Merry-Go-Round

A Sample Activity from Simple Machines

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education

Introduction

LEGO® Education is pleased to bring you the “Simple Machines” curriculum pack.

Who is it for?

This material is designed for use by teachers of students in grades three through five, who wish to introduce their students to the following simple machines:

- Gears
- Wheels and Axles
- Levers
- Pulleys

Working in pairs, students of any academic background can build, learn and investigate using the models and activities included in this curriculum pack.

What is it for?

LEGO Education STEM solutions enable students to work as young scientists and engineers, helping them to investigate and understand the operation of simple and compound machines found in everyday life. The materials promote an enjoyable but challenging classroom environment in which students can develop skills such as creative problem-solving, communication of ideas, and teamwork. The activities lead students to make initial use of scientific method through observation, reasoning, prediction, and critical thinking.

The “Simple Machines” curriculum pack enables you to partially cover the following Crosscutting Concepts and overall Science and Engineering Practices, which have been set forth in the Next Generation Science Standards (NGSS).

Science and Engineering Practices:
- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Crosscutting Concepts:
- Patterns
- Cause and effect: Mechanism and explanation
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter: Flows, cycles, and conservation
- Structure and function
- Stability and change

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What is in it?

The 9689 Brick Set

The set consists of four full-color sets of building instructions for the four simple machines, including building instructions for both the principle models and the main models, and 204 LEGO® elements, including an element (brick) separator. The main models and the principle models described in this curriculum pack can all be built from the elements in the set, though only one at a time.

9689

The 9689 Curriculum Pack

This curriculum pack contains teaching suggestions and materials that will enable teachers to make effective use of the Simple Machines Set in class. The curriculum pack is divided into the following sections:

Curriculum:

Please refer to the NGSS and Common Core State Standards grids in the 'Curriculum' section of this curriculum pack to see which of the main activities and problem-solving activities match your current teaching program.

The four simple machine sections:

These sections provide information and activities for the four simple machines: gears, wheels and axles, levers, and pulleys. All four simple machine units are presented in the same way.

- An overview of the simple machine in focus is given. The overview starts with an introduction and with ideas for establishing the concept and providing the vocabulary relevant to the simple machine. A brief outline for using the principle models is also included.
- Following this is an overview of relevant images from Images for Classroom Use, a collection of photographs, pictures, drawings, and illustrations that can be used to support the teaching of simple machines. These images are intended to help students understand the links between the models they build and the real world. There is also an overview of the elements used for building both the principle models and the main models.
- Each unit then introduces the Teacher's Notes and student worksheets for the principle models, the related main model, and the problem-solving activity.

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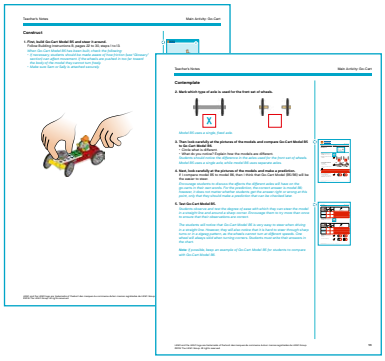
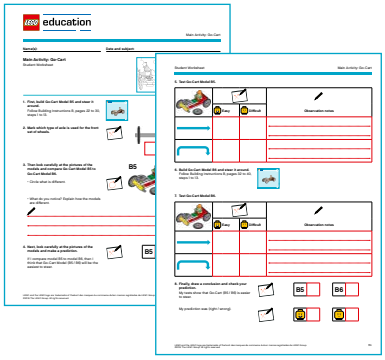
Teacher's Notes
There are detailed Teacher's Notes for each simple machine section. In some cases, additional materials will be necessary for the main activities and investigations; these are listed. The Teacher's Notes indicate key learning areas, give suggestions for carrying out each main activity, provide hints, questions, and vocabulary specific to the main activity, and suggest further ideas for investigation. The answers to questions asked on the Student Worksheets, together with comments to the teacher, are written in blue italics in the Teacher's Notes.

In the Teacher's Notes you will find eight main activities, each of which includes including student worksheets, assessment tools, 'Connect' stories, and questions and ideas for for further investigation. You will also find four problem-solving activities, which also include assessment tools and 'Connect' stories, as well as a design brief and a possible design solution – all ready for you to introduce to your students.



Main Activities and Student Worksheets
The student worksheets help students to work individually, in pairs, or in groups to apply the knowledge they have acquired about the simple machine concept through building or discussion activities. The student worksheets can be copied as required. Writing is kept to a minimum on the student worksheets for the principle models—students only need to mark choices, draw lines to label illustrations, or write numbers.

