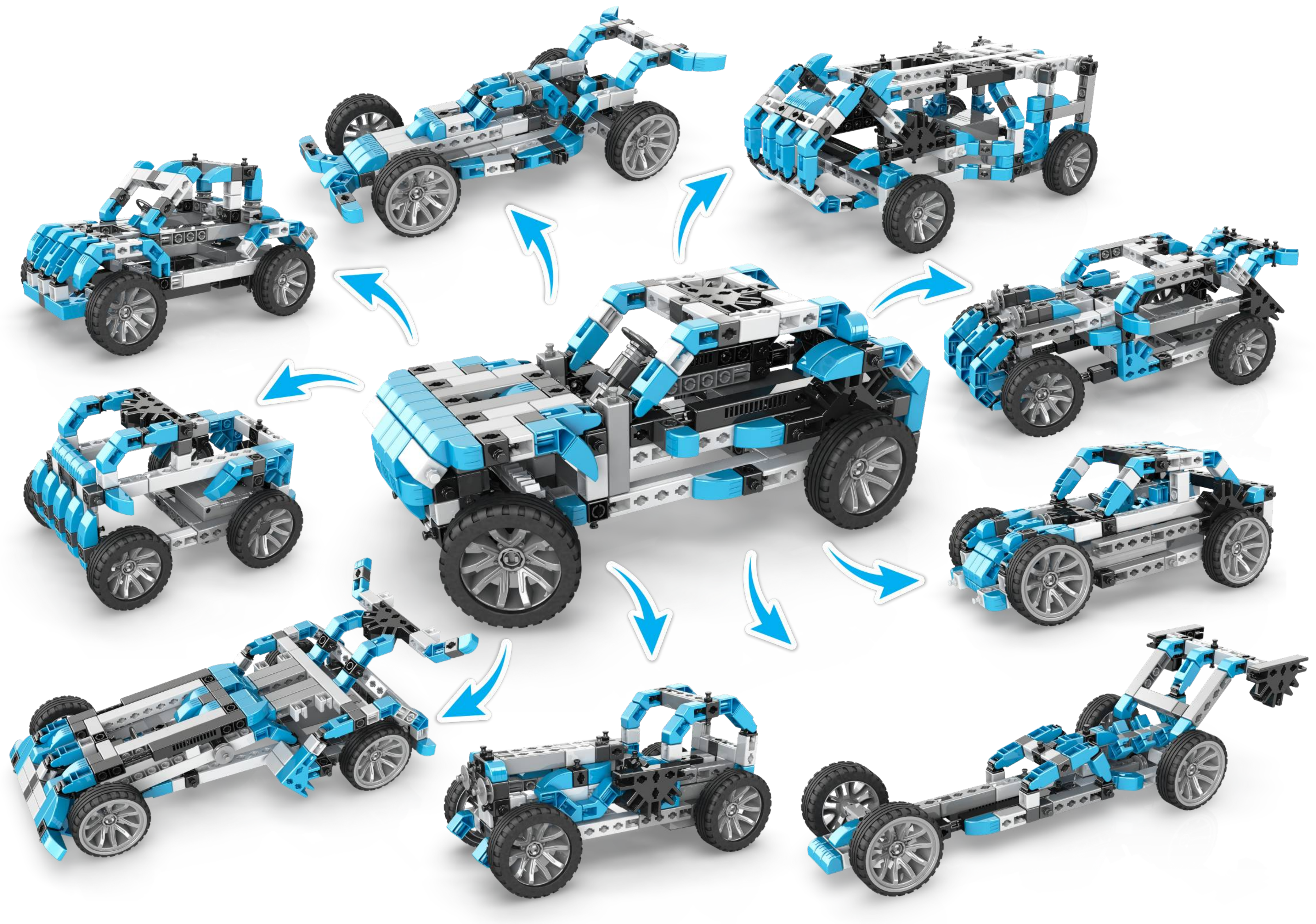
Engino Engino

INVENTOR MOTORIZED

offroader

» Multi-model Creation

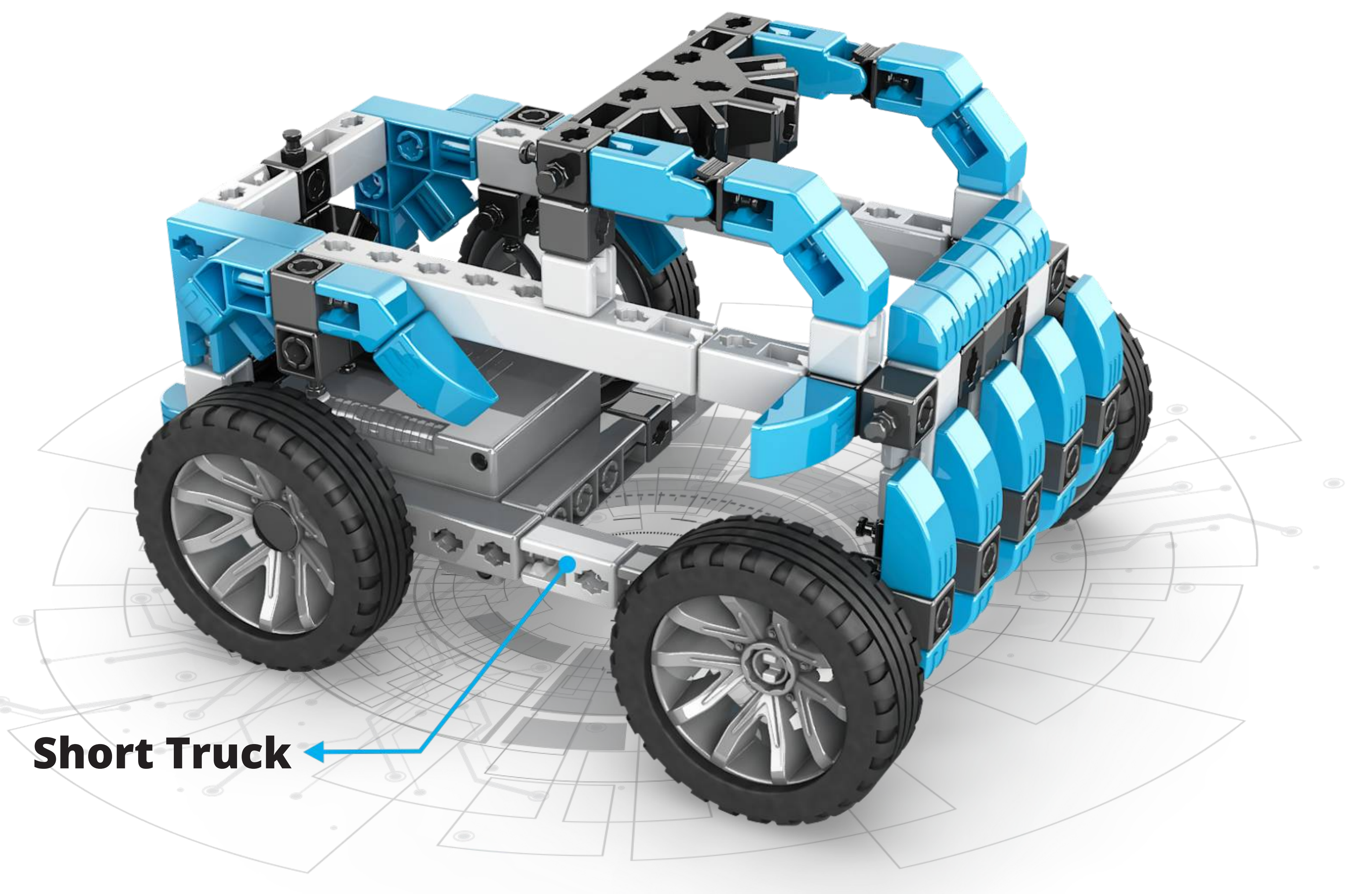


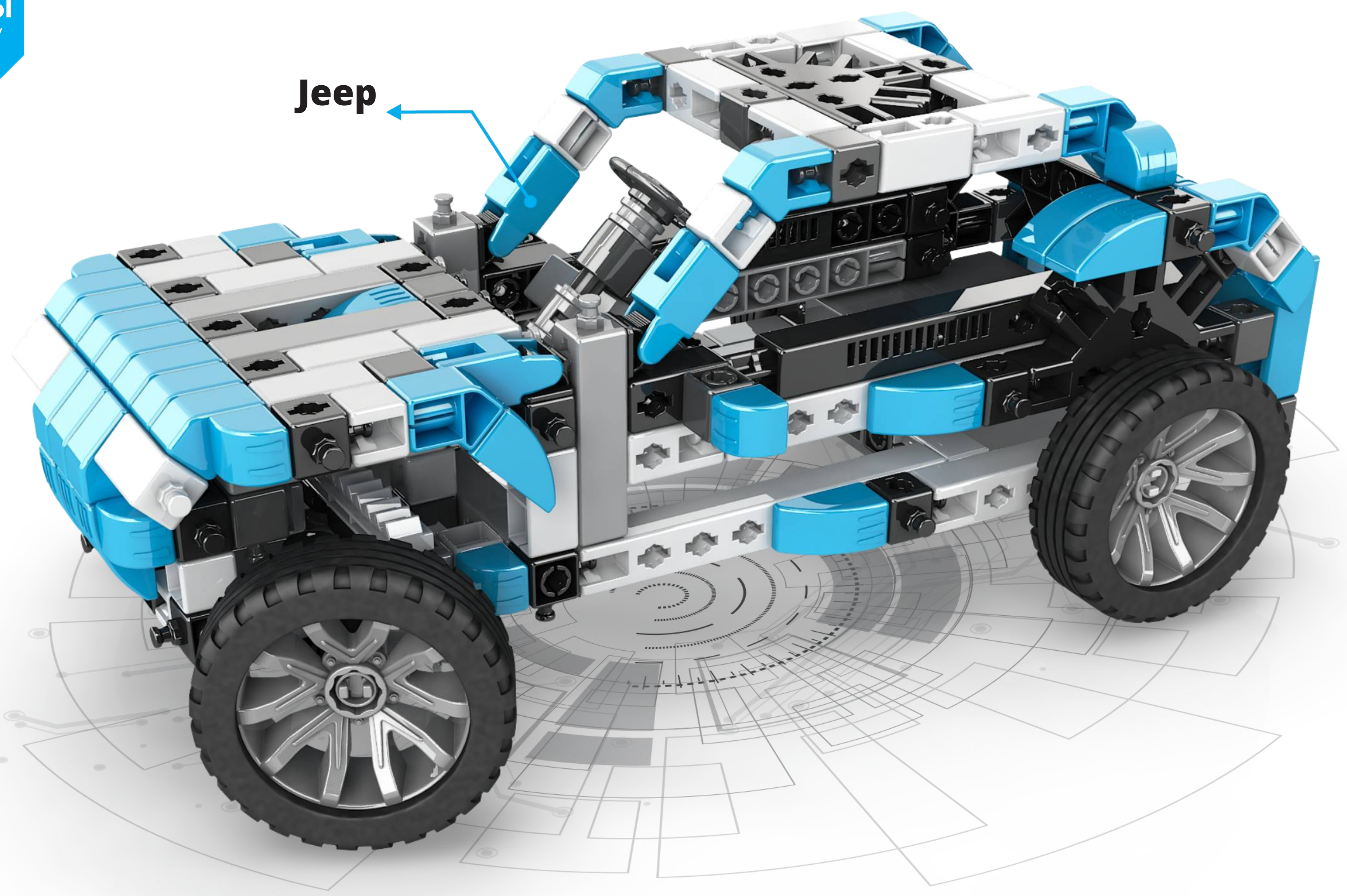
9+ Appropriate Ages

3 Years Warranty

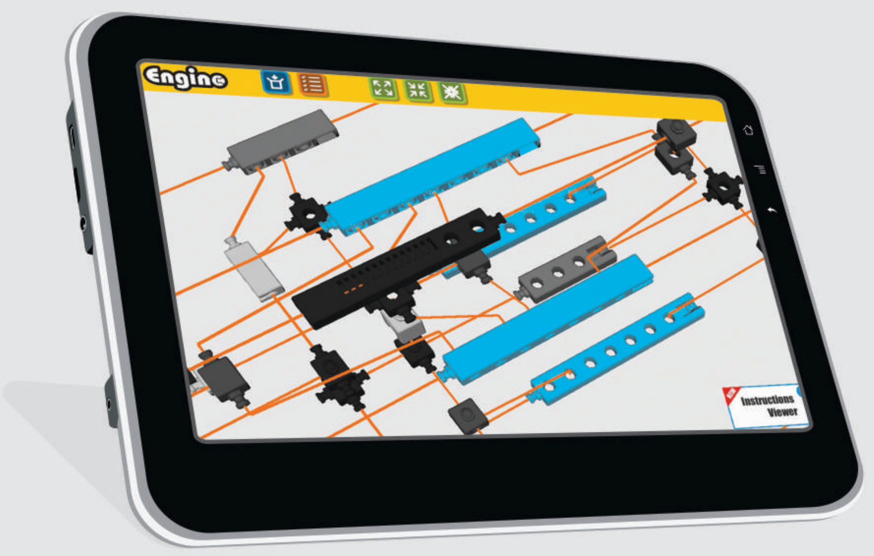
Free 3D Viewer App

Extraction Tool
For easy disassembly of small parts





» More Models Online



A Use your PC or tablet and go to the following link for more models:

www.engino.com/instructions/in60

B Download the app to discover step-by-step instructions in 3D view!

Engino kidCAD (3D Viewer) app:

GET IT ON Google Play | Download on the App Store

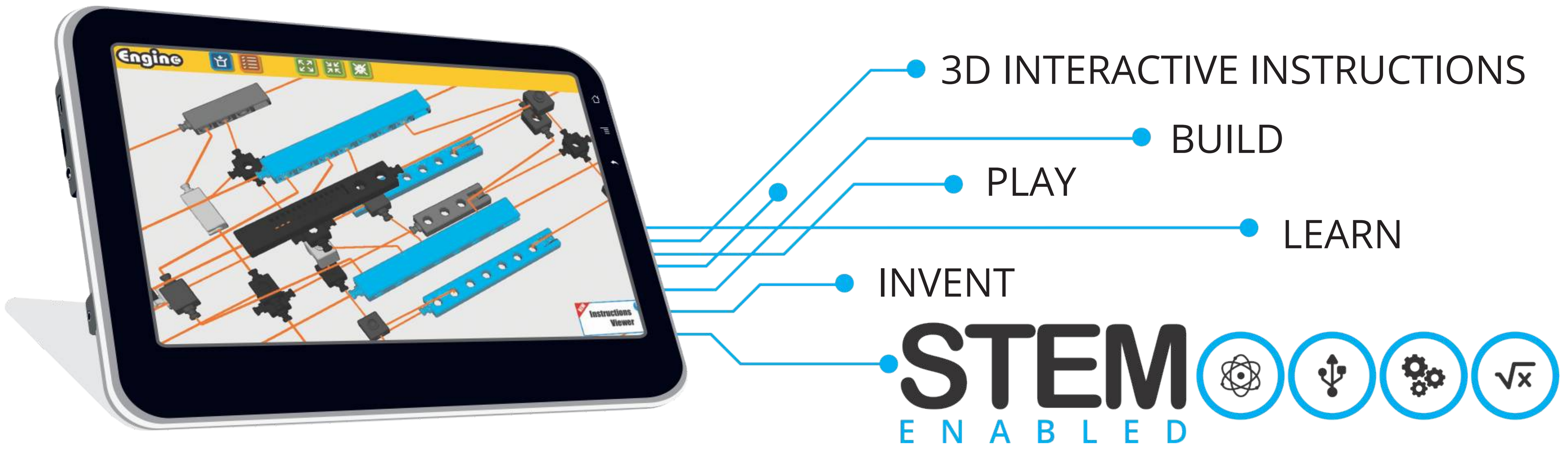
STEM ENABLED

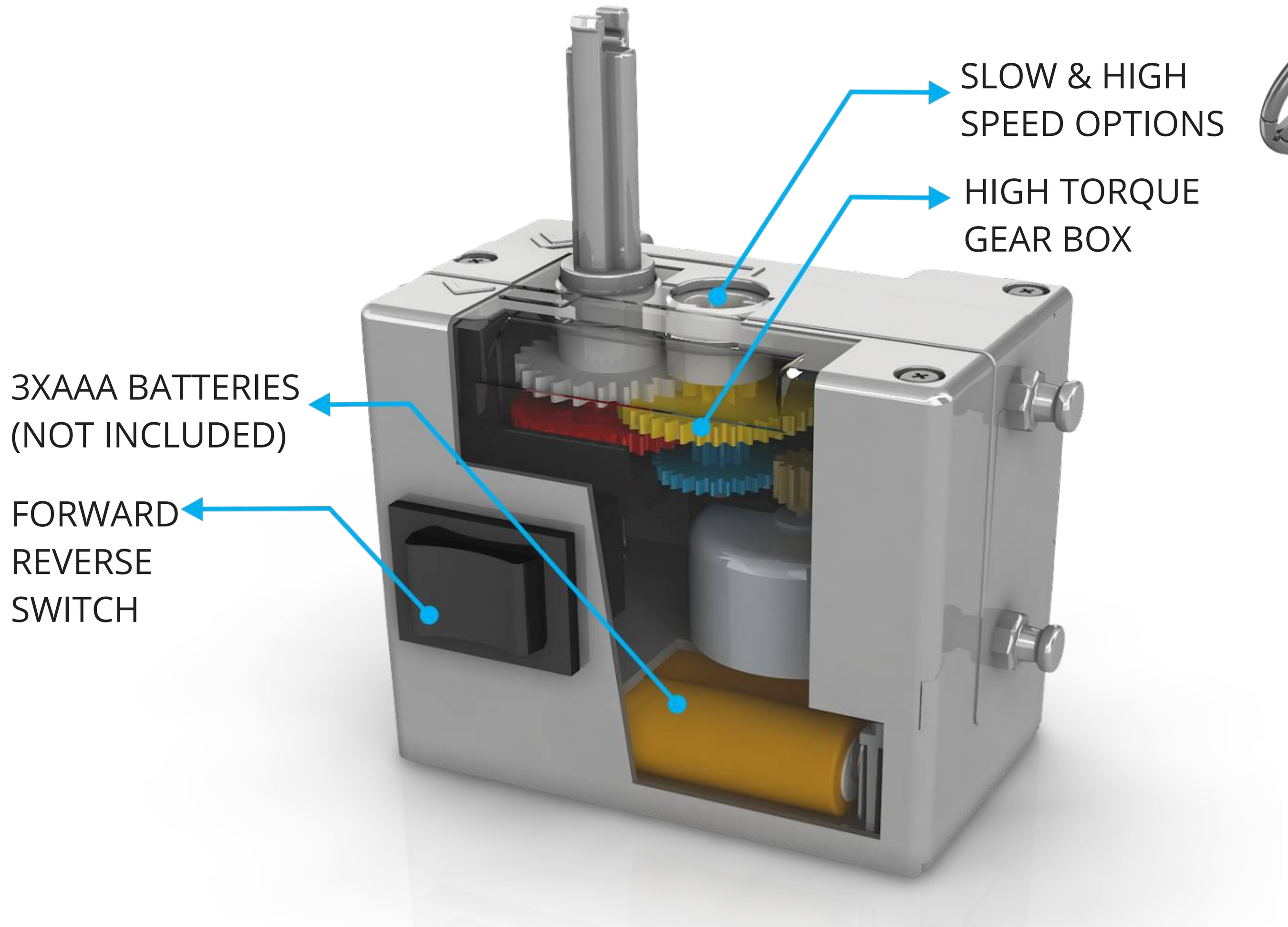
Made in EUROPE

10 BONUS MODELS

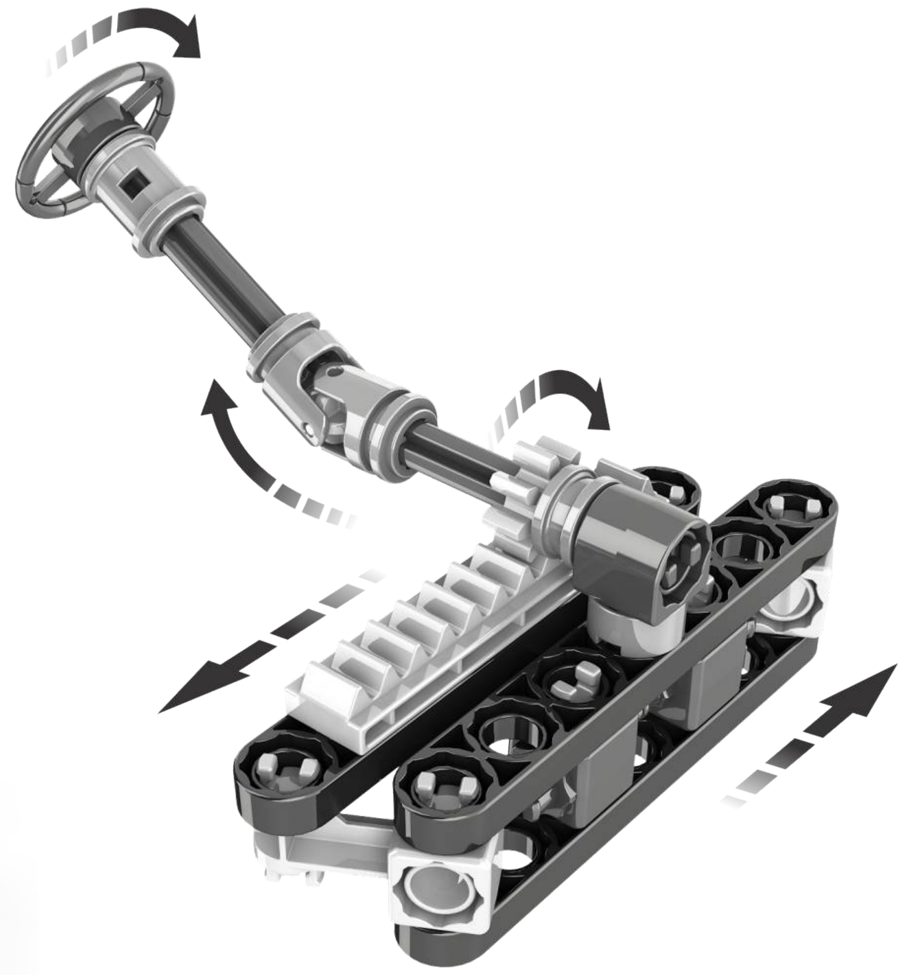
2 models printed instructions (included)

8 models online 3D instructions





MOTOR POWER

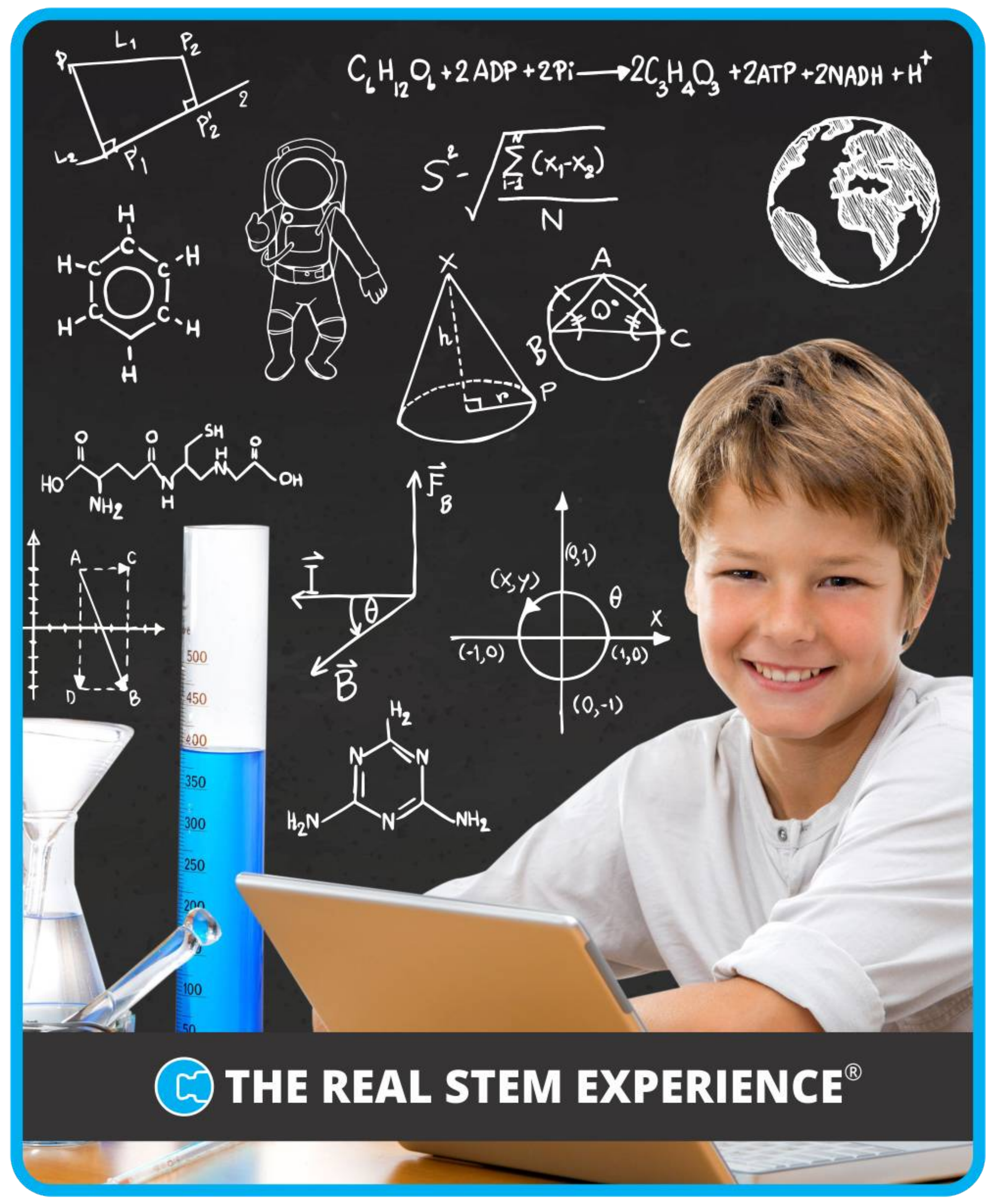


RACK & PINION MECHANISM

3 x AAA

Power motor included.
Batteries required but not included.

