2009656

LEGO education

Teacher's Guide

LEGO education

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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 Key Stage 1. 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.

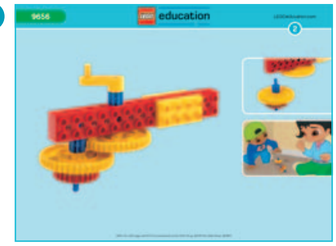
What is it?

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.

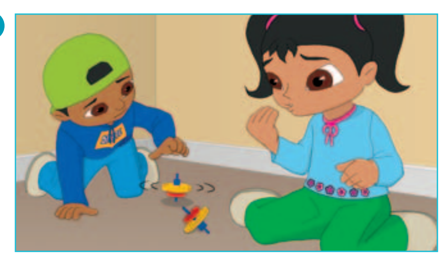
Teacher's Notes

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.

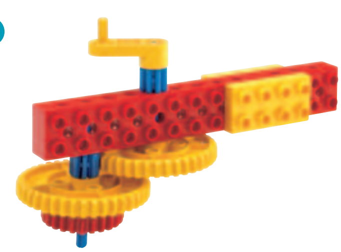
Connect



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.

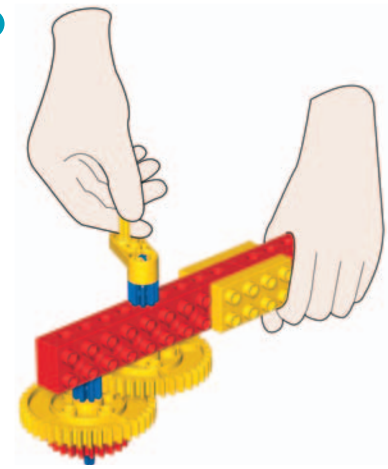
Construct



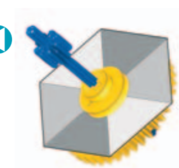
Using the building instructions, children build models embodying the concepts related to the key learning areas. Tips are provided for testing and making sure each model functions as intended.

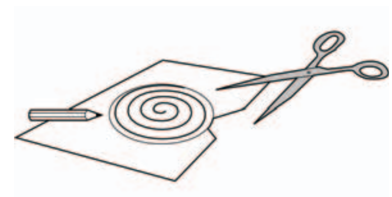
Contemplate
This involves children carrying out scientific investigations with what they have constructed.
Through their investigations the children will learn to identify and compare test results. The activities will introduce them to the concepts of measurement, speed, balance, mechanical movement, 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.



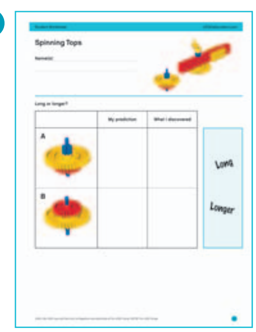
Continue
Ideas are provided for further investigations drawing on the children's creativity and previous experiences. The children will experiment, design additions or changes to their models, and invent related games.





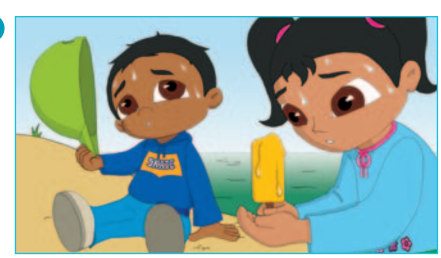
Worksheets for the children
The illustrations in the worksheets will guide the children to use and explore their models without too much assistance. The children will predict, test and describe outcomes using words presented in the worksheet. These words will encourage the children to use the correct 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.



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!
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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.

	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	• Investigating wind power • Investigating area	• Properties of materials • Designing
2. Spinning Top	• Investigating gearing • Investigating rotation	• Designing mechanical toys • Structures and stability
3. Seesaw	• Investigating balance • Investigating weight	• Levers • Designing mechanical toys
4. Raft	• Investigating wind power • Investigating area	• Properties of materials
5. Car Launcher	• Investigating pushes • Investigating friction • Investigating inclined plane	• Mechanisms: wheels and axles
6. Ice Hockey Player	• Investigating gearing • Investigating forces	• Levers • Designing mechanical toys
7. Measuring Car	• Reading scales to measure distance • Investigating forces	• Mechanisms: worm gear • Mechanisms: wheels and axles
8. Sam's New Dog	• Investigating pulley drive and gearing	• Designing mechanical toys • Mechanisms: pulley wheels

Links to QCA Schemes of work

There are significant links between the activities and the QCA schemes of work.
The activities are particularly appropriate for children aged 5-7, i.e. QCA Units 1 and 2.

The QCA Science **Unit 1C: Sorting and using materials**:
children learn about the characteristics and uses of a range of common materials.

The QCA Science **Unit 1E: Pushes and pulls**:
children learn about how movement can be described in many ways.

The QCA Science **Unit 2D: Grouping and changing materials**:
children learn to distinguish an object from the material from which it is made.

The QCA Science **Unit 2E: Forces and Movement**:
extends children's understanding of how push and pull affect the movement and shape of objects.

The QCA Design and Technology **Unit 1A: Moving pictures**:
children develop an understanding of simple mechanisms.

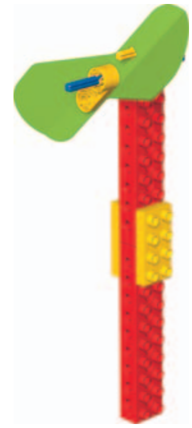
The QCA Design and Technology **Unit 1B: Playgrounds**:
children learn about framework structures and how to make them stable and able to support loads.

The QCA Design and Technology **Unit 2A: Vehicles**:
children learn about wheels and axles and how to use these when making wheeled vehicles for a specific purpose.

The QCA Design and Technology **Unit 2C: Winding up**:
children are introduced to the concept of winding mechanisms.

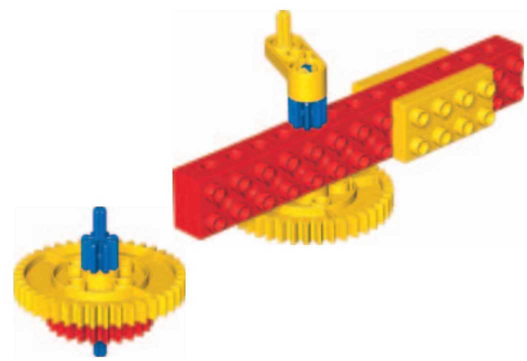
1. Pinwheel

You can use this activity to meet some of the requirements of QCA Science **Unit 1E: Pushes and pulls**; QCA Science **Unit 2E: Forces and movement**; and QCA Design and Technology **Unit 2A: Vehicles**.



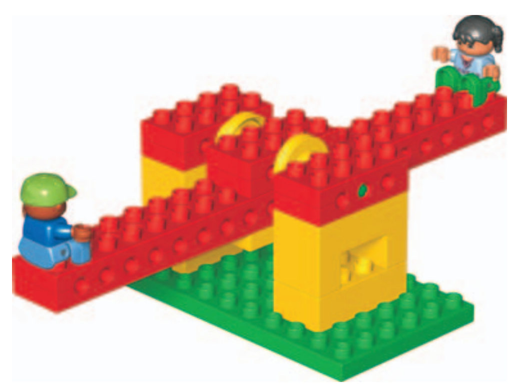
2. Spinning Top

You can use this activity to meet some of the requirements of QCA Science **Unit 1E: Pushes and pulls**; QCA Science **Unit 2E: Forces and movement**; QCA Design and Technology **Unit 1B: Playgrounds**; and QCA Design and Technology **Unit 2A: Vehicles**.



3. Seesaw

You can use this activity to meet some of the requirements of QCA Science **Unit 1E: Pushes and pulls**; QCA Science **Unit 2E: Forces and movement**; and QCA Design and Technology **Unit 1B: Playgrounds**.



4. Raft

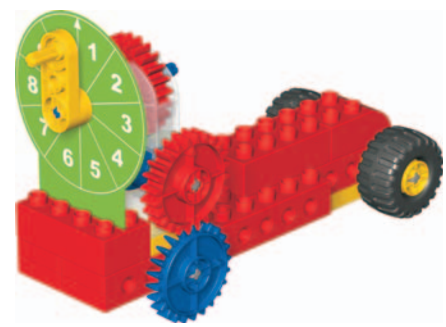
You can use this activity to meet some of the requirements of QCA Science **Unit 1C: Sorting materials**; QCA Science **Unit 1E: Pushes and pulls**; QCA Science **Unit 2D: Grouping and changing materials**; and QCA Science **Unit 2E: Forces and movement**.

5. Car Launcher

You can use this activity to meet some of the requirements of QCA Science **Unit 1E: Pushes and pulls**; and QCA Science **Unit 2E: Forces and movement**.
This activity meets some of the requirements of QCA Design and Technology **Unit 2A: Vehicles**.

6. Measuring Car

You can use this activity to meet some of the requirements of QCA Science **Unit 1E: Pushes and pulls**; QCA Science **Unit 2E: Forces and movement**; and QCA Design and Technology **Unit 2A: Vehicles**.



7. Ice Hockey Player

You can use this activity to meet some of the requirements of QCA Science **Unit 1E: Pushes and pulls**; QCA Science **Unit 2E: Forces and movement**; and QCA Design and Technology **Unit 1A: Moving pictures**.

8. Sam's New Dog

You can use this activity to meet some of the requirements of QCA Science **Unit 1E: Pushes and pulls**; QCA Science **Unit 2E: Forces and movement**; and QCA Design and Technology **Unit 2C: Winding it up**.

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
- Card
- 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.

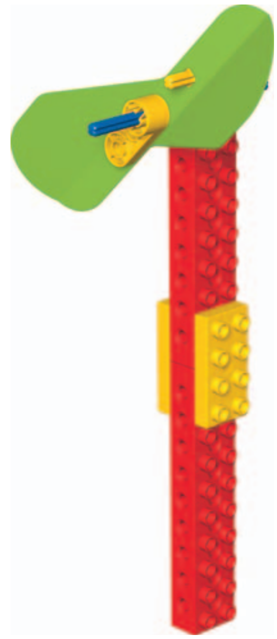
Can you help Sam and Sara build a pinwheel with wings that will turn faster?
Let's find out!

Construct

Build the Pinwheel using building instruction 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 children handle them with great care!



Contemplate

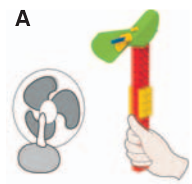
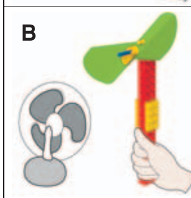
Near or far?

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 children 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…

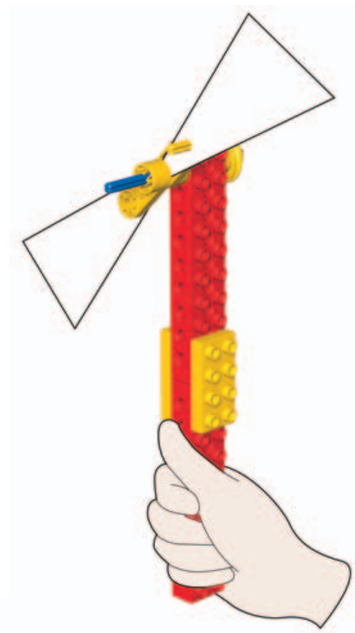
Tip:
Use a ruler to accurately measure the distance between the fan and the pinwheel.

