

Ramp

Name(s): _____

Date and Subject: _____

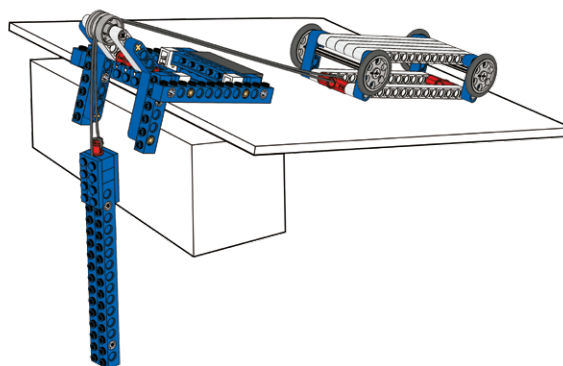
Build the Box Frame, Roller and Effort Weight

(building instructions 17A and 17B to page 11, step 15)

- Make sure the wheels on the box frame turns freely
- The box frame can be turned upside down, to be used as a sled, without the wheels. Or turned around again as a cart with wheels

Build the Ramp

- Place a support so the top of the 30 cm (≈ 11.8 in) plank is situated 10 cm (≈ 3.9 in) off the floor
- Place the box frame on the ramp and the roller at the top edge. Let the effort weight hang loose over the edge
- Have the 60 cm (≈ 23.6 in) plank ready to make changes to the ramp



What is the advantage of using the ramp?

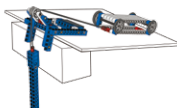


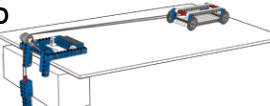
Investigate the difference between ideal and actual mechanical advantage.

First, calculate the ideal mechanical advantage and predict how much effort is actually needed to pull box frame A to the top of the ramp.

Then test how much effort is needed by adding LEGO® bricks to the effort weight and calculate the actual mechanical advantage.

Calculate the percentage of accuracy between the ideal mechanical advantage and the actual mechanical advantage.

Next, follow the same procedure for box frames B, C and D.

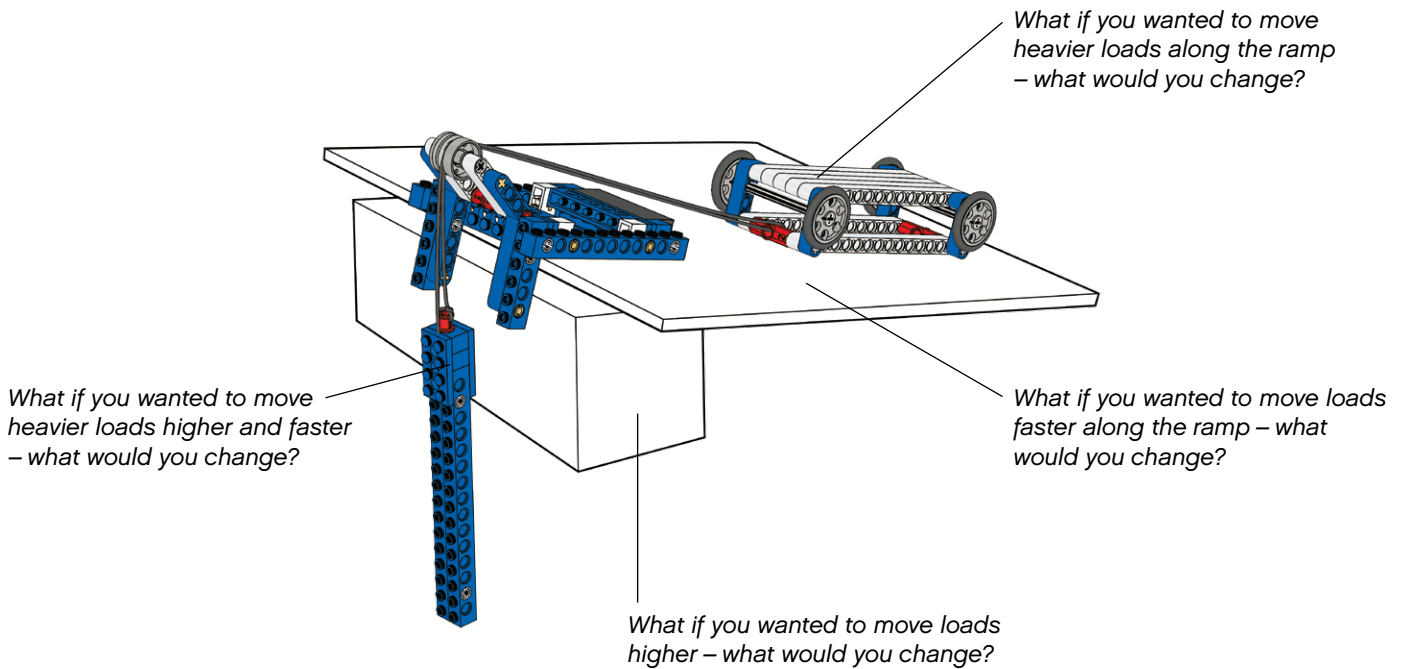
	Ideal Mechanical Advantage	My Prediction of Effort Needed	Actual Effort Needed	Actual Mechanical Advantage	Percentage of Accuracy
A  (page 11, step 15)					
B  (page 12, step 16)					
C  (page 11, step 15)					
D  (page 12, step 16)					

