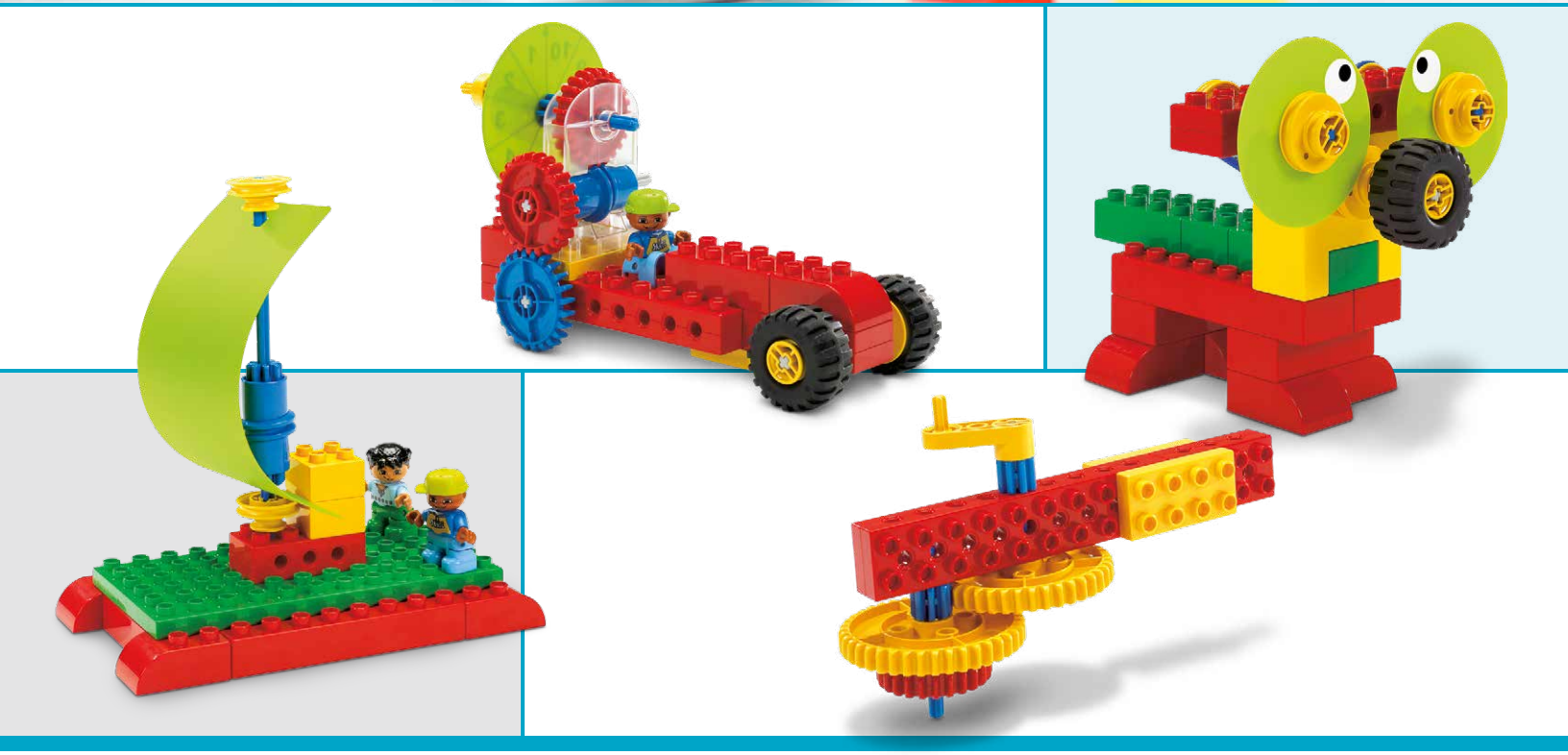
Early Simple Machines
Curriculum Pack



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Introduction

LEGO® Education is pleased to bring you the 'Early Simple Machines' curriculum pack, which provides ideal opportunities for young students to develop an understanding of science concepts through investigation and hands-on activities.

Who is it for?

This material is designed for use by teachers of students in grades K through 2. No prior science training is required – only creativity and enthusiasm. Working alone or in pairs, students of all abilities from 5 years and up can build, learn and enjoy with the eight models and activities.

Please refer to the Next Generation Science Standards (NGSS) and Common Core State Standards grids in the 'Curriculum' section of this curriculum pack to see which activities match your current teaching program.

What is it for?

LEGO Education STEM solutions enable young students to behave as young scientists, by providing them with tools and tasks that promote scientific enquiry. Using our solutions, students are encouraged to pose 'What if…?' questions. They make predictions, test the behavior of their models, and then record and present their findings.

The 'Early 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 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

What is in it?

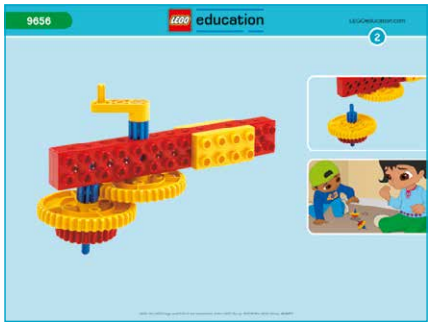
The 9656 Brick Set

The set comes in a practical and durable storage box. Inside the storage box you will find the 101 bricks, eight building instructions numbered 1-8, and an element survey that displays the set's unique mix of LEGO® DUPLO® bricks.

Exclusive for this product is a plastic punch-out sheet with eyes, sails, scales and wings. The curriculum pack contains eight activities and four problem-solving activities. Each of these represents one level of progression and are described in more detail below.

Building Instructions

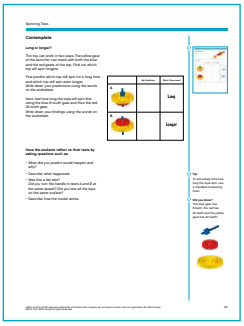
The eight building instructions support the students' building process step-by-step with clear instructions on how to build each model. To interpret the 2D building instructions and turn them into a 3D model can be a demanding task and some students may need your help and encouragement.



We recommend students try to build the exact models from the cards to ensure that the model will perform as intended for the activity. The building instructions will support the development of technical knowledge and understanding.

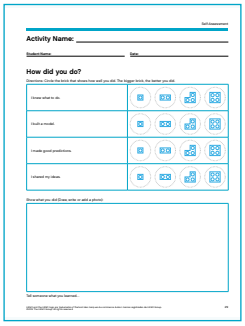
Teacher's Notes

In the Teacher's Notes you will find eight activities, each of which includes student worksheets, assessment tools, 'Connect' stories, and questions and ideas 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.



Activities and Student Worksheets

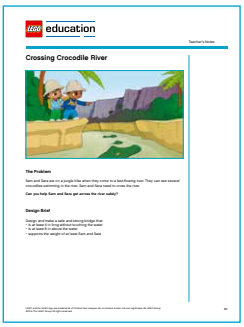
The illustrations in the student worksheets will guide the students to use and explore their models without too much assistance. The students will predict, test and describe outcomes using scientific words that are relevant to the NGSS, and presented in the student worksheets. These words will encourage the students to use the correct vocabulary to describe scientific concepts such as balance, direction, distance, speed and time.

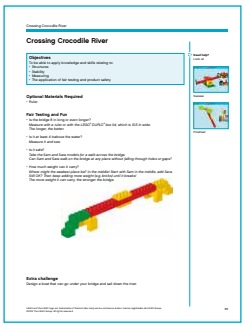


Problem-Solving Activities
Each of the four problem-solving activities starts off with a short story supported by an illustration featuring the problem that needs solving. To solve the problem, a design brief states a number of criteria the students have to incorporate into their model solution.

The ‘fair testing and fun’ questions and suggested answers help students focus on their models in order to meet the design brief criteria and support the test situation. The suggested model solution can help you in your preparation and differentiation, or when some of your students are struggling to create their own solution. However, it is not the one and only solution to the problem. Students must always be encouraged to build their own solution to a given problem.

If possible, take a picture of the students’ model solution and have them explain how they have solved the problem. Keep the picture as inspirational material for future problem solvers.



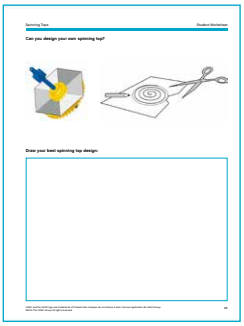


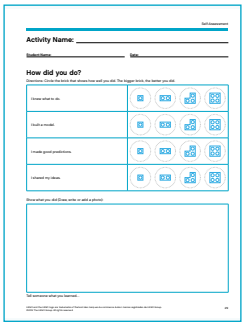
Assessments

Assessment materials provided for all eight of the 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 activity. 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 each student's logbook or portfolio.

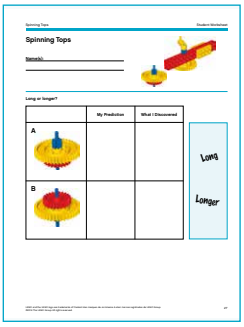




Student Self-Assessment Tools

There are two generic student self-assessment rubrics. One has been developed for use during the 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.

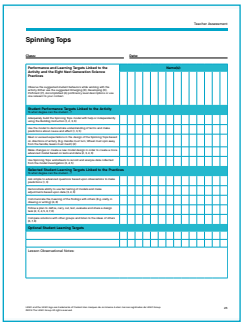
Using these rubrics, students assess themselves according to the 'Four Bricks Scale' in which the biggest brick represents the highest rating. In certain situations, you might consider asking your students to assess themselves using only two of the four bricks.



Teacher Assessment Tools

The Observation Checklists are linked directly to each of the 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.



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 activities and problem-solving activities.

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 and get to know the bricks by working with one of the activities. Use the relevant student worksheets and assessment tools.

2. During Class
- At the beginning of the first lesson, allow the students some time get to know the LEGO brick set.
- Use a box 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?
Each activity can be carried out within one lesson. A double lesson is ideal for more in-depth investigations of the key learning area(s) and to allow students to make creative model variations of their own.

For the open-ended problem-solving activities, students may need more time to build and explain their models.

How do I organize the building instructions?
For easy classroom management we suggest storing the building instructions either in a separate plastic folder or directly in the boxes so that they are 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. A desk fan may be needed to create a breeze, boxes may be needed for a ramp, etc.

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.

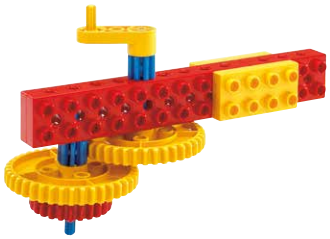
LEGO® Education's 4C Approach

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

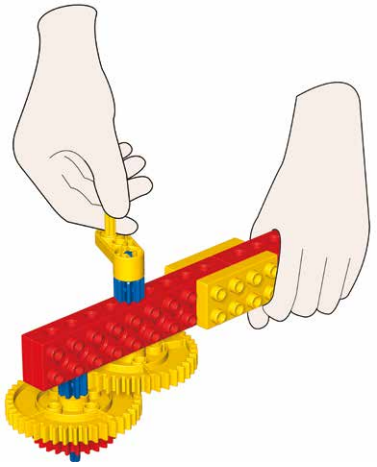
Connect
A short story introduces Sam and Sara and provides the students with the opportunity to help identify the problem and investigate how best to come up with a solution.

You may choose to read the story or retell it in your own words. Please also draw on your own experience and current events from both near and far to set the scene for the students.

Construct
Using the building instructions, students build models embodying the concepts related to the key learning areas. Tips are provided for testing and making sure each model functions as intended.



Contemplate
This involves students carrying out scientific investigations with what they have constructed.



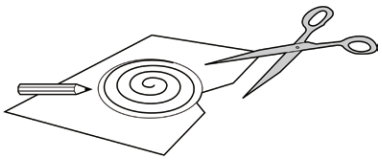
Through their investigations the students will learn to identify and compare test results. The activities will introduce them to the concepts of measurement, speed, balance, mechanical movement, structures, force and energy. They will be encouraged to describe the outcomes of their investigations. You will find all test results presented in the same chart as in the worksheet.

It may be a good idea to carry out the tests several times as test results may vary.

A series of questions are included to further deepen the students' experience and understanding of the investigation.

This phase also includes the possibility for you to start evaluating the learning and the progress of the individual student.

Continue
Ideas are provided for further investigations drawing on the students' creativity and previous experiences. The students will experiment, design additions or changes to their models, and invent related games.



Curriculum Grid

Objective Number	NGSS Grades K-2 ● = Fully covered ◐ = Partially covered	Activities								Problem-Solving Activities			
		Pinwheel	Spinning Tops	Seesaw	Raft	Car Launcher	Measuring Car	Ice Hockey Player	Sam's New Dog	Crossing Crocodile River	Hot Day	Scarecrow	Swing
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	●	●	●	●	●	●	●	●	●	●	●	●

Objective Number	Common Core State Standards for Mathematics Grades K-2 ● = Fully covered ◐ = Partially covered	Activities								Problem-Solving Activities			
		Pinwheel	Spinning Tops	Seesaw	Raft	Car Launcher	Measuring Car	Ice Hockey Player	Sam's New Dog	Crossing Crocodile River	Hot Day	Scarecrow	Swing
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													
K.MD.A	Describe and compare measurable attributes.	●	●	●	●	●	●	●	◐	●	●		●
1.MD.A	Measure lengths indirectly and by iterating length units.					●	●	●		●			
1.MD.C	Represent and interpret data.	◐	◐	◐	◐	●	●	●	◐	●	◐	◐	◐
2.MD.A	Measure and estimate lengths in standard units.					●	●	●		●			
2.MD.D	Represent and interpret data.	◐	◐	◐	◐	●	●	●	◐	●	◐	◐	◐
Writing Standards													
W.K.2	Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.	●	●	●	●	●	●	●	●	●	●	●	●
W.1.2	Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.	●	●	●	●	●	●	●	●	●	●	●	●
W.2.2	Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.	●	●	●	●	●	●	●	●	●	●	●	●
Speaking and Listening													
SL.K.1	Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.	◐	◐	◐	◐	●	●	◐	◐	◐	◐	◐	◐
SL.K.2	Confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood.												
SL.K.3	Ask and answer questions in order to seek help, get information, or clarify something that is not understood.	●	●	●	●	●	●	●	●	●	●	●	●
SL.K.4	Describe familiar people, places, things, and events and, with prompting and support, provide additional detail.												
SL.K.5	Add drawings or other visual displays to descriptions as desired to provide additional detail.	●	●		●	●	●	●	●	◐	◐	◐	◐
SL.K.6	Speak audibly and express thoughts, feelings, and ideas clearly.	●	●	●	●	●	●	●	●	●	●	●	●
SL.1.1	Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.	●	◐	◐	◐	●	●	◐	◐	◐	◐	◐	◐
SL.1.2	Ask and answer questions about key details in a text read aloud or information presented orally or through other media.												
SL.1.3	Ask and answer questions about what a speaker says in order to gather additional information or clarify something that is not understood.	●	●	●	●	●	●	●	●	●	●	●	●
SL.1.4	Describe people, places, things, and events with relevant details, expressing ideas and feelings clearly.												
SL.1.5	Add drawings or other visual displays to descriptions when appropriate to clarify ideas, thoughts, and feelings.	●	●		●	●	●	●	●	◐	◐	◐	◐
SL.1.6	Produce complete sentences when appropriate to task and situation. (See grade 1 Language standards 1 and 3 here for specific expectations.)												
SL.2.1	Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.	●		●	●	●	●	◐	◐	◐	◐	◐	◐
SL.2.2	Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.												
SL.2.3	Ask and answer questions about what a speaker says in order to clarify comprehension, gather additional information, or deepen understanding of a topic or issue.	●	●	●	●	●	●	●	●	●	●	●	●
SL.2.4	Tell a story or recount an experience with appropriate facts and relevant, descriptive details, speaking audibly in coherent sentences.	◐	●	●	◐	●	●	●	●	●	●	●	●
SL.2.5	Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings.												
SL.2.6	Produce complete sentences when appropriate to task and situation in order to provide requested detail or clarification. (See grade 2 Language standards 1 and 3 here for specific expectations.)												

1. Pinwheel

Science
- Energy
- Forces
- Friction
- Rotation

Design and Technology
- Assembling components
- Combining materials
- Evaluating
- Properties of materials

Vocabulary
- Area
- Friction
- Rotation
- Speeding up
- Wind force

Other Materials Required
- Cardstock
- Fan
- Paper
- Ruler
- Scissors

Connect

On their way home from school Sam and Sara passed a group of children running around playing with pinwheels. It looked like great fun and Sam and Sara would both really like one.
Once back home, Sam and Sara wanted to try out different ideas for the best wing design, for example big wide wings and small narrow wings.
Sara has built a beautiful pinwheel with tiny wings but no matter how much Sam blows it only turns slowly.

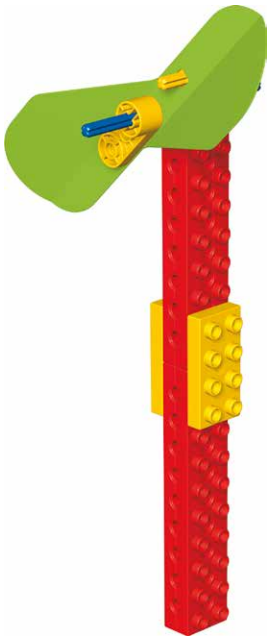
Can you help Sam and Sara build a pinwheel with wings that will turn faster?
Let's find out!

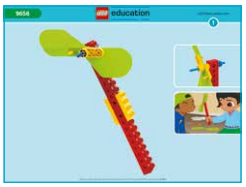
Construct

Build the pinwheel using building instructions no. 1

- The wings should be bent at the same angle
- The wings should spin freely
- If they don't turn, there is too much friction from the blue gear rubbing on the red beam. Try moving the wings forward slightly on the blue axle

Warning!
Fans are potentially dangerous. Make sure that students handle them with great care!





Contemplate

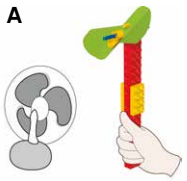
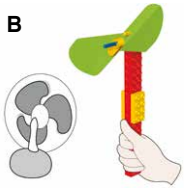
Near or far?

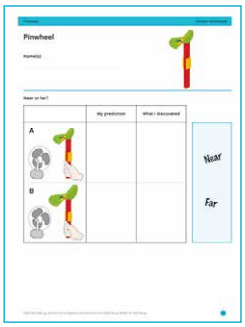
Point the pinwheel at the centre of the fan and begin moving it slowly towards the fan, but be careful to not get too close. Find out which of the pinwheel wings starts turning furthest from the fan.

First predict which of the pinwheels will only start turning near the fan and which will start turning far from the fan.
Write down your predictions using the words on the worksheet

Next, test how far from the fan the pinwheels will start turning.
Write down your findings using the words on the worksheet.

The force of the wind turns the pinwheel. The wind turns the wings, creating energy – just like a wind turbine or windmill.

	My Prediction	What I Discovered
A 		Near
B 		Far



Have the students reflect on their tests by asking questions such as:

- What did you predict would happen and why?
- Describe what happened.
- How did you make it into a fair test? *Was the pinwheel held at the same angle every time? Did you adjust/change the speed at which the fan blows? Were the wings bent at the same angle?*
- Describe how the model works.
- What do you believe to be important things to think about in making a good pinwheel? *Maybe the size of the wings or how many there are, or their shape – or perhaps the speed of the wind…*

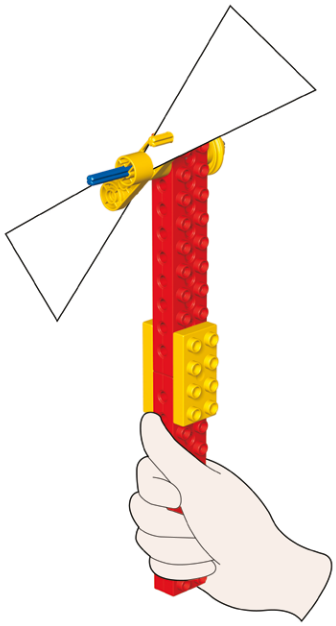
Tip:
Use a ruler to accurately measure the distance between the fan and the pinwheel.