Technology Explained



This new INVENTOR Mechanics range has been developed to inspire children of ages 7-14, to follow STEM careers and develop 21st century skills such as problem solving and critical thinking. The multi-theme approach motivates children to construct a model they can relate to, while the ability to build many different models from the same set enhances creativity and engineering design thinking. INVENTOR Mechanics includes a range of new, highly technical parts that help create fully functional models and learn about various technologies. The top of the range is GINOBOT, a unique robotic vehicle with built-in sensors and Bluetooth which is fully programmable with simple-to-use coding software!

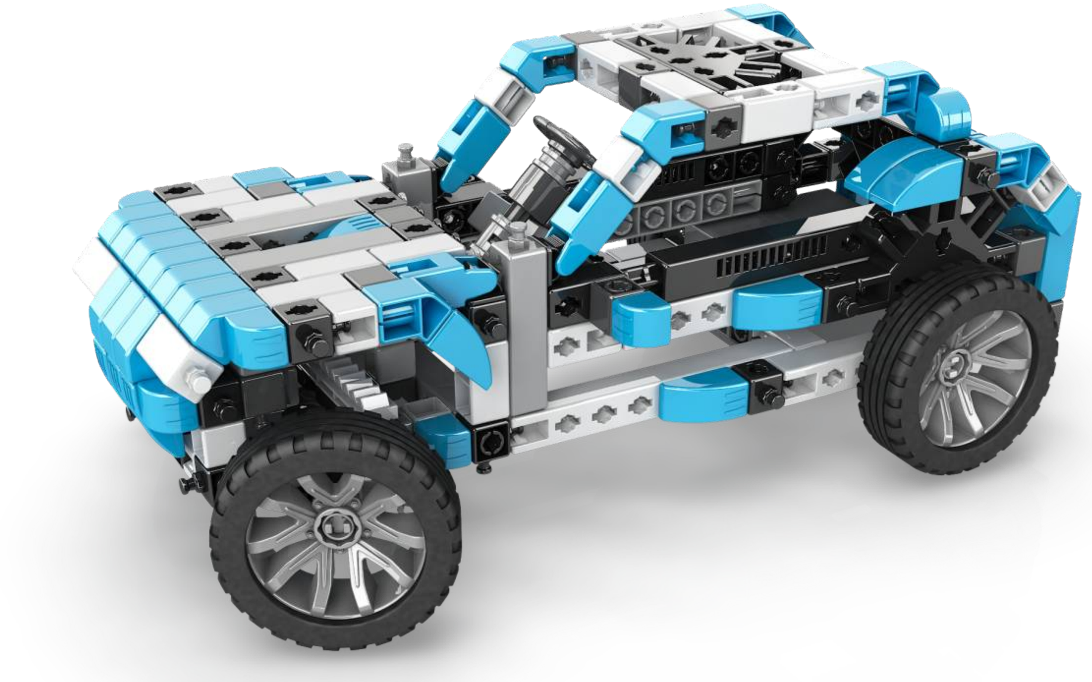
Some more advanced products of INVENTOR range:

IN90

Visit www.engino.com to find out more details!

Did you know?

Did you know for example that fuel driven car engines release poisonous gases that pollute the air and are the major source of global warming? Even though the first electric car technology was invented nearly 200 years ago in 1832, it was not until recently that we have seen its mainstream adoption by the car industry. In fact, Electric Vehicle (EV) registrations have grown by 2400% since 2013, showing a steady trend that would perhaps lead to most cars being electric within the next one or two decades! The main reason for this increase, besides the environmental benefits and the low cost of traveling, is the exponential drop of battery costs due to new technologies and high production volumes. A big disad-vantage of older EV has been the distance traveled on a single charge, but new cars can travel up to 500 miles!



STEM Levels

Construction Levels:

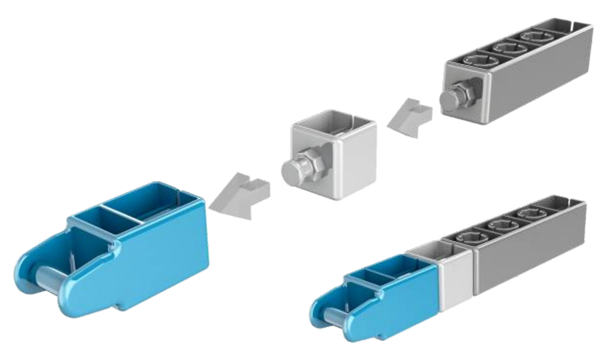
Building	Mechanics	Motors	Coding
Level 1● 2●	Level 1● 2●	Level 1● 2○	Level 1○ 2○

Learning Levels:

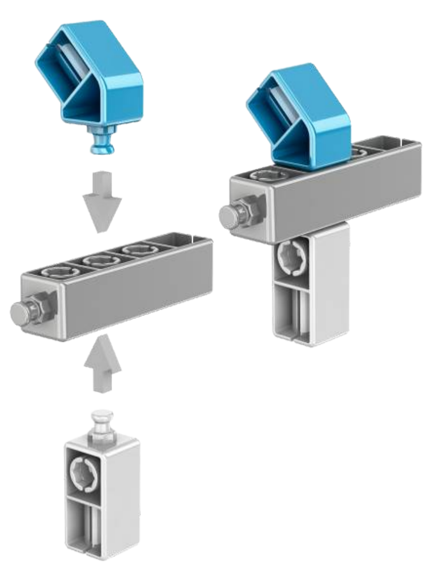
Theory	Quiz & Exercices	Experiments	Open projects
Level 1● 2●	Level 1● 2●	Level 1● 2●	Level 1○ 2○

