Students investigate, observe, calculate, and apply their knowledge to solve specific tasks.

Challenge Missions

Students apply and creatively adapt programming and problem-solving skills to make robots solve Challenge Missions related to space exploration.

Research Projects

Discussions and Projects designed to familiarize students with planning for space exploration.

The Space Challenge also includes additional categories with Building Instructions and other supporting materials.
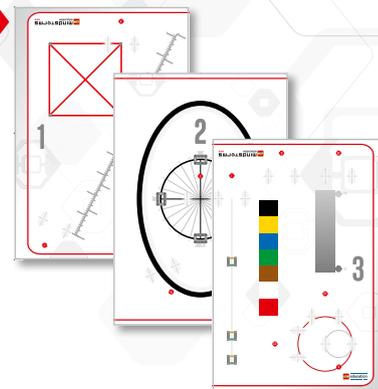
Assessment

Where Can I Find the Assessment Materials?
Assessment materials are provided for all missions.

You can find these materials in three places:

- In the **Teacher's Guide** Category, there is a PDF checklist for tracking student progress when using the **Basics of Gears** Project and the **Learning Missions**. From there, you can print one copy for each student or student group.
- As PDF documents in the **Challenge Missions**, **Research Projects**, and **Research Projects – Teacher** Categories. From there, you can print assessment pages as handouts for you or your students. The Research Projects come with both teacher and student versions of the rubrics.
- For the **Challenge Missions**, assessment pages are also available within each Project. This way, assessment is directly integrated into the student's electronic documentation. The EV3 Projects are fully editable, so you can modify the learning goals or formatting.
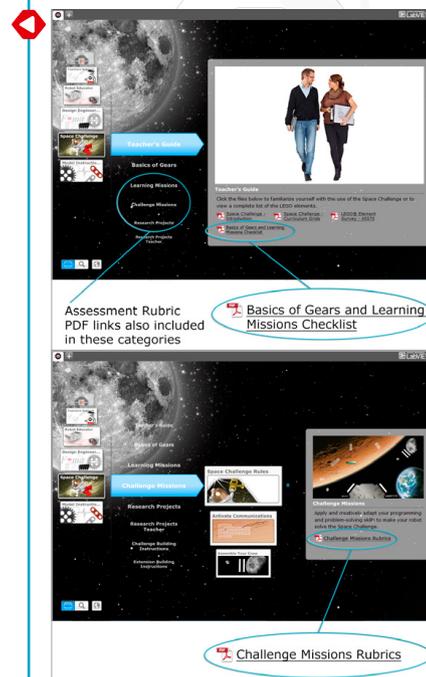
What Learning Goals Are Assessed?
Each Challenge Mission includes two assessment pages:

1. **Evaluate Challenge Mission Goals:** A rubric page on which a judge or the students can evaluate their project work according to learning goals, specifically:
   - How well did their design meet the requirements of the mission?

2. **Evaluate Creativity and Collaboration Goals:** A second rubric page on which a judge or the students can evaluate their project work according to learning goals which are prominent in both the Common Core, and 21st century learning literature, specifically:
   - How creative was their solution?
   - How well did their team work together?

Each rubric includes four levels: Bronze, Silver, Gold and Platinum. The intention is to help students reflect on what they have done well in relation to the learning goals and what they might do better.

A judge or the students can type an X or type in a date to mark the appropriate rubric level.

You can use the rubrics to do your own evaluation of the students' work, adding your own X to the appropriate column. You can also type comments in the Notes column.

Assessment Rubric PDF links also included in these categories

Basics of Gears and Learning Missions Checklist

Challenge Missions Rubrics

How Do I Get Started?

Before Starting the First Lesson
If you have never worked with LEGO® MINDSTORMS® Education EV3 before, you should ensure that:

1. Each student's computer has a preinstalled student version of the LEGO MINDSTORMS Education EV3 Software. Refer to the **readme.txt** file for installation instructions. You can see which version is installed in the top bar of the Software.

2. Each EV3 Brick has the latest firmware and is fully charged.

Depending upon your teaching goals, you might want the students to understand the relevance of the elements in the brick set. Discuss the naming and basic functionality of the key hardware components, and establish a set of brick management rules.

The User Guide is your source for everything relating to the LEGO MINDSTORMS EV3 hardware.

The First Lesson
1. Take a look at the Quick Start Videos that are available in the Lobby. The **Programming** Video and **Programming Overview** Video are recommended for most users. However, we suggest watching all Quick Start Videos to gain a better understanding of the capabilities of the LEGO MINDSTORMS Education Software.