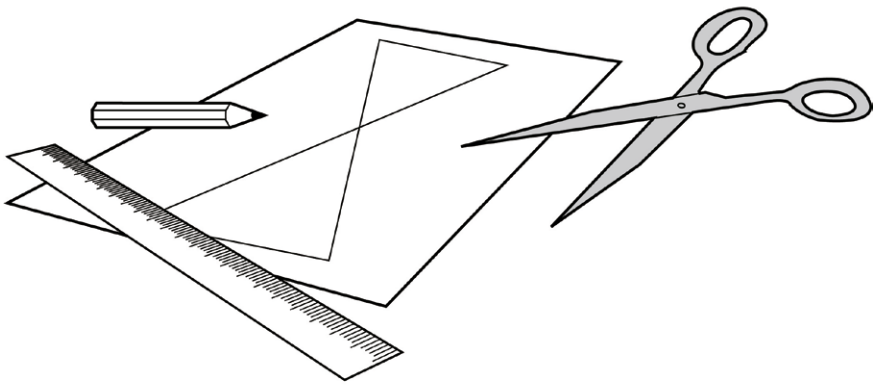
Continue

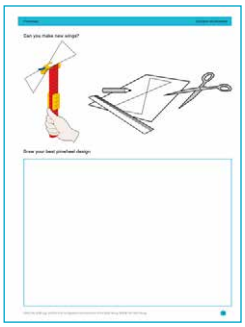
Can you make new wings for your pinwheel?

Give your imagination wings and design your very own pinwheel wings!

Design wings of different shapes and test how they work. Consider which materials would be best. Then make them beautiful and colourful. *On the worksheet, draw your best pinwheel design.*





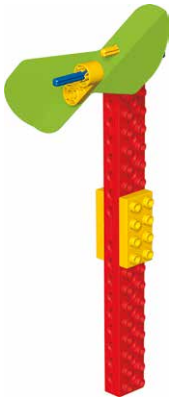


Pinwheel

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 pinwheel model with help or independently using the building instructions (1, 2, 3, 6)														
Use the model to demonstrate understanding of terms and make predictions about force and motion (1, 3, 5)														
Meet or exceed expectations in the design of the pinwheel based on directions of activity (E.g. Wings are bent at same angle. Wings spin freely) (2)														
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 pinwheel 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 simple to advanced questions based upon observations to make predictions (1, 3)														
Demonstrate ability to use fair testing of models and make adjustments based upon data (3, 4, 6)														
Communicate the meaning of the findings with others (E.g. orally, in drawing or writing) (4, 8)														
Follow a plan to define, carry out, test, evaluate and share a design task (2, 3, 4, 5, 6, 7, 8)														
Compare solutions with other groups and listen to the ideas of others (6, 7, 8)														
Optional Student Learning Targets														
Lesson Observational Notes:														

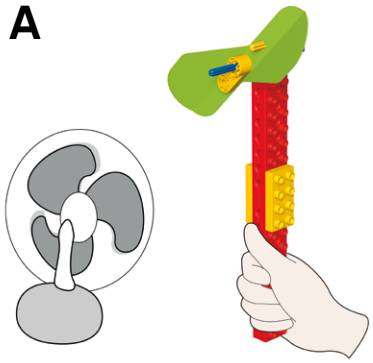
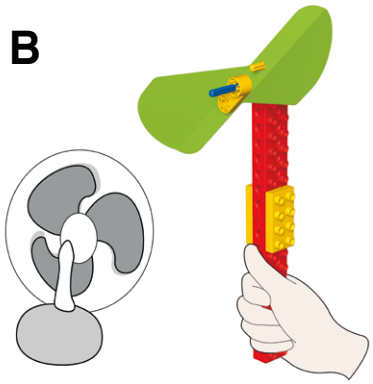
Pinwheel



Name(s): _____

_____

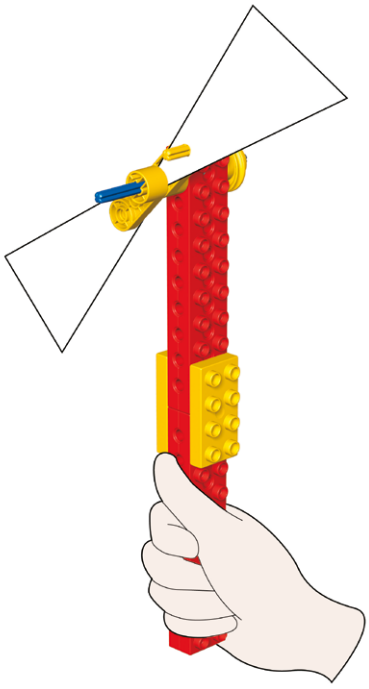
Near or far?

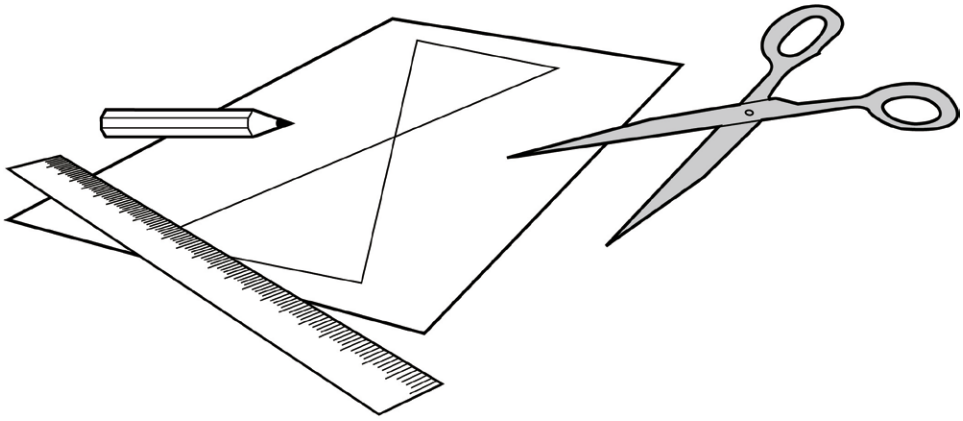
	My Prediction	What I Discovered
A 		
B 		

Near

Far

Can you make new wings?





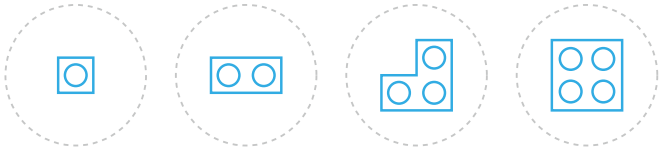
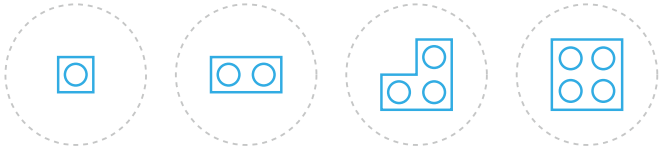
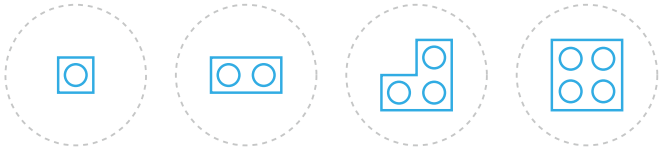
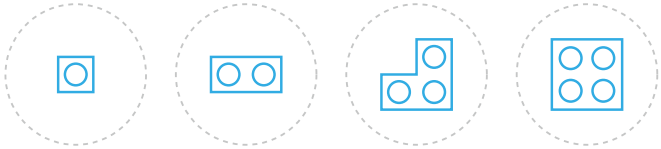
Draw your best pinwheel design:

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 knew what to do.	
I built a model.	
I made good predictions.	
I shared my ideas.	

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

Tell someone what you learned...

2. Spinning Tops

Science
- Energy
- Fair testing
- Measuring
- Movement

Design and Technology
- Combining materials
- Evaluating
- Game design
- Gears

Vocabulary
- Gearing up
- Speed
- Spin
- Stable
- Unstable

Other Materials Required
- Colored pencils or markers
- Paper
- Scissors
- Several square yards of smooth, flat floor space
- Timer or clock

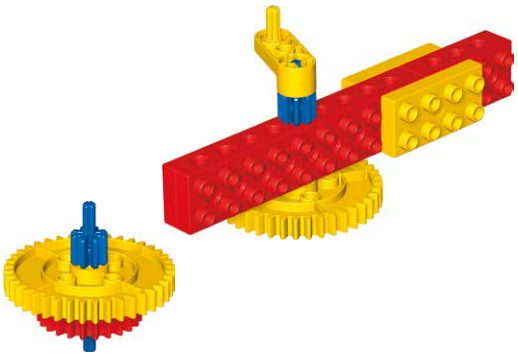
Connect

One day at the park Sam and Sara saw some other children playing with spinning tops. Their tops spun for a long time before falling over. Great fun! Sam and Sara thought about how to make some tops themselves and in no time they were spinning their own tops. But their tops didn't spin for long and soon their fingers started to hurt from all the spinning. They needed a device that could make the spinning tops spin faster and better!

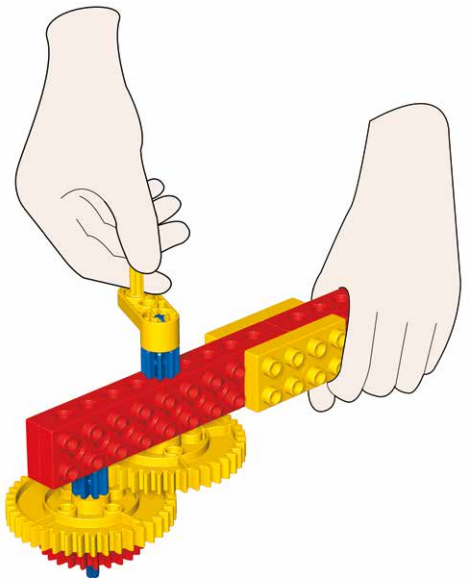
Can you help Sam and Sara build a device that can make the spinning tops spin? Let's find out!

Construct

Build the launcher and the spinning top using building instructions no. 2

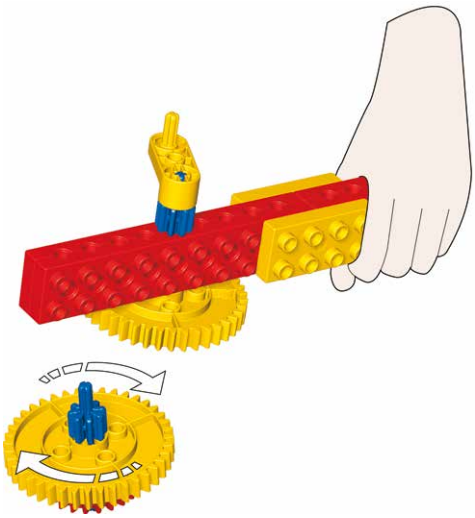


- Hold the launcher and place the gear end of the launcher over the blue gear axle
- The blue gear should mesh with the big yellow gear and spin as you turn the handle



Tip:
Launching tops requires good coordination skills! Try it yourself.

- To launch the top, turn the handle and lift the launcher straight upwards



Idea:
It may be a good idea to let younger students play with the top and launcher before embarking on serious testing.

Contemplate

Long or longer?

The top can work in two ways. The yellow gear of the launcher can mesh with both the blue and the red gears of the top. Find out which top will spin longest.

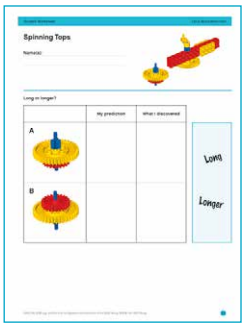
First predict which top will spin for a long time and which top will spin even longer.
Write down your predictions using the words on the worksheet.

Next, test how long the tops will spin first using the blue 8-tooth gear and then the red 24-tooth gear.
Write down your findings using the words on the worksheet.

	My Prediction	What I Discovered
A 		Long
B 		Longer

Have the students reflect on their tests by asking questions such as:

- What did you predict would happen and why?
- Describe what happened.
- Was this a fair test?
  Did you turn the handle in tests A and B at the same speed? Did you test all the tops on the same surface?
- Describe how the model works.



Tip:
To accurately time how long the tops spin, use a standard measuring timer.

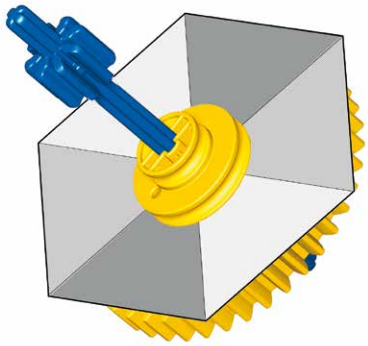
Did you know?
The blue gear has 8 teeth, the red has 24 teeth and the yellow gear has 40 teeth!

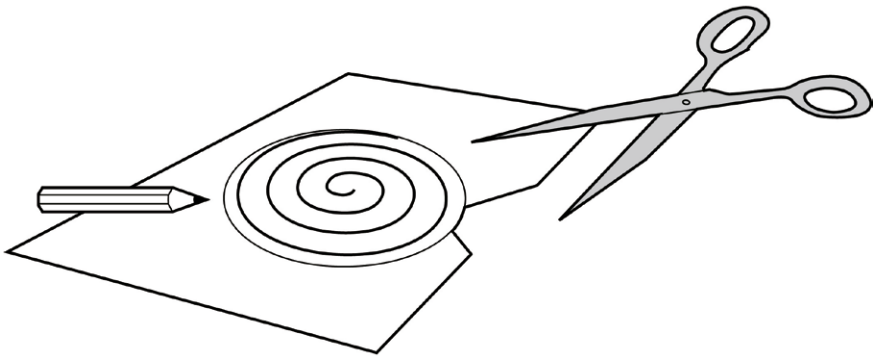
Continue

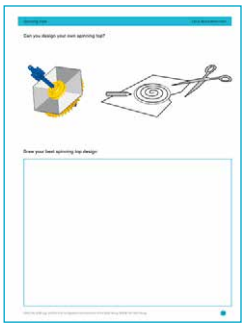
Can you design your own spinning top?

Design and make your own spinning tops.

Consider which materials and shapes would be best.
Create amazing optical effects and tops for all sorts of games.
On the worksheet, draw your best spinning top design.







Spinning Tops

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 Spinning Tops model with help or independently using the Building Instruction (1, 2, 3, 6)														
Use the model to demonstrate understanding of terms and make predictions about cause and effect (1, 3, 5)														
Meet or exceed expectations in the design of the Spinning Tops based on directions of activity (E.g. Handle must turn, Wheel must spin away from the handle, Gears must mesh) (2)														
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 Spinning Tops worksheets to record and analyze data collected from the model investigation (3, 4, 5)														
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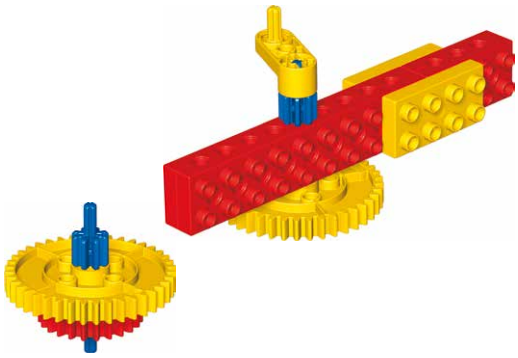
Optional Student Learning Targets														
Lesson Observational Notes:														

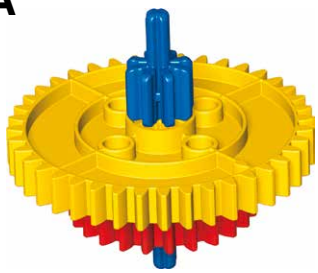
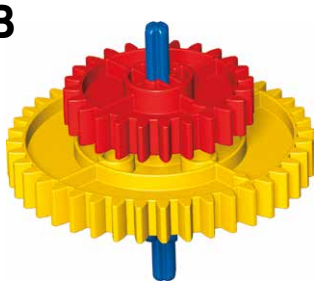
Spinning Tops



Name(s): _____

_____

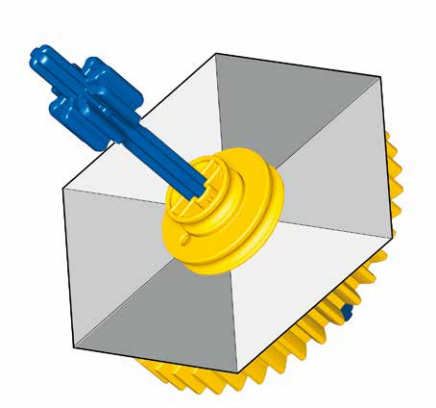
Long or longer?

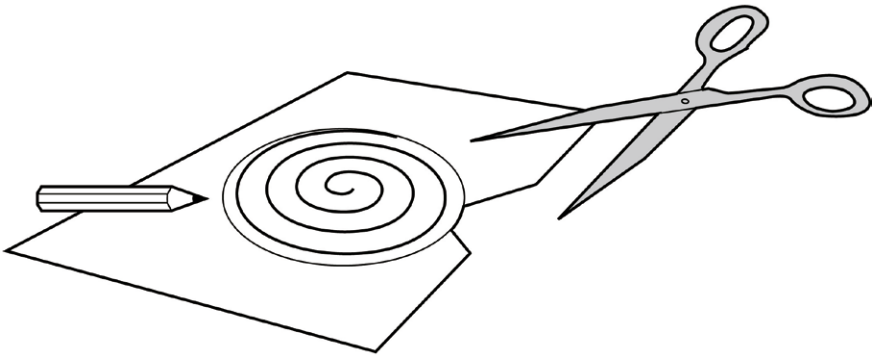
	My Prediction	What I Discovered
A 		
B 		

Long

Longer

Can you design your own spinning top?





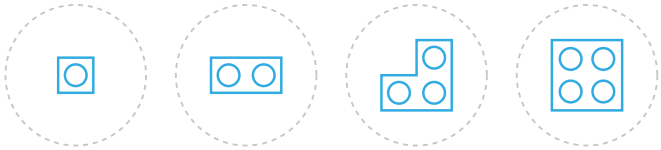
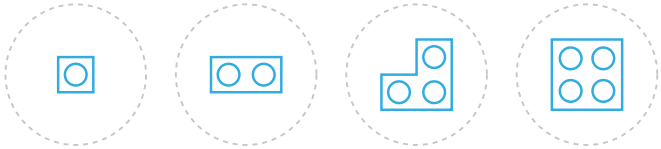
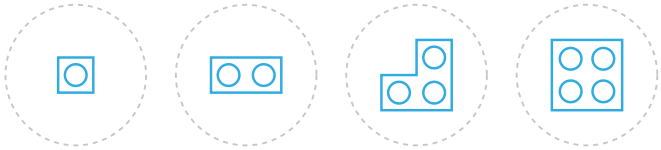
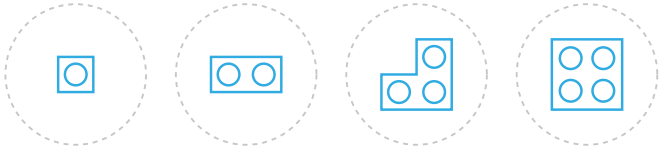
Draw your best spinning top design:

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 knew what to do.	
I built a model.	
I made good predictions.	
I shared my ideas.	

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

Tell someone what you learned...

