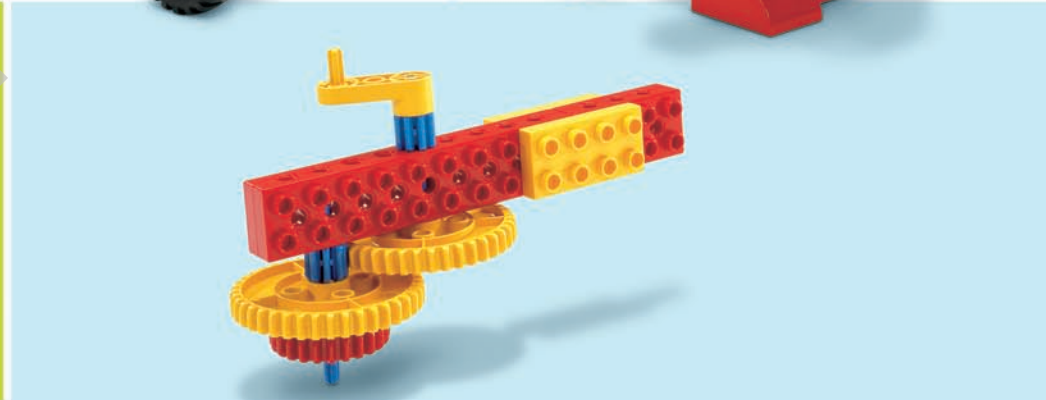
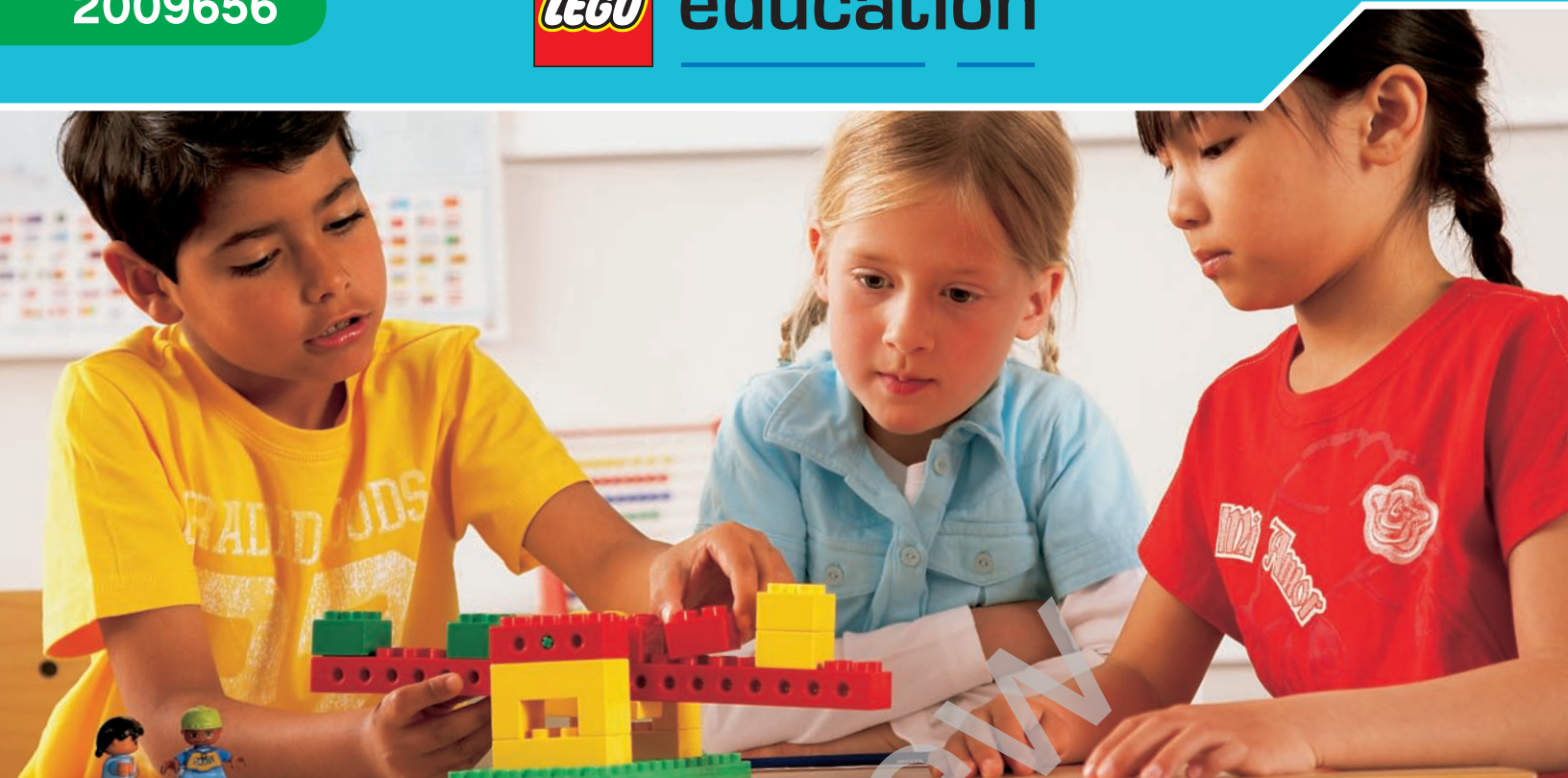