On the student worksheets for the main models students will be challenged to predict an outcome, which they will then investigate, and finally they will document their findings.



Text on the student worksheets is kept to a minimum, but nevertheless early readers may need help in understanding the written instructions. Icons have been included on the student worksheets to help students through the main activity in focus; these symbolize, for example, that something must be marked or drawn, circled, or joined, or that students are asked to write in a number.

Problem-Solving Activities
These problem-solving activities are intended to encourage students to apply the knowledge they have gained from both the different principle models and/or the main model concerning the simple machine in focus. The suggested problem-solving model solution that is included is only meant as a guiding principle to solving the problem posed.

If possible, take a picture of each of the students' model solutions and have the students explain how they have solved the problem. Keep the pictures as inspirational material for future problem solvers.

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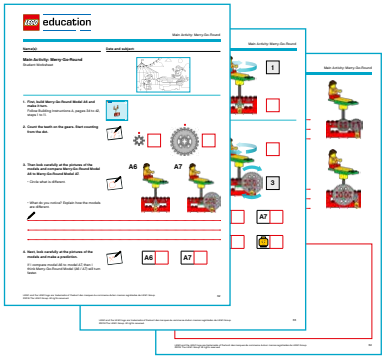
Assessments

Assessment materials are provided for all four of the main activities and the four problem-solving activities. These materials define clear learning goals before the students start each activity and motivate the students to challenge themselves throughout the learning process. You can also use these materials to assess your students' development in different learning areas.

Student Worksheets

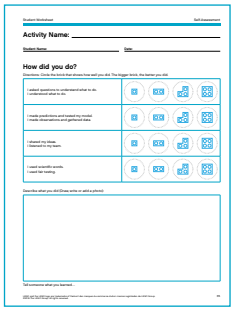
The student worksheets should be used to document each student's work and to support them throughout each of the main activities. These worksheets are an easy-to-use tool for assessing each student's level and achievement during the activities. They can also comprise a valuable part of the each student's logbook or portfolio.



Student Self-Assessment Tools

There are two generic student self-assessment rubrics. One has been developed for use during the main activities, and the other is intended for use with the problem-solving activities. These rubrics help students to reflect on and evaluate their work during each lesson.

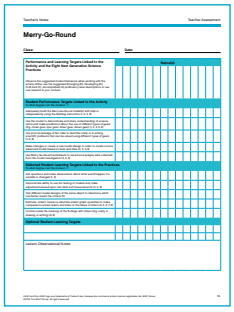
Using these rubrics, students assess themselves according to the 'Four Bricks Scale' in which the biggest brick represents the highest rating. In certain situations, you might also consider asking your students to assess themselves using only two of the four bricks.



Teacher Assessment Tools

The Observation Checklists are linked directly to each of the main activities and the problem-solving activities. You can use these checklists to assess the science and engineering practices of your students individually, in pairs, or in groups.

You either can use the Emerging, Developing, Proficient, or Accomplished proficiency level descriptions described on the next page, or use other assessment criteria that are relevant to your school context.



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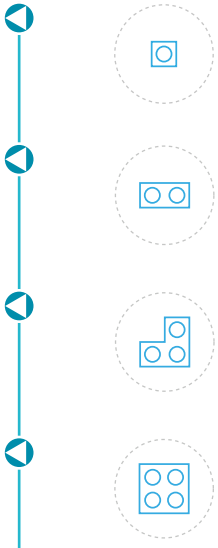
Emerging
The student is at the beginning stages of development in terms of content knowledge, ability to understand and apply content, and/or demonstration of coherent thoughts about a given topic.

Developing
The student is able to present basic knowledge only (e.g., vocabulary), and cannot yet apply content knowledge or demonstrate comprehension of the concepts being presented.

Proficient
The student has concrete levels of comprehension of the content and concepts, and can demonstrate adequately the topics, content, or concepts being taught. The ability to discuss and apply concepts outside of the required assignment is lacking.

Accomplished
The student can take concepts and ideas to the next level, apply concepts to other situations, and synthesize, apply, and extend knowledge to discussions that include extensions of ideas.

Where can I find the assessment materials?
You can find the assessment materials in the Teacher's Notes for each of the main activities and problem-solving activities.



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Classroom Management Tips

For Your First LEGO® Education Activity, and Beyond

1. Before Class
- Download the curriculum pack from the URL that is printed on the lid of each LEGO® brick set.
- Open one of the sets, sort the bricks, and get to know the bricks by working with one of the principle models, followed by a main activity. Use the relevant student worksheets and assessment tools.