3. Seesaw

Science
- Balancing forces
- Energy
- Levers
- Non-standard measuring
- Pivots

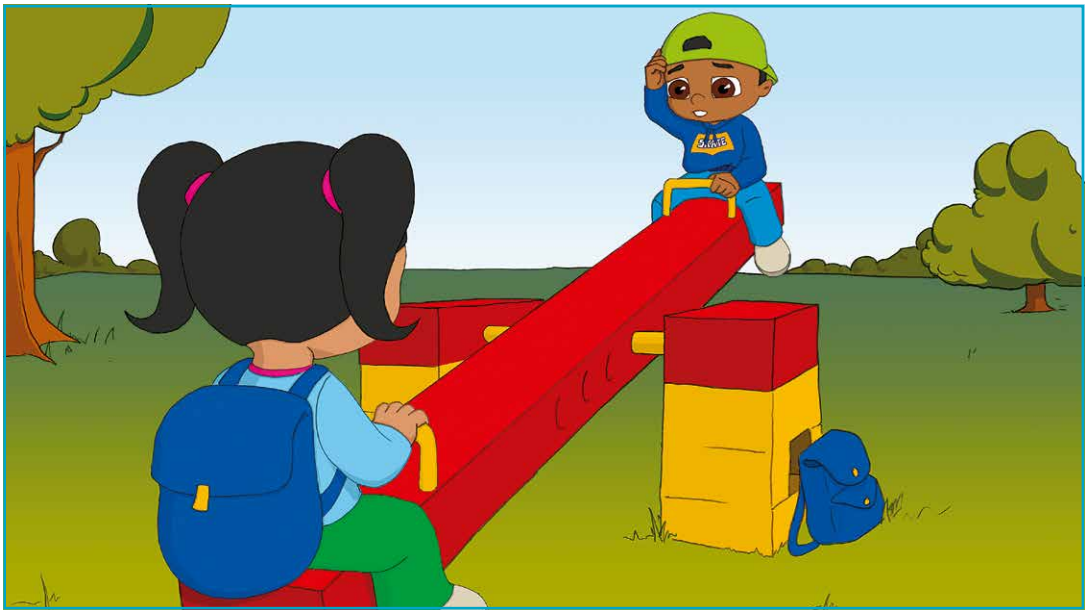
Design and Technology
- Assembling components
- Evaluating
- Game design

Vocabulary
- Balance
- Mass
- Position
- Weight

Connect

On their way home from school Sam and Sara stopped at the playground. Sam and Sara jumped onto the seesaw only to find out that something was different that day. There wasn't any going up and down. Sara was down and Sam was up. No matter how hard Sara pushed away from he ground she couldn't get herself up and Sam down, and they both wondered what was so different today from any other day.

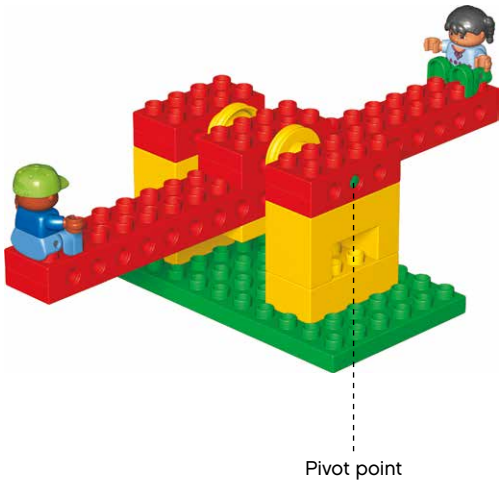
Can you help Sam and Sara build a seesaw that will balance?
Let's find out!

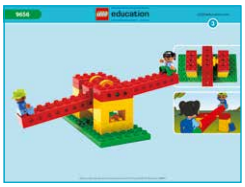


Construct

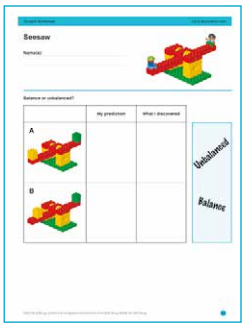
Build the seesaw using building instructions no. 3

- Be sure that it balances and moves up and down smoothly
- If it does not balance, check that the pivot position is correct
- If it does not move smoothly, check that the yellow pulley wheels are not rubbing against the fixed red bricks





Contemplate



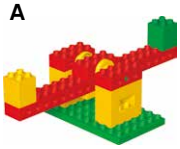
Balance or unbalanced?

When you add weight (2x2 bricks) to the seesaw it will either balance or tip to one of the two sides. Find out which seesaw will balance and which will be unbalanced.

First predict which seesaw will balance and which will be unbalanced.
Write down your predictions using the words on the worksheet.

Next, test the different brick positions.
Write down your findings using the words on the worksheet.

Balancing the seesaw depends on the size of the weight (mass) at each end and the distance of the weight from the pivot point.

	My Prediction	What I Discovered
A 		Balance
B 		Unbalanced

Have the students reflect on their tests by asking questions such as:

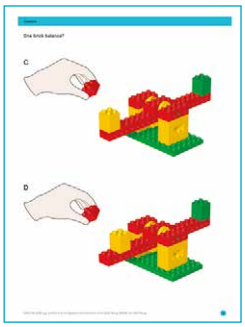
- What did you predict would happen and why?
- Describe what happened.
- Was this a fair test?
- Describe how the model works.

Continue

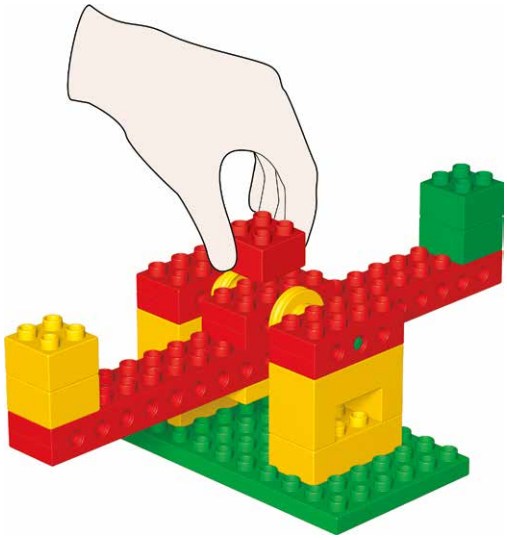
One brick balance?

First try to predict where to place the brick to make the seesaw balance.

Next, test to see if what happens is what you have predicted.
On the worksheet, draw where to put the brick that will make the seesaw balance.



C



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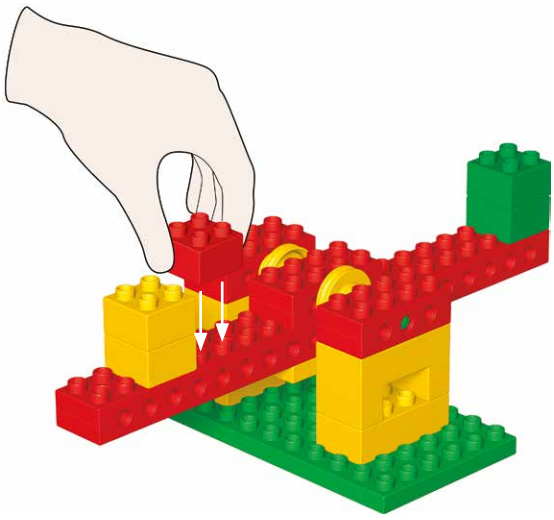

Seesaw

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 seesaw model with help or independently using the Building Instruction (1, 2, 3, 6)														
Use the model to demonstrate understanding of terms and make predictions about cause and effect on balanced and unbalanced forces (1, 3, 4, 5)														
Meet or exceed expectations in the design of the seesaw based on directions of activity (E.g. Ability to balance, Has a functional pivot and a working pulley) (2)														
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 seesaw worksheets to record and analyze data collected from the model investigation (3, 4, 5)														
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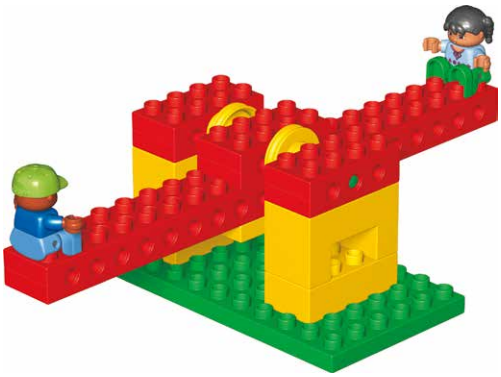
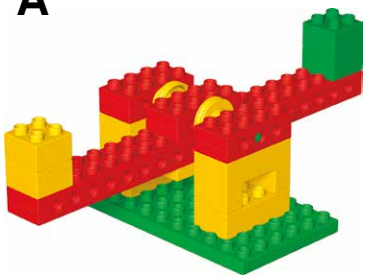
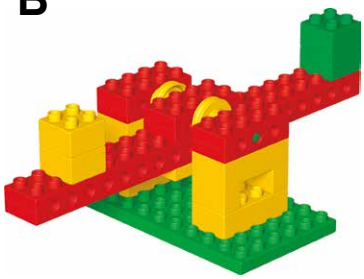
Seesaw



Name(s): _____

_____

Balance or unbalanced?

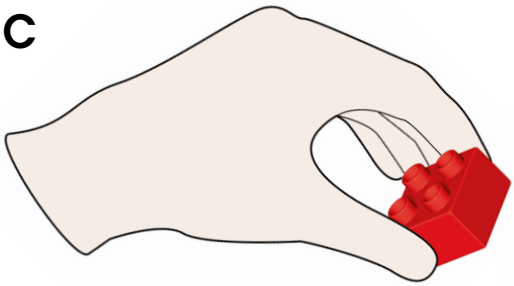
	My Prediction	What I Discovered
A 		
B 		

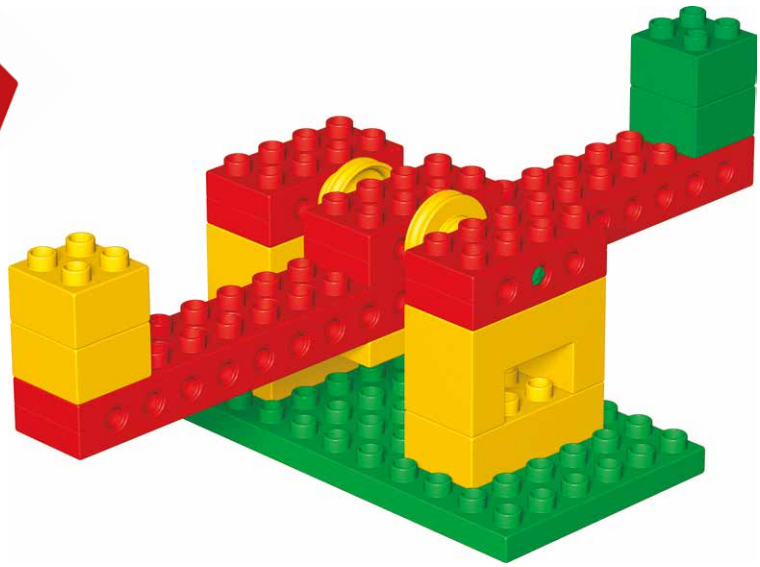
Unbalanced

Balance

One brick balance?

C





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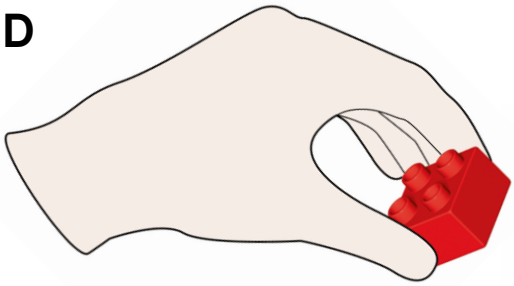
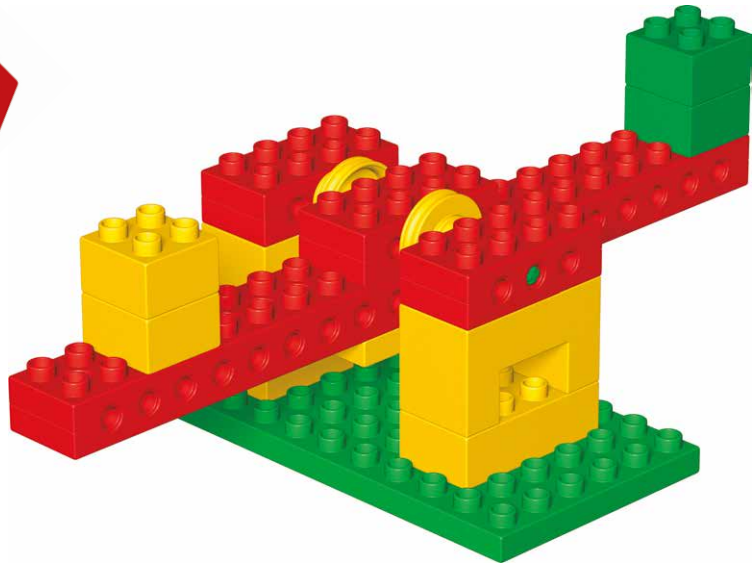


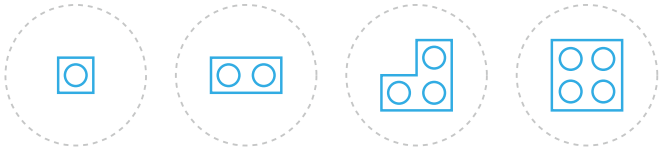
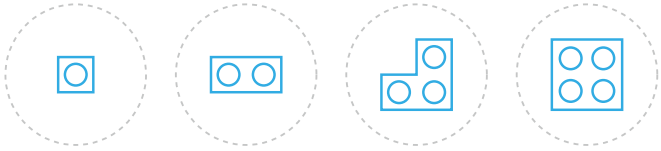
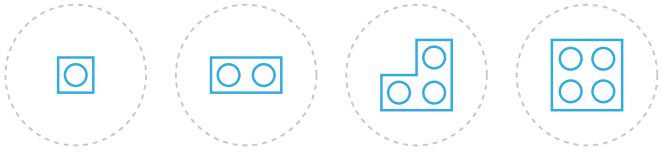
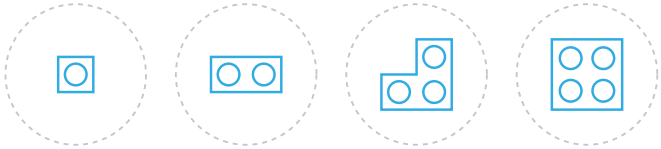


Activity Name: _____

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 knew what to do.	
I built a model.	
I made good predictions.	
I shared my ideas.	

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

Tell someone what you learned...

4. Raft

Science
- Balance
- Buoyancy
- Pushes and pulls
- Wind energy

Design and Technology
- Assembling components
- Combining materials
- Evaluating
- Properties of materials

Vocabulary
- Area
- Float
- Force
- Load
- Sail
- Sink
- Stable
- Unstable

Other Materials Required
- Large tub
- Ruler
- Timer or clock
- Towels to dry the wet bricks

Connect

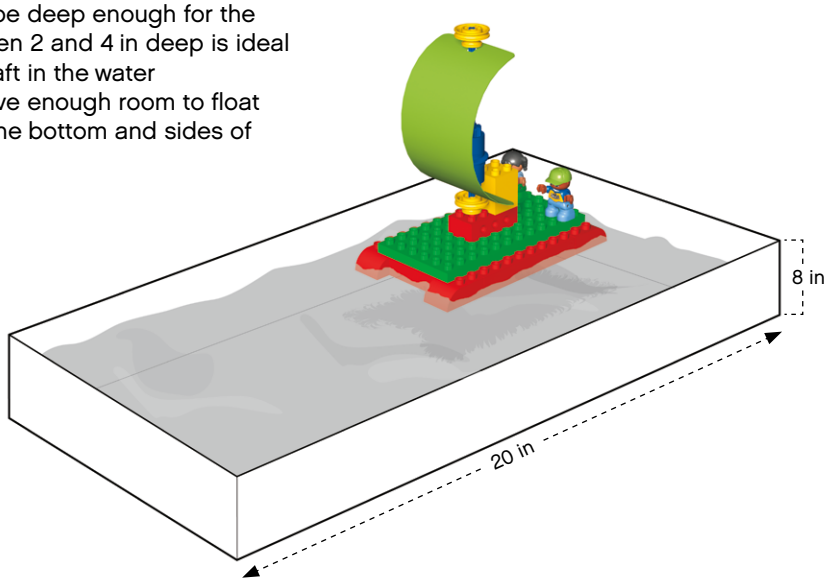
Captains Sam and Sara are dangerous pirates on their way to Treasure Island.
They are going to bury all their precious treasure of silver and gold.
They must hurry so nobody sees them since they wouldn't want anyone to steal their loot.
But Captains Sam and Sara and their infamous raft aren't going very fast. Sam blows hard on the sail to make the raft go faster. Sara says they will need to hurry if they are not to be seen.

Can you help Sam and Sara make their raft sail faster?
Let's find out!

Construct

Build the raft using building instructions no. 4

- Fill the tub
- The tub should be a minimum of 20 in long
- The water should be deep enough for the raft to float. Between 2 and 4 in deep is ideal
- Gently place the raft in the water
- The raft should have enough room to float without bumping the bottom and sides of the tub



Contemplate

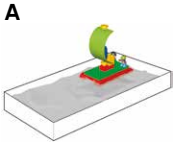
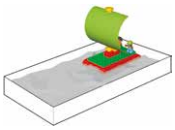
Fast or faster?

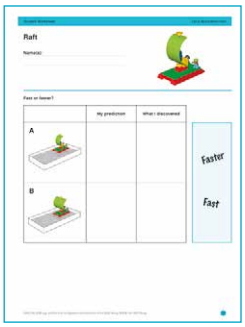
Blow or wave the box lid as a 'breeze maker.' Find out which sail will make your raft sail faster.

First predict which of the rafts will sail fast and which will sail faster.
Write down your predictions using the words on the worksheet.

Next, test the raft with the small sail and then with the big sail.
Write down your findings using the words on the worksheet.

The large sail has more area to catch the force of the wind. The wind pushes the sail, thereby pushing the raft forward.

	My Prediction	What I Discovered
A 		Fast
B 		Faster



Have the students reflect on their tests by asking questions such as:

- What did you predict would happen and why?
- Describe what happened.
- How did you make sure your tests were fair? *Did you blow or wave at the same speed? Did you blow or wave from the same position?*
- Describe how the model works.
- If you could improve three things about your raft, what would you do and why?

Tip:
When making changes to the raft, it is a good idea to dry it with a towel first. Water collected on the raft can influence its buoyancy.

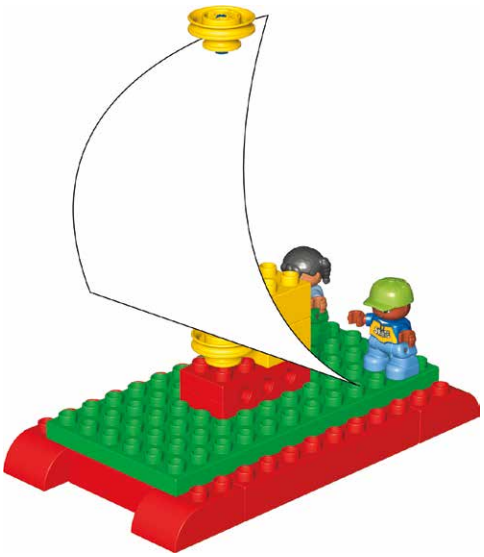
Did you know?
The air trapped under the LEGO® DUPLO® bricks makes them float (buoyant).
If all the air leaks out, the raft will sink.

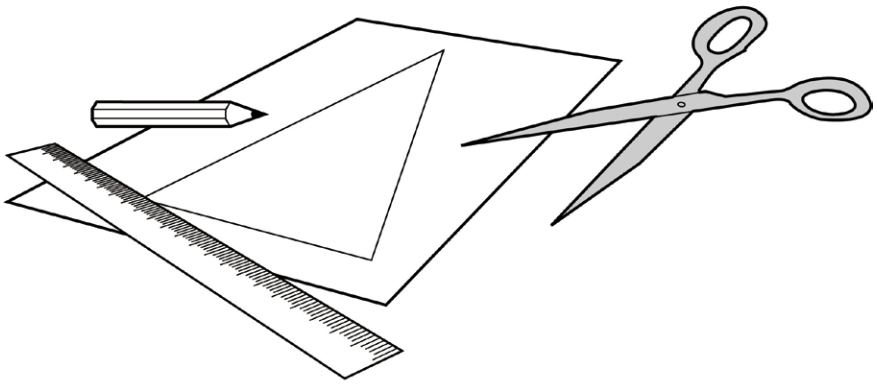
Continue

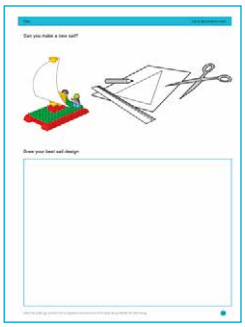
Can you design and make a new sail?

