



Freewheeling

Design and technology

- Using mechanisms – wheels and axles
- Assembling components

Science

- Measuring distance
- Reading and calibrating scales
- Forces
- Moving energy
- Energy of position
- Friction and air resistance
- Scientific investigation

Vocabulary

- Mass
- Position
- Friction
- Efficiency

Other materials required

- 4 metres of smooth floor
- Masking tape
- Metre rule or measuring tape
- Plank of wood or shelf at least 1 metre long
- Pile of books or boxes to elevate the plank
- Spare LEGO® bricks for taking measurements
- Whiteboard marker
- Scissors

Connect

Jack and Jill are arguing as usual. They are making carts to see which one can roll the furthest down Launching Hill in their local Greenall Park.

Jill says that if she puts some extra weight on her cart, she will roll further because the cart is heavier. Jack thinks that because heavy loads are hard to move, he will go further. He prefers to go for bigger wheels, but Jill is not so sure this approach will help.

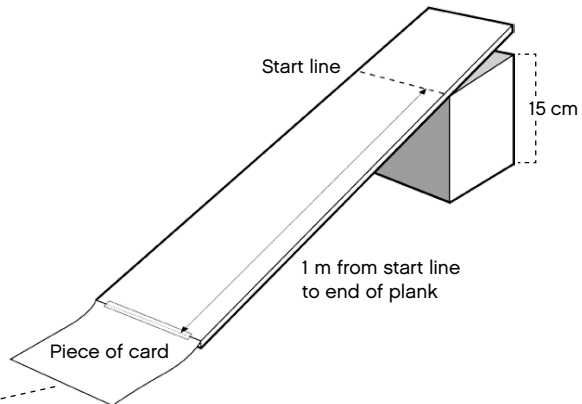
**Which will roll further? Heavier or lighter carts, with bigger or smaller wheels?
Let's find out!**



Construct

Make Launching Hill

Draw a start line, 1 metre from one end of the plank. Place a support so that the start line is 15 cm from the floor. Why do we need a start line?



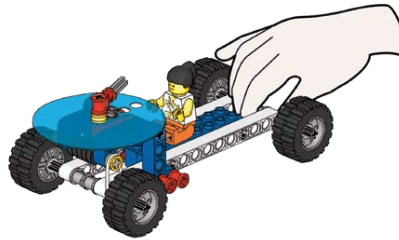
Approx. 4 m of smooth floor

Tip:
If the thickness of the plank means that carts bump down from it onto the floor, use a piece of card to make a smooth transition from plank to floor.

Build the Freewheeler

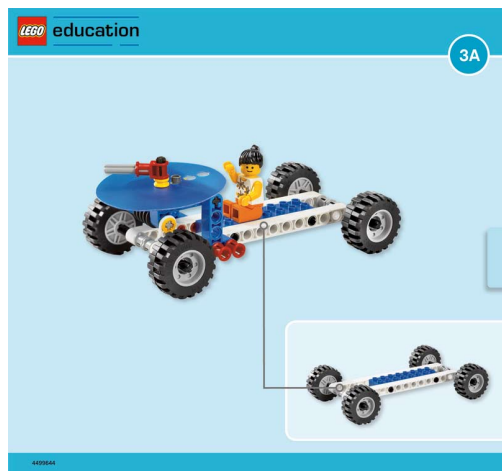
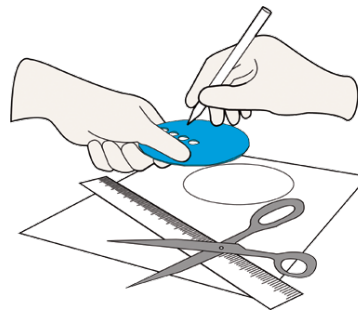
(all of book 3A and book 3B to page 6, step 12).

- Test the Freewheeler on the ramp. Is the model running smoothly? If not, check all axles and bushings to make sure the wheels are turning smoothly. Also check that all elements are firmly linked to one another.



Trace the scale

Mark on the blue plastic disc or trace around it and cut out a paper copy. Put on scale markings and attach it on top of the blue plastic disc.



Contemplate

Measure how far the empty cart rolls. Measure with a metre rule and compare with the pointer and scale. Record the distance and use a LEGO® brick as a marker of where it stopped. Test at least 3 times to be sure you have made a scientifically correct answer.

Trace the 1 m scale divisions on the plastic scale with an erasable whiteboard marker. Let the Freewheeler go down the ramp again and see if it runs approximately 160 cm by looking at the scale and pointer (one full revolution of the disc and a little more than another half). Carry out several tests. There is no need to use rulers or measuring tapes – just use the readings on the scale disc.

Add a weight brick to the cart (page 7, step 13). Predict how far it will roll this time by placing another marker brick along the track. Then test.

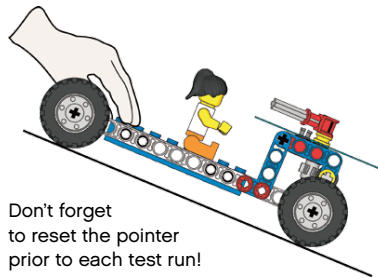
What do you notice about the pointer?

Test several times to make sure your findings are consistent.

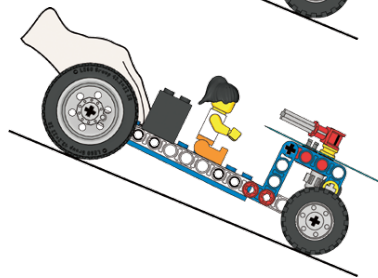
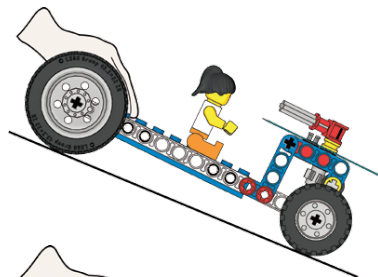
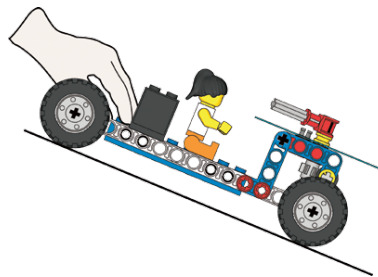
Jack's Big Wheel Deal

Will big wheels help the cart to roll further than the smaller wheels? Fit them onto the rear axle and test on the ramp (page 7, step 14).

First test unloaded (page 7, step 14), then test loaded (page 8, step 15).



Don't forget to reset the pointer prior to each test run!



Tip: Look at the distance the cart travels down the plank. The pointer on the plastic disc passes zero for the first time just as the cart hits the floor. It measures almost exactly 1 m in one rotation.

Did you know? The empty cart weighs about 58 g. And the weight brick weighs 53 g ... almost the same!

Did you know? The big wheels weigh about 16 g and the small wheels about 8 g.

Continue

Super Scale

Build book 3B to page 12, step 12.
Replace the 8-tooth gear wheel with the 24
tooth gear. Predict and then test how far
the cart will roll before the pointer completes
one revolution.

Super Slope

Predict first and then test what will happen if
you double the height of the hill.