2. During Class
- At the beginning of the first lesson, allow the students some time to get to know the LEGO brick set.
- Use a jar to collect stray pieces.
- Make adjustments in order to challenge the students who are ready to improve and develop new skills.
- Allow time for students to use the self-assessment rubric when they are done with the activity.
- Label the boxes so that you can recognize which box belongs to which student(s).
- Plan to stop the lesson with enough time to allow the students to tidy up.

3. After Class
- If you did not finish the activity, store the LEGO sets and the models so that they are ready for the next lesson.
- Evaluate the lesson.

How much time is needed?
There are many ways to use the Simple Machines Set in your classroom, and many different ways to plan your class schedule. Activities can be completed by individuals or by small teams or groups, depending upon the number of sets that are available to your class.

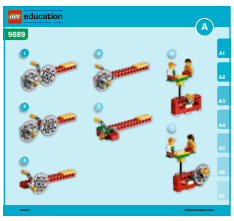
If you choose to introduce the principle models of one simple machine, 2-3 of the models can be built, investigated, and explored, and the parts put away again, within a single 45-minute lesson if the students are already experienced LEGO builders.

Hint
We suggest students work together in pairs, sharing a set between them.

However, if you choose to continue with a main activity, then at least two more class periods will be needed, depending on the time spent on discussion, the building skills of your students, and the time you allow for experimentation. A double lesson is ideal to be able to explore, build, and investigate in depth most of the (optional) extension ideas built into the main activity, and especially for the students to make any creative variations of their own.

In the case of the problem-solving activities, students should be able to tackle the challenge within a sequence of two lessons.

How do I organize the building instructions?
For easy classroom management we suggest storing the building instructions in binders so that they are close at hand and ready to use at the beginning of each lesson.



What's needed in my classroom?
Tables may be pushed aside to let models roll across a smooth floor and boxes may be needed for a ramp.

Students need to be able to construct in pairs facing each other or side-by-side. It is also an advantage to have a cupboard or shelves where you can store the sets lying flat with any unfinished models on top of them.

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LEGO® Education's 4C approach

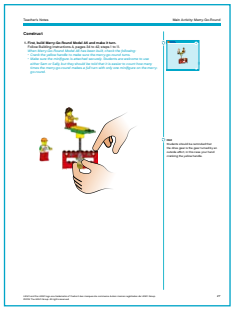
The main activities in the "Simple Machines" curriculum pack follow LEGO® Education's 4C approach: Connect, Construct, Contemplate, and Continue. This enables you to progress naturally through the main activities.

Connect

The Connect story places the characters Sam and Sally in real-life surroundings, linking an object/item from the real world that most students will recognize to the simple machine concept under consideration. This real-world object will closely resemble the LEGO models students will work with and build. In the Connect passage the language is more child-oriented, as it is intended for you to read aloud.

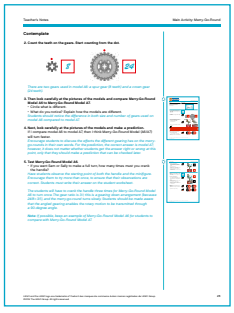
Construct

Using the building instructions, students build models covering the concepts related to the simple machine in focus. Tips are provided for testing and for making sure that each model functions as intended.



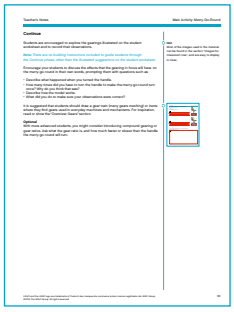
Contemplate

This stage involves students investigating the models they have constructed. Through these investigations, students will learn to observe and compare results from tests that they make, and to report on their observations. They will be encouraged to describe the outcomes of their investigations. Questions are included that are designed to further deepen students' experience and understanding of the investigation. This phase provides the opportunity for you to begin evaluating learning outcomes and the progress of individual students, especially by looking at their worksheets and talking to them about their reflections and answers.



Continue

Continued learning is always more enjoyable and creative when it is sufficiently challenging. Extension ideas are therefore provided to encourage the students to change or add features to their models and to investigate further—always with the key learning area in mind. This phase encourages students to experiment and to apply their knowledge creatively.



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What Are Simple Machines?

We use simple machines every day—when we open a door, turn on a faucet, open a tin can, or ride a bike. Simple machines make it easy for us to do work. A force (a push or a pull effort) makes something (a mass or load) move a distance.