Use your imagination to design your very own raft sail.

Design sails of different shapes and test how they work. Consider which materials would be best. Then make them beautiful and colourful. *On the worksheet, draw your best sail design.*







Optional: Build Your Own Raft
Can you build a raft that will carry lots of silver and gold – without sinking?

Raft

Class: _____ **Date:** _____

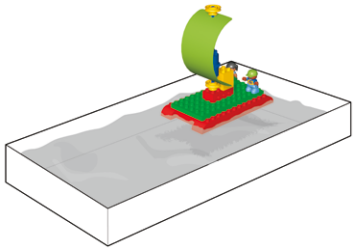
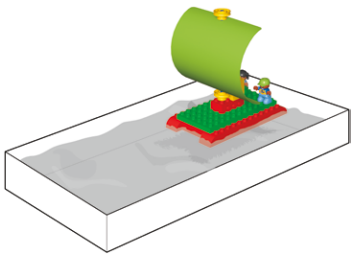
Performance and Learning Targets Linked to the Activity and the Eight Next Generation Science Practices Observe the suggested student behaviors while working with the activity. Either use the suggested Emerging (E), Developing (D), Proficient (P), Accomplished (A) proficiency level descriptions or use one relevant to your context.	**Name(s):**													
Student Performance Targets Linked to the Activity To what degree can the student…?														
Adequately build the raft model with help or independently using the Building Instruction (1, 2, 3, 6)														
Use the model to demonstrate understanding of terms and make predictions about speed and stability (1, 3, 4, 5)														
Meet or exceed expectations in the design of the raft based on directions of activity (E.g. Must have a sail, Fill tub adequately with water, Create stable base) (2)														
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 raft 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 simple to advanced questions based upon observations to make predictions (1, 3)														
Demonstrate ability to use fair testing of models and make adjustments based upon data (3, 4, 6)														
Communicate the meaning of the findings with others (E.g. orally, in drawing or writing) (4, 8)														
Follow a plan to define, carry out, test, evaluate and share a design task (2, 3, 4, 5, 6, 7, 8)														
Compare solutions with other groups and listen to the ideas of others (6, 7, 8)														
Optional Student Learning Targets														
Lesson Observational Notes:														

Raft

Name(s): _____

_____

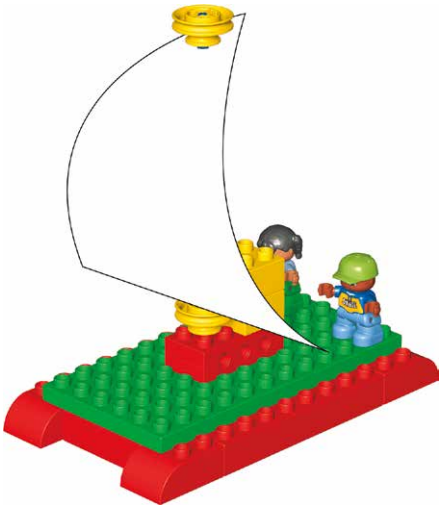
Fast or faster?

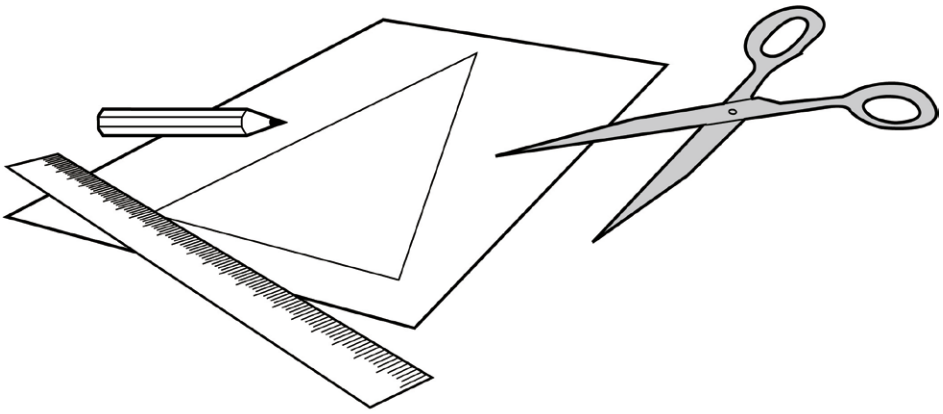
	My Prediction	What I Discovered
A 		
B 		

Faster

Fast

Can you make a new sail?





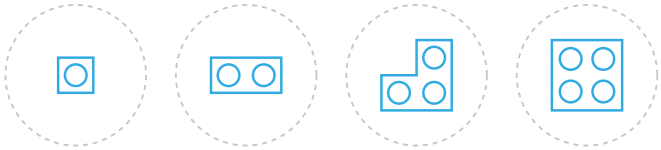
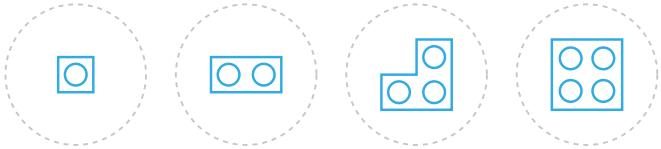
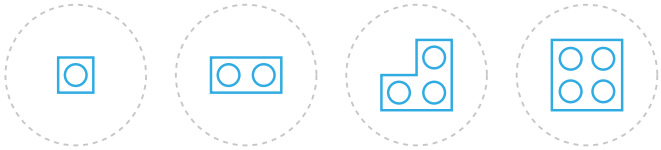
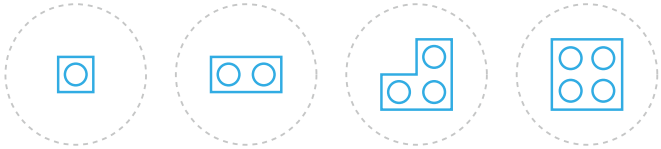
Draw your best sail design:

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 knew what to do.	
I built a model.	
I made good predictions.	
I shared my ideas.	

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

Tell someone what you learned...

5. Car Launcher

Science
- Energy
- Friction
- Measuring distance
- Push and pull
- Wheels

Design and Technology
- Assembling components
- Evaluating
- Using mechanisms

Vocabulary
- Angle
- Axles
- Force
- Friction
- Ramp
- Tires
- Wheels

Other Materials Required
- Boxes or books
- Cardstock
- Plank or wooden shelf – 60 in or more
- Ruler
- Sticky tape

Connect

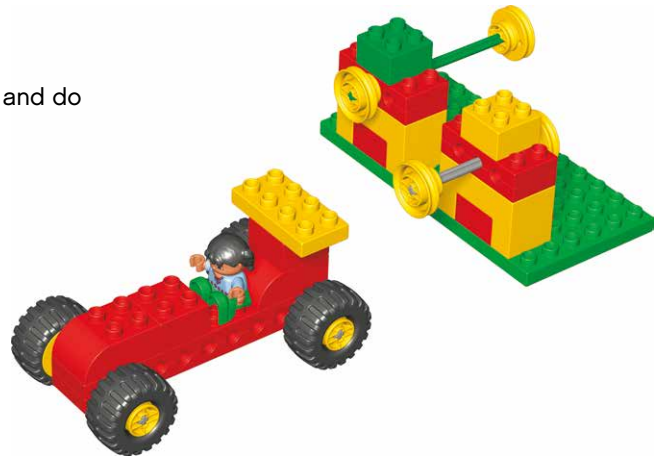
Sam and Sara are having a fantastic time racing down the hill with their super fast car. The steep hill behind their house makes a great ramp and it is a lot of fun racing down the hill and feeling the excitement in their tummies.
Once the car has stopped, it's hard work pushing the car back up to the top again. Sara believes there must be an easier way of getting the car up the hill than all this hard pushing. Sam would like it if he could just launch Sara and the car up the hill. That would be super!

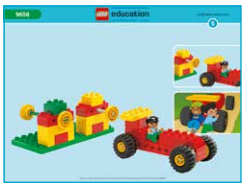
Can you help Sam and Sara build a launcher that can launch the car back up the hill? Let's find out!

Construct

Build the car and launcher using building instructions no. 5

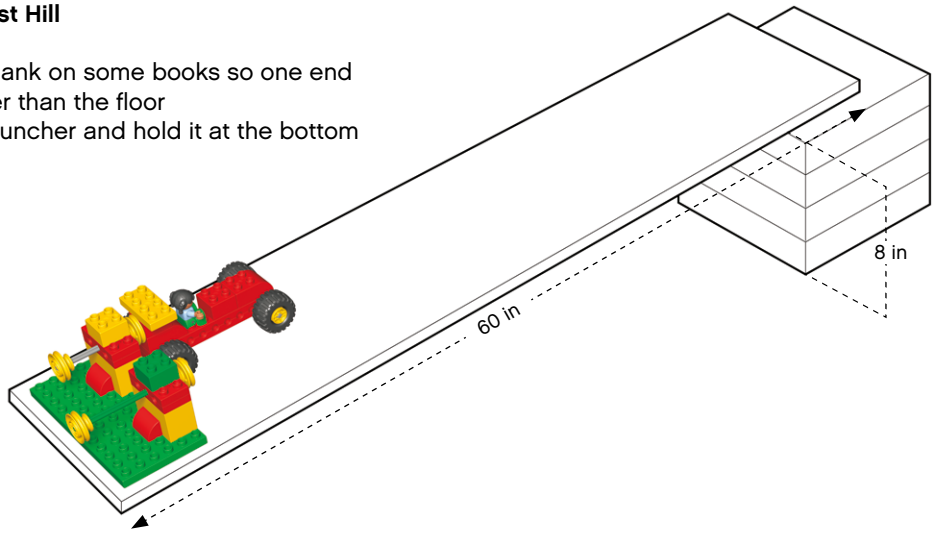
- Make sure the wheels spin smoothly and do not rub on the sides of the car





Make Your Test Hill

- Place the plank on some books so one end is 8 in higher than the floor
- Place the launcher and hold it at the bottom of the ramp



Idea:
You could use sticky tape to hold the launcher in place

Contemplate

Far or further?

Using the two launchers you will be able to send the car back up the ramp.
Find out which will send the car further.

First predict which of the launchers will send the car far up the ramp and which will send the car further up the ramp?
Write down your predictions using the words on the worksheet.

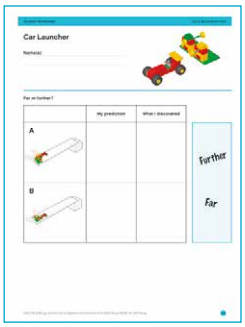
Next, test how far you can launch the car using first the small and then the big launcher.
Write down your findings using the words on the worksheet.

The longer axle of the big launcher means more time to get speed and energy into the launch. More energy means more distance.

	My Prediction	What I Discovered
A 		Far
B 		Further

Have the students reflect on their tests by asking questions such as:

- What did you predict would happen and why?
- Describe what happened.
- How did you make sure your tests were fair? *Were your pushes equal in force? Did you launch from the same spot every time?*
- Describe how the model works.



Tip:
Use a ruler for standard measuring of the distance the car travels.

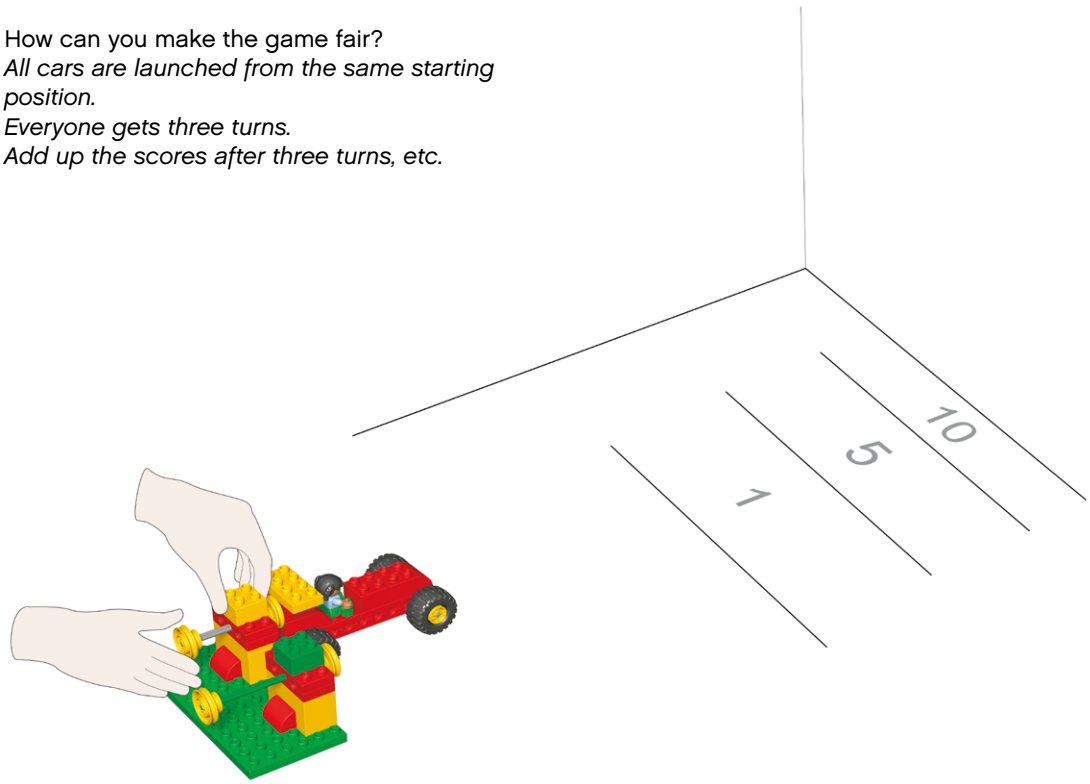
Continue

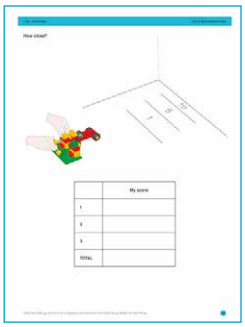
How close?

Make a game to see who can launch their cars closest to a wall without the cars actually hitting the wall.

The closer to the wall your car stops the more points you get!
Note your scores on the worksheet.

How can you make the game fair?
All cars are launched from the same starting position.
Everyone gets three turns.
Add up the scores after three turns, etc.



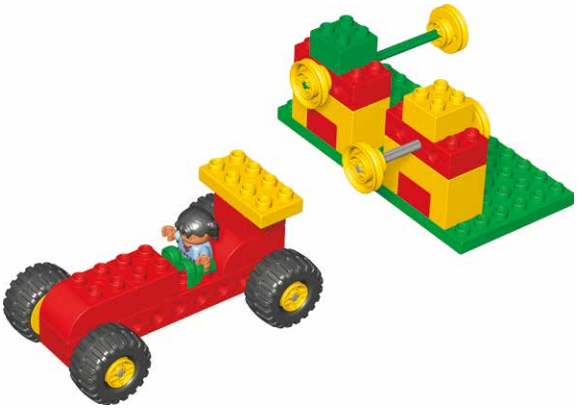


Car Launcher

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 car launcher model with help or independently using the Building Instruction (1, 2, 3, 6)														
Use the model to demonstrate understanding of terms and make predictions about pushes and pulls (1, 3, 4, 5)														
Meet or exceed expectations in the design of the car launcher based on directions of activity (E.g. Wheels spin smoothly) (2)														
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 car launcher 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 simple to advanced questions based upon observations to make predictions (1, 3)														
Demonstrate ability to use fair testing of models and make adjustments based upon data (3, 4, 6)														
Communicate the meaning of the findings with others (E.g. orally, in drawing or writing) (4, 8)														
Follow a plan to define, carry out, test, evaluate and share a design task (2, 3, 4, 5, 6, 7, 8)														
Compare solutions with other groups and listen to the ideas of others (6, 7, 8)														
Optional Student Learning Targets														
Lesson Observational Notes:														

Car Launcher



Name(s): _____

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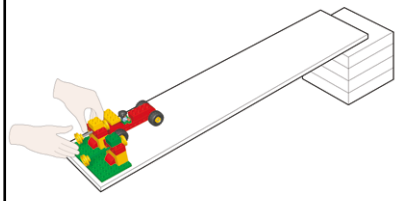
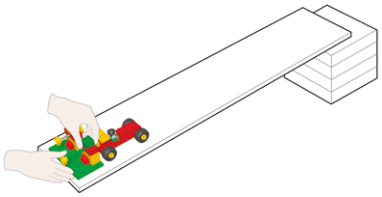
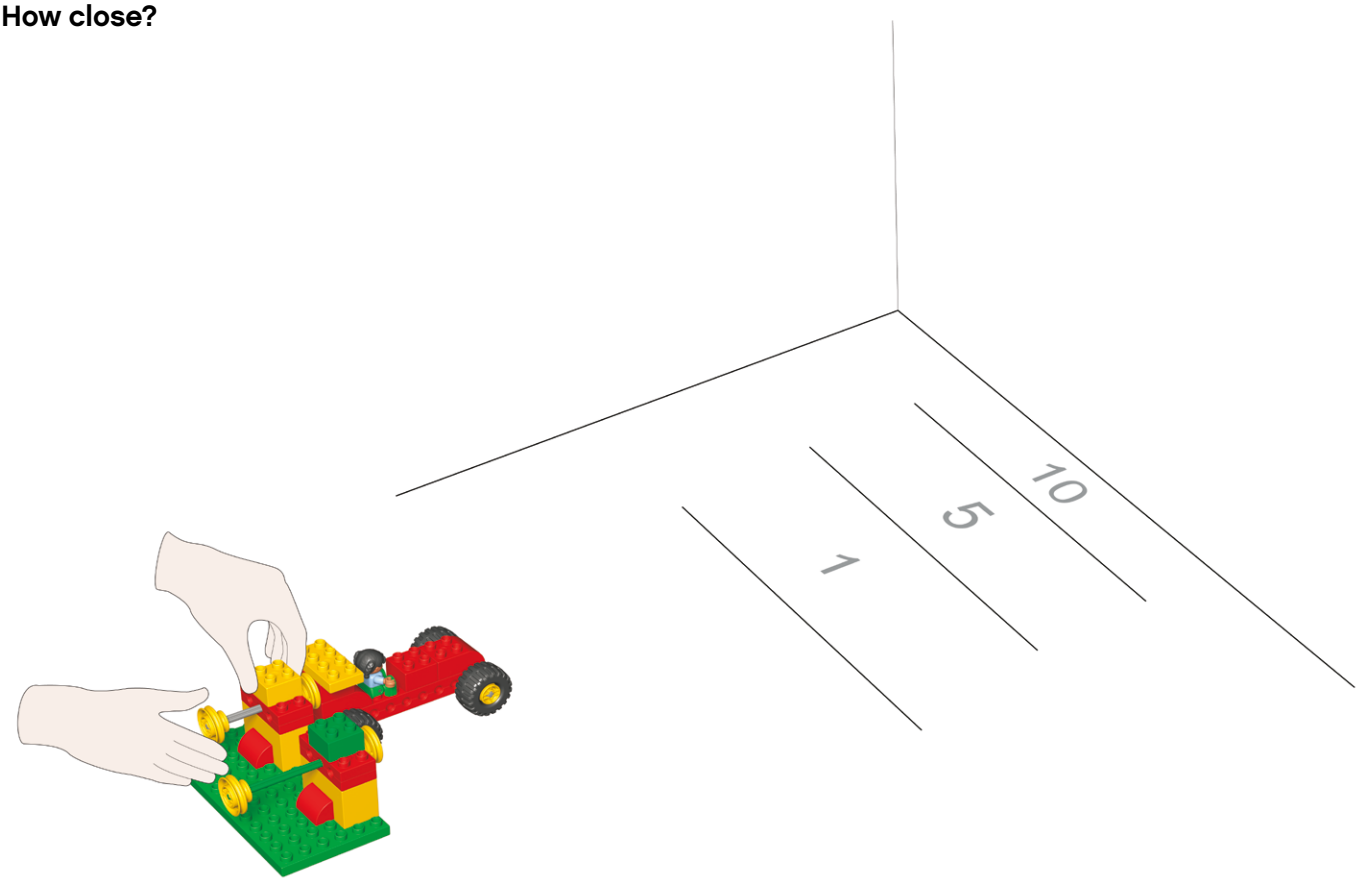
Far or further?