Building System

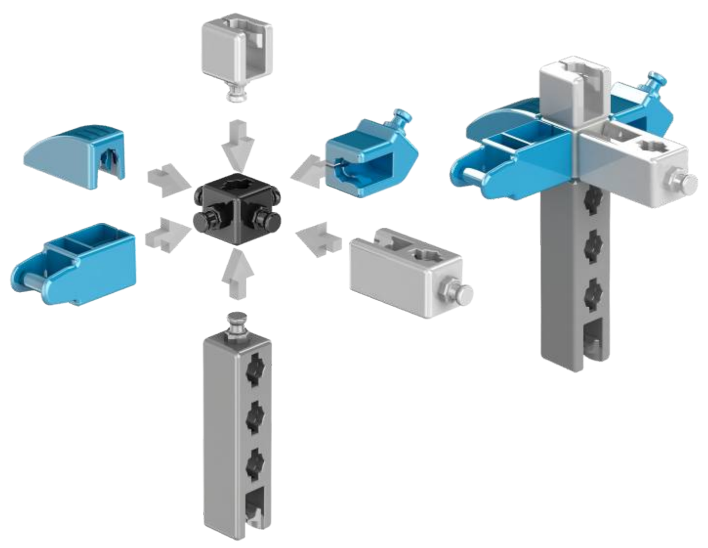
1 Building in one direction



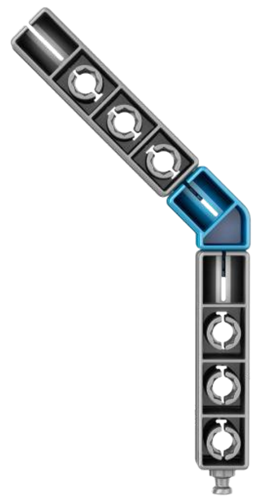
2 Building in two directions



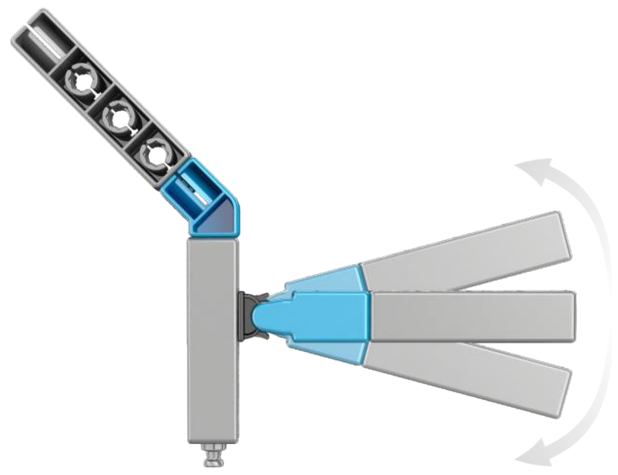
3 Building in three directions



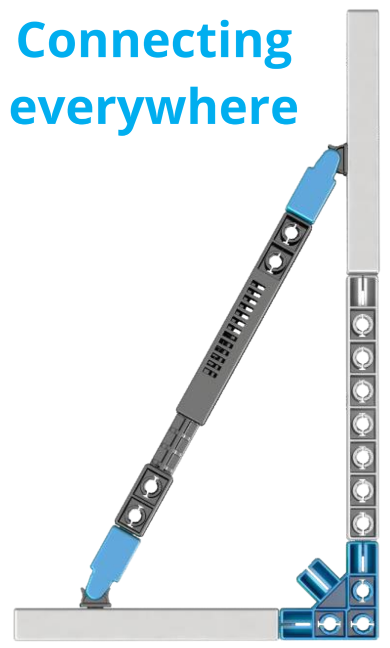
4 Connecting in fixed angles



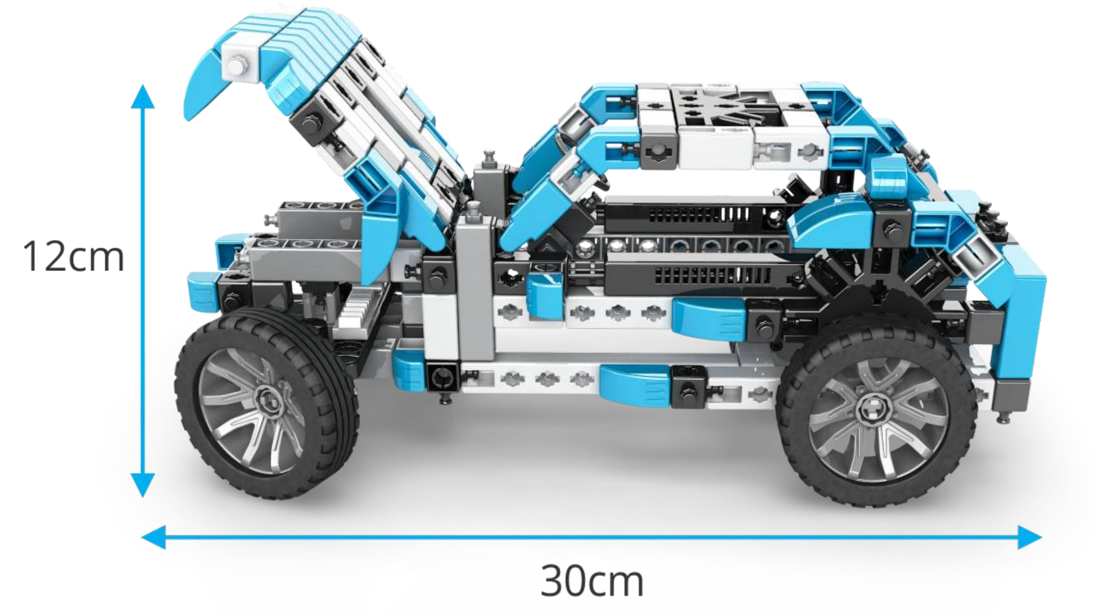
5 Connecting in every angle

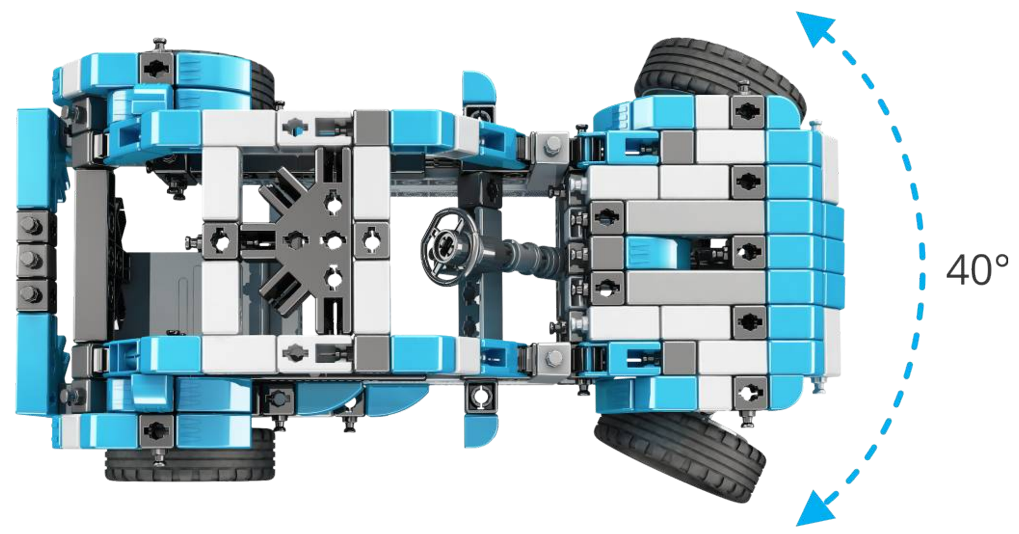


6 Connecting everywhere



Size & Functions

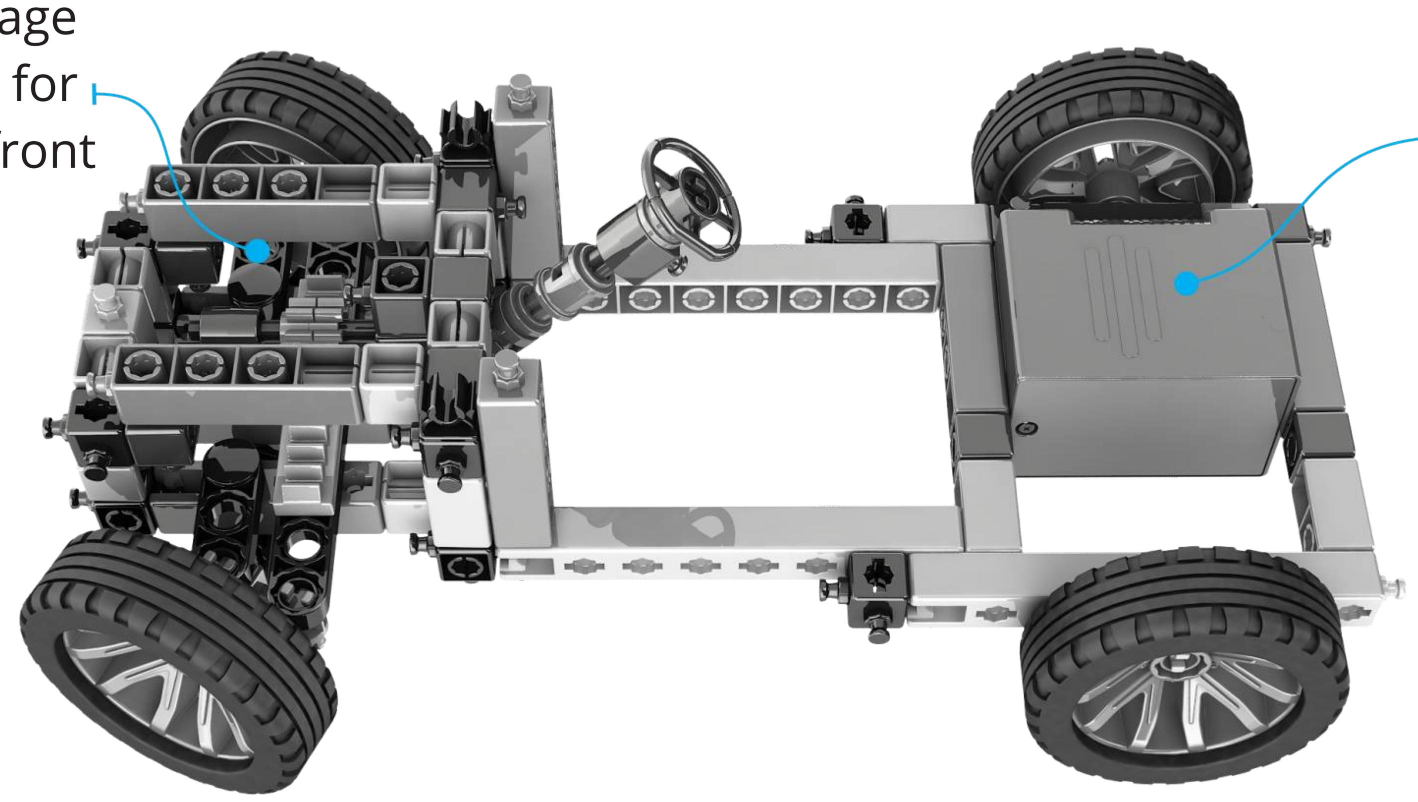