Simple machines have only one part to do the work and they have very few or even no moving parts. A lever is an example of such a simple machine. You can use a lever, for example a crowbar, to move a large load with a smaller effort than you would need if you did not have a machine to help you. The force applied to the lever makes the load move, but the effort needed is less than if the force was applied directly to the load. The work is thus easier to do.

The terms *load* and *effort* are used in describing how simple machines work. The load is the object that is moved, e.g., a box. The effort is the force used to do the work. In the situation illustrated, the effort is the force that someone will apply to the moving dolly to move (or lift) the load (the box).

Simple machines have very few parts; compound machines are made up of two or more simple machines. A moving dolly is one example of a compound machine. It has combined two simple machines. The handles are levers that help lift the load, and the wheel and axle help move the load forward easily. The same principle applies to a wheelbarrow.

Machines help us do many things: they help us lift, pull, split, fasten, cut, carry, mix, etc. All machines are made up of simple machines. More complicated machines (compound machines) are made up of a number of simple machines that function together to help do the work. Gears are sometimes categorized as compound machines, but in this material we have regarded them as simple machines.

Did you know?

A crowbar is a simple machine called a lever.

Did you know?

A wheelbarrow is a compound machine.

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Curriculum

Objective Number	NGSS Grades 3-5 ● = Fully covered ◐ = Partially covered	Simple Machines											
		Gears			Wheels and Axles			Levers			Pulleys		
		1. Principle Models: Gears	2. Main Activity: Merry-Go-Round	3. Problem-Solving Activity: Popcorn Cart	1. Principle Models: Wheels and Axles	2. Main Activity: Go-Cart	3. Problem-Solving Activity: Wheelbarrow	1. Principle Models: Levers	2. Main Activity: Catapult	3. Problem-Solving Activity: Railroad Crossing Gate	1. Principle Models: Pulleys	2. Main Activity: Crazy Floors	3. Problem-Solving Activity: Crane
Disciplinary Core Ideas: Physical Science													
1	MS-PS2 Motion and Stability: Forces and Interactions	◐	●	●	●	●	●	●	●	◐	●	●	●
Crosscutting Concepts													
1	Patterns	◐										◐	
2	Cause and effect: Mechanism and explanation	●	●	◐		●	◐	●	●	●	●	●	●
3	Scale, proportion, and quantity	●			●								
4	Systems and system models		◐	●	◐	●	◐		●	●	◐	●	◐
5	Energy and matter: Flows, cycles, and conservation												
6	Structure and Function			●	◐	◐	●		●	◐		◐	●
7	Stability and change	◐	●	●	●	●	●	●	●	◐		◐	●
Science and Engineering Practices													
1	Asking questions and Defining Problems	●	●	●	●	●	●	●	●	●	●	●	●
2	Developing and using models	●	●	●	●	●	●	●	●	●	●	●	●
3	Planning and carrying out investigations	●	●	●	●	●	●	●	●	●	●	●	●
4	Analyzing and interpreting data	●	●	●	●	●	●	●	●	●	●	●	●
5	Using mathematics, Informational and Computer Technology, and computational thinking	◐	◐	◐	◐	●	◐		●		◐		
6	Constructing explanations and designing solutions	●	●	●	●	●	●	●	●	●	●	●	●
7	Engaging in argument from evidence	◐	●	●	◐	●	●	◐	●	●	◐	●	●
8	Obtaining, evaluating, and communicating information	●	●	●	●	●	●	●	●	●	●	●	●

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Objective Number	Common Core State Standards ● = Fully covered ◐ = Partially covered	Simple Machines											
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Mathematical Practice													
MP1	Make sense of problems and persevere in solving them.	◐	●	●	◐	●	●	◐	●	●	◐	●	●
MP2	Reason abstractly and quantitatively.			●		●	●		●	●			◐
MP3	Construct viable arguments and critique the reasoning of others.		●	●		◐	◐		●	●		●	●
MP4	Model with mathematics.	●			●	●			●				
MP5	Use appropriate tools strategically.	●	●	●	●	●	◐	●	●	●	●	●	●
MP6	Attend to precision.	●	●	●	●	●	●	●	●	●	●	●	●
MP7	Look for and make use of structure.		●	●	◐	●	●	◐	●	●	◐	●	●
MP8	Look for and express regularity in repeated reasoning.	◐		◐		●			●			◐	
Measurement & Data													
3.MD.B.4	Generate measurement data by measuring lengths					●	●		●				
4.MD.A.2	Use the four operations to solve word problems involving distance.					◐	◐		◐				
Writing Standards													
W.3.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly.	●	●		●	●		●	●		●	●	
W.3.7	Conduct short research projects that build knowledge about a topic.			●			●			●			●
W.3.8	Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.			◐			◐			◐			◐
W.4.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly.	●	●		●	●		●	●		●	●	
W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic.			●			●			●			●
W.4.8	Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.			◐			◐			◐			◐
W.5.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly.	●	●		●	●		●	●		●	●	
W.5.7	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.			●			●			●			●
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.			◐			◐			◐			◐