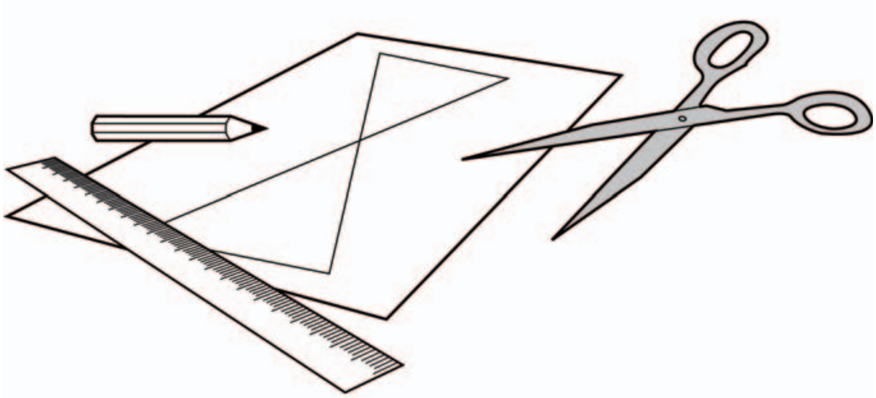
Continue

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.*



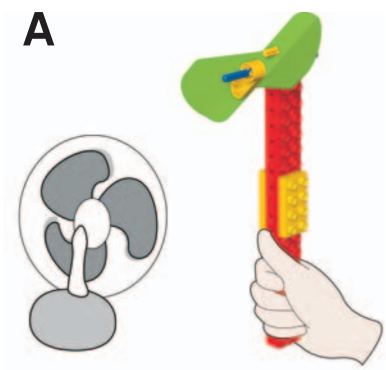
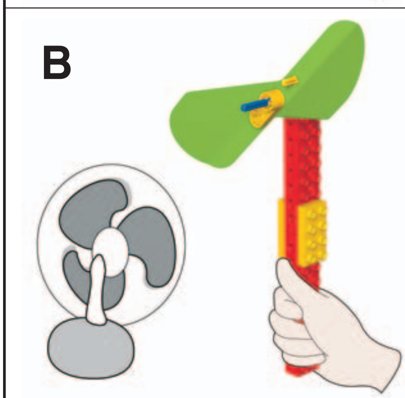


Pinwheel

Name(s): ______________________

____

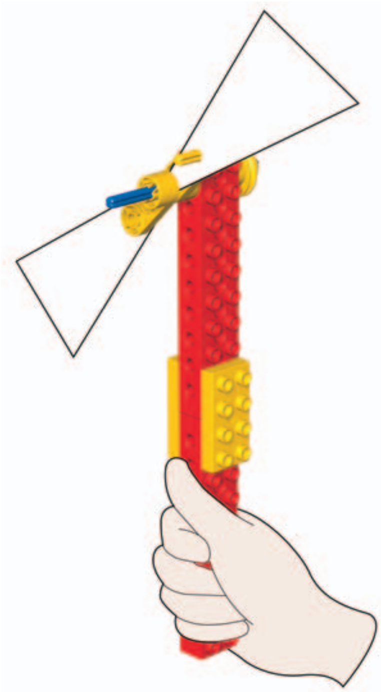
Near or far?

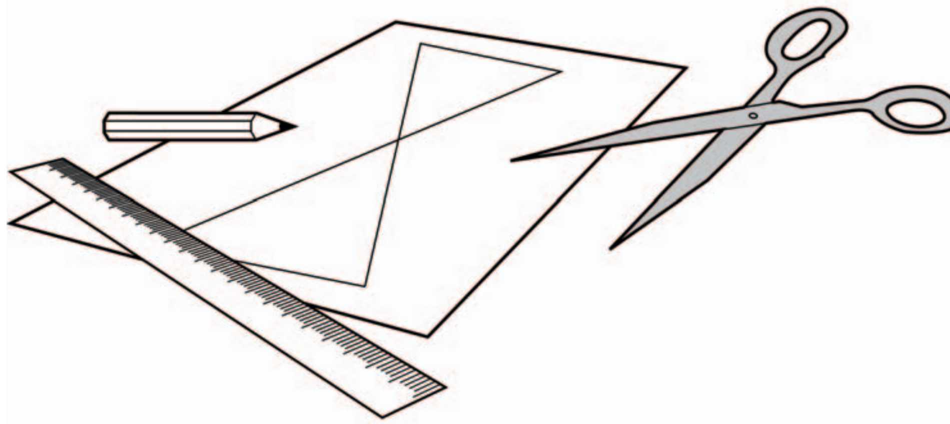
	My prediction	What I discovered
A 		
B 		

Near

Far

Can you make new wings?





Draw your best pinwheel design

LEGO education

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
- Coloured pencils or markers
- Paper
- Scissors
- Several square metres of smooth, flat floor space
- Timer or clock

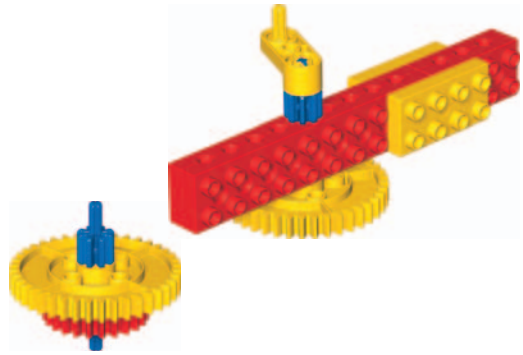
Connect

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!

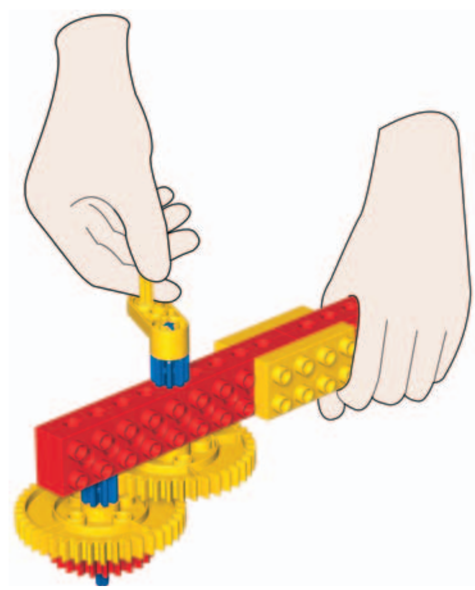
Can you help Sam and Sara build a device that can make the spinning tops spin?
Let's find out!

Construct

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

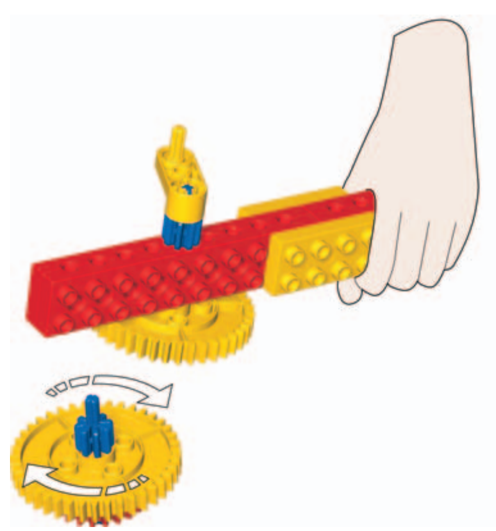


- Hold the launcher and place the gear end of the launcher over the blue gear axle
- The blue gear should mesh with the big yellow gear and spin as you turn the handle



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 children play with the top and launcher before embarking on serious testing.

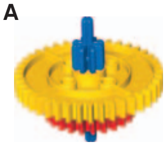
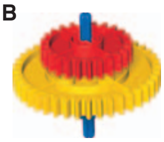
Contemplate

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.

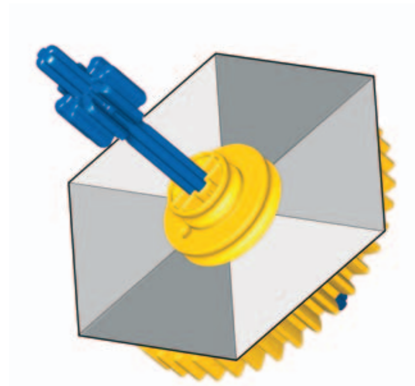
Did you know?
The blue gear has 8 teeth, the red has 24 teeth and the yellow gear has 40 teeth!

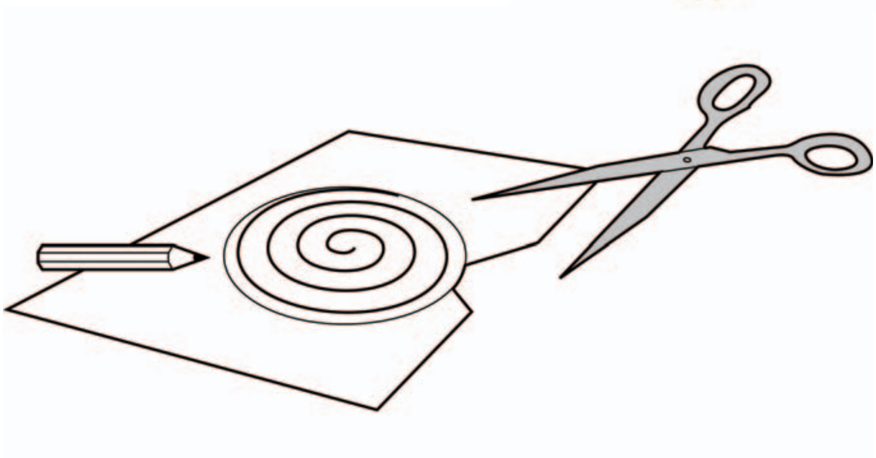
Continue

Can you design your own spinning top?

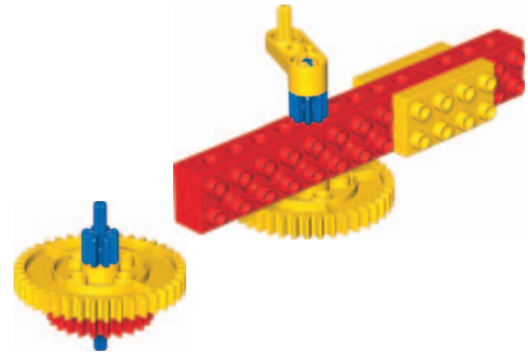
Design and make your own spinning tops.

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.



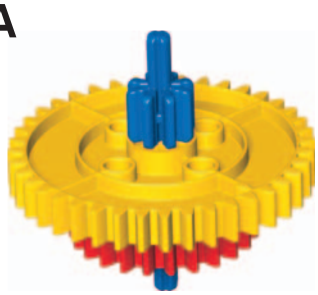


Spinning Tops



Name(s):

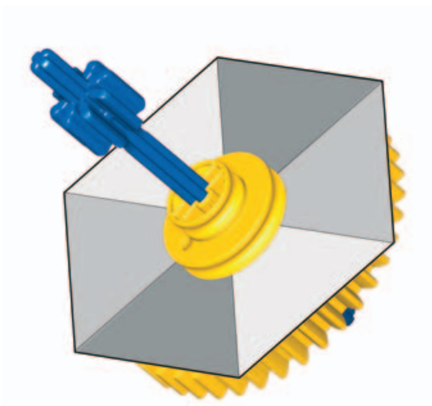
Long or longer?

