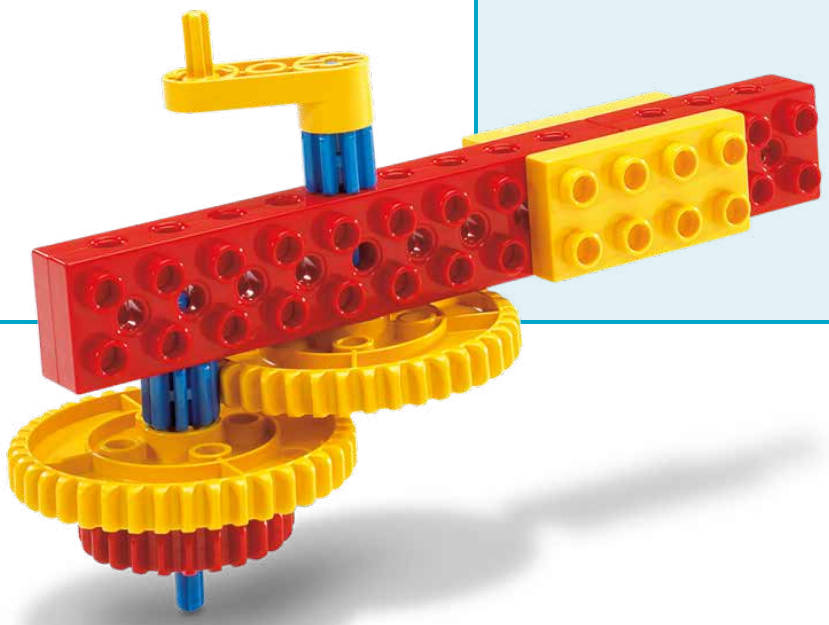
Spinning Tops

A Sample Activity from Early Simple Machines



education

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?

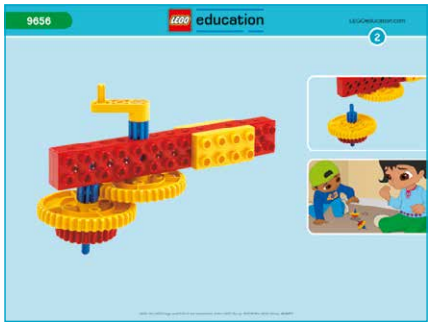
The 9656 Brick Set

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

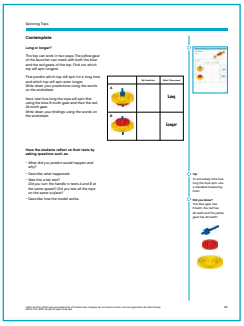
The eight building instructions support the students' building process step-by-step with clear instructions on how to build each model. To interpret the 2D building instructions and turn them into a 3D model can be a demanding task and some students may need your help and encouragement.



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.

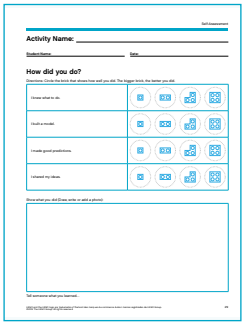
Teacher's Notes

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

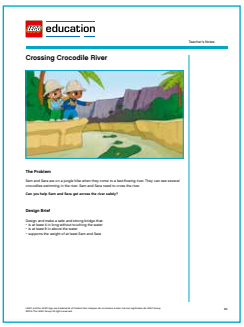
The illustrations in the student worksheets will guide the students to use and explore their models without too much assistance. The students will predict, test and describe outcomes using scientific words that are relevant to the NGSS, and presented in the student worksheets. These words will encourage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

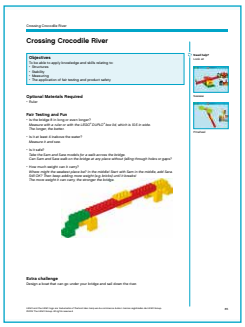


Problem-Solving Activities
Each of the four problem-solving activities starts off with a short story supported by an illustration featuring the problem that needs solving. To solve the problem, a design brief states a number of criteria the students have to incorporate into their model solution.

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.



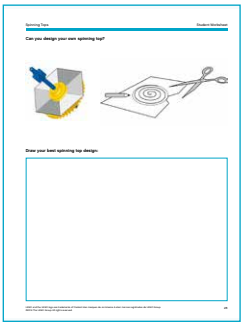


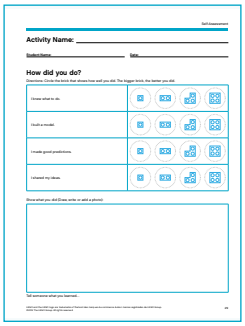
Assessments

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.