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Speaking and Listening													
SL.3.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.	●	●	●	●	●	●	●	●	●	●	●	●
SL.3.3	Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐
SL.3.4	Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐
SL.4.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.	●	●	●	●	●	●	●	●	●	●	●	●
SL.4.3	Identify the reasons and evidence a speaker provides to support particular points.	●	●	●	●	●	●	●	●	●	●	●	●
SL.4.4	Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.		◐	◐		◐	◐		◐	◐		◐	◐
SL.5.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.	●	●	●	●	●	●	●	●	●	●	●	●
SL.5.3	Summarize the points a speaker makes and explain how each claim is supported by reasons and evidence.		◐	◐		◐	◐		◐	◐		◐	◐
SL.5.4	Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.		◐	●		◐	●		◐	●		◐	●
SL.5.5	Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.			◐			◐			◐			◐

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Main Activity: Merry-Go-Round

Teacher's Notes

Learning Objectives

In this activity students will build and test models that use the following techniques associated with gears:

- Decreasing speed of rotation
- Increasing speed of rotation
- Gearing at an angle

To perform this activity, students should be familiar with the following vocabulary associated with gears:

- Drive gear
- Driven gear
- To mesh

If students have already worked with the principle models, they will already have observed gears, and the terms used in this activity should be familiar to them. Predictions should now be easier to make based on the observations made earlier. If the students have not worked on the principle models, then additional time will be needed, for example to introduce and explain the technical vocabulary used. If additional guidance is required, please turn to the "Overview: Gears" or "Principle Models" sections.

Materials Required

- 9689 LEGO® Education Simple Machines Set

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Connect

Sam and Sally love going to the fair. The ride they enjoy most is the merry-go-round. It's such fun to spin around and around, waving to their friends and families!

Do you like merry-go-rounds?
What do you enjoy most about them?
Which simple machine might be needed for a merry-go-round to turn?

Let's build a merry-go-round!

Hint
Most of the images used in the material can be found in the section "Images for Classroom Use", and are easy to display in class.

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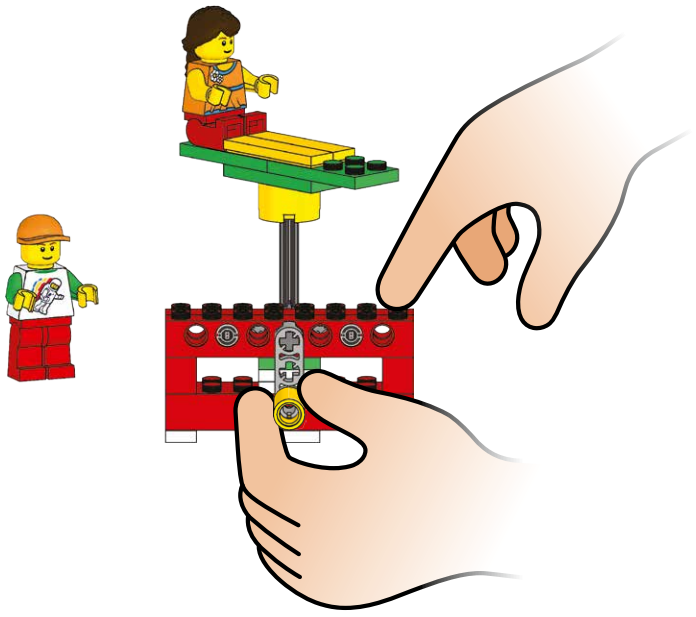
Construct

1. **First, build Merry-Go-Round Model A6 and make it turn.**
   Follow Building Instructions A, pages 34 to 42, steps 1 to 11.
   When Merry-Go-Round Model A6 has been built, check the following:
   - *Crank the yellow handle to make sure the merry-go-round turns.*
   - *Make sure the minifigure is attached securely. Students are welcome to use either Sam or Sally, but they should be told that it is easier to count how many times the merry-go-round makes a full turn with only one minifigure on the merry-go-round.*



Hint
Students should be reminded that the drive gear is the gear turned by an outside effort, in this case your hand cranking the yellow handle.