2009656



education



Teacher's Guide



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Introduction

LEGO Education is pleased to bring you the 9656 Early Simple Machines set that provides ideal opportunities for young children to develop an understanding of science concepts through investigation and hands-on activities.

Who is it for?

The material is designed for use by teachers of grades K-2. No prior science training is required – only creativity and enthusiasm.

Working alone or in pairs, children of all abilities from 5 years and up can build, enjoy and learn from the 8 models and activities.

What is it for?

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

What is it?

The 9656 Early Simple Machines set comes in a practical and durable storage box. Inside the storage box you will find the 101 bricks, 8 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 activity pack contains 8 main activities and 4 problem-solving activities.

The 9656 Early Simple Machines set is designed for easy use, easy classroom management, and lots of fun!



How to use it?

Building instructions

The 8 building instructions support the children's 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 children may need your help and encouragement.

We recommend children 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 8 activities, including connect stories, and questions and further ideas for investigating – all ready for you to introduce to your children.

Every activity is carefully linked to the overall objectives of the Science, and Design and Technology curriculum. At the start of each activity, we list outcomes unique to that particular activity. The outcomes that are common to all activities are listed in the section called 'What are the curriculum highlights'. We also list the specific vocabulary focus and the additional materials needed for each activity.

The lessons follow LEGO Education's well-tested methodology – the 4C approach: Connect, Construct, Contemplate and Continue. This enables you to progress naturally through the activities.

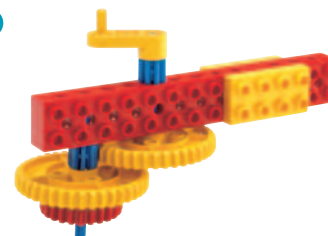
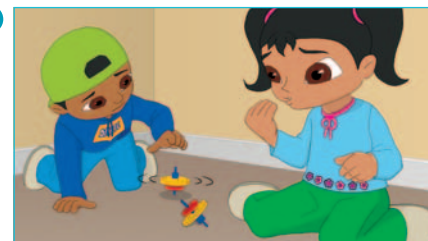
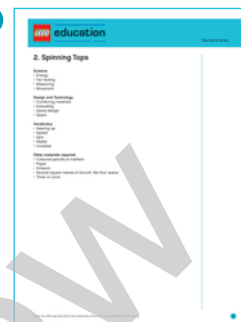
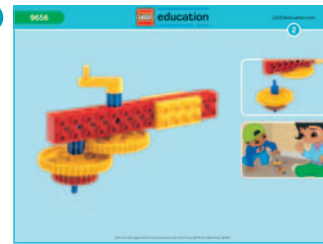
Connect

A short story introduces Sam and Sara and provides the children 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 children.