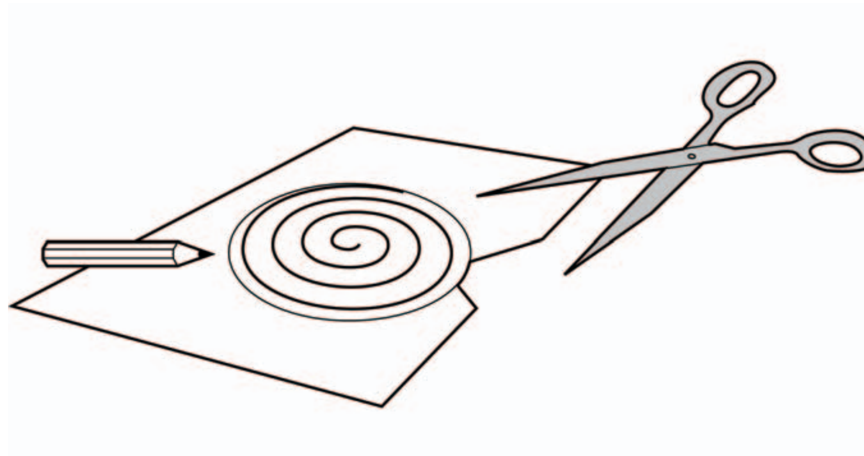
	My prediction	What I discovered
A 		
B 		

Long

Longer

Can you design your own spinning top?





Draw your best spinning top design


SKATE

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

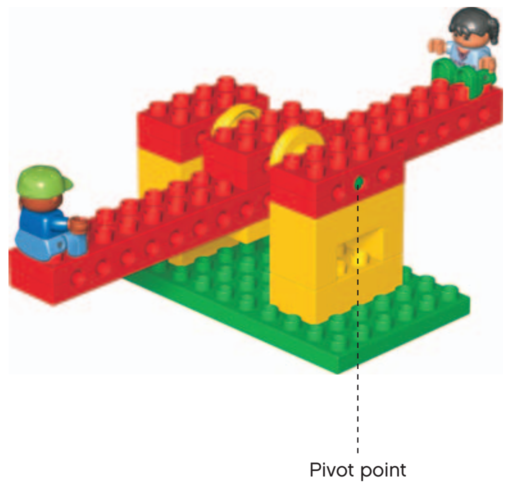
On their way home from school Sam and Sara stopped at the playground. Sam and Sara jumped onto the seesaw only to find out that something was different that day. There wasn't any going up and down. Sara was down and Sam was up. No matter how hard Sara pushed away from he ground she couldn't get herself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

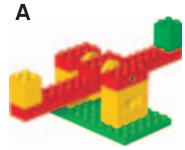
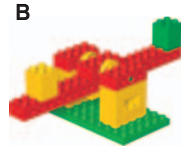
Balance or unbalanced?

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.

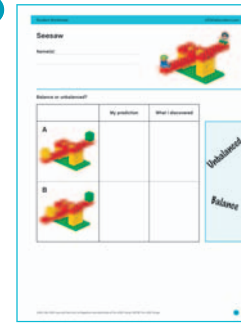
Next, test the different brick positions.
Write down your findings using the words on the worksheet.

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 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?
- Describe how the model works.

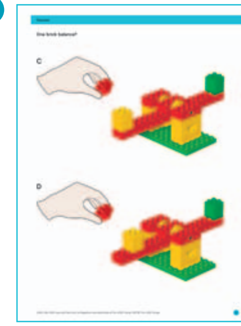


Continue

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.



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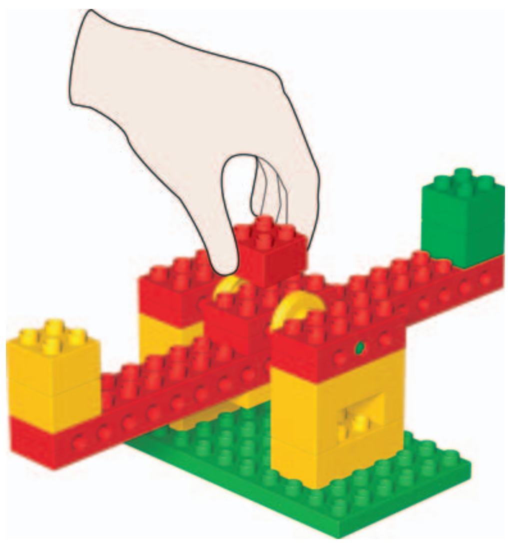
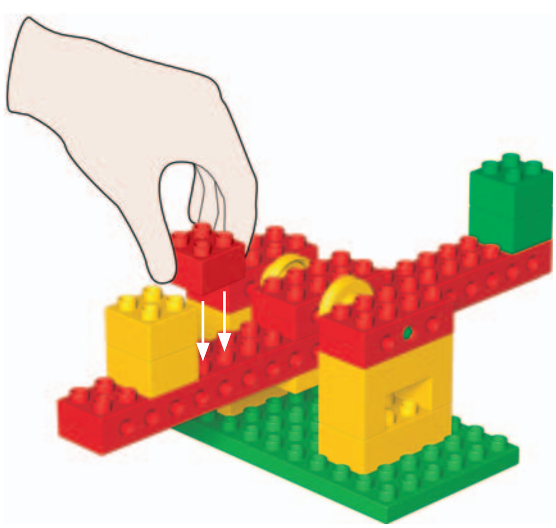
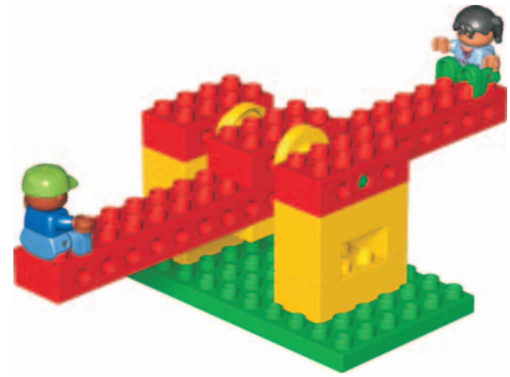


D



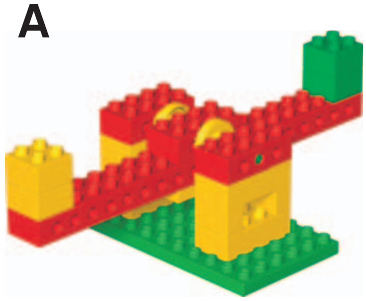
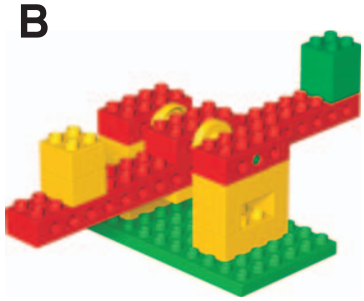
Seesaw



Name(s): ______________________________

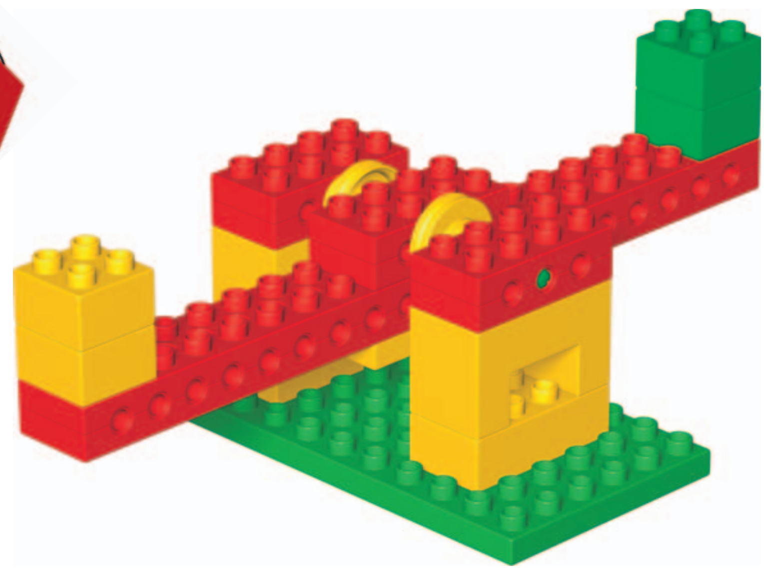
____

Balance or unbalanced?

	My prediction	What I discovered
A 		
B 		

One brick balance?

C



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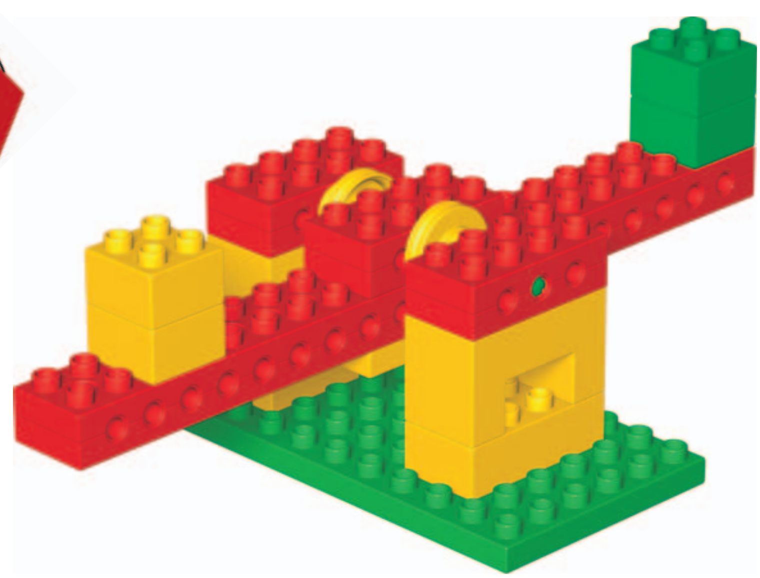



SKATE

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

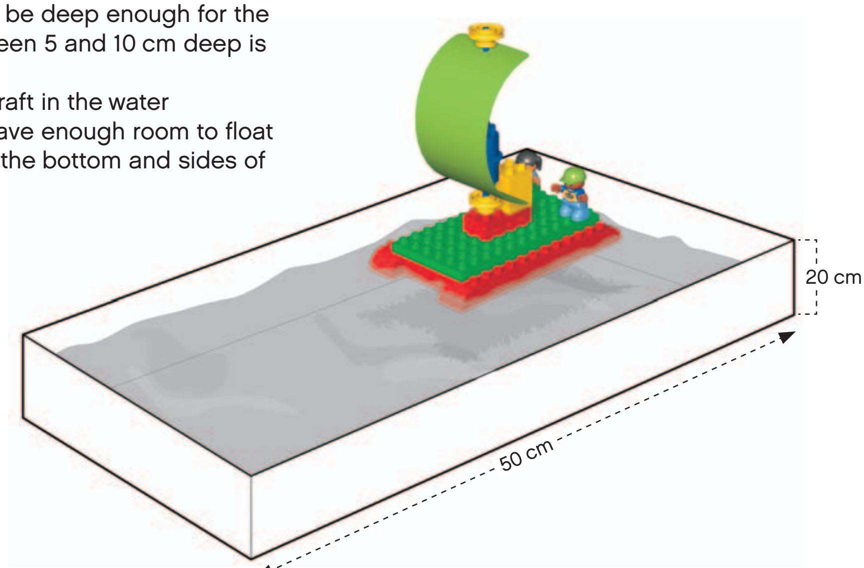
Captains Sam and Sara are dangerous pirates on their way to Treasure Island.
They are going to bury all their precious treasure of silver and gold.
They must hurry so nobody sees them since they wouldn't want anyone to steal their loot.
But Captains Sam and Sara and their infamous raft aren't going very 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 instruction no. 4

- Fill the tub
- The tub should be a minimum of 50 cm long
- The water should be deep enough for the raft to float. Between 5 and 10 cm 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

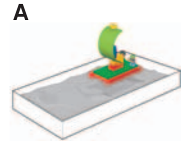
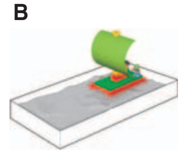
Fast or faster?

