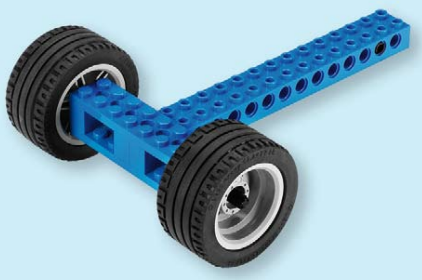
education

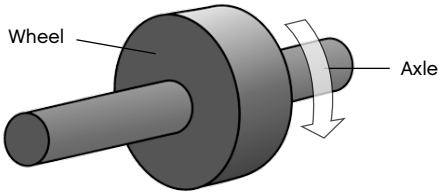


Wheel and Axle

Student Worksheet

Simple Machines: Wheel and Axle

Wheels and axles are usually circular objects, often a big wheel and a smaller axle, rigidly secured to one another.



The wheel and axle will always rotate at the same speed. Due to the bigger circumference of the wheel, the surface of the wheel will turn at a greater speed – and with a greater distance too.

Placing a load on a wheeled vehicle almost always reduces friction compared to dragging it over the ground. Wheels in science and engineering are not always used for transport. Wheels with grooves are called pulleys and wheels with teeth are called gears.

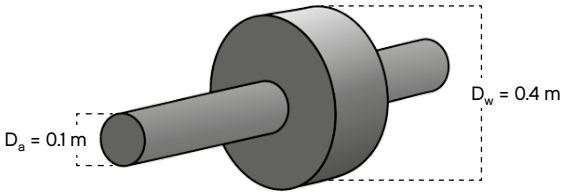
Common examples of wheels and axles are rolling pins, roller skates and pushcarts.

Did you know?
The first constructed wheel found so far was made by the Sumerians some 5,600 years ago.

The mechanical advantage of a wheel and axle

The mechanical advantage of wheels and axles describes the ratio of rotation between the wheel and axle. Depending on where the effort is applied, the mechanical advantage can be calculated using the following formula:

$$\text{Mechanical advantage} = \frac{D_w}{D_a}$$



The mechanical advantage of this wheel and axle is 4:1 or 4 if the effort is applied to the axle. Meaning four times an increase in speed and distance, but at the same time a decrease in force by four times.
If the effort is applied to the wheel the mechanical advantage is 1:4, meaning a four times decrease in speed and distance, but four times increase in force.

Hint:

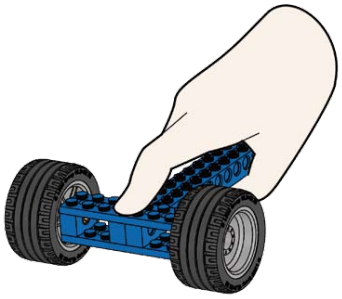
The diameter of large LEGO® wheels are 43.2 mm (≈ 1.7 in).

The diameter of LEGO axles are 4.7 mm (≈ 0.18 in).

B1

Build B1 book I, pages 8 to 9

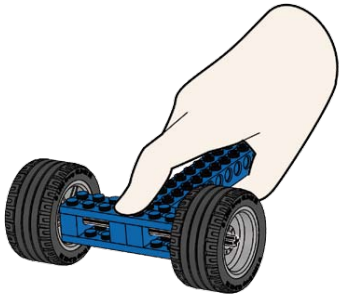
Push the model along the table in a straight line.
Then try driving it in a zigzag pattern with sharp turns.
Explain what happens and why.



B2

Build B2 book I, pages 10 to 11

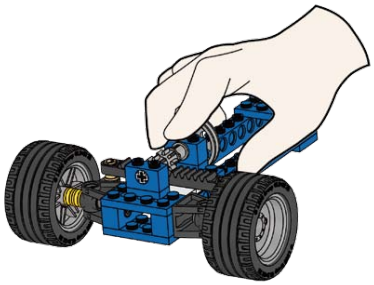
Push the model along the table in a straight line.
Then try driving it in a zigzag pattern with sharp turns.
Explain what happens and why, compare with the model above.



B3

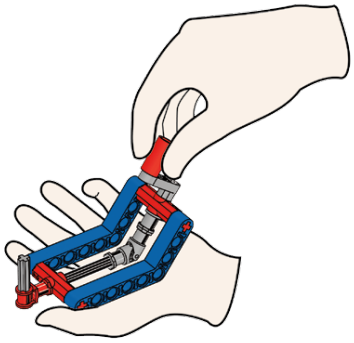
Build B3 book I, pages 12 to 15

Push the model along the table in a straight line.
Then try driving it in a zigzag pattern with sharp turns.
Explain what happens and why, compare with the models above.



B4

Build B4 book I, pages 16 to 17
Turn the handle and explain what happens.



B5

Build the model as shown.
Calculate the mechanical advantage of a LEGO® wheel and axle.