Construct

Using the building instructions, children 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 children carrying out scientific investigations with what they have constructed.

Through their investigations the children 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 children's 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 child.

Continue

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

Worksheets for the children

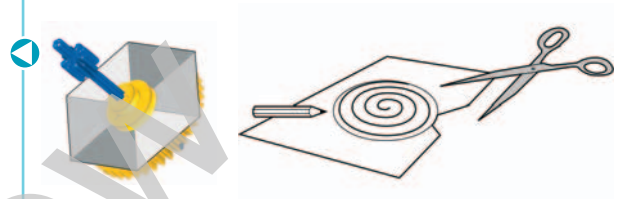
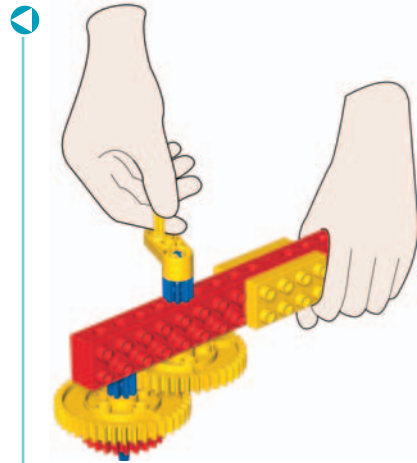
The illustrations in the worksheets will guide the children to use and explore their models without too much assistance. The children will predict, test and describe outcomes using words presented in the worksheet. These words will encourage the children to use the correct vocabulary to describe concepts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

The worksheets can also help you in assessing the individual child's level and achievement. They also form a valuable part of the children's log books.

Problem-solving activities

Each of the 4 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 children have to incorporate into their model solution. The 'Fair testing and fun' questions and suggested answers help focus the models to meet the design brief criteria and support the test situation. A suggested model solution helps you, the teacher, help the children. It is not the one and only solution to the problem! Children must always be encouraged to build their own solution to a given problem.

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



Experiment Log		
Name: _____		
Using as target?		
	My prediction	What I observed
A		
B		
		Left Longer

Can you design your own spinning top?	
Draw your best spinning top design	



How much time do I need?

Each activity can be carried out within a lesson. A double lesson is ideal for more in-depth investigations of the key learning area and to allow children to make creative variations of their own. For the open-ended problem-solving activities children may need more time to build and explain their models.

Enjoy!

LEGO Education

Preview



What are the curriculum highlights?

The process of children actively building, exploring, investigating, enquiring and communicating develops a wide range of skills, knowledge and understanding. For more details see the curriculum grid on the next page. Here is an overview:

Science

Investigating energy, force, speed, the effect of friction, reading scales, fair testing, predicting and measuring, collecting data, and describing outcomes.

Design and Technology

Investigating gears, wheels, axles, levers and pulleys; matching solutions to needs, choosing appropriate materials; designing, making and testing; using instructions in 2 dimensions to create 3-dimensional models; working cooperatively in a team; and evaluating.

Mathematics

Both non-standard and standard measurement of distance, time, weight (mass) and reading scales. Counting, calculating, shape and problem-solving.