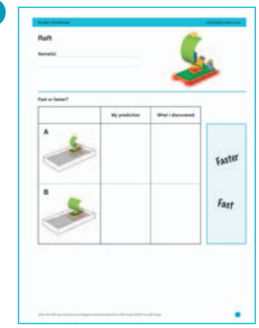
Blow or wave the box lid as a 'breeze maker'. Find out which sail will make your raft sail faster.

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 children 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.

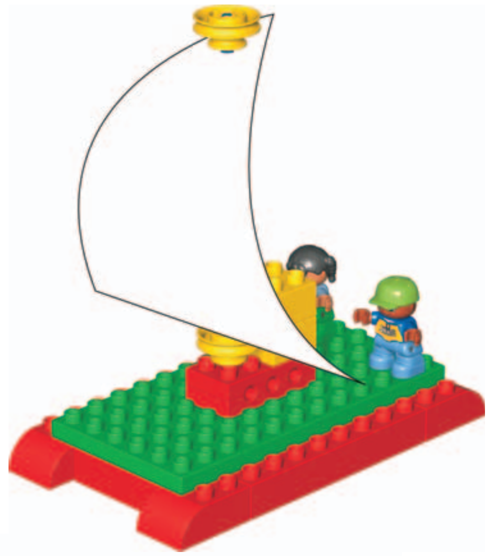
Did you know?
The air trapped under the LEGO® DUPLO® bricks makes them float (buoyant).
If all the air leaks out, the raft will sink.

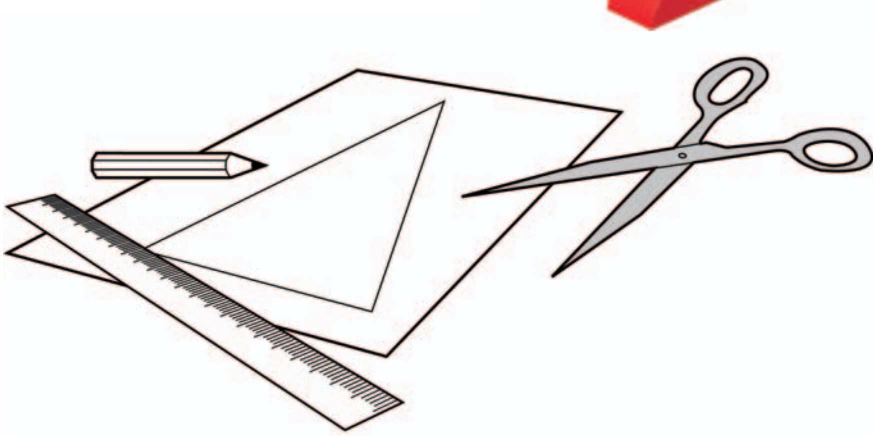
Continue

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.*



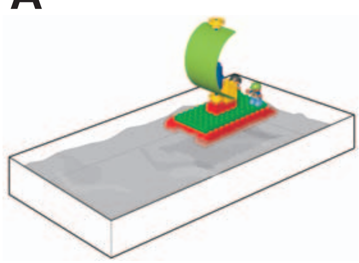
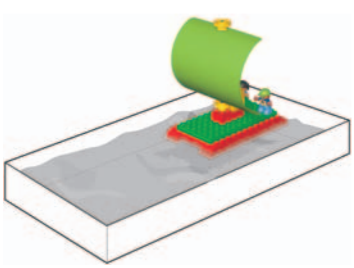


Optional: Build your own raft
Can you build a raft that will carry lots of silver and gold – without sinking?

Raft

Name(s):

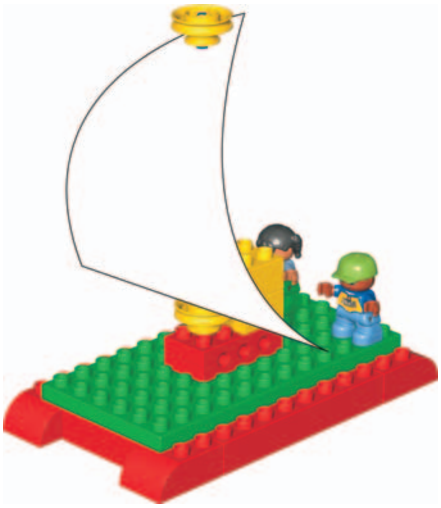
Fast or faster?

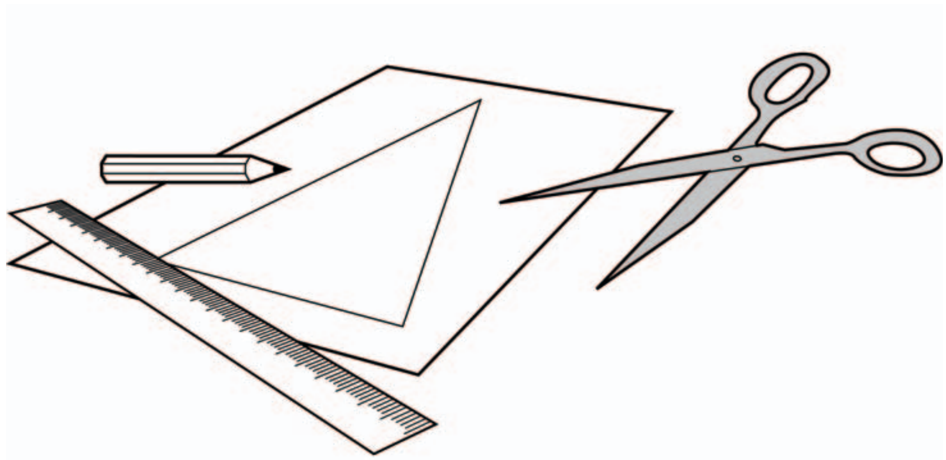
	My prediction	What I discovered
A 		
B 		

Faster

Fast

Can you make a new sail?





Draw your best sail design

LEGO education

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
- Tyres
- Wheels

Other materials required
- Boxes or books
- Card
- Plank or wooden shelf – 150 cm 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!

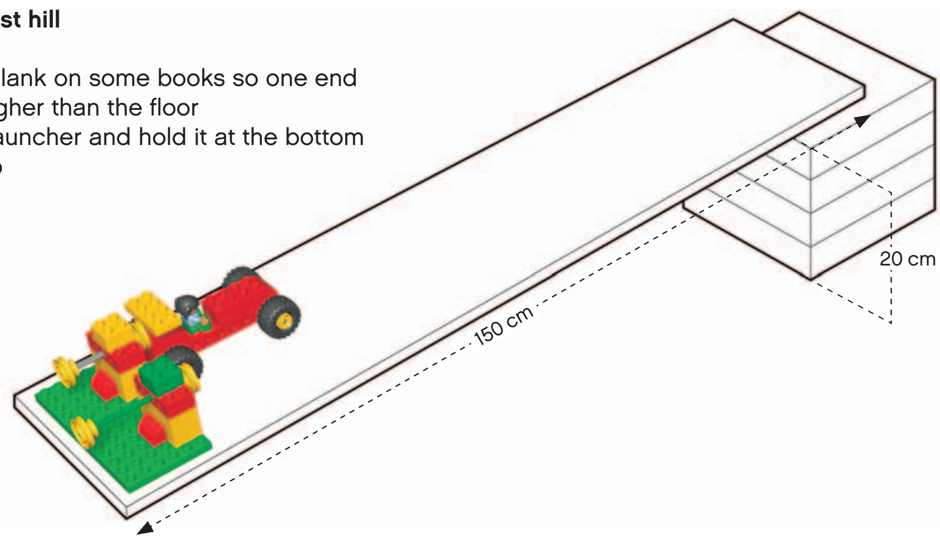
Construct

Build the car and launcher using building instruction 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 20 cm 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

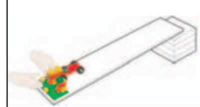
Far or further?

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 children 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.

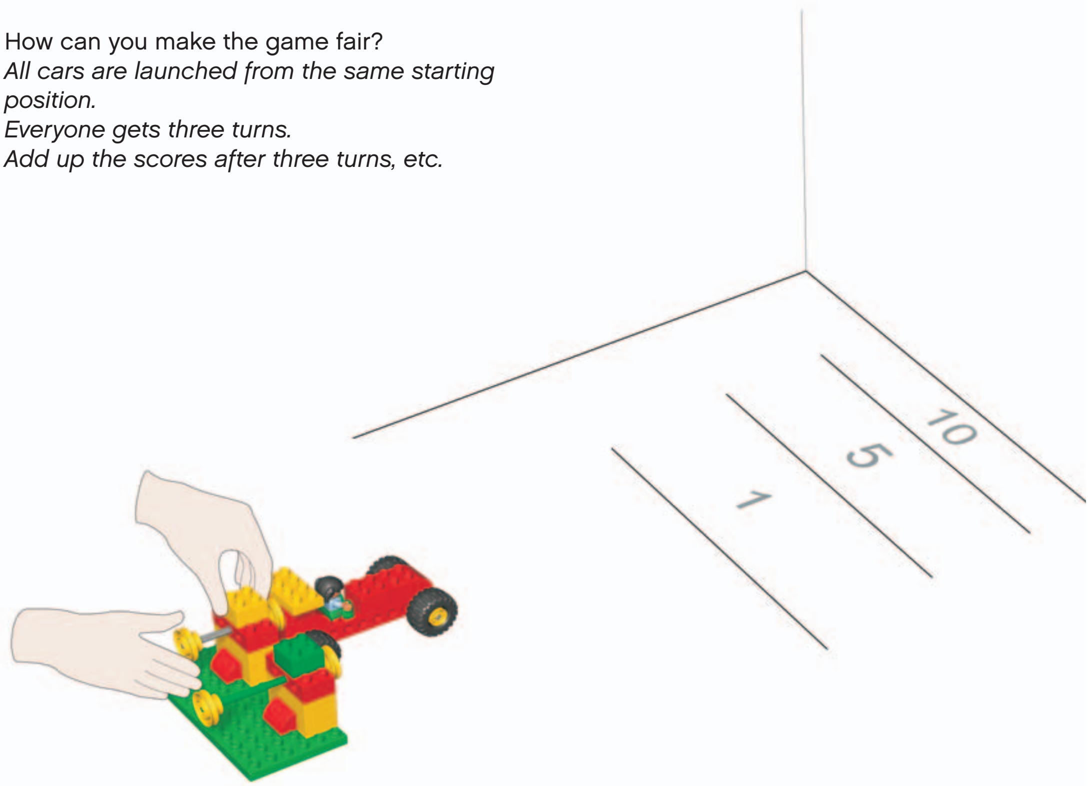
Continue

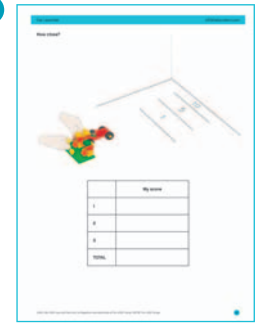
How close?

