Experiment with the carrying cart

As you have already learned a racer is a four wheeled motor vehicle. Vehicles have the ability to obtain movement due to the use of wheels. Wheels can be found everywhere in all kinds of sizes and materials! Basically, anything that is circular and capable of rotating is considered to be a *wheel*. What you may not know is that a wheel cannot function without the help of another part: *the axle*. In fact, we wouldn't have cars or any other type of vehicle if the wheel and axle weren't joined together! The applications of the wheel have literally changed the world!

- Why is the wheel one of the most important inventions?
- How does the car turn to the right or to the left?

Are you ready to discover how wheels amplify the effort needed to carry a heavy object?
Get ready to find out which force enables the car to move.
Let's perform the next page's experiment to learn about wheels and axles!

01

Learning about: **Wheels and axles**

Carrying Cart
Carrying carts has been used from ancient times until today. Heavy objects can be easily transferred using them. Conduct the experiment below to find out the use of the wheels.

Discover:
- How does the wheel multiple the force?
- How do cars turn?

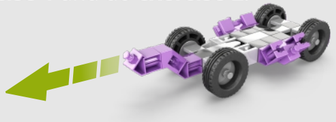
Level Of Difficulty ★★★☆☆

Materials Needed:
- Engino® (STH16).

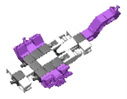
Procedure:
1. Find the instructions and build the **Carrying Cart** model until **step 2** .

2. For **case 1**, pull the model from its front edge to move forward.

3. For **case 2** follow **the rest building instructions**. Repeat the procedure of step 2. Complete the table of **exercise 1** and do **exercise 2**.



1. Complete the table using the words: **medium** and **easy** to compare the effort you applied to move the model.

	Case 1	Case 2
		
Effort		

2. Complete the following gaps using the words from the box.

wheels, big, small

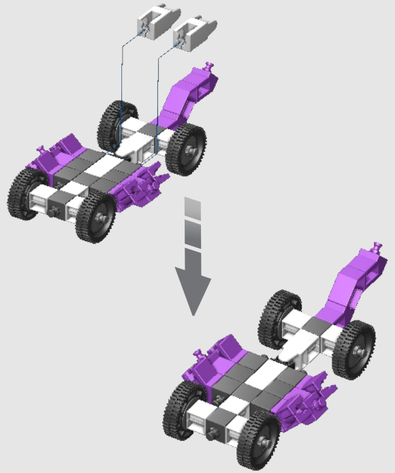
The difference between the two cases is that ..... were added on the model. With the help of wheels, we can apply a ..... amount of effort in order to move a ..... weight.

02

Procedure:

4. Hold the model from the front edge and try to turn it while moving it forward. Check what happens and do **exercise 3**

5. Modify your model by removing the two light grey parts as it is shown below. Repeat the procedure above and complete **exercises 4** and **5**.



3. Does the carrying cart move easily to the right or to the left? Are the wheels rotating?

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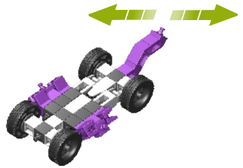

4. What do you observe now? Can you easily make the model turn into a sharp corner? Compare the behaviour of the wheels this time.

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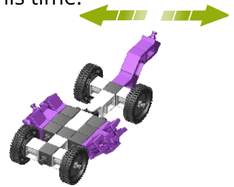
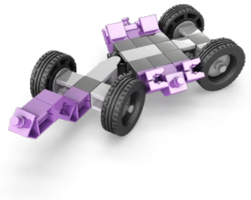


5. Put a ✓ into the correct box to state whether the statement is true or false.



a) The front edge is working as a steering wheel.

☐ True ☐ False

b) A resistance force is acting as a friend and enables the carrying cart to turn.