Preview

	Key Science Curriculum Scientific enquiry including investigating the effect of variables on the performance of simple machines, predicting and estimating the performance of simple machines. Careful observation, describing and presenting results, plus:	Key D & T Curriculum Working with different mechanical and structural components to develop specific knowledge and understanding. Evaluating products against technical criteria; developing design skills, plus:
1. Pinwheel	<ul style="list-style-type: none"> Investigating wind power Investigating area 	<ul style="list-style-type: none"> Properties of materials Designing
2. Spinning Top	<ul style="list-style-type: none"> Investigating gearing Investigating rotation 	<ul style="list-style-type: none"> Designing mechanical toys Structures and stability
3. Seesaw	<ul style="list-style-type: none"> Investigating balance Investigating weight 	<ul style="list-style-type: none"> Levers Designing mechanical toys
4. Raft	<ul style="list-style-type: none"> Investigating wind power Investigating area 	<ul style="list-style-type: none"> Properties of materials
5. Car Launcher	<ul style="list-style-type: none"> Investigating pushes Investigating friction Investigating inclined plane 	<ul style="list-style-type: none"> Mechanisms: wheels and axles
6. Measuring Car	<ul style="list-style-type: none"> Reading scales to measure distance Investigating forces 	<ul style="list-style-type: none"> Mechanisms: worm gear Mechanisms: wheels and axles
7. Ice Hockey Player	<ul style="list-style-type: none"> Investigating gearing Investigating forces 	<ul style="list-style-type: none"> Levers Designing mechanical toys
8. Sam's New Dog	<ul style="list-style-type: none"> Investigating pulley drive and gearing 	<ul style="list-style-type: none"> Designing mechanical toys Mechanisms: pulley wheels



Early Science & Technology Learning Grid

	9656									
	Pinwheel	Spinning Tops	Seesaw	Raft	Car Launcher	Measuring Car	Ice Hockey Player	Sam's New Dog	Crossing Crocodile River	Hot Day
Science										
Scientific inquiry										
Conduct simple investigation										
Using simple equipment and tools to gather information										
Communicate investigations and explanations										
Fair testing										
Properties of materials										
Describing position and direction										
Describing way of movement										
Pushes and pulls										
Observations										
Reasoning										
Sharing findings										
Teamwork										
Technology										
Inventing and turning ideas into action										
Solve problems through design										
Constructing and testing										
Making improvements										
Discover how things work										
Energy comes in many different forms										
Transportation										
Vehicles										
Structures										
Purposeful use of tools										
Expressing ideas to other										
Engineering										
Identifying need or problem										
Modeling in two and three dimensions										
Test and evaluate										
Redesigning										
Meeting design constraints										
Math										
Whole number relationships										
Using standard and non-standard units										
Adds and subtracts whole numbers										
Estimating										
Counting										
Timing										
Measuring										
Checking estimates against measurements										
Common language of spatial sense										
Organizing lists or tables of information										
Organizing and displaying data										



1. Pinwheel

Preview



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

Preview

Connect

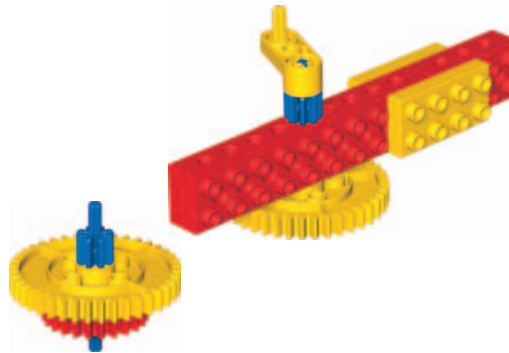
One day at the park Sam and Sara saw some other children playing with spinning tops. Their tops spun for a long time before falling over. Great fun! Sam and Sara thought about how to make some tops themselves and in no time they were spinning their own tops. But their tops didn't spin for long and soon 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!**