	My Prediction	What I Discovered
A 		
B 		

Further

Far

How close?



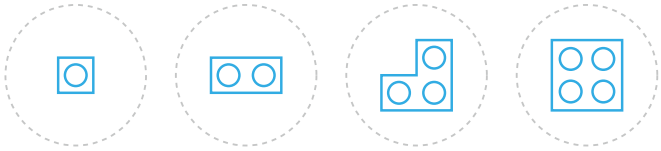
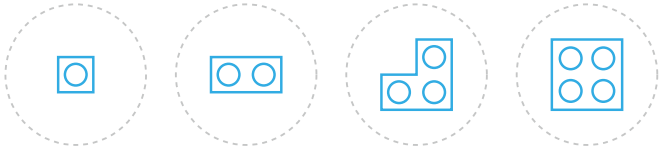
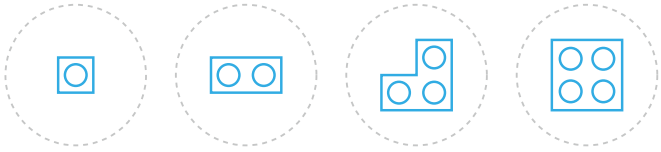
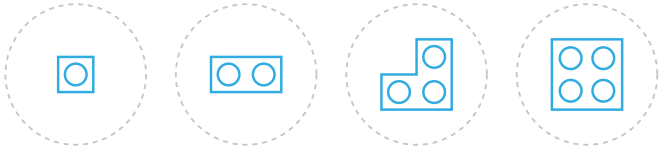
	My Score
1	
2	
3	
TOTAL	

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 knew what to do.	
I built a model.	
I made good predictions.	
I shared my ideas.	

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

Tell someone what you learned...

6. Measuring Car

Science
- Energy
- Forces
- Friction
- Standard and non-standard measuring

Design and Technology
- Assembling components
- Evaluating
- Using mechanisms

Vocabulary
- Accuracy
- Angle
- Distance
- Friction
- Mass
- Ramp

Other Materials Required
- Boxes or books
- Paper or cardstock
- Plank or wooden shelf – 60 in or more
- Ruler

Connect

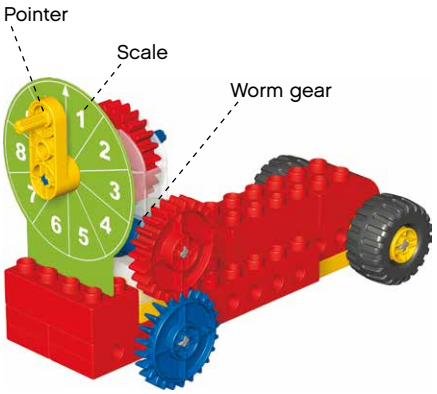
After a day of measuring at school, Sam and Sara have tried to measure almost everything on their way home. When they get to their favorite play area, Sam wonders how far it is from the tree house to the ice-cream shop.
Sam says that it doesn't look that far from where he's standing. Sam pulls out a measuring tape and wants to start measuring, but Sara thinks there could be a much better way of measuring distance.

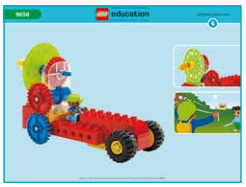
Can you help Sam and Sara build a car that measures how far it travels?
Let's find out!

Construct

Build the measuring car using building instructions no. 6

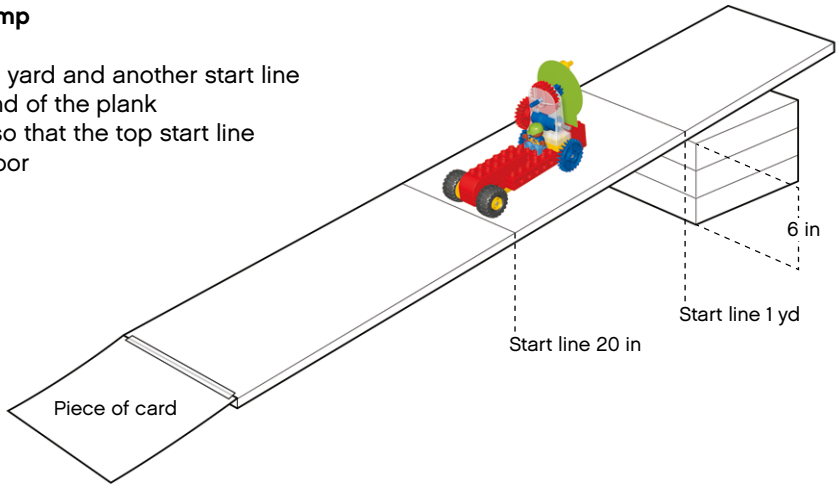
- The wheels should turn freely and not rub on the sides of the car
- When the blue gear wheels turn, the pointer should also move
- The pointer should not rub on the scale





Make Your Test Ramp

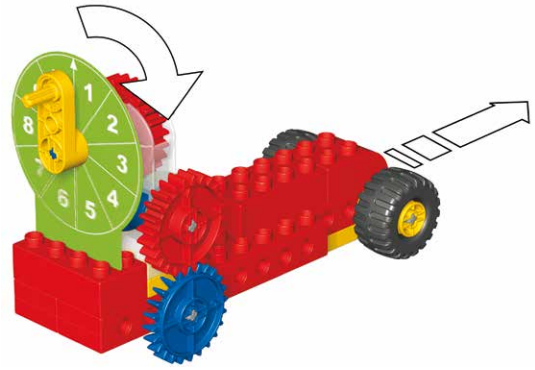
- Draw a start line 1 yard and another start line 20 in from one end of the plank
- Place a support so that the top start line is 6 in from the floor



Idea:
If the thickness of the plank means that the measuring car bumps down onto the floor, use a piece of paper or card and sticky tape to make a smooth transition from plank to floor.

Using the Scale

- The scale is divided into 10 units and can be used for non-standard measurement
- Push the measuring car forward
- Notice that as the measuring car moves forward the pointer turns
- The pointer will point to the scale and give you a reading of the distance (units) the measuring car has traveled forward



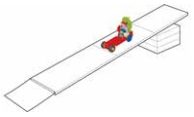
Contemplate

How far?

By using the scale you can measure the distance the measuring car travels. Find out how far the measuring car will travel when rolling down from the two different start lines.

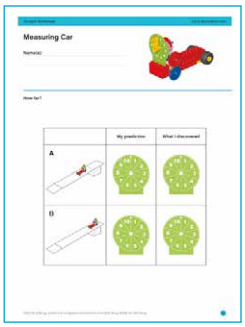
First predict how far the measuring car will roll down from the two start lines.
Mark your predictions using the scale and numbers on the worksheet.

Next, test how far the measuring car actually rolls down from the two start lines by reading the scale.
Mark your findings using the scale and numbers on the worksheet.

	My Prediction	What I Discovered
A 		
B 		

Have the students reflect on their tests by asking questions such as:

- What did you predict would happen and why?
- Describe what happened.
- How did you make sure your tests were fair? *Did you always start at the same spot? Did you push the measuring car as it started going down the ramp? Was the pointer reset after each test?*
- Describe how the model works.

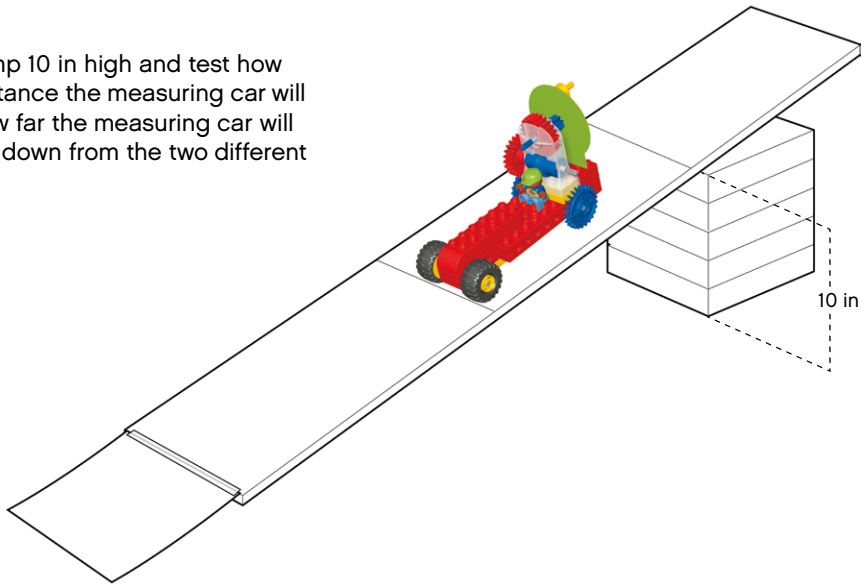


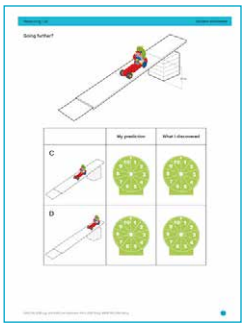
Tip:
Remember to reset the pointer to zero after every test by turning the blue gear wheels until the pointer is at the top of the scale.

Continue

Going further?

Make your test ramp 10 in high and test how this affects the distance the measuring car will travel. Find out how far the measuring car will travel when rolling down from the two different start lines.





First predict how far the measuring car will roll down from the two start lines.
Mark your predictions using the scale and numbers on the worksheet.

Next, test how far the measuring car actually rolls down from the two start lines by reading the scale.
Mark your findings using the scale and numbers on the worksheet.

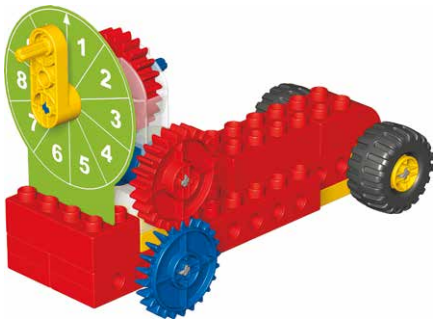
	My Prediction	What I Discovered
C		
D		

Measuring Car

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 measuring car model with help or independently using the Building Instruction (1, 2, 3, 6)														
Use the model to demonstrate understanding of terms and make predictions about force and motion as it relates to distance (1, 3, 4, 5)														
Meet or exceed expectations in the design of the measuring car based on directions of activity (E.g. Wheels turn freely, Blue gear turns pointer, Pointer does not rub scale) (2)														
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 measuring car 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 simple to advanced questions based upon observations to make predictions (1, 3)														
Demonstrate ability to use fair testing of models and make adjustments based upon data (3, 4, 6)														
Communicate the meaning of the findings with others (E.g. orally, in drawing or writing) (4, 8)														
Follow a plan to define, carry out, test, evaluate and share a design task (2, 3, 4, 5, 6, 7, 8)														
Compare solutions with other groups and listen to the ideas of others (6, 7, 8)														
Optional Student Learning Targets														
Lesson Observational Notes:														

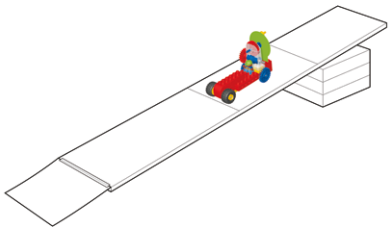
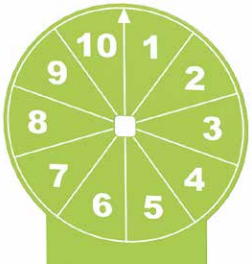
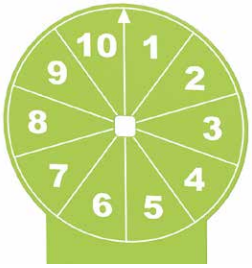
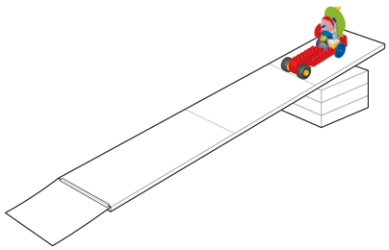
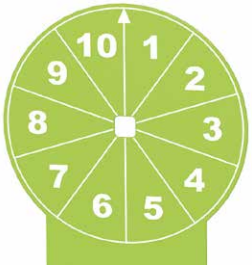
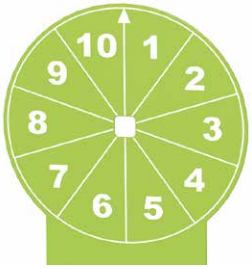
Measuring Car



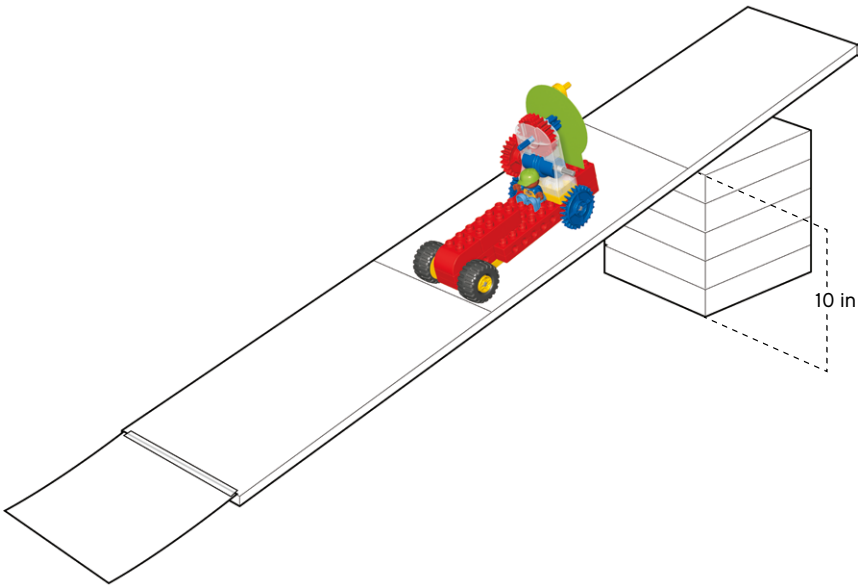
Name(s): _____

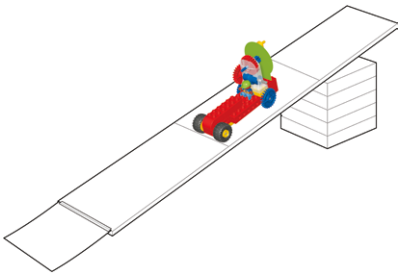
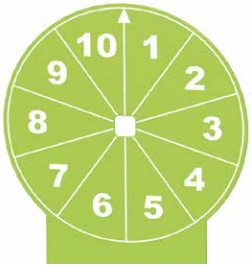
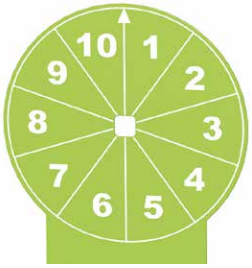
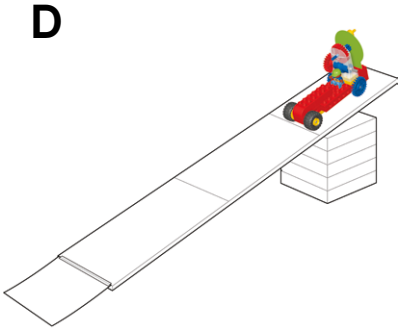
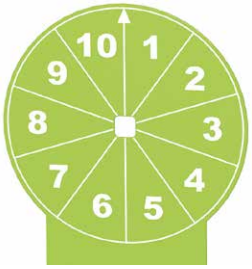
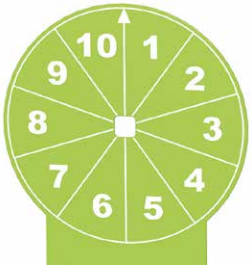
_____

How far?

	My Prediction	What I Discovered
A 		
B 		

Going further?



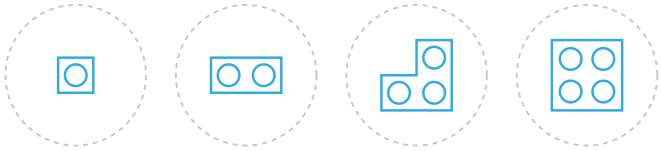
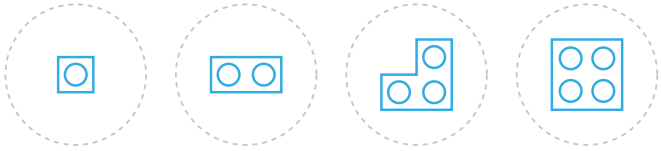
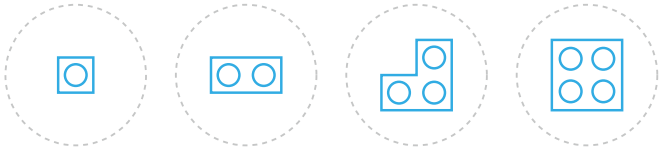
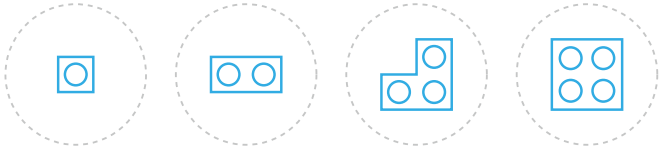
	My Prediction	What I Discovered
C 		
D 		

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 knew what to do.	
I built a model.	
I made good predictions.	
I shared my ideas.	

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

Tell someone what you learned...

7. Ice Hockey Player

Science
- Energy
- Force
- Motion
- Standard and non-standard measuring

Design and Technology
- Assemble components
- Game design
- Evaluating

Vocabulary
- Angle
- Distance
- Efficiency

Other Materials Required
- Minimum 2 yards of smooth floor
- Ruler

Connect

Sam is a great ice hockey goalkeeper and Sara is fantastic in attack. They have arranged an ice hockey match against the school's best ice hockey team. Sara believes their biggest problem is making the difficult long shots. To become unbeatable Sara says that all they need is a big third team member to stand in the middle of the field and do good long shots. Sam thinks that's the best idea ever!

Can you help Sam and Sara build a third team member that is good at long shots?
Let's find out!

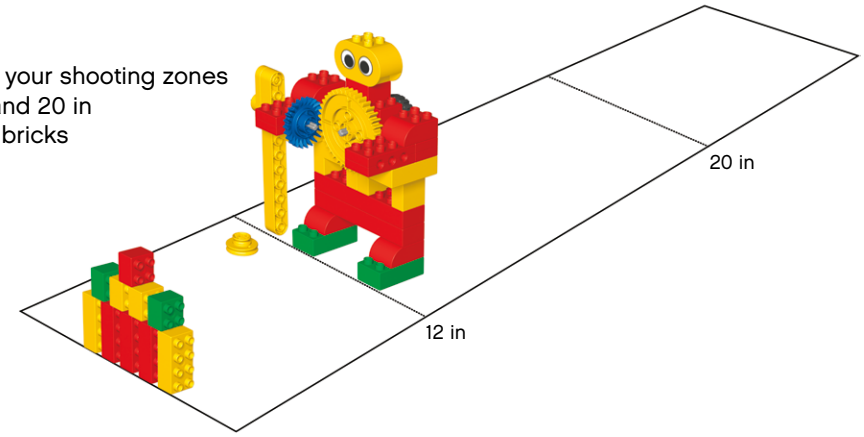
Construct

Build the ice hockey player using building instructions no. 7

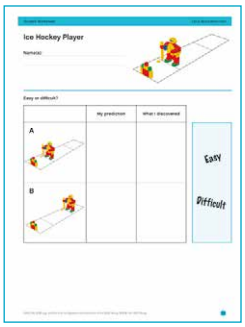
- Turn the handle on the back of the ice hockey player to make sure the arm swings freely
- Place a yellow pulley wheel in front of the arm, turn the handle on the back and hit the pulley wheel
- If the arm doesn't hit the pulley wheel then check if the arm is built as shown in the building instruction

Make the Field

- Measure and mark your shooting zones at distances 12 in and 20 in
- Make a goal using bricks



Contemplate

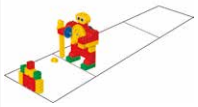
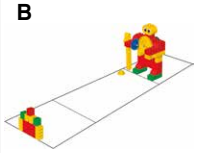


Easy or difficult?