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.

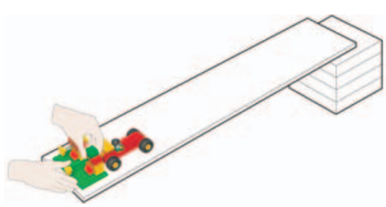




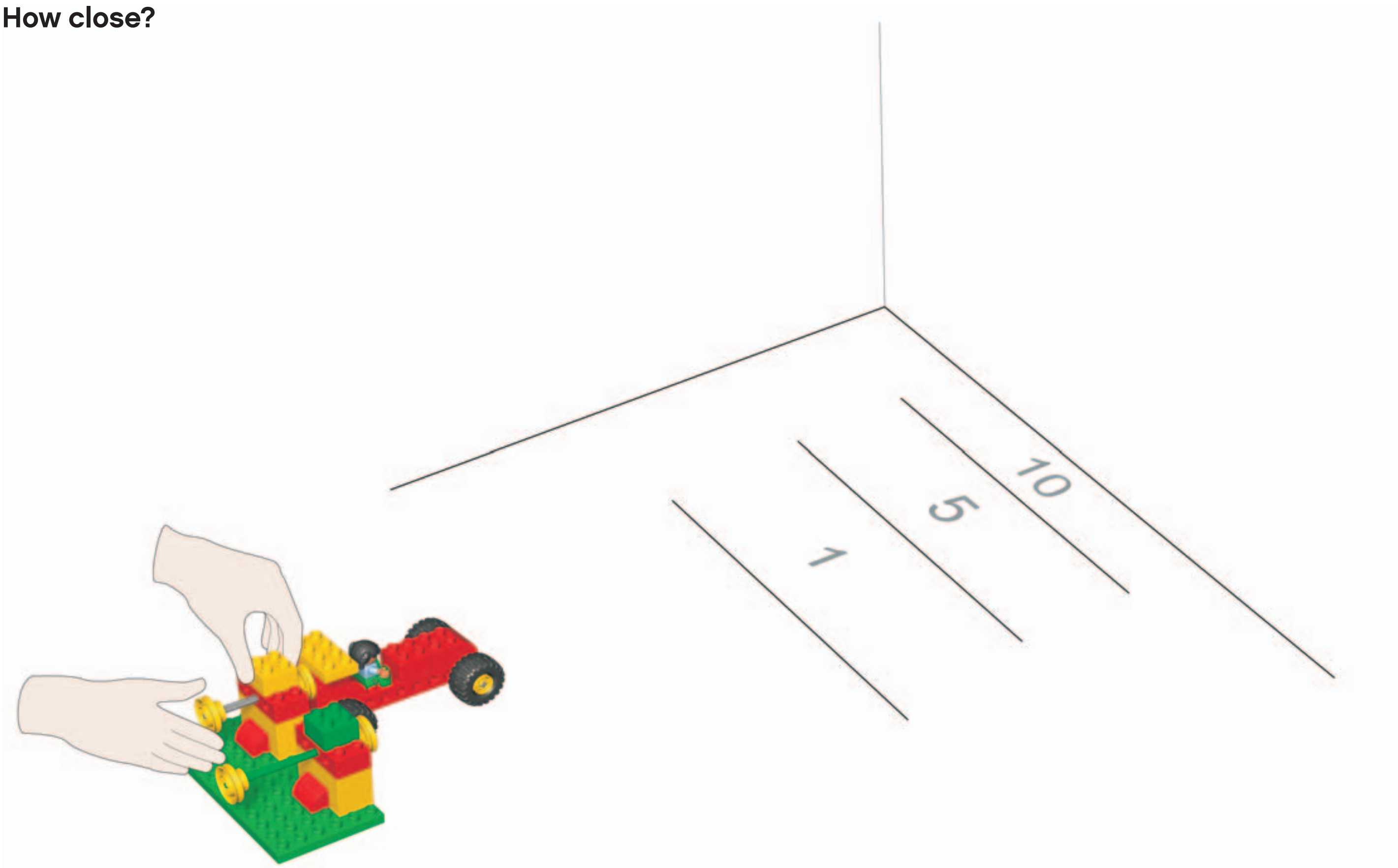
Car Launcher

Name(s):

Far or further?

	My prediction	What I discovered
A 		
B 		

How close?



	My score
1	
2	
3	
TOTAL	

LEGO education

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 card
- Plank or wooden shelf – 150 cm or more
- Ruler

Connect

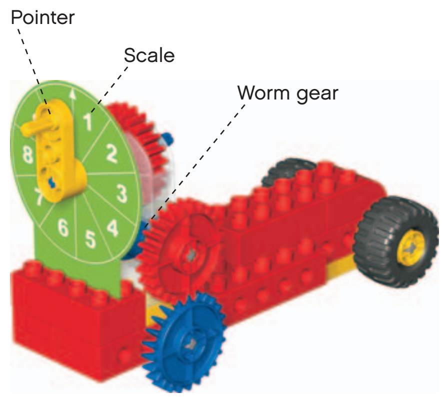
After a day of measuring at school, Sam and Sara have tried to measure almost everything on their way home. When they get to their favourite play area, Sam wonders how far it is from the tree house to the ice-cream shop.
Sam says that it doesn't look that far from where he's standing. Sam pulls out a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

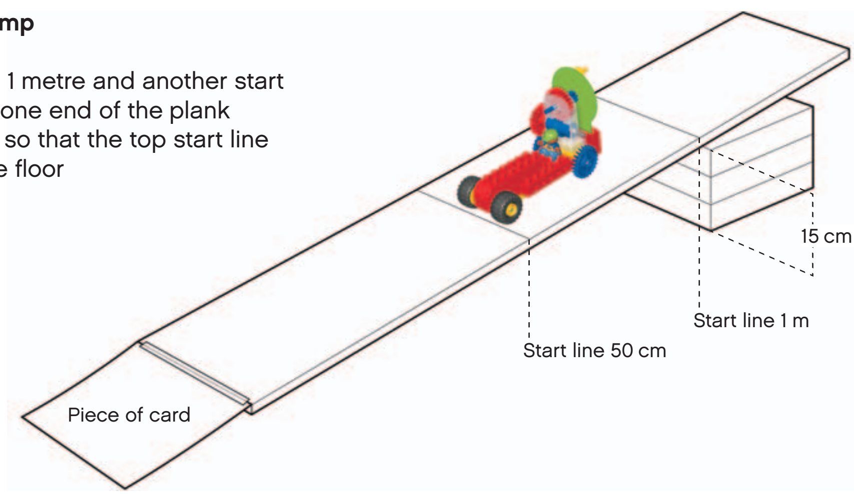
Build the Measuring Car using building instruction no. 6

- 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

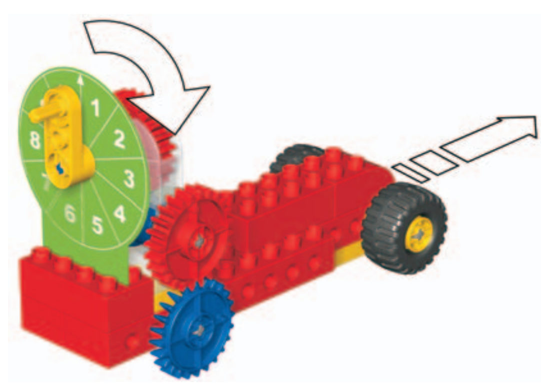
- Draw a start line 1 metre and another start line 50 cm from one end of the plank
- Place a support so that the top start line is 15 cm from the floor



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 travelled forward



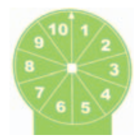
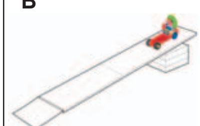
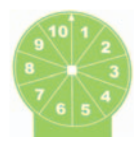
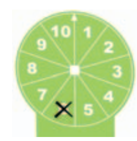
Contemplate

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.

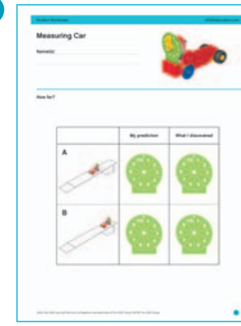
First predict how far the Measuring Car will roll down from the two start lines.
Mark your predictions using the scale and numbers on the worksheet.

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 children 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.

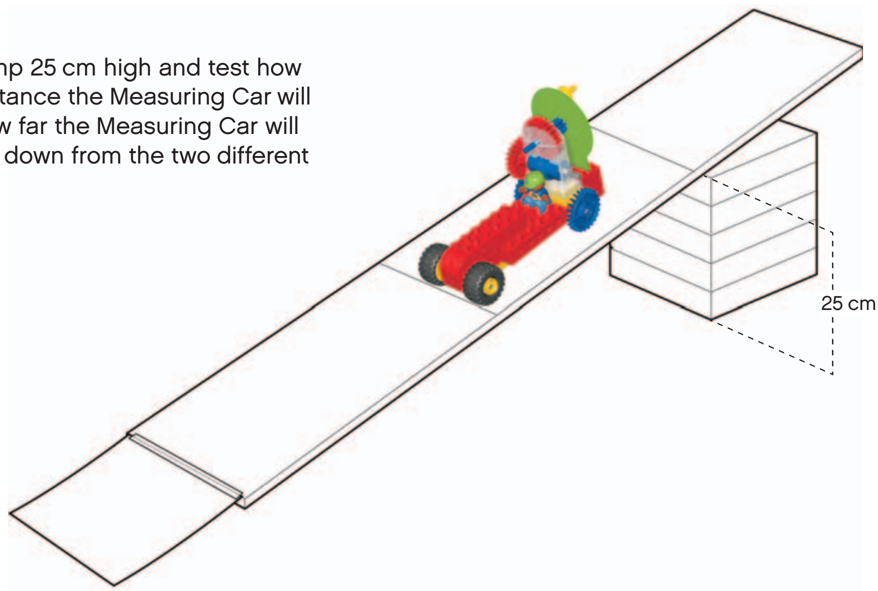


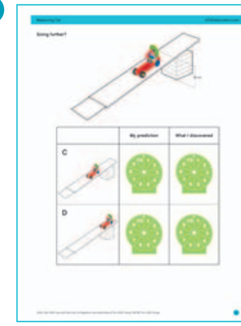
Tip:
Remember to reset the pointer to zero after every test by turning the blue gear wheels until the pointer is at the top of the scale.