☐ True ☐ False

Theory

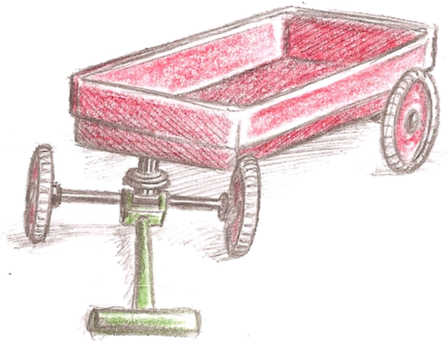
Wheel and axle

A **wheel** is a circular (round) device that is capable of rotating on its axis. The importance of the invention of the wheel, besides its usage on vehicles since ancient times, lies on its ability to be converted to a variety of other forms of similar parts, like pulleys, gears, cams and many more. An **axle** is a circular shaft (round rod) that fits on a rotating wheel or a gear. It is used for holding the wheel in place and for transferring its force and motion. Simple machines are the simplest types of mechanisms that have the ability to multiply the force applied on them. This ability is called mechanical advantage.

The wheel does not belong to in the “Simple Machines” category on its own, because even though it rotates, we cannot transfer its motion and force in order to gain mechanical advantage. Therefore, a connecting axle is needed for transferring these at any point we want them to go. The wheel and axle, as a mechanism, transfers and multiplies a force, just like a simple machine does. The wheel evolved in different forms. The changes aimed in making the wheel lighter and more durable. The wheel is being used as a tire, which is a material made out of natural rubber filled with air and placed on a metal base (rim). The tire is linked to a suspension (spring) that absorbs the vibrations coming from the road.

Steering wheel

The steering wheel is used to direct the vehicle. It is joined with a steering system used to control the direction of the vehicle's front wheels. The rotation of the steering wheel causes a swivelling movement of the front wheels. You may be surprised to read that cars did not always use a steering wheel to steer. A tiller was the mechanism primarily used to steer a vehicle, similar with the one that boats used to direct the angle of the boat. The invention of the steering wheel is significant. The steering wheel outmatches the tiller since it makes driving much easier, offers more precise steering and higher driving speeds.



Friction

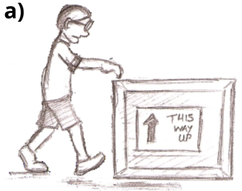
One of the most important factors that influence the operation and overall efficiency of all machines is **friction**. Friction is the force that resists motion and is created when an object is moving. There are two types of friction between solid objects, depending on whether the two objects in contact are in motion (kinetic friction) or not (static friction). Different materials and surfaces lead to different frictional forces, even if the same effort is applied. Another factor influencing friction is the weight of the object! In many cases friction is desirable, acting as a friend. If there was no friction, normal movement of objects could not be achieved (for example driving a car on the road), as everything would slide! Carrying a heavy object will be easier with the help of wheels since they reduce friction.

Quiz

Exercise

a) In the following pictures, Jack is moving the same load, but in a different way. In which case do you think it is easier to move the load? Put a ✓ in the correct box.
b) Can you explain why it is easier in that case?

a)



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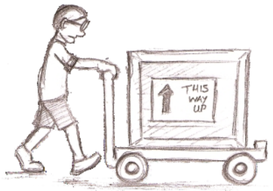

☐

b) .....

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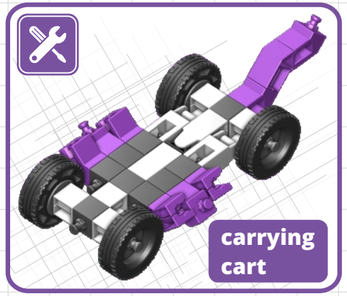
Knowledge check: check what you have learned.