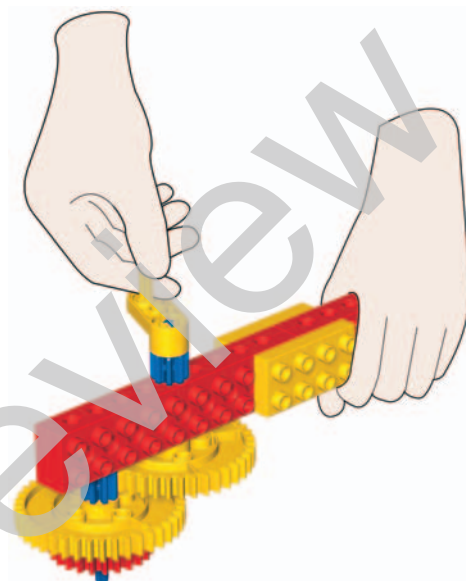


Construct

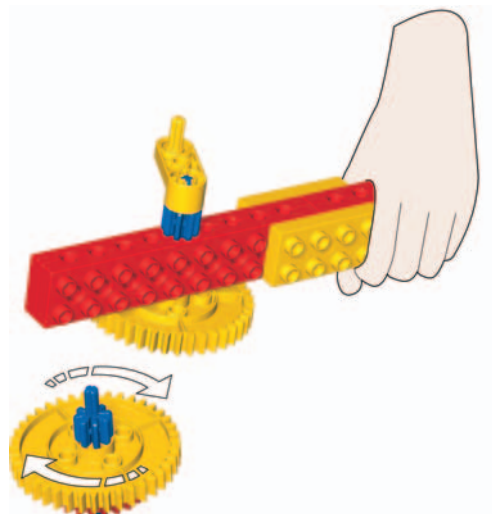
Build the Launcher and the Spinning Top using building instruction no. 2



- 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



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



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

Idea:
It may be a good idea to let younger children 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.

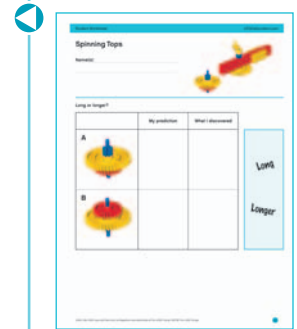
First predict which top will spin for a long time and which top will spin even longer. Write down your predictions using the words on the worksheet.

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

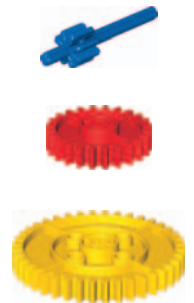
Have the children reflect on their tests by asking questions such as:

- 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

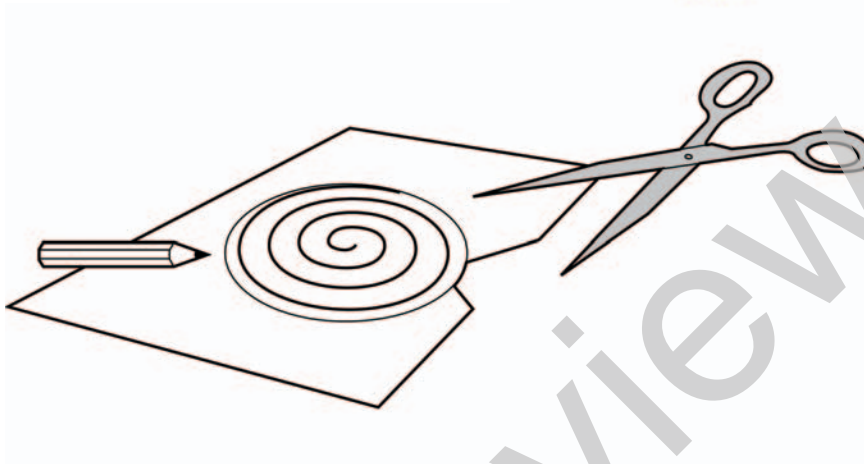
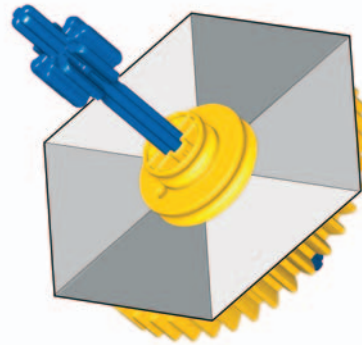
Can you design your own spinning top?

Design and make your own spinning tops.

Consider which materials and shapes would be best.

