

1. Introduction to the Maker Lessons



The LEGO® MINDSTORMS® Education EV3 Maker Lessons have been developed to engage and motivate middle school students, piquing their interest in learning design, engineering, and coding using motorized models and simple programming.

Each lesson provides an initial brief as a starting point. The open ended prompts allow for unlimited answers and enable students to express a wide range of creative solutions as they sketch, build, and test prototypes of the designs they create.

The teacher's role in these lessons is to provide students with the tools and necessary freedom to connect with and define a problem, make a solution, and share what they have made.

Use your creativity to adapt these activities to suit the needs of your students.

"The role of the teacher is to create the conditions for invention rather than provide ready-made knowledge."

– Seymour Papert

Classroom Management Tips

Required Materials

- LEGO® MINDSTORMS® Education EV3 Core Set
- Lesson plan
- Student Worksheet for each activity
- Inspirational images for each activity
- Modeling materials already available in your classroom

How much time do you need?

Each lesson is designed to take 90 minutes. If you work in shorter class periods, you can break this down into two 45 minute sessions.

Preparation

It is important to establish student groups. Groups of two work well. Ensure that each student has a copy of the Student Worksheet for recording their design process, or alternatively, they can use their own preferred method for recording their design journey. They will also need the LEGO MINDSTORMS Education EV3 Core Set (one set for every two students is recommended).

Prior Learning

Before beginning these Maker activities, it is recommended that students complete the lessons from the Introduction to Robotics Lesson Plan. These lessons can be found in both EV3 Lab and EV3 Programming. These tutorial lessons last between 45 – 90 minutes each, and you will need to factor this into your lesson planning.

However, if you prefer a more open-ended, explorative method, you can start out with this activity and allow students to find help on their own by referring to the Robot Educator Tutorials.



The LEGO Education Maker (Design) Process



Defining the Problem

It is important that students define a real problem to solve, or find a new design opportunity from the start. The “Connect” images are provided to help students think about designing their solutions. At this stage of the process, it is important that you not show examples of a final or sample solution.



Brainstorm

Brainstorming is an active part of making. Some students will find it easier to explore their thoughts through tinkering (hands-on experimentation) with the LEGO bricks, and others will prefer to record sketches and notes. Group work is essential, but it is important to allow time for students to work alone before sharing their ideas with their groups.



Define the Design Criteria

Discussing and reaching an agreement about the best solution to build can involve a lot of negotiation and may require different techniques that are dependent on the students' skills. For example:

- Some students draw well.
- Others may build part of a model, and then describe what they mean.
- Other students may be good at describing a strategy.



Encourage an ethos where students can share anything, no matter how abstract it might sound. Be active during this phase and ensure that the ideas the students choose are achievable.

It is important that students set clear design criteria. Once the solution to the problem has been made, the students will return to these criteria, which will then form the basis for testing how well their solution works.



Go Make

Students must make one of their ideas using the LEGO® set, and can use other materials if needed. If they are finding it hard to build their idea, encourage them to break problems down into smaller parts. Explain that they do not have to come up with the whole solution from the start. Remind students that this process is iterative and they must test, analyze, and revise their idea as they go.

Using this Maker process does not mean you are following an inflexible set of steps. Instead, think of it as a set of practices.

For example, brainstorming may be prominent at the beginning of the process. However, students may also need to brainstorm ideas when they are trying to figure out ways to improve their idea, or when they have a bad test result and must change a feature of their design.



Review and Revise Your Solution

To help students develop their critical thinking and communication skills, you may wish to have students from one group observe and critique another group's solution. Peer review and formative feedback helps both the students giving, and the students receiving the feedback to improve their work.



Communicate Your Solution

The Student Worksheet is helpful for basic documentation of the activity. Students can also refer to it when presenting their work in front of the class. You may also wish to use the Student Worksheet as a portfolio for performance evaluations or for student self-evaluation.



Design criteria example:

The design must..
The design should..
The design could..



The LEGO® Education Maker (Design) Process



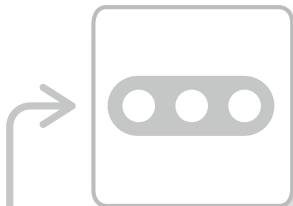
Define the Problem



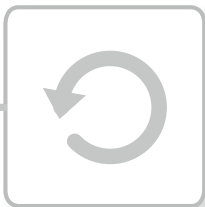
Brainstorming



Define the Design Criteria



Go Make



Review and Revise Your Solution



Communicate Your Solution

Assessment

Where can I find the assessment materials?

Assessment materials are provided on the following page for the first three projects.

What learning goals are assessed?

Students use the Student Worksheet assessment rubric to evaluate their design work according to the learning goals. Each rubric includes four levels: Bronze, Silver, Gold, and Platinum. The intention of the rubric is to help students reflect on what they have done well in relation to the learning goals and what they could have done better. Each rubric can be linked to engineering-related learning goals from the Next Generation Science Standards (NGSS).

NGSS Science Standards:

Science and Engineering Practices

MS-ETS1.1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4

Disciplinary Core Ideas

ETS1.A, (MS-ETS1-1)

ETS1.B, (MS-ETS1-2), (MS-ETS1-3), (MS-ETS1-4)

ETS1.C, (MS-ETS1-3), (MS-ETS1-4)

Common Core State Standards

ELA/Literacy

WHST.6-8.8

SL.8.5

Mathematics

MP.2, 7.EE.3

Share It

We encourage you to share your students' brilliant projects on the appropriate social media platforms using the hashtag **#LEGOMaker**.

Students can also share their own projects if they are over 13 years old and if it complies with the rules of your school/Maker space.

The Maker Activities


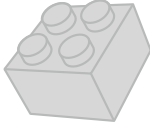


Start your Maker journey with the following three activities:

- Sound Machine
- Security Gadget
- Puppet

 **#LEGOMAKER**

Self-Assessment

Name(s): _____ Date: _____

GOALS	 BRONZE	 SILVER	 GOLD	 PLATINUM
Maker task: Sound Machine Linked to: NGSS Practice 6 Designing Solutions	<ul style="list-style-type: none"> We successfully built and tested one design based upon a single design criteria and design idea. <input type="checkbox"/>	<ul style="list-style-type: none"> We successfully used two design criteria and ideas to build a solution to a defined problem. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Silver and refined our idea, improving it further through testing, revising, and retesting. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Gold and successfully met all three design criteria. <input type="checkbox"/>
Maker task: Security Gadget Linked to: NGSS Practice 1 Defining Problems	<ul style="list-style-type: none"> We understood the design problem. <input type="checkbox"/>	<ul style="list-style-type: none"> We defined a design problem and used one design criteria and idea to build our solution. <input type="checkbox"/>	<ul style="list-style-type: none"> We achieved Silver and used two design criteria and ideas to build our solution. <input type="checkbox"/>	<ul style="list-style-type: none"> We achieved Gold and used three design criteria and ideas to build an effective solution. <input type="checkbox"/>
Maker task: Puppet Linked to: NGSS Practice 1 Obtaining, Evaluating, and Communicating Information	<ul style="list-style-type: none"> We drew and labeled the different parts of our design. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Bronze and identified the location of the key component parts responsible for making our design work. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Silver and included a diagram showing how our design works. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Gold and used words and a diagram to explain how our new design works. <input type="checkbox"/>
<p>Notes:</p>				

Well done! What will you make next?