Continue

Going further?

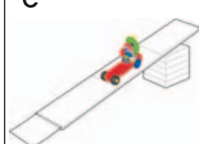
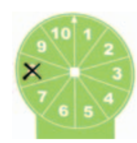
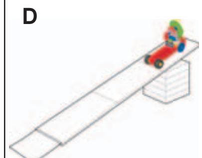
Make your test ramp 25 cm high and test how this affects the distance the Measuring Car will travel. Find out how far the Measuring Car will travel when rolling down from the two different start lines.



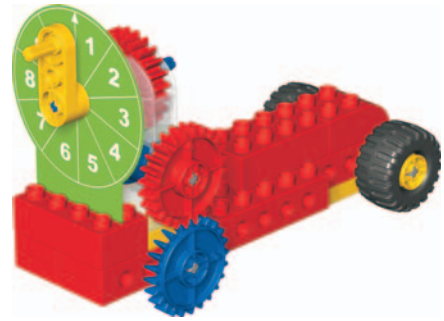


First predict how far the Measuring Car will roll down from the two start lines.
Mark your predictions using the scale and numbers on the worksheet.

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.

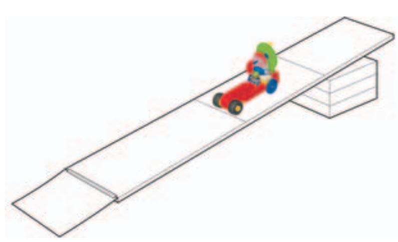
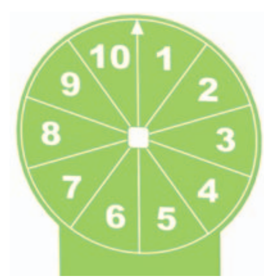
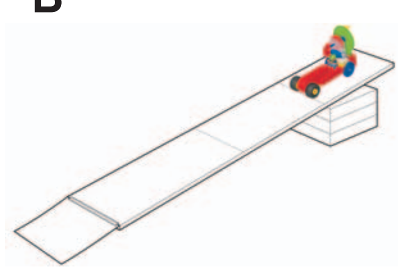
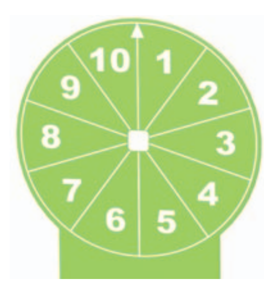
	My prediction	What I discovered
C 		
D 		

Measuring Car

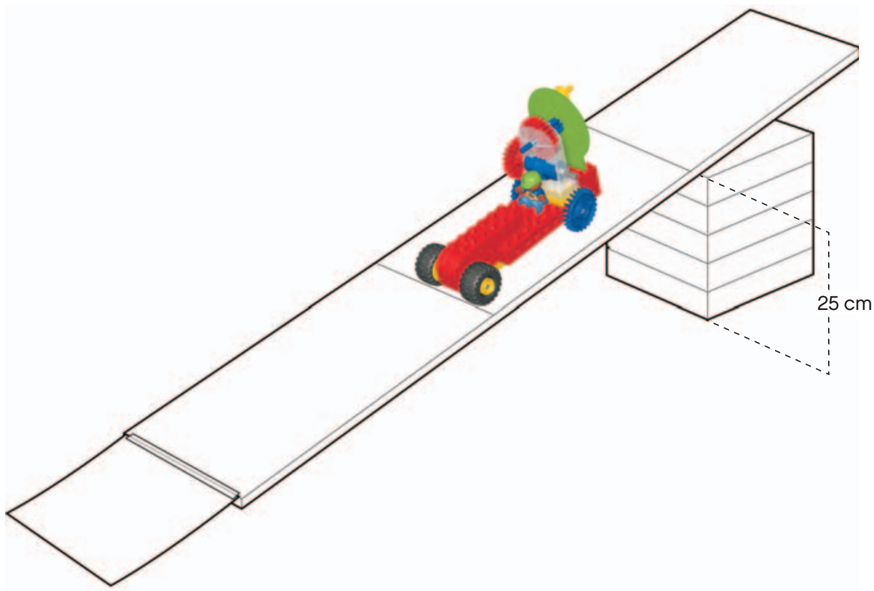


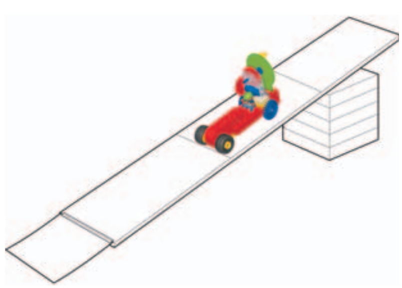
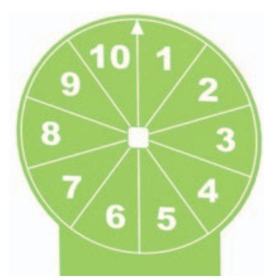
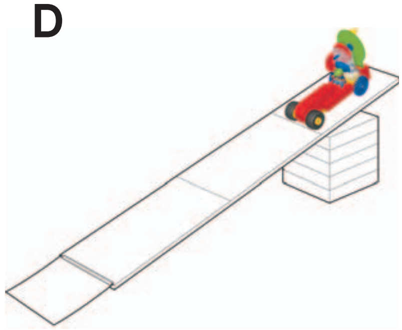
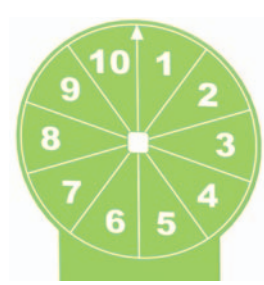
Name(s):

How far?

	My prediction	What I discovered
A 		
B 		

Going further?



	My prediction	What I discovered
C 		
D 		

LEGO education

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 metres of smooth floor
- Ruler

Connect

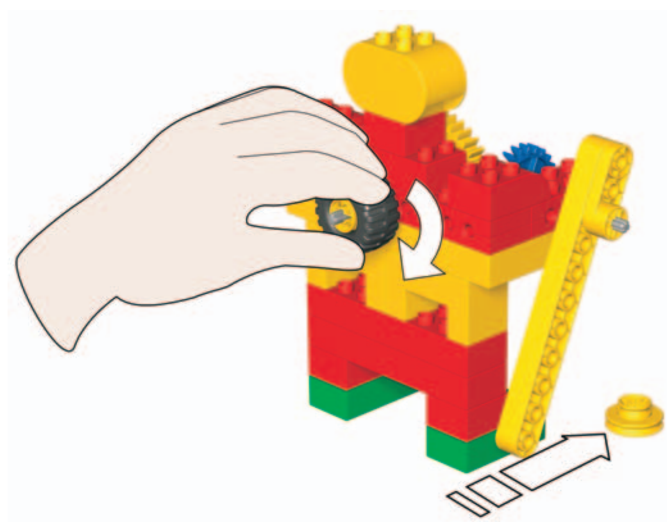
Sam is a great ice hockey goalkeeper and Sara is fantastic in attack. They have arranged an ice hockey match against the school's best ice hockey team. Sara believes their biggest problem is making the difficult long shots. To become unbeatable Sara says that all they need is a big third team member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

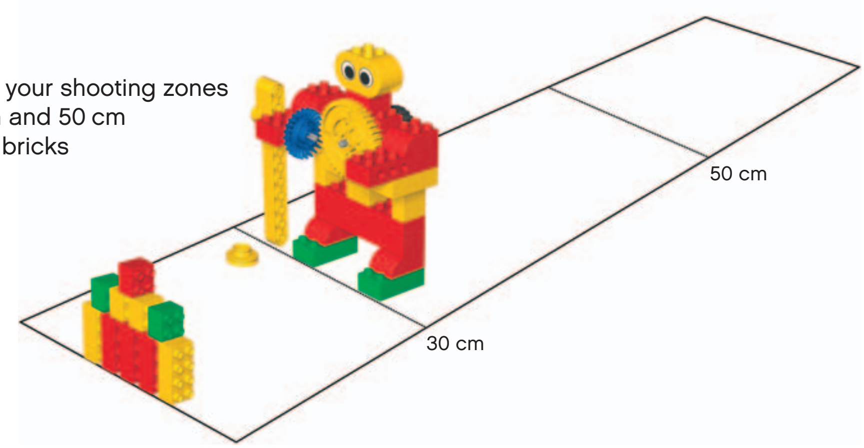
Build the Ice Hockey Player using building instruction no. 7

- 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 30 cm and 50 cm
- Make a goal using bricks



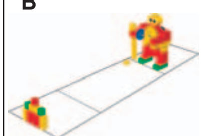
Contemplate

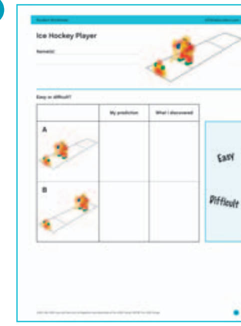
Easy or difficult?

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 children 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

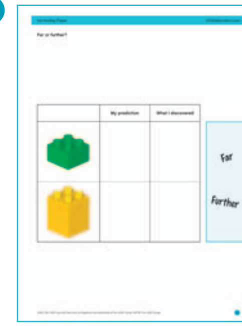
Far or further?

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

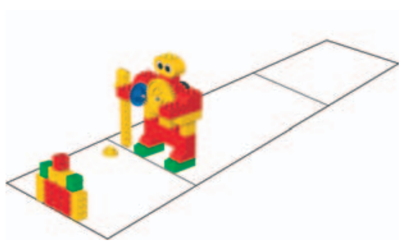
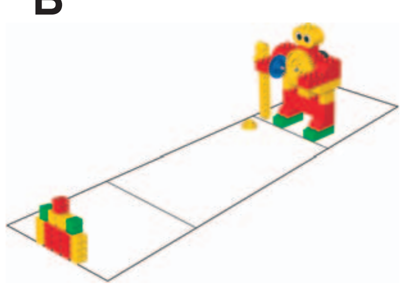


Ice Hockey Player

Name(s): ______________________

____

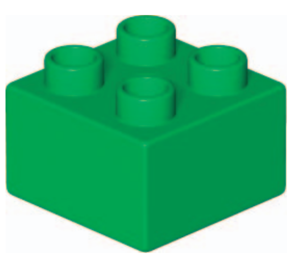
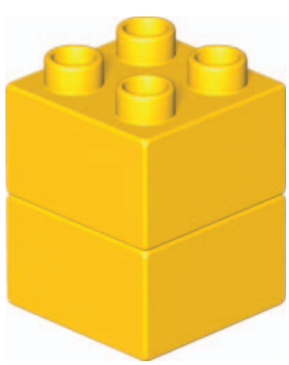
Easy or difficult?

	My prediction	What I discovered
A 		
B 		

Easy

Difficult

Far or further?