Scoring at a distance can be difficult.
Find out which level of difficulty it will be for the ice hockey player to score.

First predict at which distance it will be easy and at which it will be difficult for the ice hockey player to score.
Write down your predictions using the words on the worksheet.

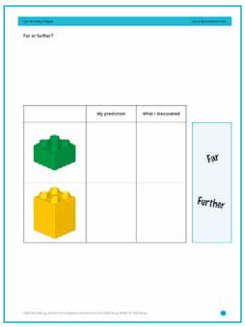
Next, test how difficult it is to score from the two distances.
Write down your findings using the words on the worksheet.

	My Prediction	What I Discovered
A 		Easy
B 		Difficult

Have the students reflect on their tests by asking questions such as:

- What did you predict would happen and why?
- Describe what happened.
- How did you make sure your tests were fair? *Did the ice hockey player always shoot from the same position?*
- Describe how the model works.

Continue



Far or further?

Find out which, one or two bricks, can be shot further.

First try to predict which, one or two bricks, can be shot far and which can be shot further.
Write down your predictions using the words on the worksheet.

Next, test to see if what happens is what you have predicted.
Write down your findings using the words on the worksheet.

	My Prediction	What I Discovered
		Further
		Far

Ice Hockey Player

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):**													
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Meet or exceed expectations in the design of the ice hockey player based on directions of activity (E.g. Arm swings freely, Arm hits pulley wheel) (2)														
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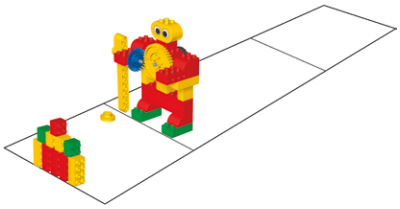
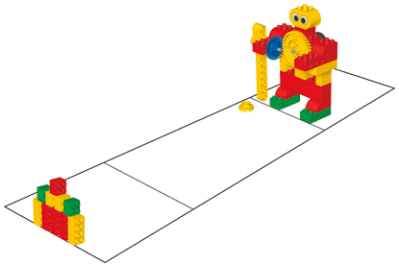
Optional Student Learning Targets														
Lesson Observational Notes:														

Ice Hockey Player

Name(s): _____

_____

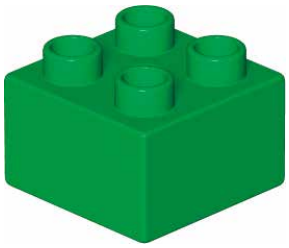
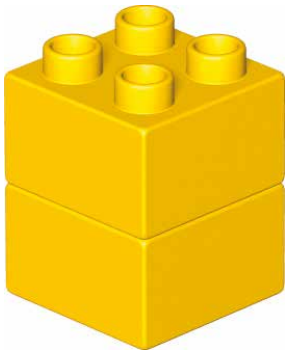
Easy or difficult?

	My Prediction	What I Discovered
A 		
B 		

Easy

Difficult

Far or further?

	My Prediction	What I Discovered
		
		

Far

Further

Activity Name: _____

Student Name: _____ **Date:** _____

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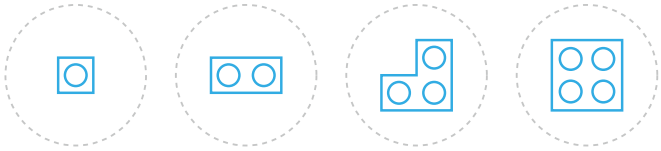
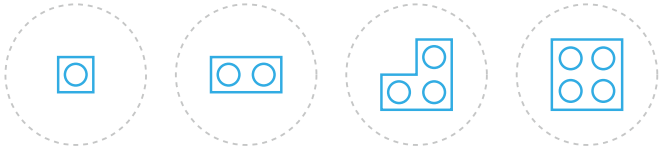
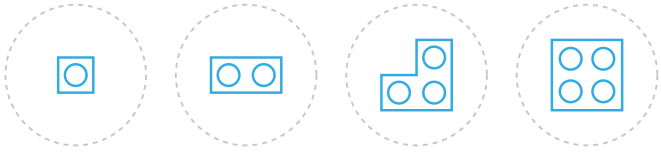
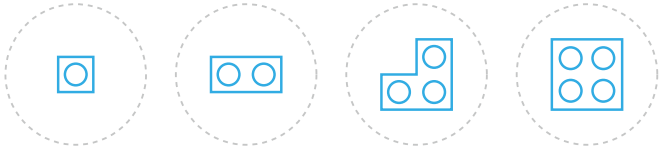
Directions: Circle the brick that shows how well you did. The bigger brick, the better you did.

I knew what to do.	
I built a model.	
I made good predictions.	
I shared my ideas.	

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

Tell someone what you learned...

8. Sam's New Dog

Science
- Friction
- Pulleys

Design and Technology
- Assembling components
- Evaluating
- Toy design

Vocabulary
- Direction
- Friction
- Pulley belt
- Pulley wheel
- Rotation

Other Materials Required
- Cloth
- Colored pencils or markers
- Paper
- Scissors

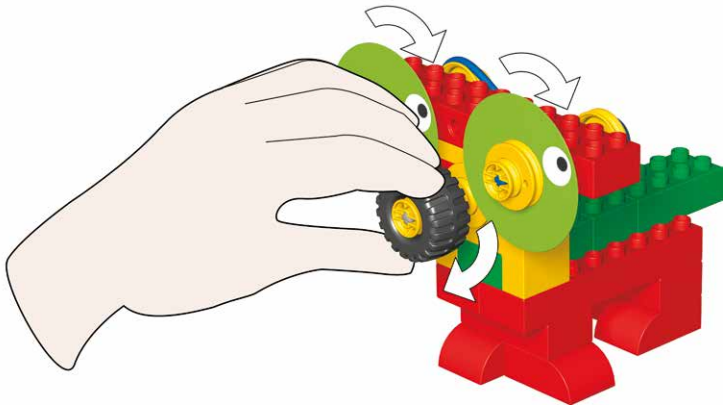
Connect

Sam's neighbors have decided to move and Sam is very sad. His best friend, after Sara of course, is Buddy, the dog from next-door. Buddy is the cutest little puppy with big, funny eyes and Sam often takes Buddy for walks and they play together. This is going to change now that Buddy is moving!
Sara feels very sorry for Sam and decides that she wants to cheer him up and get him a new dog friend with funny eyes to play with – a friend just like Buddy.

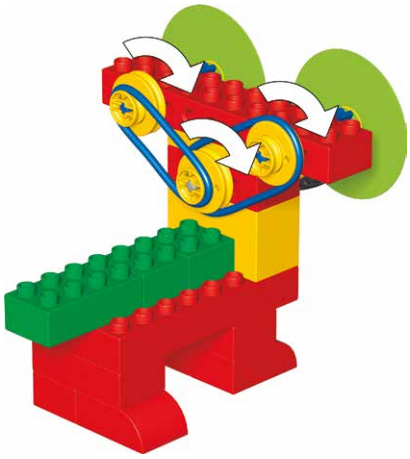
Can you help her build a Buddy-look-alike with big eyes that move?
Let's find out!

Construct

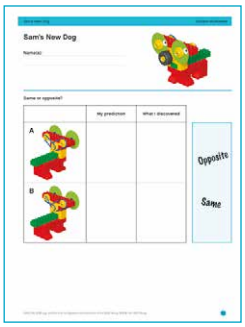
Build Sam's new dog using building instructions no. 8



- Place the eye disks on the axles as shown
- Each of the axles should spin smoothly
- If not, just loosen the yellow pulley wheels so they do not rub on the red beam



Contemplate

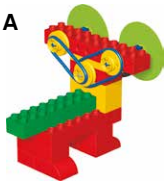
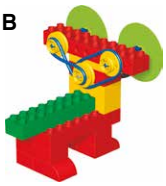


Same or opposite?

By turning the nose you can make Sam's new dog's eyes rotate. Find out which of the pulley belt settings will rotate the eyes in the same or in opposite directions.

First predict which pulley belt setting will make the eyes rotate in the same direction and which will make the eyes rotate in opposite different directions?
Write down your predictions using the words on the worksheet.

Next, test the two pulley belt settings.
Write down your findings using the words on the worksheet.

	My Prediction	What I Discovered
A 		Same
B 		Opposite

Have the students reflect on their tests by asking questions such as:

- What did you predict would happen and why?
- Describe what happened.
- How did you make sure your tests were fair? *Was the pulley belt adjusted correctly?*
- Describe how the model works.

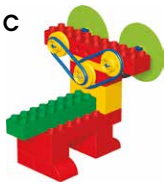
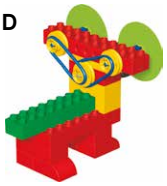
Continue

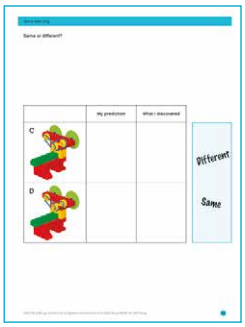
Same or different?

Change the pulley belt settings and you can change speed at which Sam's new dog's eyes rotate. Find out which of the pulley belt settings will rotate the eyes at the same or at different speeds.

First predict which pulley belt setting will make the eyes rotate at the same speed and which will make the eyes rotate at different speeds?
Write down your predictions using the words on the worksheet.

Next, test to see if the result supports your prediction.
Write down your findings using the words on the worksheet.

	My Prediction	What I Discovered
C 		Different
D 		Same



Optional: Dress up Sam's New Dog

Dress up Sam's new dog to look nice, sweet or cool.
You may want to make ears, a tongue and even a tail using a variety of materials such as cloth, paper, etc.

Sam's New Dog

Class: _____ **Date:** _____

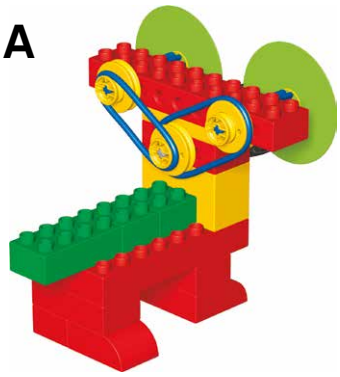
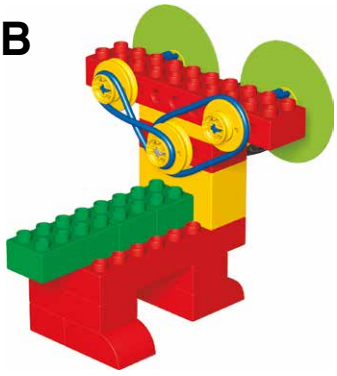
Performance and Learning Targets Linked to the Activity and the Eight Next Generation Science Practices Observe the suggested student behaviors while working with the activity. Either use the suggested Emerging (E), Developing (D), Proficient (P), Accomplished (A) proficiency level descriptions or use one relevant to your context.	**Name(s):**													
Student Performance Targets Linked to the Activity To what degree can the student…?														
Adequately build the Sam's new dog model with help or independently using the Building Instruction (1, 2, 3, 6)														
Use the model to demonstrate understanding of terms and make predictions about pulley systems (1, 3, 4, 5)														
Meet or exceed expectations in the design of the Sam's new dog based on directions of activity (E.g. Axles spin smoothly, Eyes spin, Pulley does not rub yellow beam) (2)														
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 Sam's new dog 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 simple to advanced questions based upon observations to make predictions (1, 3)														
Demonstrate ability to use fair testing of models and make adjustments based upon data (3, 4, 6)														
Communicate the meaning of the findings with others (E.g. orally, in drawing or writing) (4, 8)														
Follow a plan to define, carry out, test, evaluate and share a design task (2, 3, 4, 5, 6, 7, 8)														
Compare solutions with other groups and listen to the ideas of others (6, 7, 8)														
Optional Student Learning Targets														
Lesson Observational Notes:														

Sam's New Dog

Name(s): _____

_____

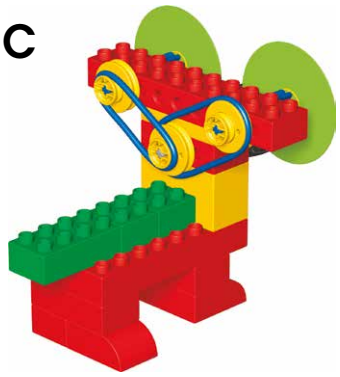
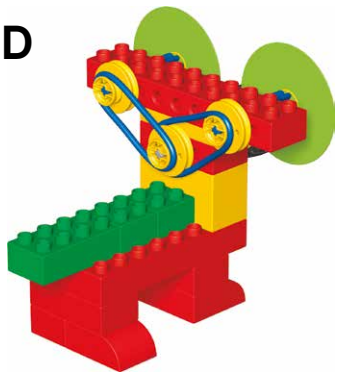
Same or opposite?

	My Prediction	What I Discovered
A 		
B 		

Opposite

Same

Same or different?

	My Prediction	What I Discovered
C 		
D 		

Different

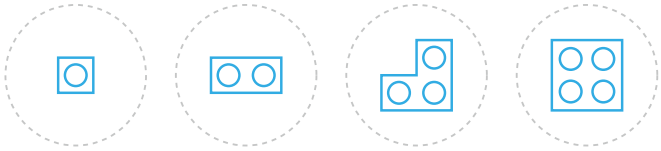
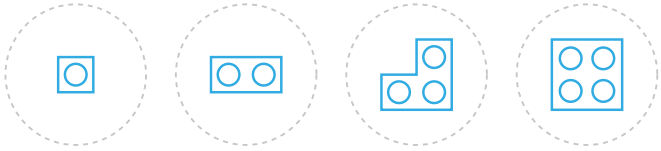
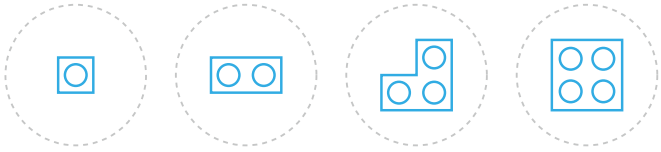
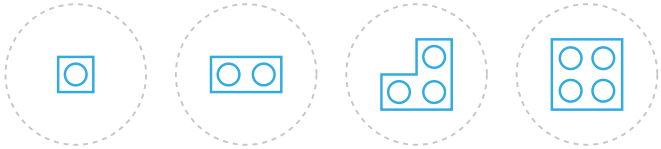
Same

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 knew what to do.	
I built a model.	
I made good predictions.	
I shared my ideas.	

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

Tell someone what you learned...

Crossing Crocodile River

The Problem

Sam and Sara are on a jungle hike when they come to a fast-flowing river. They can see several crocodiles swimming in the river. Sam and Sara need to cross the river.

Can you help Sam and Sara get across the river safely?

Design Brief

Design and make a safe and strong bridge that:
- is at least 4 in long without touching the water
- is at least 8 in above the water
- supports the weight of at least Sam and Sara

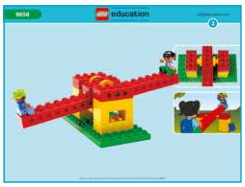
Crossing Crocodile River

Objectives

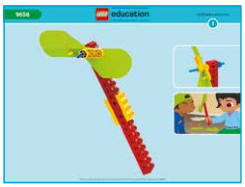
To be able to apply knowledge and skills relating to:

- Structures
- Stability
- Measuring
- The application of fair testing and product safety

Need help?
Look at:



Seesaw



Pinwheel

Optional Materials Required

- Ruler

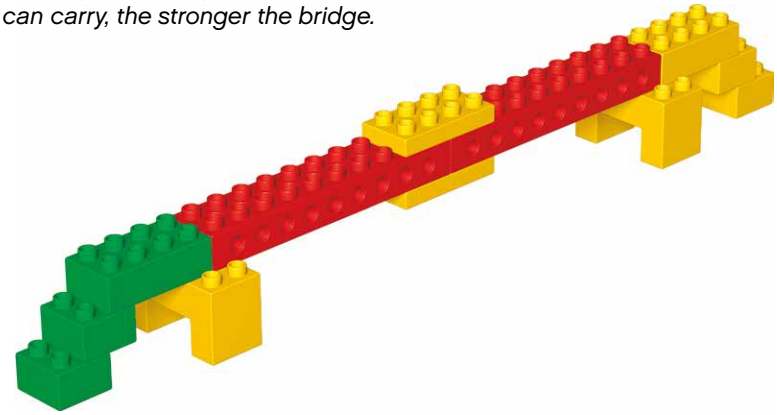
Fair Testing and Fun

- Is the bridge 8 in long or even longer?
  Measure with a ruler or with the LEGO® DUPLO® box lid, which is 10.5 in wide.
  The longer, the better.

- Is it at least 4 inabove the water?
  Measure it and see.

- Is it safe?
  Take the Sam and Sara models for a walk across the bridge.
  Can Sam and Sara walk on the bridge at any place without falling through holes or gaps?

- How much weight can it carry?
  Where might the weakest place be? In the middle! Start with Sam in the middle, add Sara.
  Still OK? Then keep adding more weight (e.g. bricks) until it breaks!
  The more weight it can carry, the stronger the bridge.



Extra challenge

Design a boat that can go under your bridge and sail down the river.