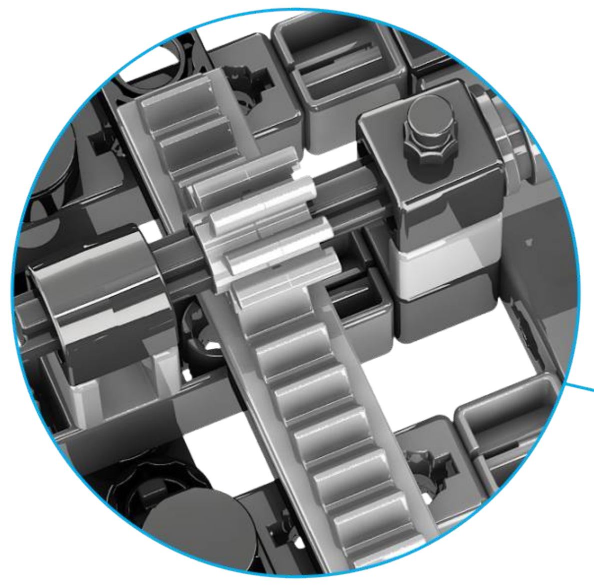
Featured Mechanisms

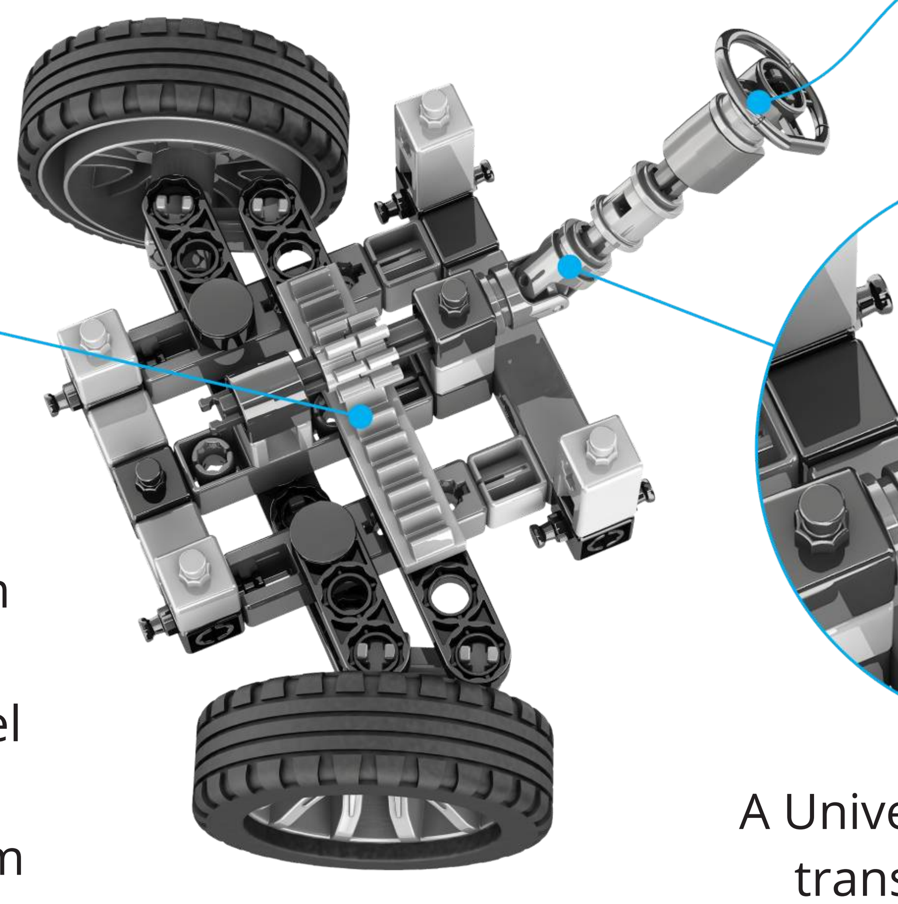
Parallel linkage mechanism for turning the front wheels

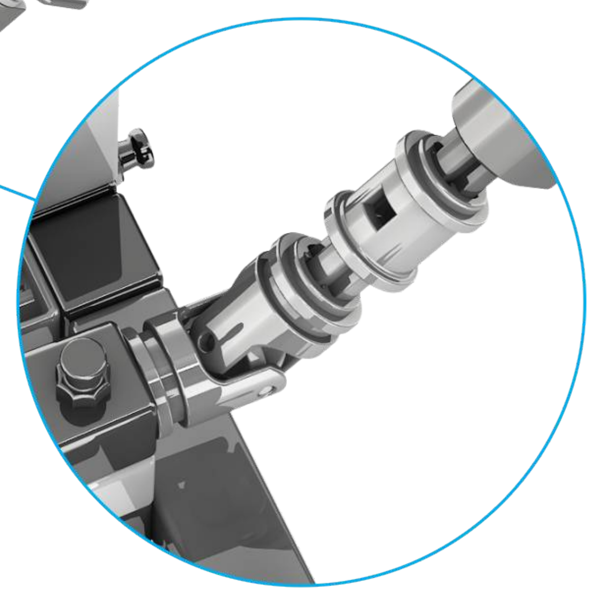
The geared 2- speed motor powers up the back wheels



Fully functional steering wheel







A rack & pinion gear system converts the rotational motion of the steering wheel to the linear motion that shifts the linkage mechanism

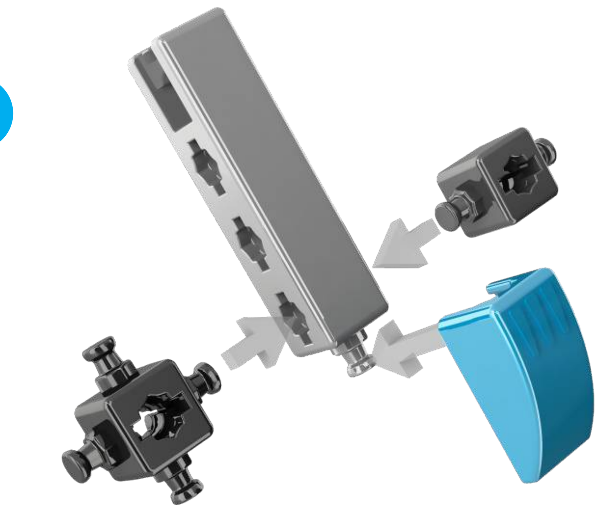
A Universal joint mechanism transmits power via the shafts, even at an angle