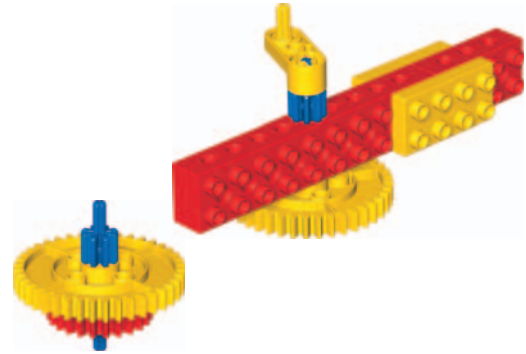
Create amazing optical effects and tops for all sorts of games.

On the worksheet, draw your best spinning top design.





Spinning Tops

Name(s): _____



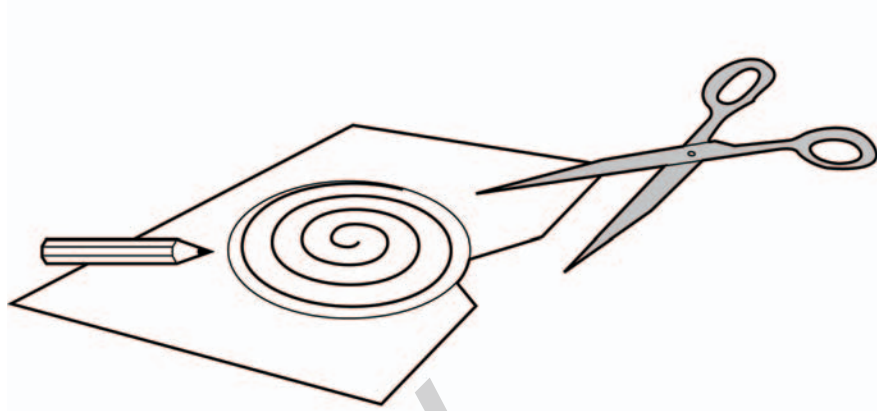
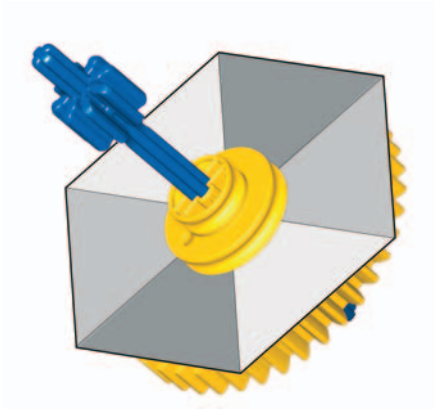
Long or longer?

	My prediction	What I discovered
A 		
B 		

Long

Longer

Can you design your own spinning top?



Draw your best spinning top design

Preview





3. Seesaw

Preview





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



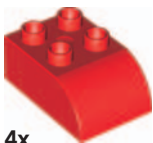
1x
LEGO® DUPLO® girl
4271511



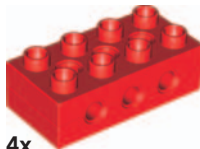
1x
LEGO® DUPLO® boy
4502103



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



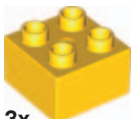
4x
Brick with arch, 2x3, red
230221



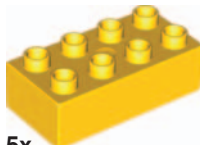
4x
Brick with holes, 2x4, red
75349



2x
Plate, 2x4, yellow
4160152



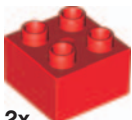
3x
Brick, 2x2, yellow
343724



5x
Brick, 2x4, yellow
301124



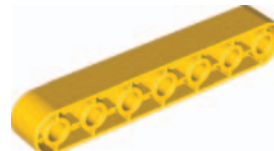
2x
Bridge element, 2x4x2, yellow
4221004