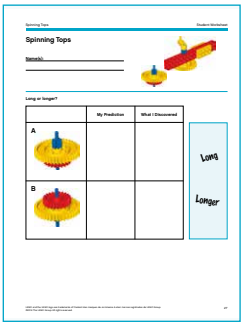




Student Self-Assessment Tools

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.

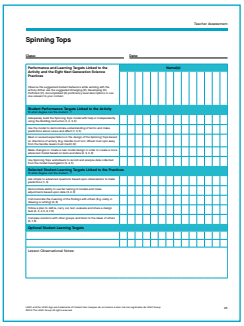
Using these rubrics, students assess themselves according to the 'Four Bricks Scale' in which the biggest brick represents the highest rating. In certain situations, you might consider asking your students to assess themselves using only two of the four bricks.



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.

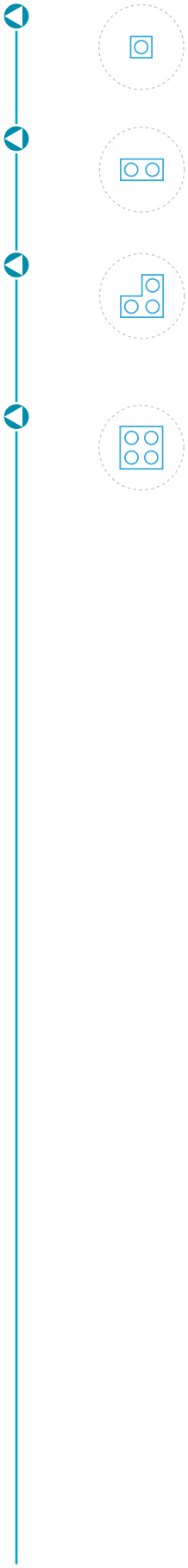


Emerging
The student is at the beginning stages of development in terms of content knowledge, ability to understand and apply content, and/or demonstration of coherent thoughts about a given topic.

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.

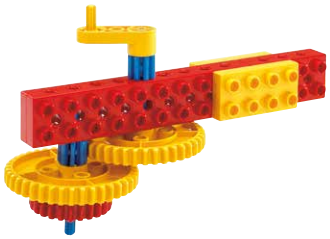
LEGO® Education's 4C Approach

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.

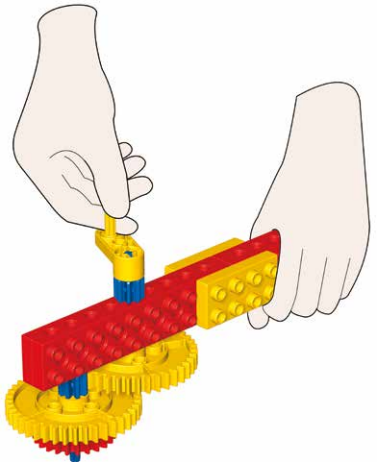
Connect
A short story introduces Sam and Sara and provides the students with the opportunity to help identify the problem and investigate how best to come up with a solution.

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.



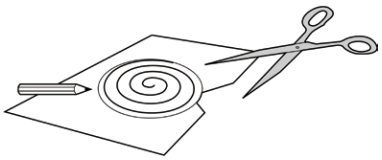
Through their investigations the students will learn to identify and compare test results. The activities will introduce them to the concepts of measurement, speed, balance, mechanical movement, structures, force and energy. They will be encouraged to describe the outcomes of their investigations. You 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.)												

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

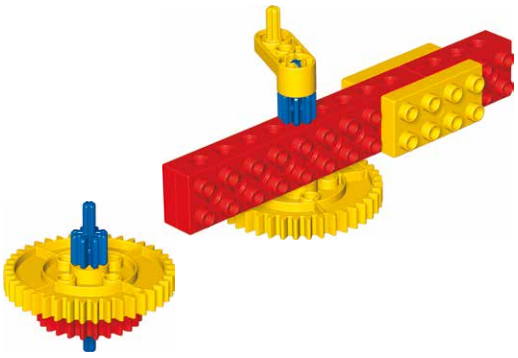
Connect

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!