List of Materials

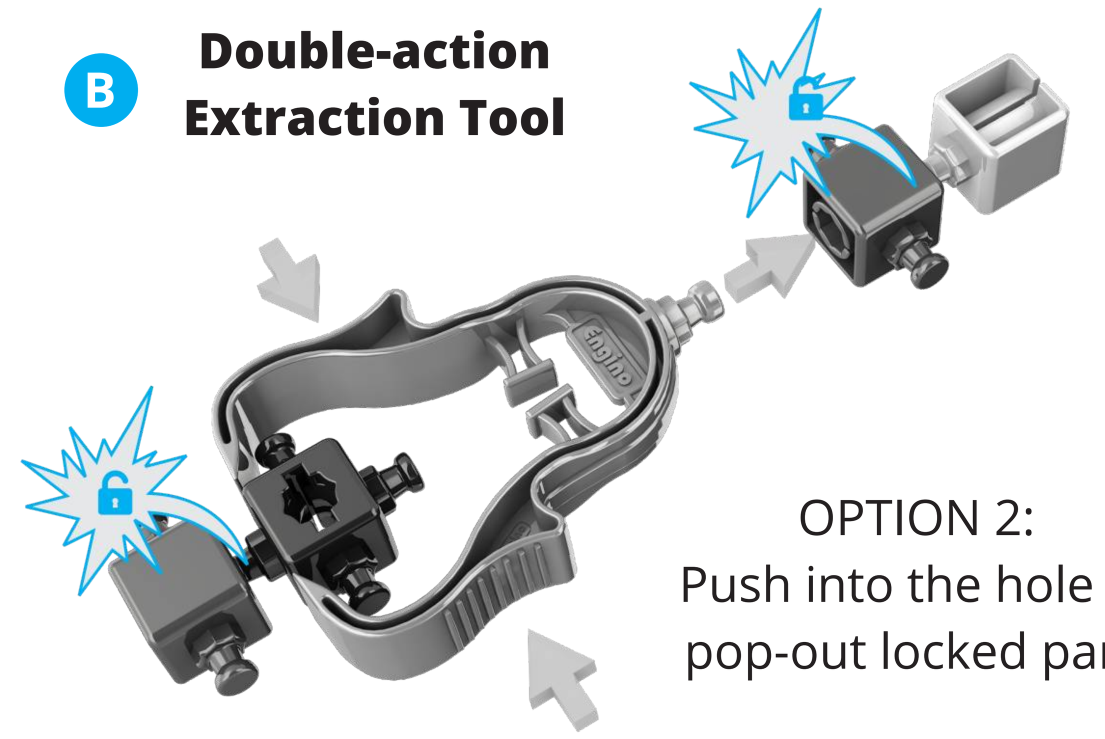
SCALE 1:1

Building Tips

A



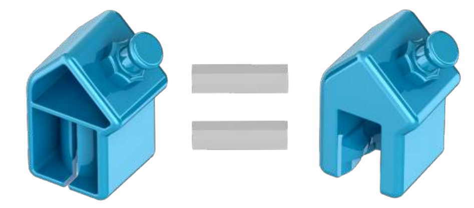
B **Double-action Extraction Tool**



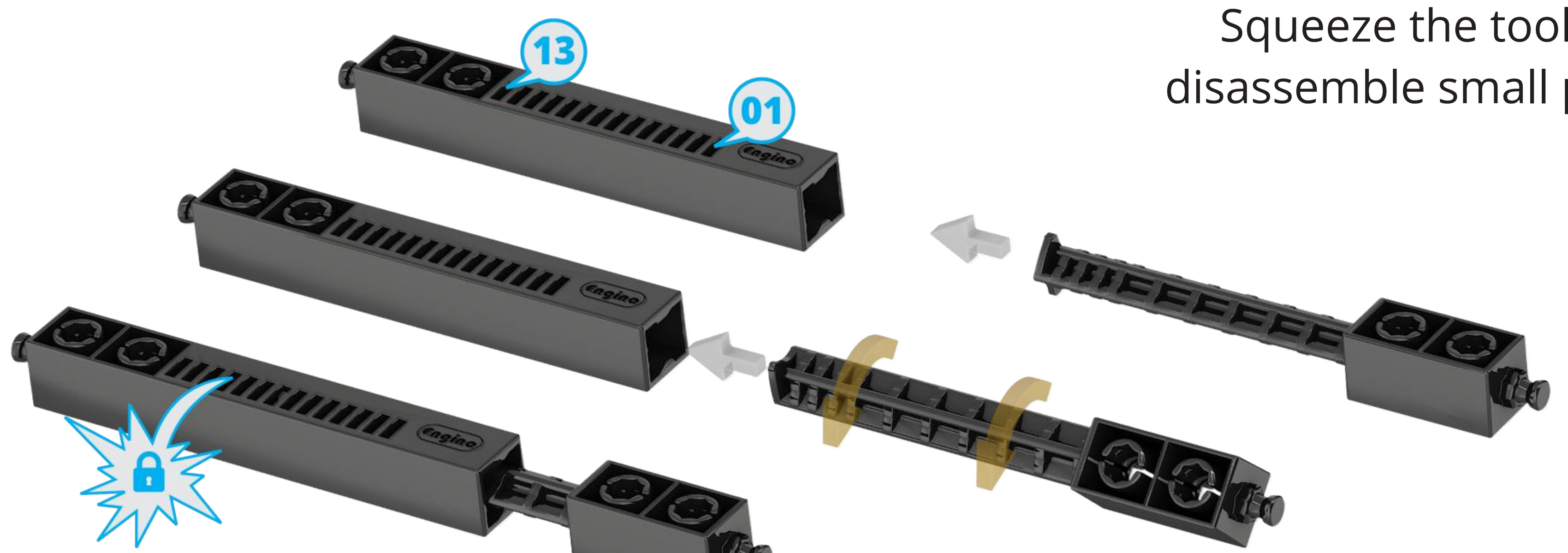
OPTION 2:
Push into the hole to pop-out locked part!

OPTION 1:
Squeeze the tool to disassemble small parts!

C

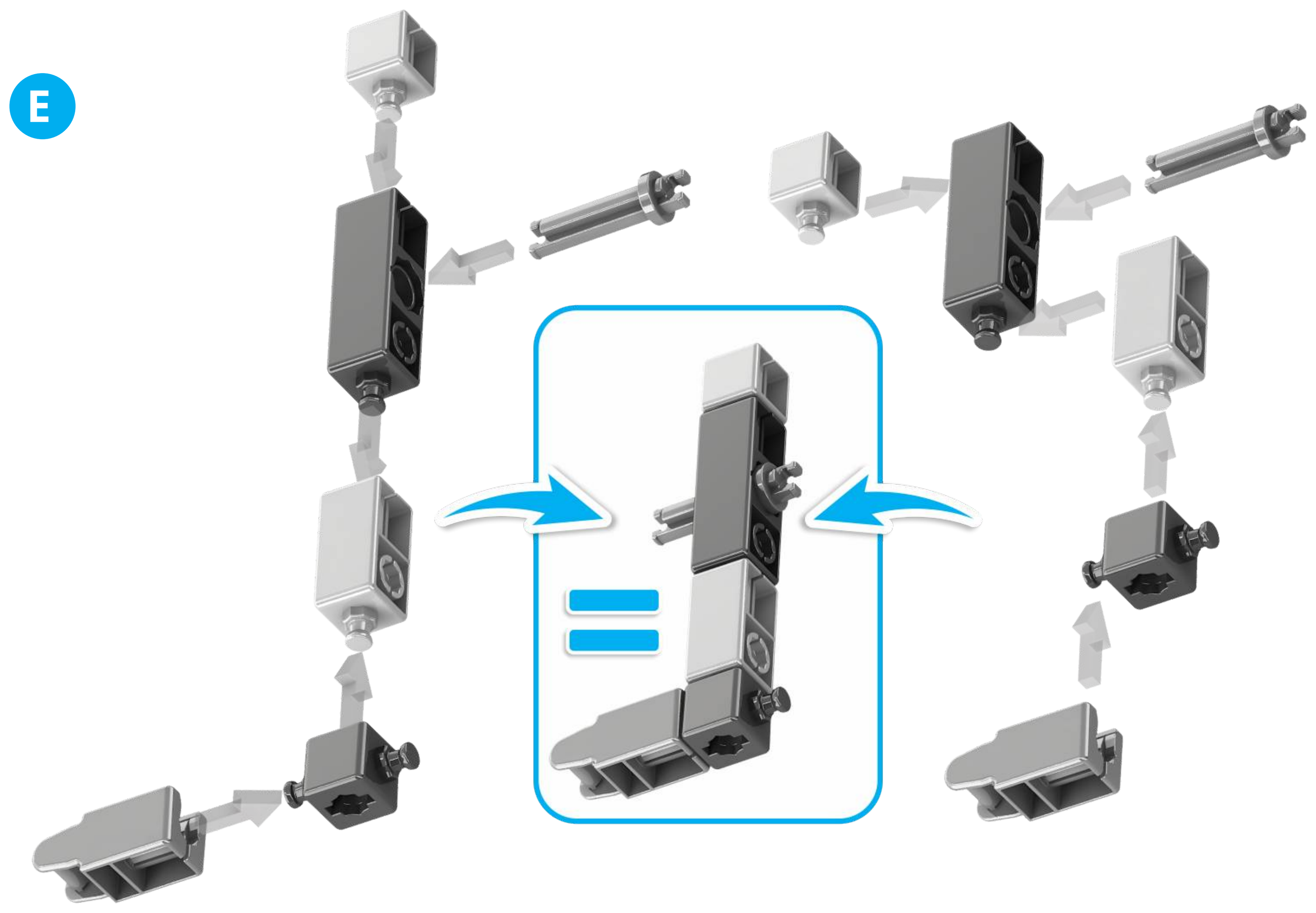


D

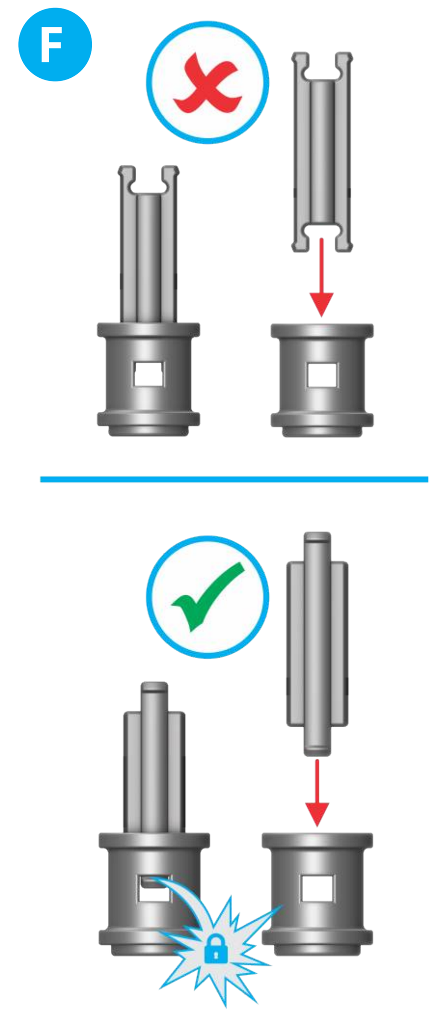


Turn to lock and adjust length!

E



F



Theory

What we will learn

Cars are probably the most common way for transporting humans and goods. They may vary in size and design, but all are defined as motor vehicles that run primarily on roads and have wheels. Cars came into global use during the 20th century and our developed economies depend on them. What are the basic parts of a car and how do they work? What are the rack and pinion?

Read through the pages to gain useful information and amazing facts about these cars. Folllow the building instructions to build your own models. Finally, take the quiz to test your newly acquired knowledge.