2. Direct your students to the Robot Educator tutorial **Configuring Blocks** in the **Basics** Category. This tutorial explains how to configure programming blocks.

Continuing with the Space Challenge
There are many ways to utilize the Space Challenge learning program to reach your specific teaching goals. Our suggestion is as follows:

1. Lead the students through the **Basics of Gears** Project and let them learn about gear ratio and mechanical advantage.

2. Let the students progress at their own pace through the Learning Missions. You may want to stop your students after the first five Learning Missions as these will teach them the basics. The remaining Learning Missions will allow the students to proceed into more complex programs and functionalities.

3. Have the students apply their skills in solving the Space Challenge.

4. Challenge the students to initiate their own Research Project and to work on designing practical solutions to complex space exploration challenges.
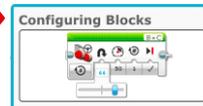
Firmware Update
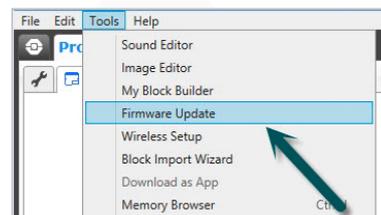
Quick Start

Configuring Blocks

Classroom Management Tips

Use the Content Editor to Create Customized Projects
The integrated Content Editor gives you the ability to customize the project files provided with the Space Challenge to create your own set of differentiated lessons.

Here are a few ways to customize the Projects:

• Rephrase the text to better match the reading ability of your students
• Add images that are more relevant to your students
• Adjust the mission criteria to increase or decrease the level of difficulty
• Change the activities brief to widen or narrow the scope of possible solutions
• Create your own Learning Mission or Challenge Missions
• Add your own rubrics or other assessment tools

To ensure that you do not overwrite the files provided in the Space Challenge, any changes you make will be saved as a new project. All of the files included with the original project will also be included in the new project file, which you are then free to share with your students (for example, on a shared network drive).

Use the Content Editor as a Student Documentation Tool
The Content Editor also allows students to document their progress and findings as they work through each activity.

The Content Editor allows them to:

• Write descriptions of their robot's behavior, as well as observations, results, and reflections
• Record their data in table or graph form
• Post audio recordings of their work in progress, discussions, and robot behavior
• Insert their own pages
• Add images and videos of their robot in action
• Share their unique solutions with others

For more information on the Content Editor, watch the Content Editor Quick Start Videos.

Classroom Management Tips

How Much Time Do I Need?
The time taken to complete each of the Space Challenges depends on a number of factors, including the level of complexity, the age of the student, and the student's experience with LEGO® MINDSTORMS®.

The following estimates provide a range of time that would be needed for an average student to complete the building and programming per mission:

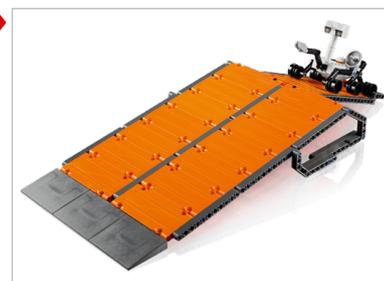| Category	Suggested Completion Time (in minutes)
Basics of Gears	45-90
Learning Missions	45-90
Challenge Missions	60-180
Research Projects	180-600

If you do not have double-block class time, students can use the digital tools to document their work and then pick up where they left off during the next class period.

Reduce Building Time
Divide the Building Instructions for the Challenge models **Rocket and Launcher** and **Crater and MSL** into two parts. Divide the students into groups, each building half of each model, then combine their builds into full models.

Store the Challenge Models
Keep the Challenge models together after use rather than taking them apart. Preserve the models by wrapping them in cloth, paper, or bubble wrap.

Space Challenge Overview

Basics of Gears	Learning Missions	Challenge Missions	Research Projects
Basics of Gears	Controlled Movements	Space Challenge Rules	Research Introduction
	Precise Turns	Activate Communications	How Can Humans Survive in Space?
	Turn Using Sensor	Assemble Your Crew	How Do We Generate Energy for Human Outposts?
	Detect a Color	Free the MSL Robot	How Can Robots Help Humans Explore?
	Detect an Object	Launch the Satellite into Orbit	
	Follow a Line	Return the Rock Samples	
	Detect and React	Secure Your Power Supply	
	Intelligent Movements	Initiate Launch	
	Calibrate Color Sensor		