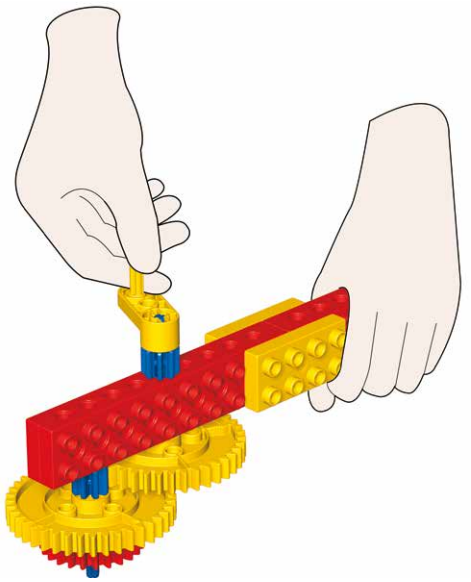
Can you help Sam and Sara build a device that can make the spinning tops spin? Let's find out!

Construct

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

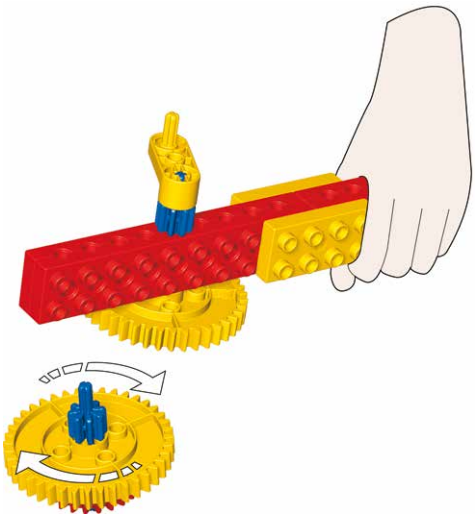


- Hold the launcher and place the gear end of the launcher over the blue gear axle
- The blue gear should mesh with the big yellow gear and spin as you turn the handle



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.

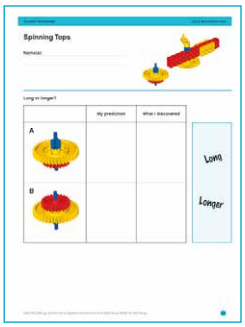
First predict which top will spin for a long time and which top will spin even longer.
Write down your predictions using the words on the worksheet.

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.

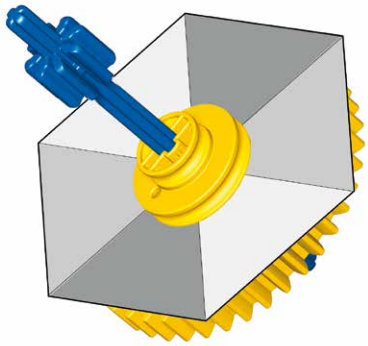
Did you know?
The blue gear has 8 teeth, the red has 24 teeth and the yellow gear has 40 teeth!

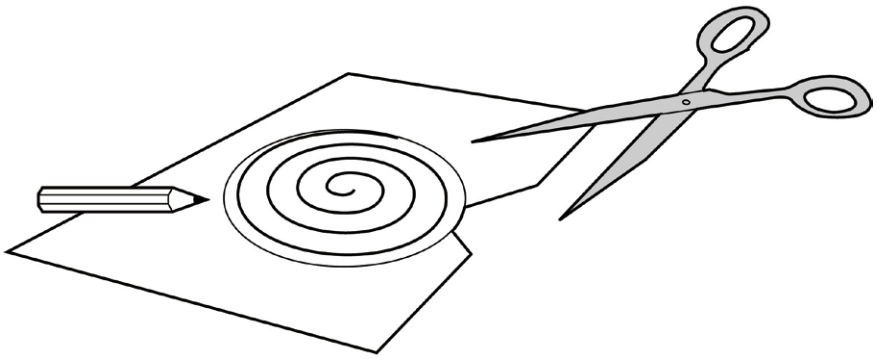
Continue

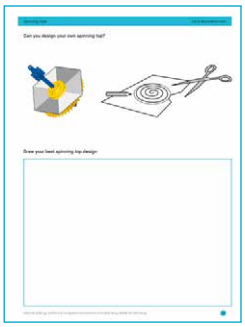
Can you design your own spinning top?

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.