	My prediction	What I discovered
		
		

Far

Further

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
- Coloured pencils or markers
- Paper
- Scissors

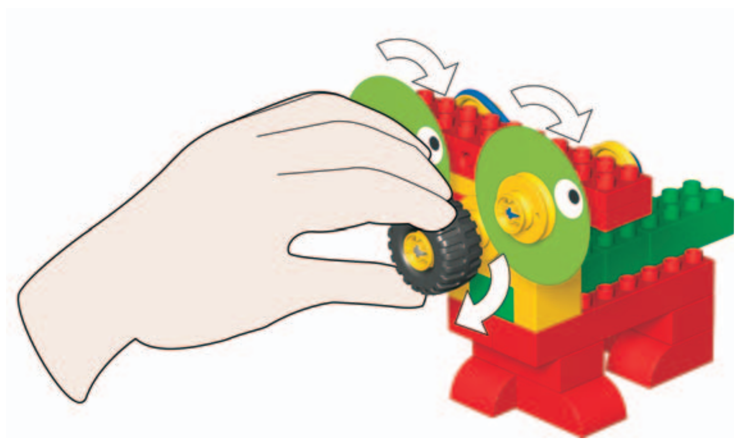
Connect

Sam's neighbours 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.

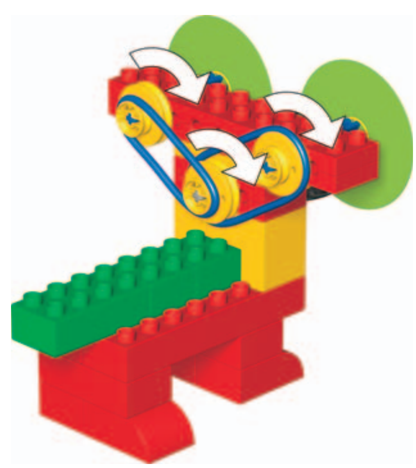
Can you help her build a Buddy-look-alike with big eyes that move?
Let's find out!

Construct

Build Sam's New Dog using building instruction 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



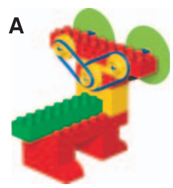
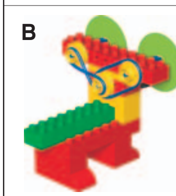
Contemplate

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 children 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.

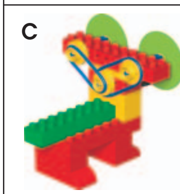
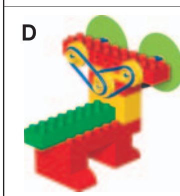
Continue

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

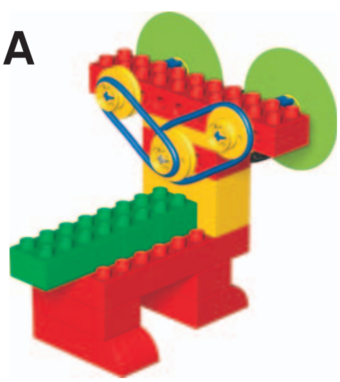
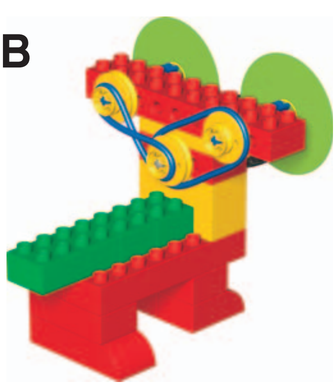
Optional: Dress up Sam's New Dog

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

Name(s):

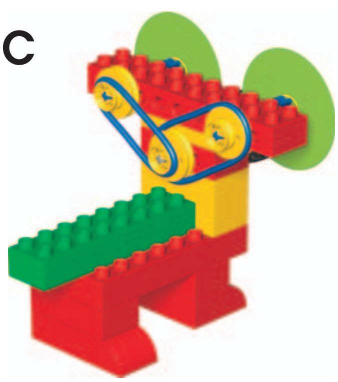
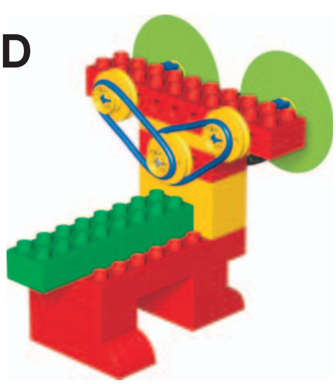
Same or opposite?

	My prediction	What I discovered
A 		
B 		

Opposite

Same

Same or different?

	My prediction	What I discovered
C 		
D 		

LEGO education

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 20 cm long without touching the water
• is at least 10 cm 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

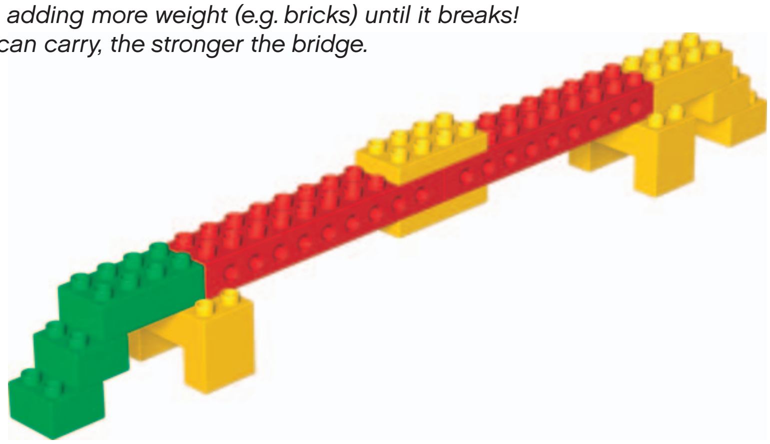
Optional materials required
- Ruler

Fair testing and fun
- Is the bridge 20 cm long or even longer?
  Measure with a ruler or with the LEGO® DUPLO® box lid, which is 27 cm wide.
  The longer, the better.

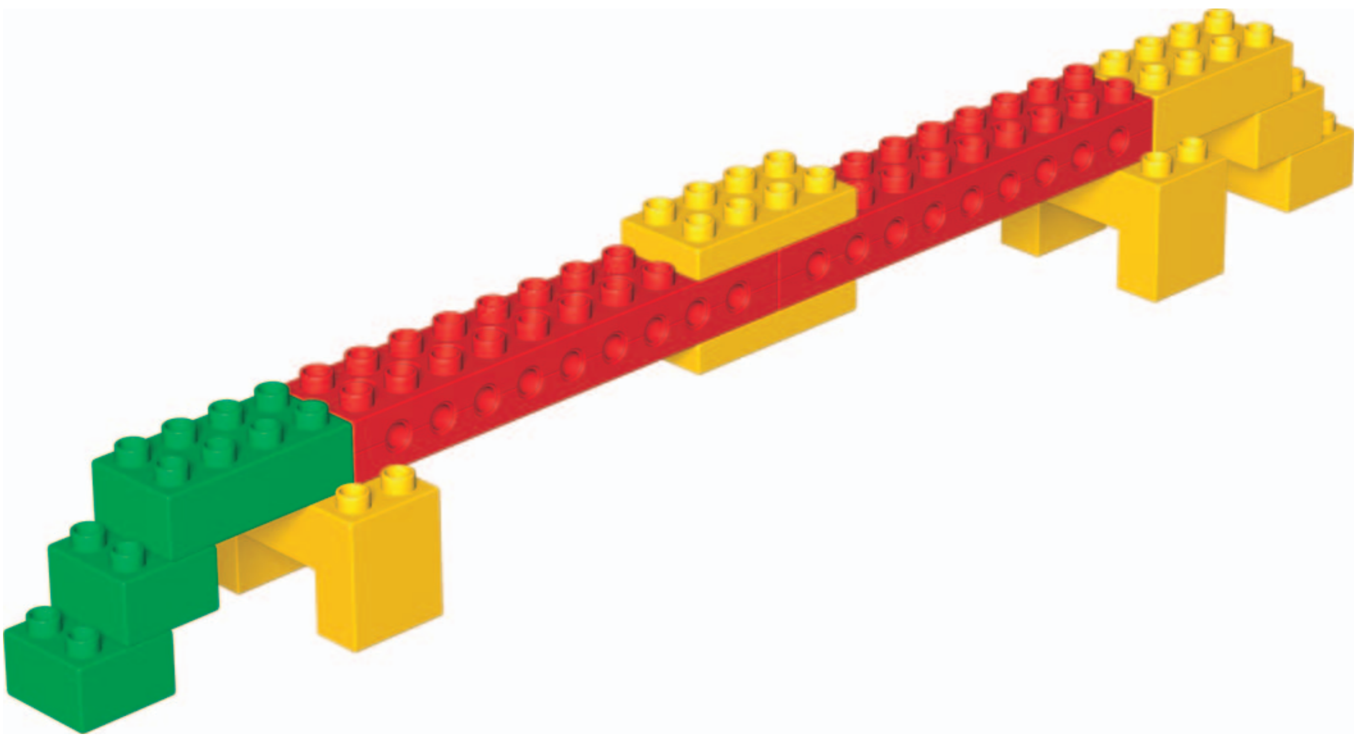
- Is it at least 10 cm above the water?
  Measure it and see.

- 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.



education

LEGOeducation.com

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

Other materials required

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

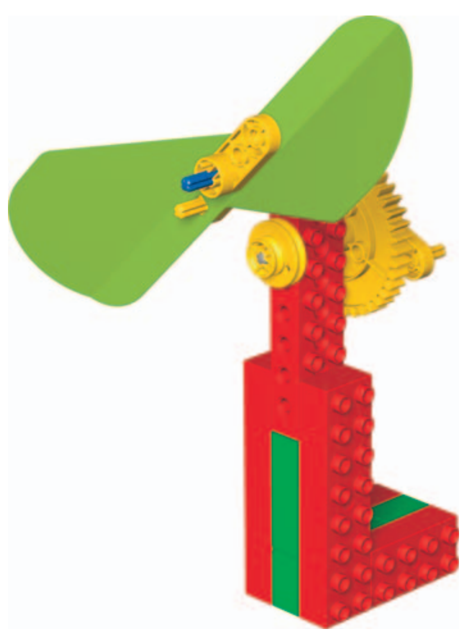
Fair testing and fun

- 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.