Redesign needed?

A ramp can come in many shapes and sizes to match specific needs.

Now redesign the ramp to make it the best in its class. We have highlighted some questions you could explore. Choose one area that you would like to investigate.





Then design a test that will help you explore how it functions and possible additional improvements you could make to your new ramp. Remember to record all of your test results.



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NGSS GOALS	 BRONZE	 SILVER	 GOLD	 PLATINUM
1. Student work related to this Crosscutting Concept: In this project, we redesigned a structure in our ramp system to move heavier loads, move them faster, or move them higher.				
Structure and Function: Design structures to serve particular functions.	<ul style="list-style-type: none"> We chose our design goal —move heavier loads, move them faster, or move them higher. We identified which structure in our ramp system needed to be changed. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Bronze. We changed the relevant ramp structure to make it function as desired. Our test data showed that we made a small improvement (< 2x improvement). <input type="checkbox"/>	<ul style="list-style-type: none"> We met Silver. Our test data showed that we made a large improvement. (> 2x improvement). <input type="checkbox"/>	<ul style="list-style-type: none"> We chose a second design goal We identified ramp structure to change. We completed the redesign and our test data showed that we made an improvement. <input type="checkbox"/>
2. Student work related to this Practice: In this project, we asked questions and defined problems to help us decide how to redesign our ramp system.				
Asking Questions and Defining Problems: Ask questions that clarify and/or refine an engineering problem.	<ul style="list-style-type: none"> We asked questions that only partially related to improving our ramp system. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Bronze. We asked questions that were relevant to the features of the ramp we wanted to improve. Our questions resulted in at least one redesign idea. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Silver. Our questions helped us clarify a test procedure to evaluate our design idea. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Gold. Our questions lead us to more than one redesign idea that we tested with an experiment. <input type="checkbox"/>
3. Student work related to this Practice: In this project, we collected data during tests of the original ramp design. We analyzed and interpreted that data to help us begin our redesign project.				
Analyzing and Interpreting Data: Analyze data to define whether a system best meets criteria for success.	<ul style="list-style-type: none"> We compared ideal mechanical advantage for all four ramp experiments. We circled the best ideal mechanical advantage. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Bronze. We compared actual mechanical advantage for all four ramp experiments. We circled the best actual mechanical advantage. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Gold. We compared percentage of accuracy for all four ramp experiments. We circled the best percentage of accuracy. <input type="checkbox"/>	<ul style="list-style-type: none"> We used our data analysis to identify which ramp structure would affect the different goals we evaluated for our redesign —height, weight, and speed. <input type="checkbox"/>
Notes:				