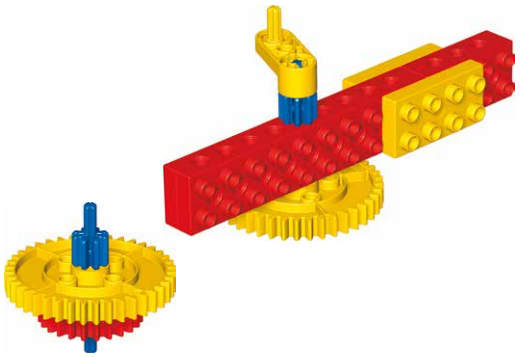


Spinning Tops

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)														
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:														

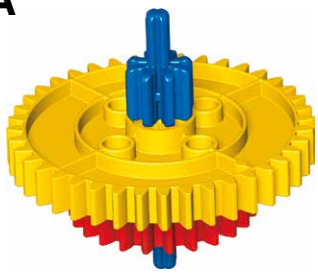
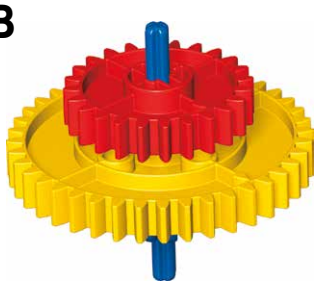
Spinning Tops



Name(s): _____

_____

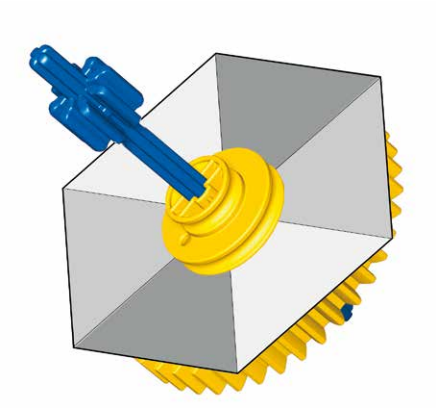
Long or longer?

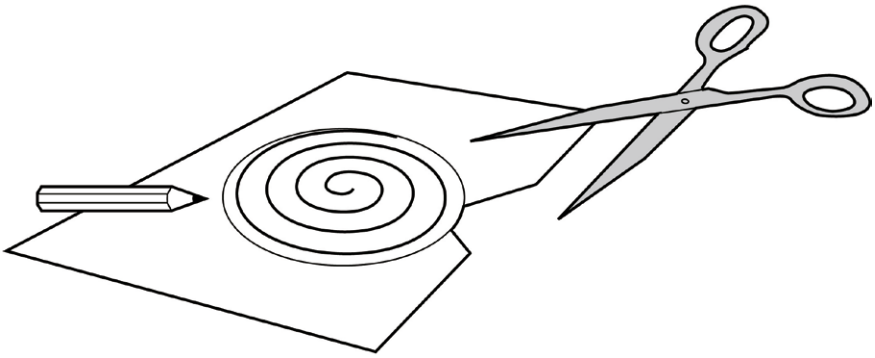
	My Prediction	What I Discovered
A 		
B 		

Long

Longer

Can you design your own spinning top?





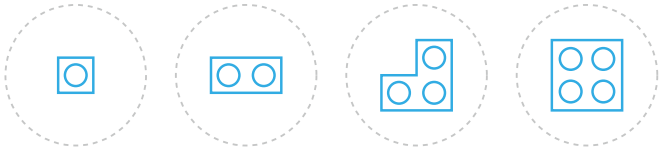
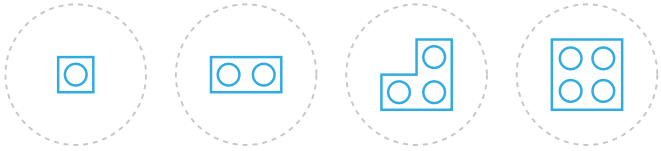
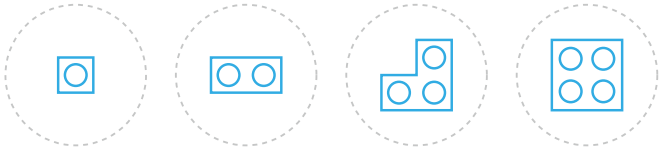
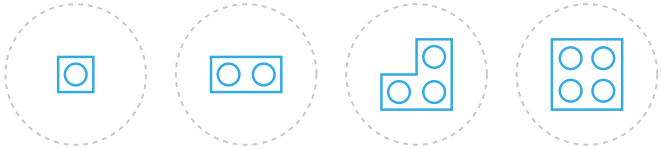
Draw your best spinning top design:

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...

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