Crossing Crocodile River

Class: _____ **Date:** _____

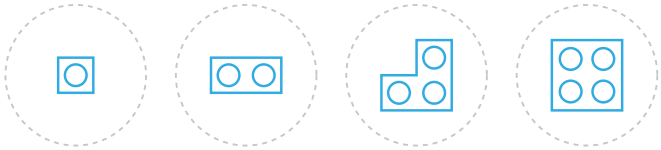
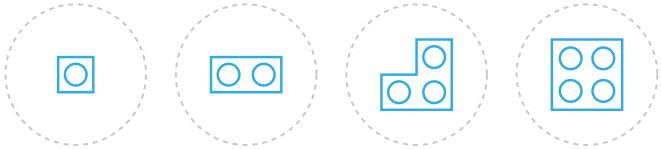
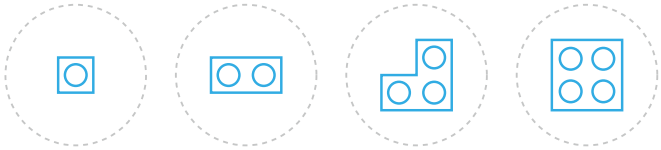
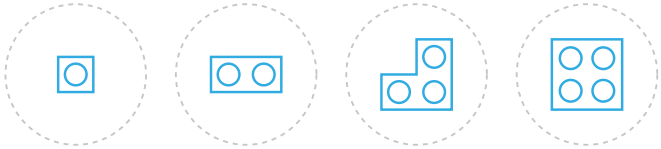
Performance and Learning Targets Linked to the Activity and the Eight Next Generation Science Practices Observe the suggested student behaviors while working with the activity. Either use the suggested Emerging (E), Developing (D), Proficient (P), Accomplished (A) proficiency level descriptions or use one relevant to your context.	**Name(s):**													
Student Performance Targets Linked to the Activity To what degree can the student…?														
Design and build a bridge model that meets or exceeds the requirements (E.g. At least 4 in. long without touching the water; At least 8 in. above the water; supports the weight of Sam and Sara) (2)														
Design and build a model that demonstrates understanding of stability and structure (2)														
Complete the crossing crocodile river extra challenge to apply the ideas of structure and function; stability and weight (2)														
Make changes or create a model design based on data in order to determine the degree to which a model works as it is intended (2, 3, 4, 5, 6)														
Use tools and/or materials to design and/or build a model that solves a specific problem (6)														
Selected Student Learning Targets Linked to the Practices To what degree can the student…?														
Ask or identify questions that can be answered in an investigation (1, 3)														
Demonstrate ability to use fair testing of models and make adjustments based upon data (3, 4, 6)														
Communicate and compare the design ideas and the meaning of the findings with others (E.g. orally, in drawing or writing) (4, 6, 7, 8)														
Develop and follow a plan to define, carry out, test, evaluate and share a design task (2, 3, 4, 5, 6, 7, 8)														
Compare the effectiveness of solutions with other groups and listen to the ideas of others (6, 7, 8)														
Optional Student Learning Targets														
Lesson Observational Notes:														

Activity Name: _____

Student Name: _____ **Date:** _____

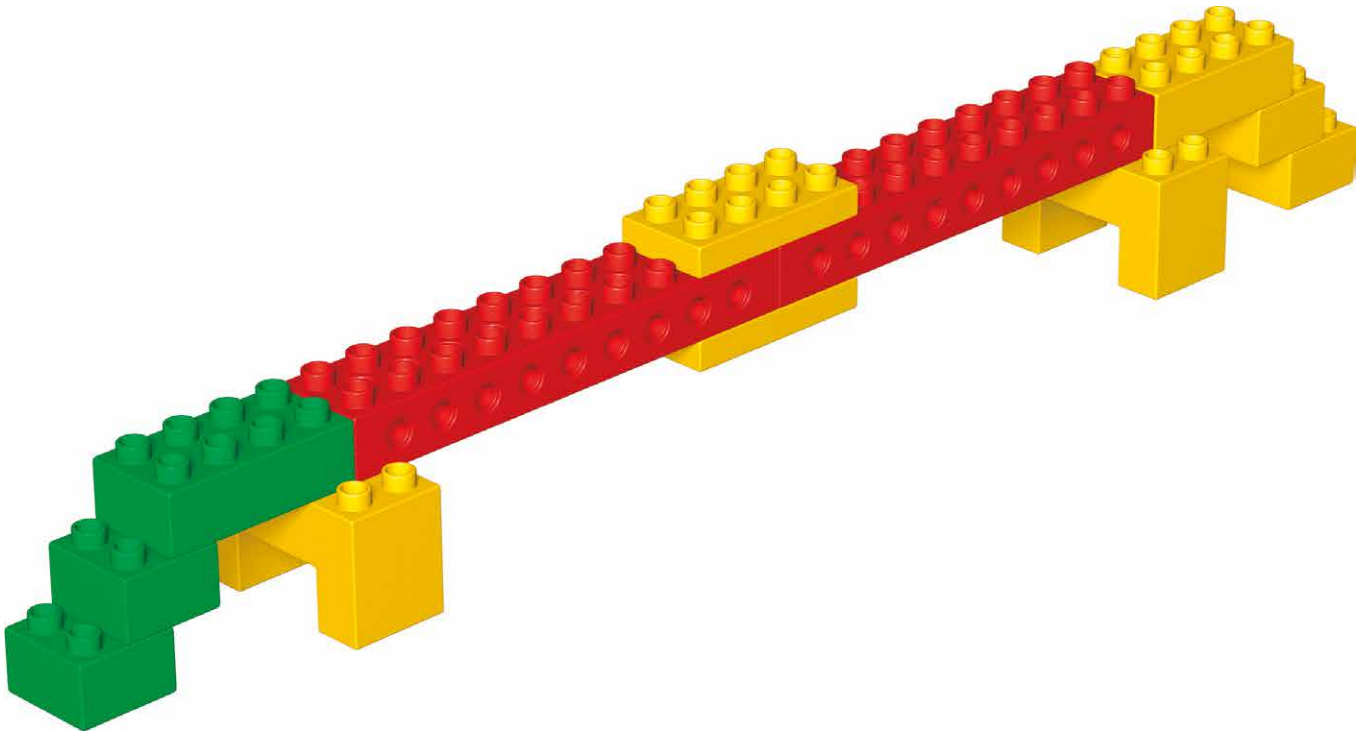
How did you do?

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

I understood the problem.	
I built a model.	
I tested my model.	
I shared my ideas.	

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

Tell someone about the problem you solved…



Hot Day

The Problem

The sun is high in the sky on a beautiful day. Sam and Sara are at the beach, but it is too hot to do anything. Not even a nice cool ice cream can help Sara cool down. They could do with a cool breeze!

Can you help Sam and Sara build a fan that can create a nice cool breeze?

Design Brief

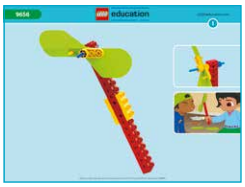
Design and make a fan that:
- can stand on its own
- uses gears or pulleys to make the strongest breeze possible
- can be turned by hand

Hot Day

Objectives

To be able to apply knowledge and skills relating to:
- Wind power
- Gears or pulleys
- Rotation
- Measuring
- The application of fair testing and product safety

Need help?
Look at:



Pinwheel

Spinning Top

Other Materials Required

- Cardstock
- Crayons
- Scissors
- Sticky tape
- Ruler
- Paper, wool or thread

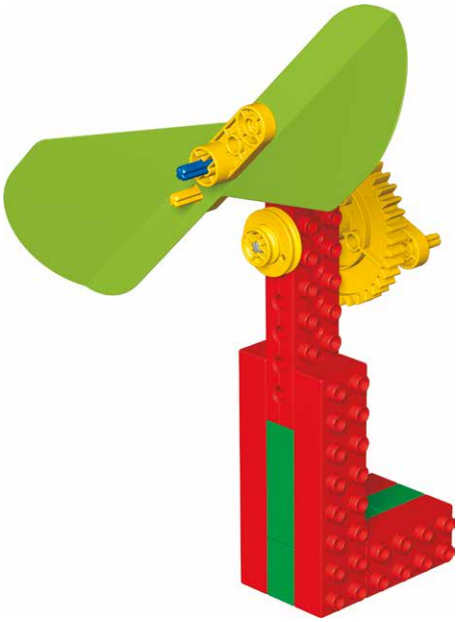
Fair Testing and Fun

- Can the fan stand on its own?
  Try it and see.

- How does the fan turn?
  Does it use gears or pulleys? Show and tell.

- How strong is the breeze?
  Make a wind tester: dangle a strip of paper, wool or thread from your fingers.
  Hold it in the breeze; the more it moves about, the stronger the breeze.
  Now move away from the fan until the wind tester stops moving.
  Measure the distance to the fan. The further, the better.

- How 'powerful' is the gearing system?
  Turn the handle once – slowly. As you are turning the handle, count the number of turns (rotations) of the fan. The more fan-rotations per turn of the handle, the better the fan.



Extra challenge

Design new and bigger fan blades to make your fan even more efficient.
Make the most colourful fan ever!

Hot Day

Class: _____ **Date:** _____

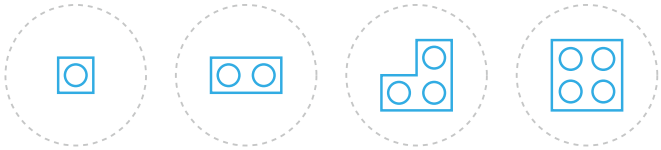
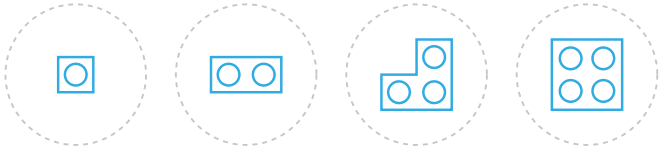
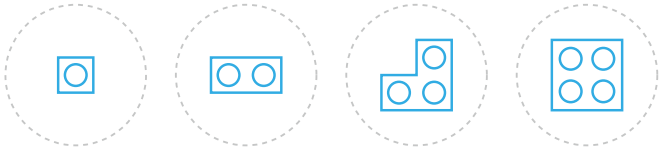
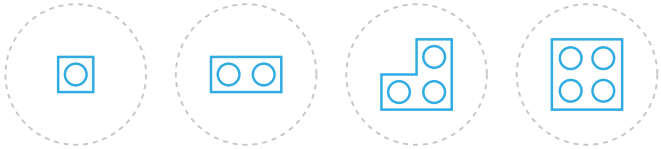
Performance and Learning Targets Linked to the Activity and the Eight Next Generation Science Practices Observe the suggested student behaviors while working with the activity. Either use the suggested Emerging (E), Developing (D), Proficient (P), Accomplished (A) proficiency level descriptions or use one relevant to your context.	**Name(s):**													
Student Performance Targets Linked to the Activity To what degree can the student…?														
Design and build a fan model that meets or exceeds the requirements (E.g. Can stand on its own, Uses gears or pulleys, Can be turned by hand) (2)														
Design and build a model that demonstrates understanding of gears and pulleys (2)														
Complete the hot day extra challenge to apply the ideas of systems and system models, structure and function & cause and effect (2)														
Make changes or create a model design based on data in order to determine the degree to which a model works as it is intended (2, 3, 4, 5, 6)														
Use tools and/or materials to design and/or build a model that solves a specific problem (6)														
Selected Student Learning Targets Linked to the Practices To what degree can the student…?														
Ask or identify questions that can be answered in an investigation (1, 3)														
Demonstrate ability to use fair testing of models and make adjustments based upon data (3, 4, 6)														
Communicate and compare the design ideas and the meaning of the findings with others (E.g. orally, in drawing or writing) (4, 6, 7, 8)														
Develop and follow a plan to define, carry out, test, evaluate and share a design task (2, 3, 4, 5, 6, 7, 8)														
Compare the effectiveness of solutions with other groups and listen to the ideas of others (6, 7, 8)														
Optional Student Learning Targets														
Lesson Observational Notes:														

Activity Name: _____

Student Name: _____ **Date:** _____

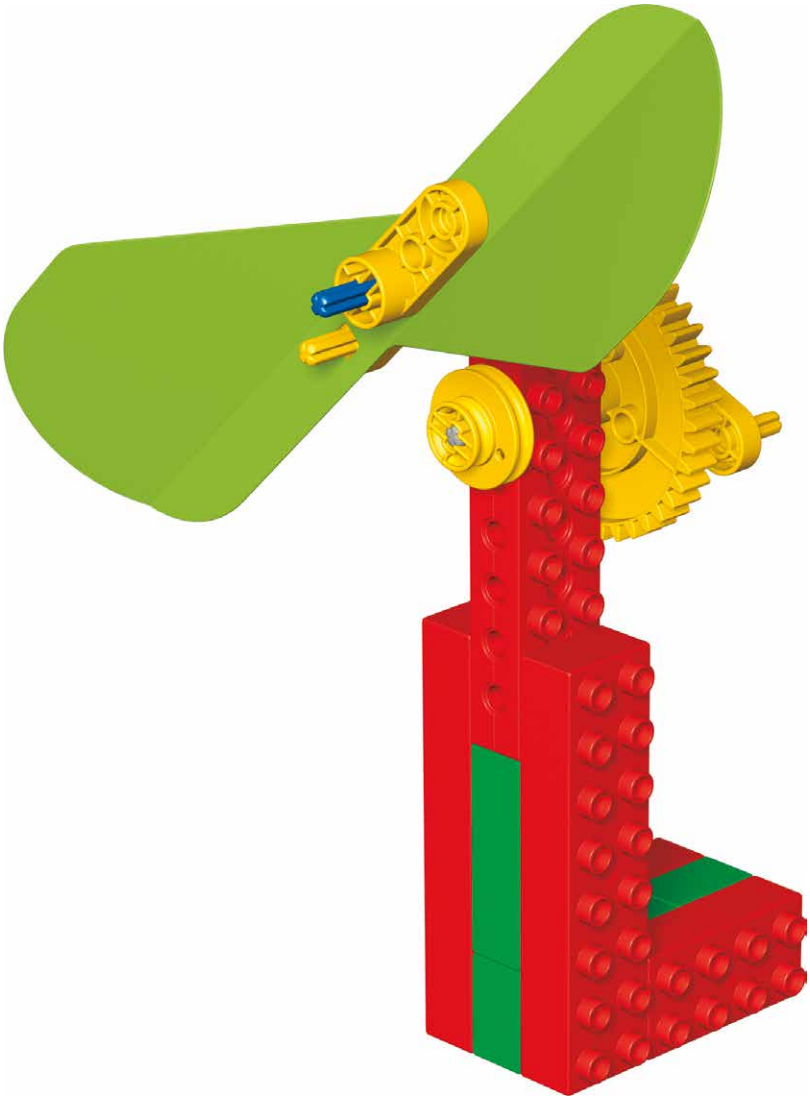
How did you do?

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

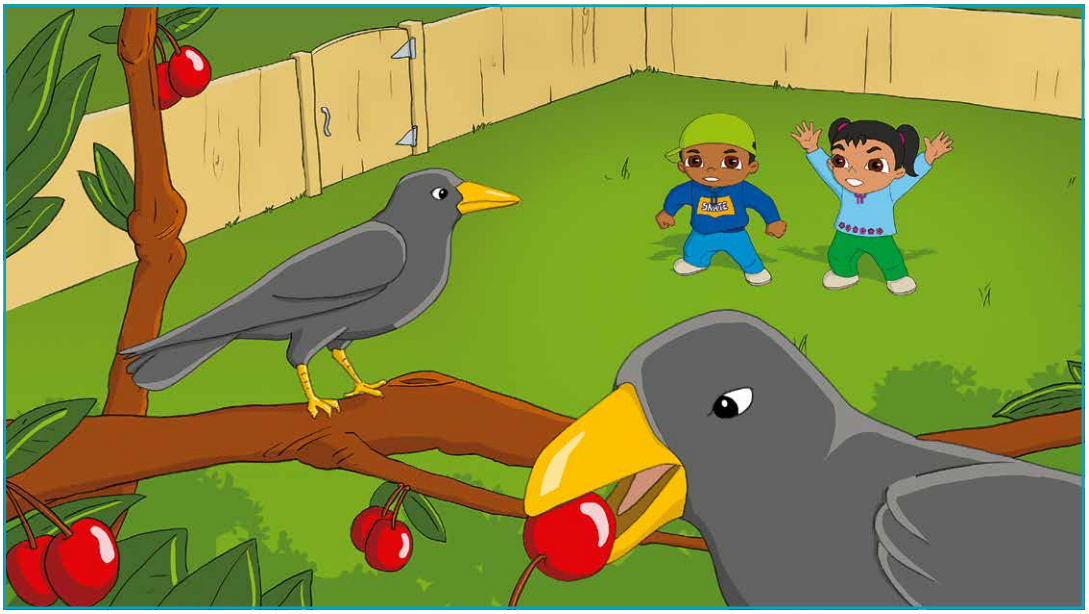
I understood the problem.	
I built a model.	
I tested my model.	
I shared my ideas.	

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

Tell someone about the problem you solved…



Scarecrow



The Problem

In the garden there is an old cherry tree with big, ripe and sweet cherries. Cherries are Sam and Sara's favorite fruit, but unfortunately they are not the only ones who like cherries. A big group of birds have landed in the tree and are eating all of the cherries. No matter how much noise Sam and Sara make they can't scare the birds away.

Can you help Sam and Sara build a moving device that can scare all the birds away?

Design Brief

Design and make a moving scarecrow that:
- has at least one type of movement
- is as scary as possible

Scarecrow

Objectives

- To be able to apply knowledge and skills relating to:
- Gears or pulleys
- Stability
- The application of fair testing and product safety

Other Materials Required

- Bells or other noisy objects
- Scrap materials

Fair Testing and Fun

- Does it look like a scarecrow?
  How can you tell it's a scarecrow?

- Which type of movement does it have?
  Show and tell.

- How scary is the scarecrow?
  Explain why. Is it to do with the shape, or what it does, or…?

Extra challenge

Build a noise-making mechanism that makes a loud noise when the scarecrow moves.

Need help?
Look at:

Ice Hockey Player

Sam's New Dog

Scarecrow

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…?														
Design and build a scarecrow model that meets or exceeds the requirements (E.g. Moves in at least one way, Is scary) (2)														
Design and build a model that demonstrates understanding of gears and pulleys (2)														
Complete the scarecrow extra challenge to add a noise making mechanism that applies the idea of stability (2)														
Make changes or create a model design based on data in order to determine the degree to which a model works as it is intended (2, 3, 4, 5, 6)														
Use tools and/or materials to design and/or build a model that solves a specific problem (6)														
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Develop and follow a plan to define, carry out, test, evaluate and share a design task (2, 3, 4, 5, 6, 7, 8)														
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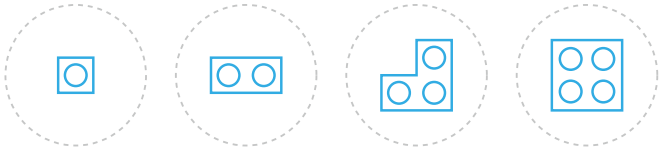
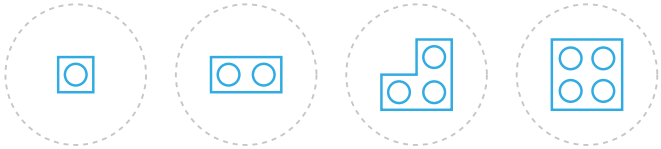
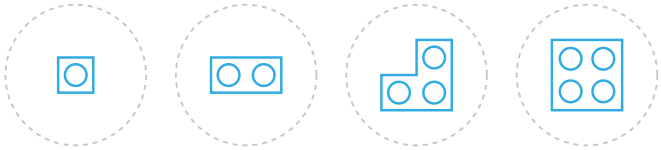
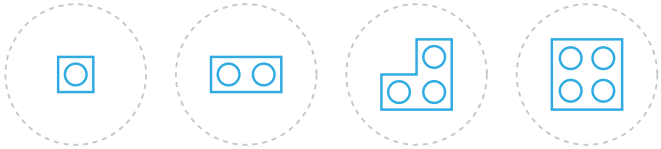
Optional Student Learning Targets														
Lesson Observational Notes:														

Activity Name: _____

Student Name: _____ **Date:** _____

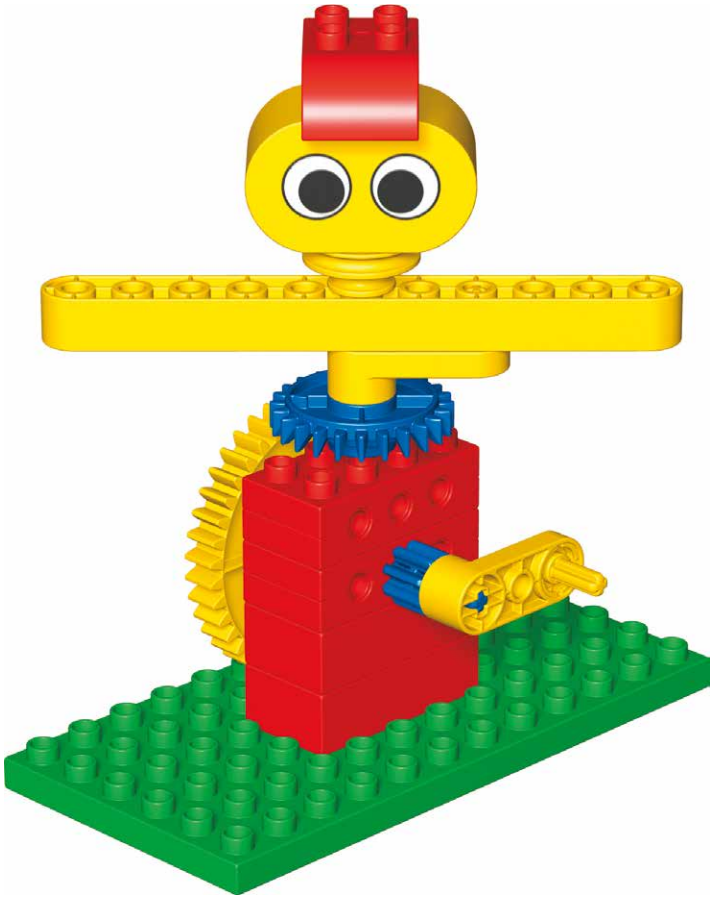
How did you do?