- ☐ Why is the **wheel** invention important?
- ☐ What is a **wheel** and what an **axle**?
- ☐ Why does the wheel and axle mechanism belong to the **simple machines**?
- ☐ What is the use of the **steering wheel**?
- ☐ What is **friction**?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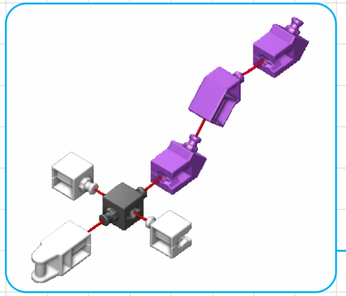
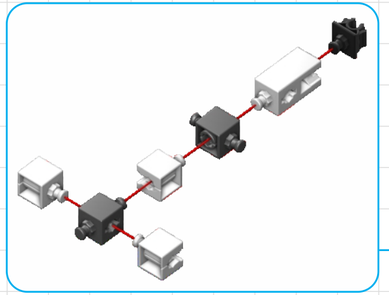
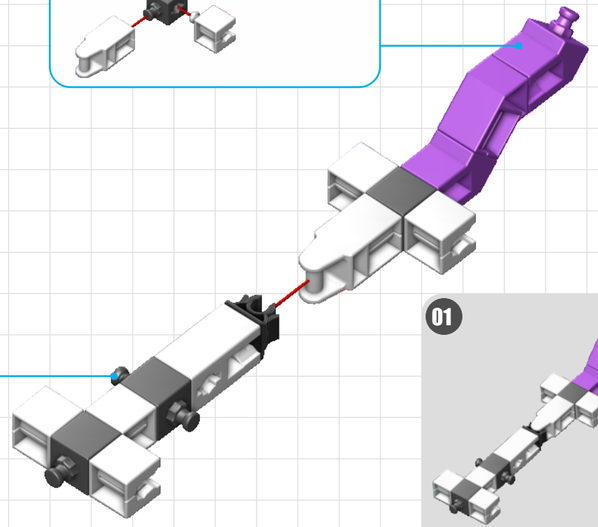
cart







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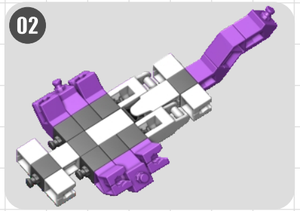
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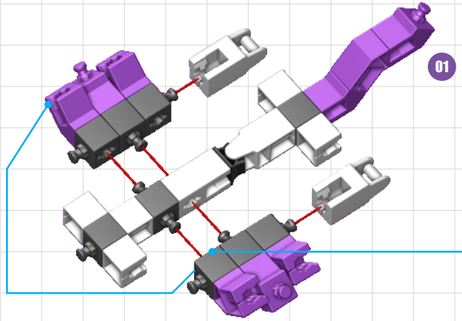
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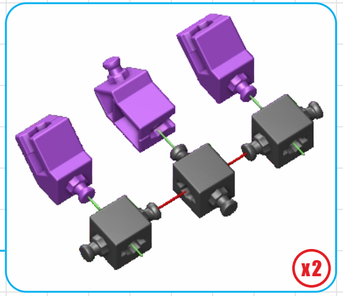
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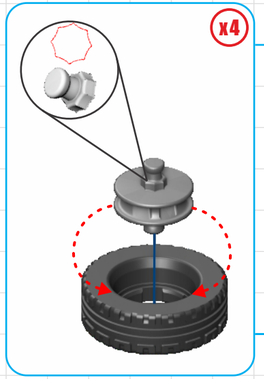
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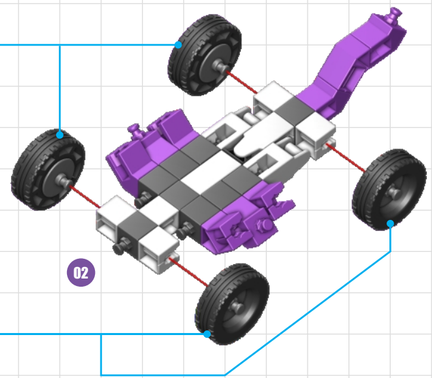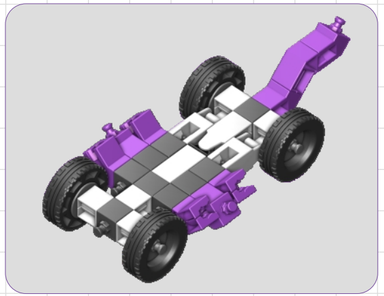
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