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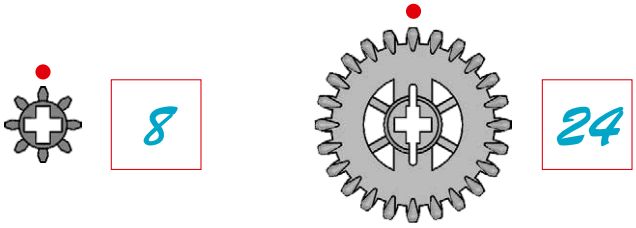
Contemplate

2. Count the teeth on the gears. Start counting from the dot.

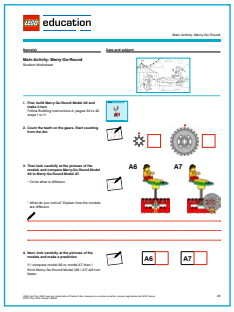


There are two gears used in model A6: a spur gear (8 teeth) and a crown gear (24 teeth).

3. Then look carefully at the pictures of the models and compare Merry-Go-Round Model A6 to Merry-Go-Round Model A7.

- Circle what is different.
- What do you notice? Explain how the models are different.

Students should notice the difference in both size and number of gears used on model A6 compared to model A7.



4. Next, look carefully at the pictures of the models and make a prediction.

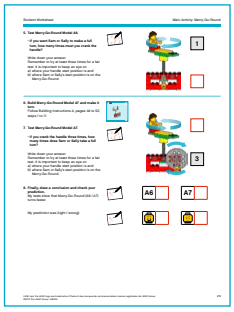
If I compare model A6 to model A7, then I think Merry-Go-Round Model (A6/A7) will turn faster.

Encourage students to discuss the effects the different gearing has on the merry-go-rounds in their own words. For the prediction, the correct answer is model A7; however, it does not matter whether students get the answer right or wrong at this point, only that they should make a prediction that can be checked later.

5. Test Merry-Go-Round Model A6.

- If you want Sam or Sally to make a full turn, how many times must you crank the handle?

Have students observe the starting point of both the handle and the minifigure. Encourage them to try more than once, to ensure that their observations are correct. Students must write their answer on the student worksheet.



The students will have to crank the handle three times for Merry-Go-Round Model A6 to turn once. The gear ratio is 3:1; this is a gearing down arrangement (because 24/8 = 3/1), and the merry-go-round turns slowly. Students should be made aware that the angled gearing enables the rotary motion to be transmitted through a 90-degree angle.

Note: *If possible, keep an example of Merry-Go-Round Model A6 for students to compare with Merry-Go-Round Model A7.*

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6. Build Merry-Go-Round Model A7 and make it turn.
Follow Building Instructions A, pages 44 to 52, steps 1 to 11.
Encourage students to identify the gears and count the teeth on the gears. There are four gears used in the model: two small spur gears (8 teeth), a crown gear (24 teeth), and a large spur gear (40 teeth).

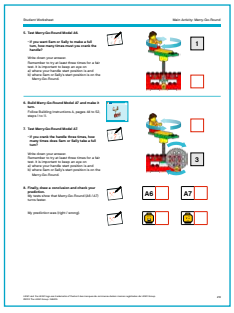
7. Test Merry-Go-Round Model A7.
- If you crank the handle three times, how many times does Sam or Sally make a full turn?

Have students pay attention to the starting positions of the handle and the minifigure as described earlier. Encourage them to try more than once, to ensure that their observations are correct.

Three turns of the 40-tooth gear produce five turns of the merry-go-round. The gear ratio is 3:5 (because 24/40 = 3/5), and the merry-go-round turns at a much faster pace.

Hint
It is recommended that students work in pairs; one student can observe the minifigure while the other cranks the handle a full turn.

8. Finally, draw a conclusion and check your prediction.
Merry-Go-Round Model A7 turns faster because of the gearing-up arrangement with the 40-tooth drive gear and the 24-tooth driven gear.



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Continue

Students are encouraged to explore the gearings illustrated on the student worksheet and to record their observations.

Note: *There are no building instructions included to guide students through the Continue phase, other than the illustrated suggestions on the student worksheet.*

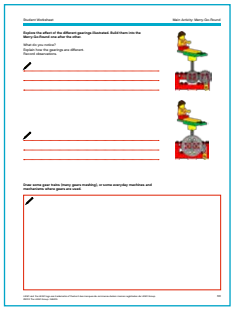
Encourage your students to discuss the effects that the gearing in focus will have on the merry-go-round in their own words, prompting them with questions such as:

- Describe what happened when you turned the handle.
- How many times did you have to turn the handle to make the merry-go-round turn once? Why do you think that was?
- Describe how the model works.
- What did you do to make sure your observations were correct?