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

I understood the problem.	
I built a model.	
I tested my model.	
I shared my ideas.	

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

Tell someone about the problem you solved…



Swing

The Problem

Sam and Sara love to play in the backyard, but their swing is old and really not very good anymore. It is broken and whenever they want a good swing they keep falling off. Sam and Sara need a swing with a good, stable seat that they won't fall off.

Can you help Sam and Sara build a new swing?

Design Brief

Design and make a safe swing that:
- has a seating space for one
- swings as long as possible after it has been pushed

Swing

Objectives

To be able to apply knowledge and skills relating to:

- Stability
- Balance
- Structures
- The application of fair testing and product safety

Other Materials Required

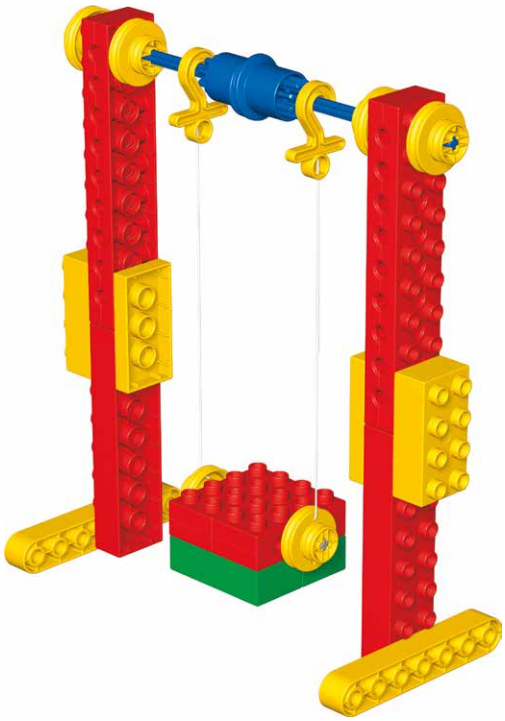
- Clock or timer

Fair Testing and Fun

- Can Sam or Sara sit on the swing?
  Put Sam or Sara on the swing and see if it can swing.

- Is the swing stable?
  Can it swing without breaking and swaying?

- How long does it swing after it has been pushed?
  Use a timer and test it.

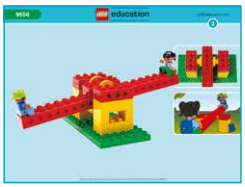


Extra challenge

For safety, build a fence around the swing.

Need help?
Look at:

Raft



Seesaw

Swing

Class: _____ **Date:** _____

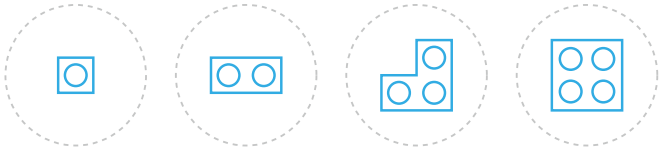
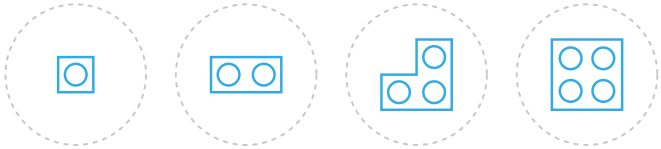
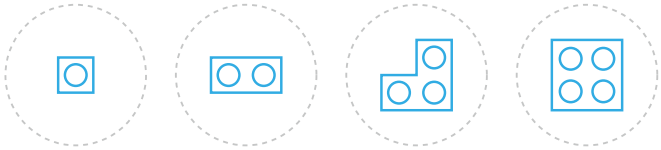
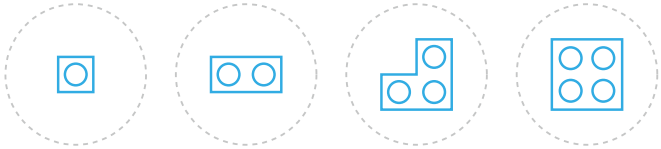
Performance and Learning Targets Linked to the Activity and the Eight Next Generation Science Practices Observe the suggested student behaviors while working with the activity. Either use the suggested Emerging (E), Developing (D), Proficient (P), Accomplished (A) proficiency level descriptions or use one relevant to your context.	**Name(s):**													
Student Performance Targets Linked to the Activity To what degree can the student…?														
Design and build a swing model that meets or exceeds the requirements (E.g. Has a seat for one, swings as long as possible (2)														
Design and build a model that demonstrates the understanding of balance (2)														
Complete the swing extra challenge to add a safety mechanism that applies the ideas of stability and balanced structures (2)														
Make changes or create a model design based on data in order to determine the degree to which a model works as it is intended (2, 3, 4, 5, 6)														
Use tools and/or materials to design and/or build a model that solves a specific problem (6)														
Selected Student Learning Targets Linked to the Practices To what degree can the student…?														
Ask or identify questions that can be answered in an investigation (1, 3)														
Demonstrate ability to use fair testing of models and make adjustments based upon data (3, 4, 6)														
Communicate and compare the design ideas and the meaning of the findings with others (E.g. orally, in drawing or writing) (4, 6, 7, 8)														
Develop and follow a plan to define, carry out, test, evaluate and share a design task (2, 3, 4, 5, 6, 7, 8)														
Compare the effectiveness of solutions with other groups and listen to the ideas of others (6, 7, 8)														
Optional Student Learning Targets														
Lesson Observational Notes:														

Activity Name: _____

Student Name: _____ **Date:** _____

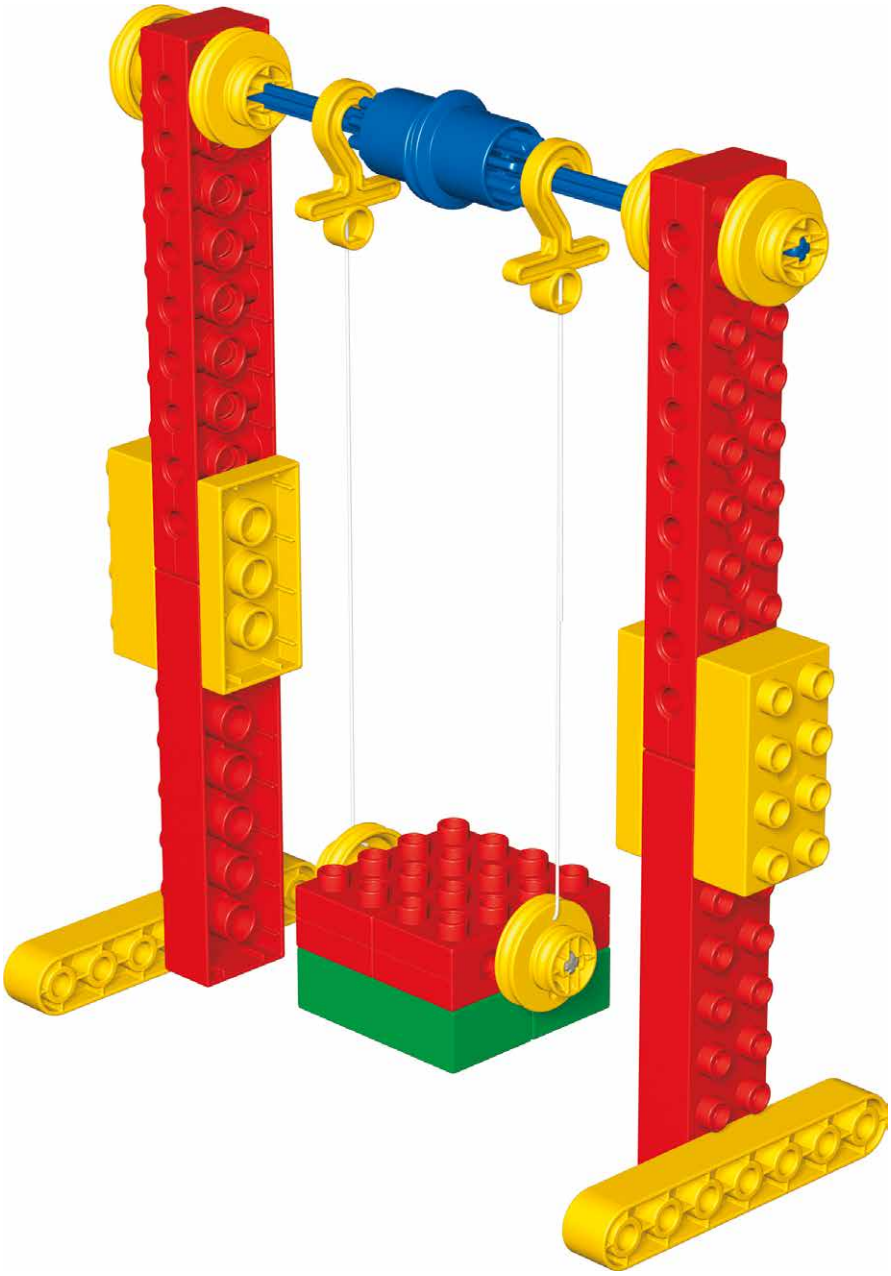
How did you do?

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

I understood the problem.	
I built a model.	
I tested my model.	
I shared my ideas.	

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

Tell someone about the problem you solved…



Glossary

We have tried to make the glossary as understandable and practical as possible without getting stuck in difficult equations and long explanations.

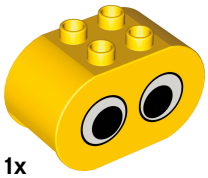
A	**Angle**	The space between two lines or planes that intersect; the inclination of one line to another; measured in degrees or radians.
	Area	Area is a quantity expressing the size of a region of space.
	Axle	A rod through the center of a wheel, or through different parts of a cam. It transmits force, via a transmission device, from an engine to the wheel in a car or from your arm via the wheel to the axle if you are winding up a bucket on a rope.
B	**Balanced force**	An object is balanced and does not move when all the forces acting on it are equal and opposite.
	Belt	A continuous band stretched around two pulley wheels so one can turn the other. It is usually designed to slip if the follower pulley suddenly stops turning.
	Buoyancy	Buoyancy is an upward force on an object enabling it to float. If the buoyancy exceeds the weight, then the object floats; if the weight exceeds the buoyancy, the object sinks.
D	**Driver**	The part of a machine, usually a gear, pulley, lever, crank or axle, where the force first comes into the machine.
E	**Efficiency**	A measure of how much of the force that goes into a machine comes out as useful work. Friction often wastes a lot of energy, thus reducing the efficiency of a machine.
	Energy	The capacity to do work. You get energy from food. The Ice Hockey Player and Spinning Top get their energy from you.
F	**Fair testing**	Measuring the performance of a machine by comparing its performance under different conditions.
	Follower	Usually a gear, pulley or lever driven by another one. It can also be a lever driven by a cam.
	Force	A push or a pull.
	Friction	The resistance met when one surface is sliding over another, e.g. when an axle is turning in a hole or when you rub your hands together.
	Fulcrum	See pivot.

G	**Gear**	A gear is a toothed wheel. A way to classify gears is by the number of teeth they have, e.g. an 8-tooth gear or a 40-tooth gear. Gears can be used to transfer force, increase or reduce speed, and change the direction of rotary motion.
	Gear, crown	Has teeth that stick out on one side, making it look like a crown. Mesh it with a second crown gear or a regular spur gear to turn the angle of motion through 90°.
	Gear, worm	A gear with one spiral tooth resembling a screw. Mesh it with another gear to deliver large forces very slowly.
	Gearing down	A small gear turns a larger gear and amplifies the force from the effort. But the follower turns more slowly.
	Gearing up	A large gear turns a small gear and reduces the force from the effort. But the follower turns more quickly.
L	**Lever**	A lever is a device that makes work easier. It is one of the most widely used of the simple machines. Seesaws, scissors, nail clippers, tongs, pianos, parking meters, pliers and wheelbarrows all use levers to operate.
M	**Mass**	Mass is the quantity of matter in an object. On Earth, gravitational force pulling your matter makes you weigh say 50 lbs. In orbit, you feel weightless – but you still have a mass of 50 lbs. Often confused with weight.
P	**Pivot**	In a seesaw, the pivot point is in the middle. The pivot point does not always have to be in the middle of the lever. In some types or classes of levers, the pivot point may be at one end, such as in a wheelbarrow.
	Power	The strength and speed at which a machine does work.
	Pulley	A pulley is a simple machine which usually consists of a grooved wheel round which a rope, cable or chain is placed. A pulley is used to transfer force, alter speed or to turn another wheel.
R	**Resetting**	Turning a pointer on a scale back to zero again. For instance, resetting the Measuring Car's scale.
	Rotation	Turning or moving about a central fixed point. Rotation is the movement of a body in such a way that the distance between a certain fixed point and any given point of that body remains constant.
S	**Speed**	Speed describes the change in position in a certain period of time.
U	**Unbalanced force**	A force that is not opposed by an equal and opposite force. An object feeling an unbalanced force must begin to move in some way; for instance the unbalanced seesaw.
W	**Weight**	See Mass.

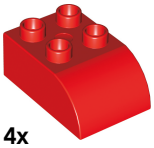
LEGO® Element Survey

1x
LEGO® DUPLO® girl
4271511

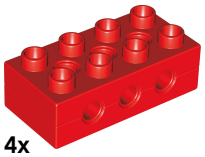
1x
LEGO® DUPLO® boy
4502103



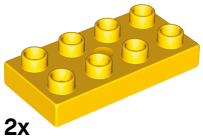
1x
Brick with eyes, oval, 2x4x2, yellow
81981



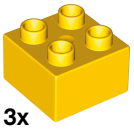
4x
Brick with arch, 2x3, red
230221



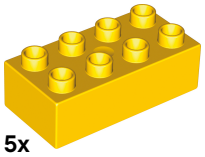
4x
Brick with holes, 2x4, red
75349



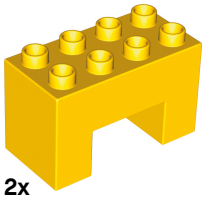
2x
Plate, 2x4, yellow
4160152



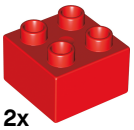
3x
Brick, 2x2, yellow
343724



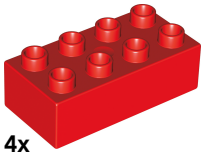
5x
Brick, 2x4, yellow
301124



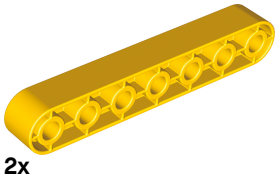
2x
Bridge element, 2x4x2, yellow
4221004



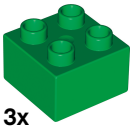
2x
Brick, 2x2, red
343721



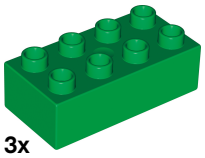
4x
Brick, 2x4, red
301121



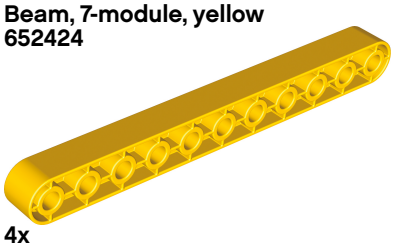
2x
Beam, 7-module, yellow
652424



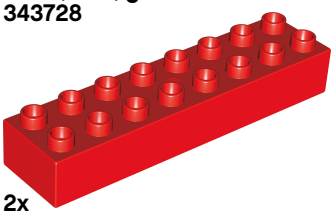
3x
Brick, 2x2, green
343728



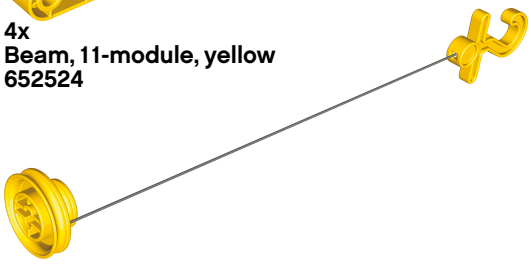
3x
Brick, 2x4, green
301128



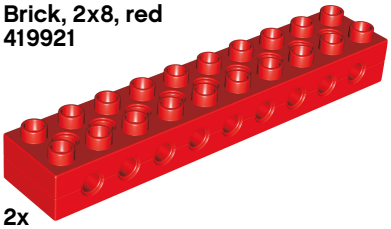
4x
Beam, 11-module, yellow
652524



2x
Brick, 2x8, red
419921



2x
String with hook, yellow
75536



2x
Brick with holes, 2x10, red
75350

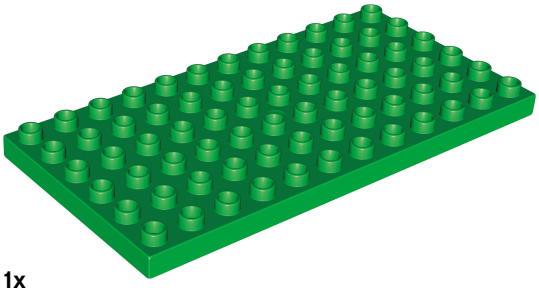
2x
Gear, 24-tooth crown, blue
4501054

2x
Gear, 24-tooth crown, red
652921

2x
Gear, 40-tooth crown, yellow
4501044

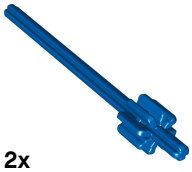
15x
Hub / pulley wheel, yellow
4271570

4x
Tyre, black
4514411



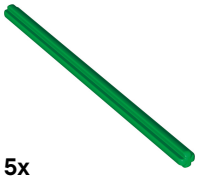
1x
Plate, 6x12, green
4281607

4x
Axle with gear,
5-module, 8-tooth, blue
652323

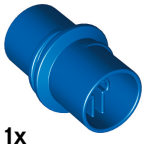


2x
Axle with gear,
8-module, 8-tooth, blue
4113296

7x
Axle, 6-module, grey
4211534



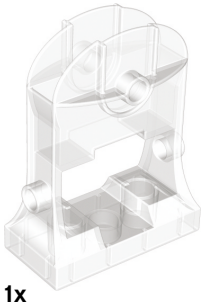
5x
Axle, 8-module, green
652128



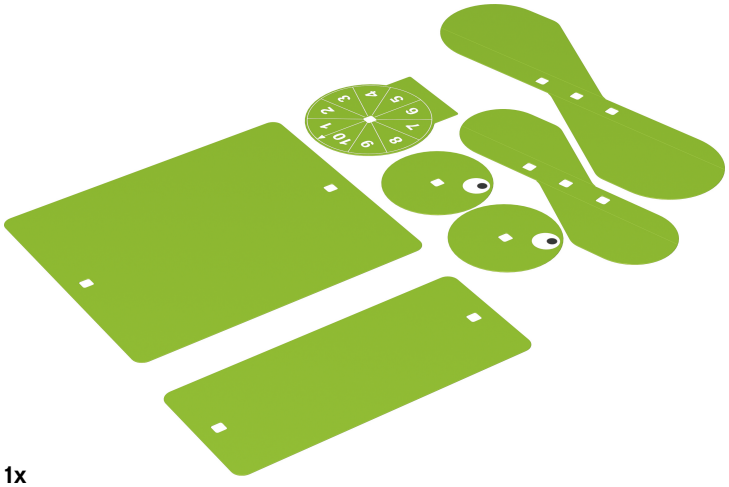
1x
Worm gear, blue
4271573

6x
Connector peg, handle, yellow
4493718

2x
Belt, blue
71059



1x
Gear block, transparent
4113297



1x
Plastic forms sheet, green
4520270

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