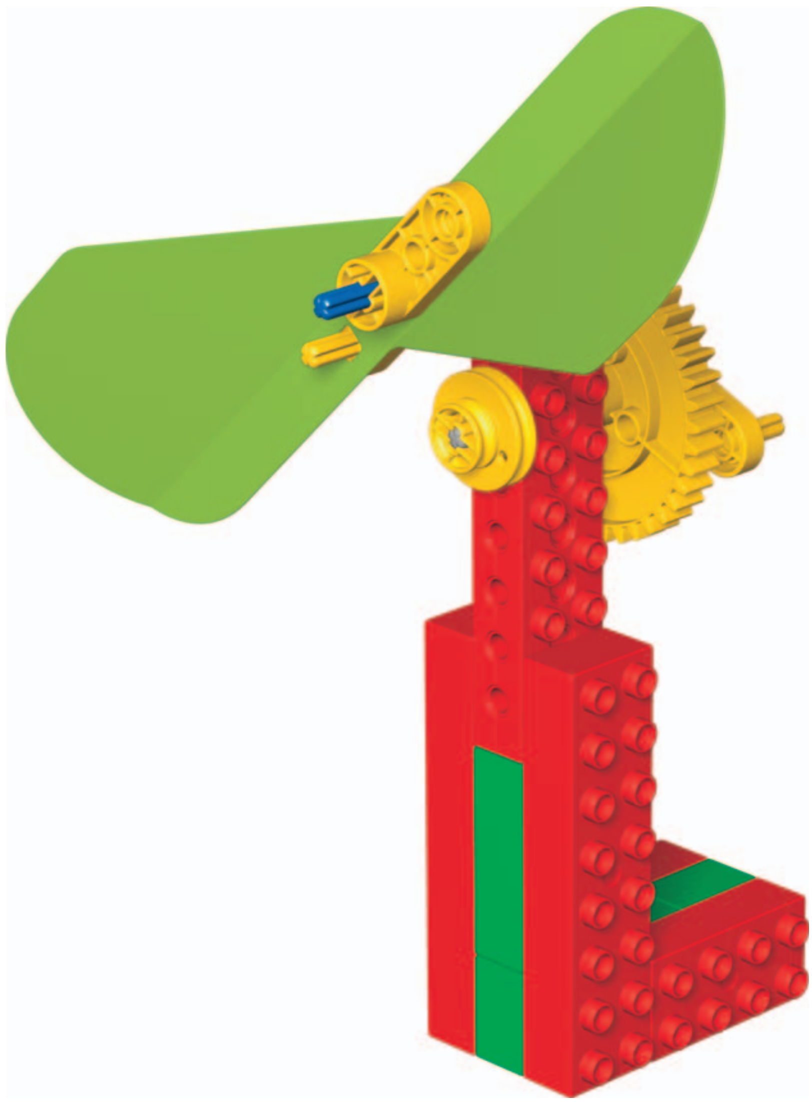
Extra challenge

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

Need help?
Look at:

Pinwheel

Spinning Top




SKATE

Scarecrow

The problem

In the garden there is an old cherry tree with big, ripe and sweet cherries. Cherries are Sam and Sara's favourite 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


SKATE

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

Need help?
Look at:

Raft

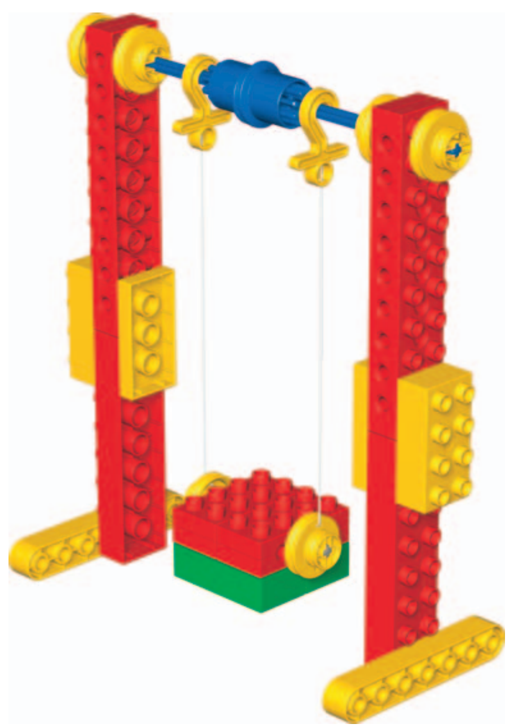
Seesaw

Other materials required
- Clock or timer

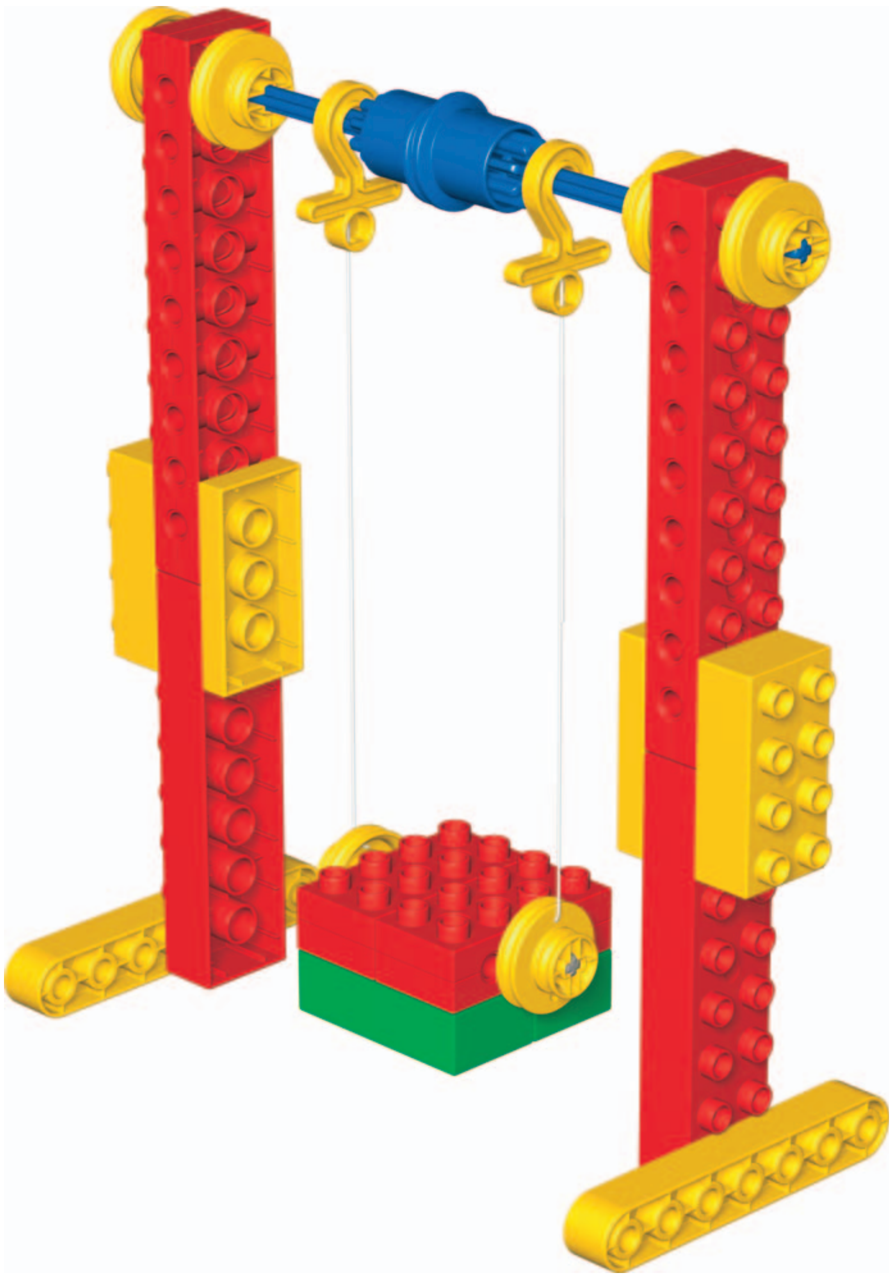
Fair testing and fun
- Can Sam or Sara sit on the swing?
  Put Sam or Sara on the swing and see if it can swing.

- 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.



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 centre 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.

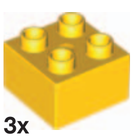
G	**Gear**	A gear is a toothed wheel. A way to classify gears is by the number of teeth they have, e.g. an 8-tooth gear or a 40-tooth gear. Gears can be used to transfer force, increase or reduce speed, and change the direction of rotary motion.
	Gear, crown	Has teeth that stick out on one side, making 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 kg. In orbit, you feel weightless – but sadly you still have a mass of 50 kg. 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® education

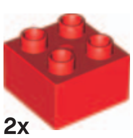
LEGO® Element Survey

1x
LEGO® DUPLO® girl
4271511

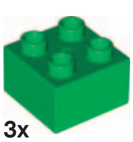
4x
Brick with arch, 2x3, red
230221



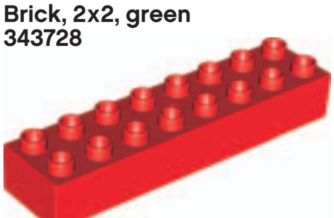
3x
Brick, 2x2, yellow
343724



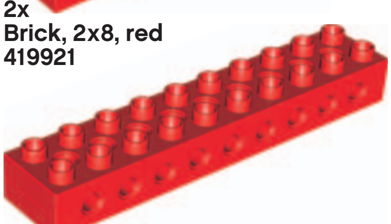
2x
Brick, 2x2, red
343721



3x
Brick, 2x2, green
343728



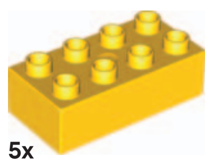
2x
Brick, 2x8, red
419921



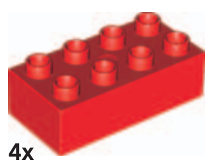
2x
Brick with holes, 2x10, red
75350

1x
LEGO® DUPLO® boy
4502103

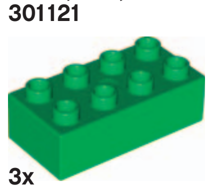
4x
Brick with holes, 2x4, red
75349



5x
Brick, 2x4, yellow
301124

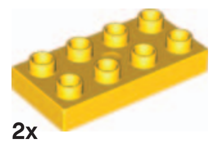


4x
Brick, 2x4, red
301121



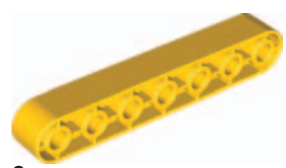
3x
Brick, 2x4, green
301128

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

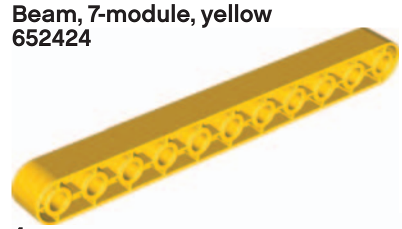


2x
Plate, 2x4, yellow
4160152

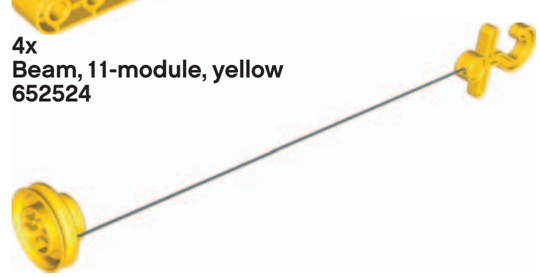
2x
Bridge element, 2x4x2, yellow
4221004



2x
Beam, 7-module, yellow
652424



4x
Beam, 11-module, yellow
652524



2x
String with hook, yellow
75536

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

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

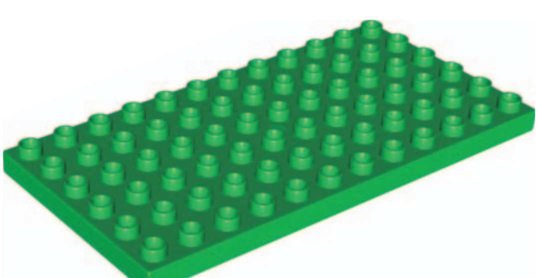
5x
Axle, 8-module, green
652128

1x
Worm gear, blue
4271573

6x
Connector peg, handle, yellow
4493718

2x
Belt, blue
71059

1x
Gear block, transparent
4113297



1x
Plate, 6x12, green
4281607

1x
Plastic forms sheet, green
4520270

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