It is suggested that students should draw a gear train (many gears meshing) or items where they find gears used in everyday machines and mechanisms. For inspiration, read or show the "Overview: Gears" section.

Optional
With more advanced students, you might consider introducing compound gearing or gear ratios. Ask what the gear ratio is, and how much faster or slower than the handle the merry-go-round will turn.

Hint
Most of the images used in the material can be found in the section "Images for Classroom Use", and are easy to display in class.



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Merry-Go-Round

Class: **Date:**

Performance and Learning Targets Linked to the Activity and the Eight Next Generation Science Practices Observe the suggested student behaviors while working with the activity. Either use the suggested Emerging (E), Developing (D), Proficient (P), Accomplished (A) proficiency level descriptions or use one relevant to your context.	**Name(s):**													
Student Performance Targets Linked to the Activity To what degree can the student…?														
Adequately build the Merry-Go-Round model(s) with help or independently using the Building Instruction (1, 2, 3, 6)														
Use the model to demonstrate and share understanding of science terms and make predictions about the use of different types of gears (E.g. crown gear, spur gear, driver gear, driven gear) (1, 3, 4, 5, 8)														
Use prior knowledge of fair rides to describe orally or in writing scientific problems that can be solved using different types of gears (1, 6, 8)														
Make changes or create a new model design in order to create a more advanced model based on tests and data (2, 3, 4, 6)														
Use Merry-Go-Round worksheets to record and analyze data collected from the model investigation (3, 4, 5)														
Selected Student Learning Targets Linked to the Practices To what degree can the student…?														
Ask questions and make observations about what would happen if a variable is changed (1, 3)														
Demonstrate ability to use fair testing of models and make adjustments based upon test data and measurements (3, 4, 6)														
Test different model designs of the same object to determine which one better meets the criteria (3)														
Estimate, collect, measure, describe and/or graph quantities to make comparisons across teams and listen to the ideas of others (4, 5, 6, 7, 8)														
Communicate the meaning of the findings with others (E.g. orally, in drawing or writing) (4, 8)														
Optional Student Learning Targets														
Lesson Observational Notes:														

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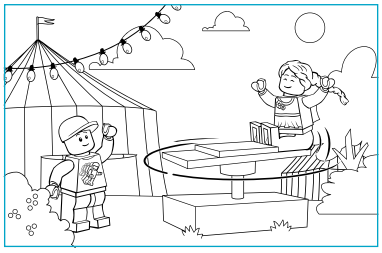
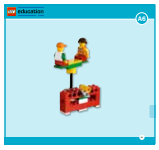
Name(s): **Date and subject:**

Main Activity: Merry-Go-Round

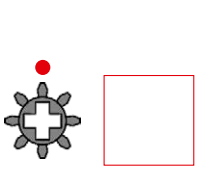
Student Worksheet

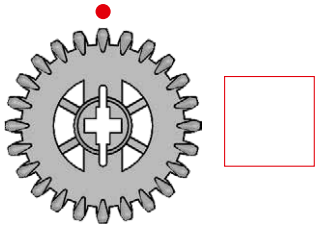


1. **First, build Merry-Go-Round Model A6 and make it turn.**
   Follow Building Instructions A, pages 34 to 42, steps 1 to 11.



2. **Count the teeth on the gears. Start counting from the dot.**

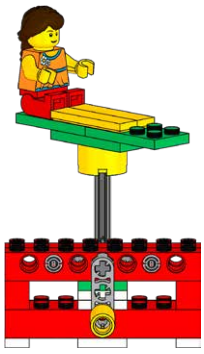




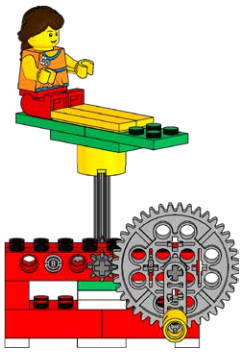
3. **Then look carefully at the pictures of the models and compare Merry-Go-Round Model A6 to Merry-Go-Round Model A7.**

   • Circle what is different.

A6



A7



   • What do you notice? Explain how the models are different.

4. **Next, look carefully at the pictures of the models and make a prediction.**

   If I compare model A6 to model A7, then I think Merry-Go-Round Model (A6 / A7) will turn faster.