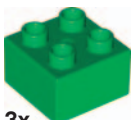
2x
Brick, 2x2, red
343721



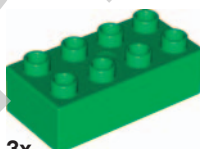
4x
Brick, 2x4, red
301121



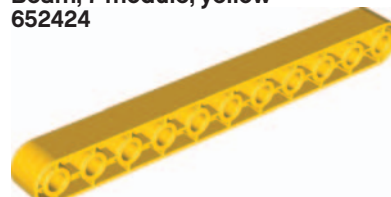
2x
Beam, 7-module, yellow
652424



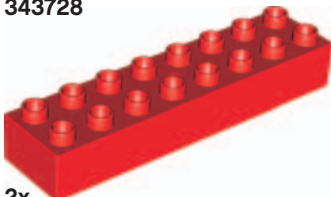
3x
Brick, 2x2, green
343728



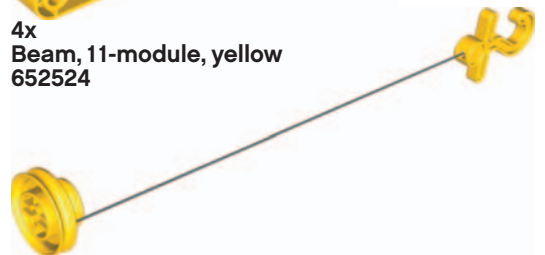
3x
Brick, 2x4, green
301128



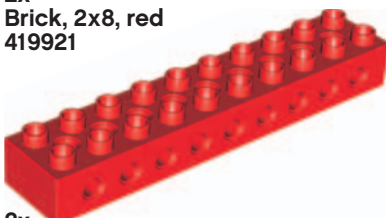
4x
Beam, 11-module, yellow
652524



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



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



1x
Worm gear, blue
4271573



2x
Gear, 24-tooth crown, red
652921



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



6x
Connector peg, handle, yellow
4493718



2x
Gear, 40-tooth crown, yellow
4501044



7x
Axle, 6-module, grey
4211534



2x
Belt, blue
71059



15x
Hub/pulley wheel, yellow
4271570



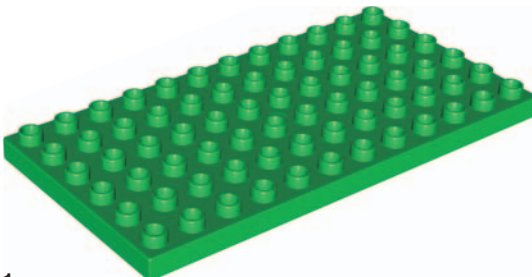
5x
Axle, 8-module, green
652128



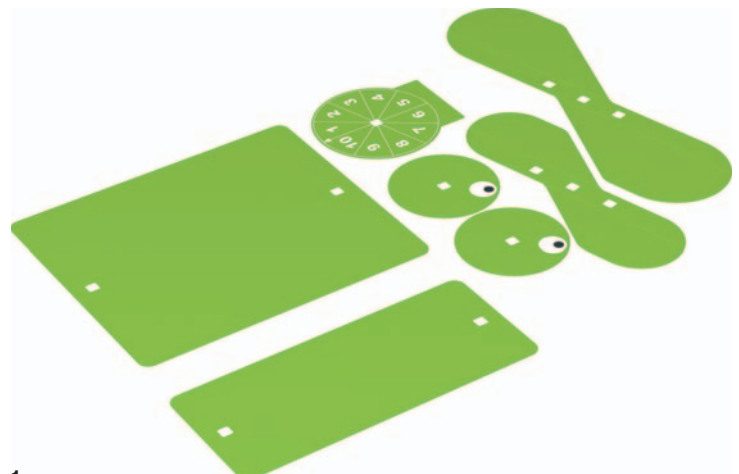
1x
Gear block, transparent
4113297



4x
Tyre, black
4514411



1x
Plate, 6x12, green
4281607



1x
Plastic forms sheet, green
4520270

Preview

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