A6 ☐ A7 ☐

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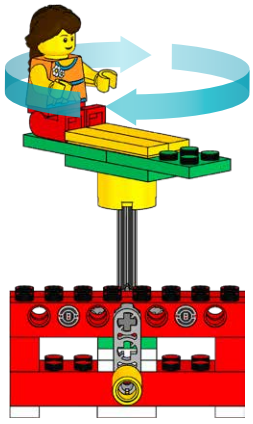
5. Test Merry-Go-Round Model A6.

- **If you want Sam or Sally to make a full turn, how many times must you crank the handle?**

Write down your answer.
Remember to try at least three times for a fair test. It is important to keep an eye on
a) where your handle start position is and
b) where Sam or Sally's start position is on the Merry-Go-Round.



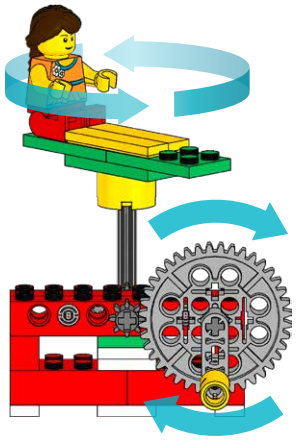
1

6. Build Merry-Go-Round Model A7 and make it turn.
Follow Building Instructions A, pages 44 to 52, steps 1 to 11.

7. Test Merry-Go-Round Model A7.

- **If you crank the handle three times, how many times does Sam or Sally take a full turn?**

Write down your answer.
Remember to try at least three times for a fair test. It is important to keep an eye on
a) where your handle start position is and
b) where Sam or Sally's start position is on the Merry-Go-Round.



3

8. Finally, draw a conclusion and check your prediction.
My tests show that Merry-Go-Round (A6 / A7) turns faster.

A6 A7

My prediction was (right / wrong).

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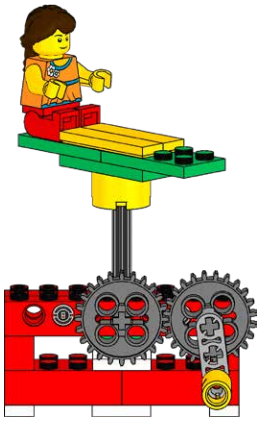
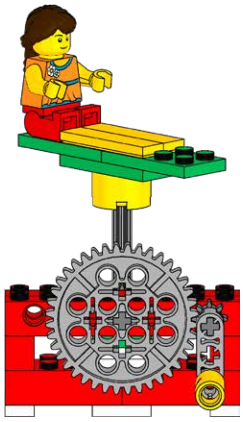
Explore the effect of the different gearings illustrated. Build them into the Merry-Go-Round one after the other.

What do you notice?
Explain how the gearings are different.
Record observations.





Draw some gear trains (many gears meshing), or some everyday machines and mechanisms where gears are used.

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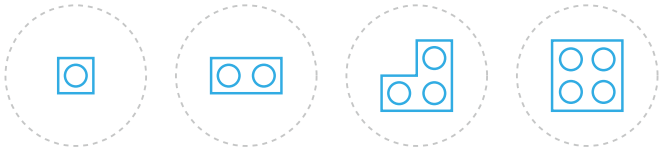
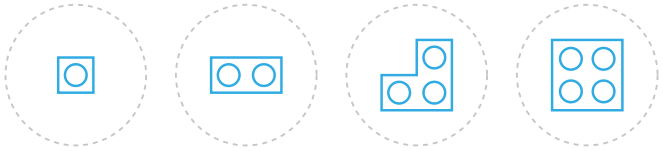
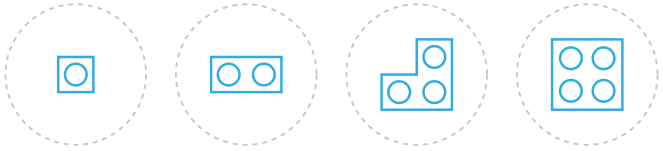
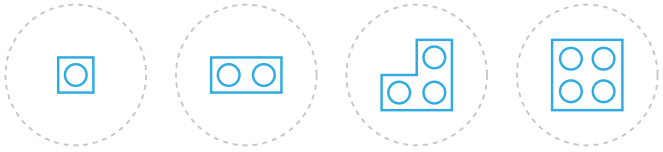
Activity Name: _____

Student Name: _____ **Date:** _____

How did you do?

Directions: Circle the brick that shows how well you did. The bigger brick, the better you did.

I asked questions to understand what to do. I understood what to do.	
I made predictions and tested my model. I made observations and gathered data.	
I shared my ideas. I listened to my team.	
I used scientific words. I used fair testing.	

Describe what you did (Draw, write or add a photo):

Tell someone what you learned…

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education