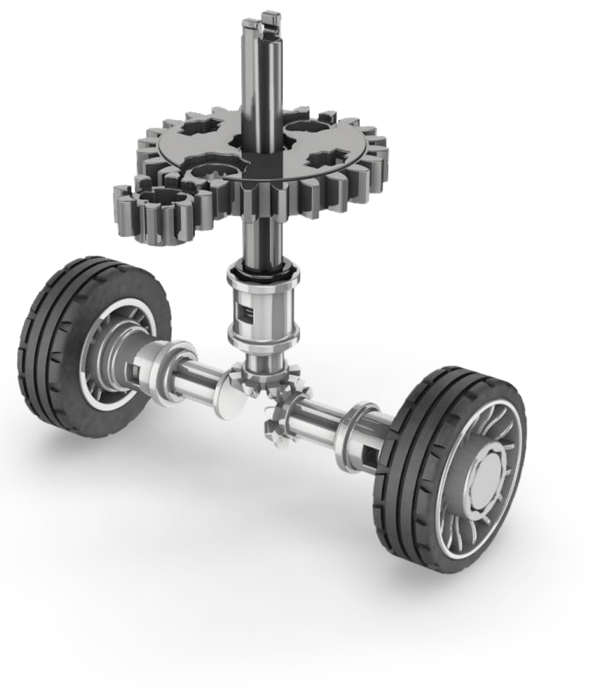
The first wheels were made of rock

History of wheels

The wheel is considered to be **one of the most important inventions** of human history. It was discovered independently from several ancient civilizations. The earliest use of the wheel is probably the pottery wheel in the 4th millennium B.C. in Mesopotamia. Stone wheels were also used as mills for food grinding.

Wheel and Axle

A wheel is a circular device that is capable of rotating on its axis. Besides its usage on ancient vehicles it is also used as a shape to a variety of other forms of similar parts, like pulleys, gears and cams.
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.



A wheel-axle mechanism with gears, made by Engino® system

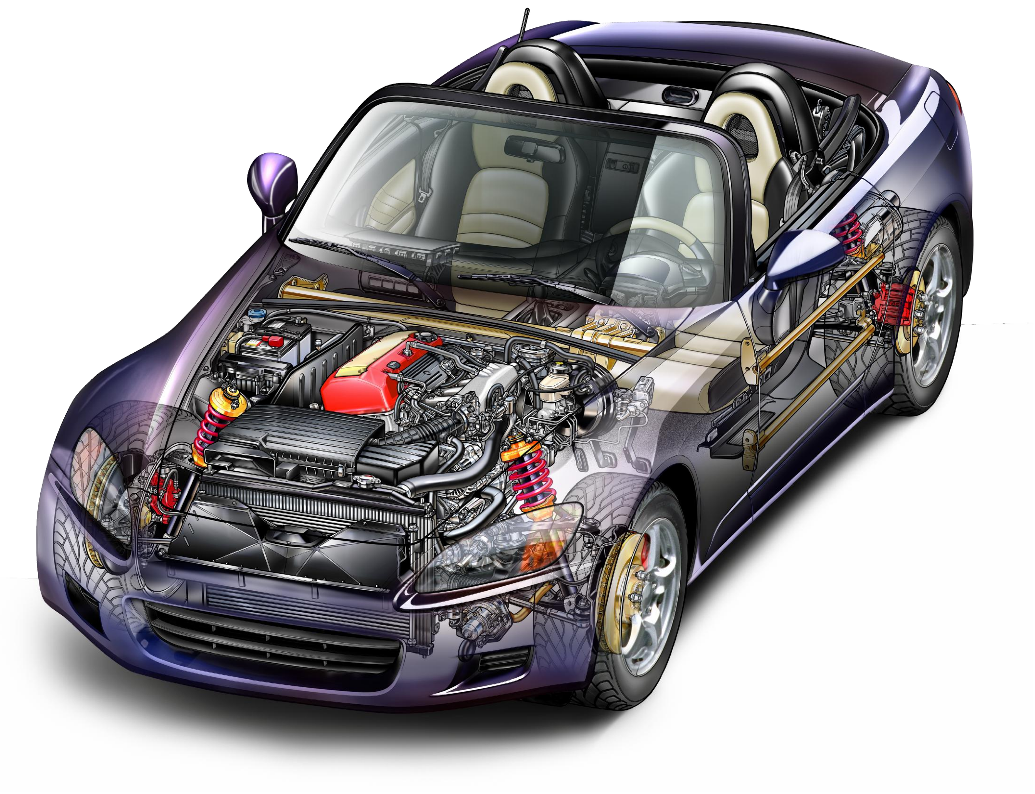
Facts

Main parts of a car

Cars have common parts which are responsible for specific processes, regardless of their type or usage. These are engine, gearbox, suspension, brakes, steering wheel and cabin.

- What is the purpose of each part?

- Why are so important for a car?

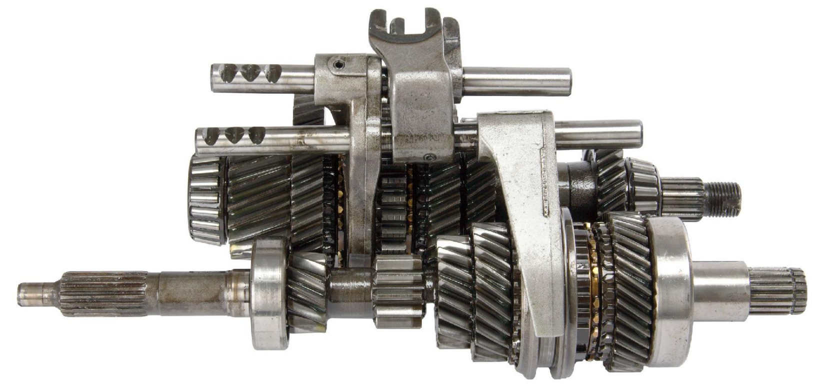


Engine & fuel burning

Chemical energy of the fuel is converted to heat through **ignition** and then to kinetic energy by the **pistons**. Each piston moves up and down inside a cylinder in a **cycle of 4 phases**. The first phase is the filling of the cylinder with fuel and oxygen. Second phase is the compression of the mixture as the piston moves inwards. Third phase is the ignition of the mixture with a spark plug. Finally, the piston moves outwards while the energy is directed to the wheels.

Gearbox

Gearbox is basically a mechanism that consists of multiple **spur gears**, called cogwheels. Their purpose is to **control the torque** and the motor's revolutions. Lower gears provide greater power to the car but less speed, whereas higher gear shifts provide high speed with low torque.

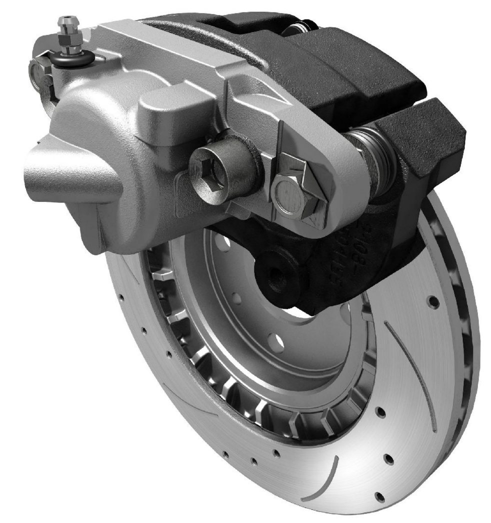


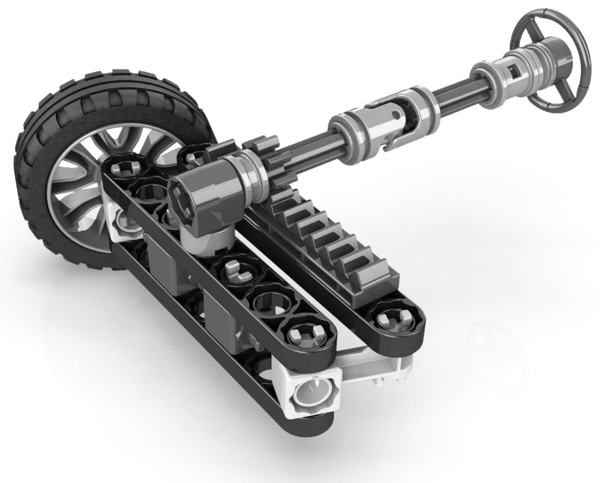
Suspension

The suspension system is responsible for driving behaviour, but also contributes to the way the car brakes behave. It establishes a safe and comfortable driving, keeping **vibrations** and disturbing sounds away from the passengers. It consists of **springs,** shock absorbers and connections that attach the vehicle to the wheels.

Brakes

The brake system is responsible for **stopping** the movement of the car. By stepping on the brake pedal, the driver directs power through a liquid to the breaking disk and is pushed to touch the wheel. Thus, the friction between the breaking disk and the wheel is causing the car to decelerate and stop.





Steering wheel

The steering wheel is the mechanism that makes the vehicle **turn**. It is connected to the front axle of the car and to the wheels. The rotation of the steering wheel causes a swivelling movement of the front wheels. It was invented back in 1894 and made driving much easier, offered more precise steering and better handling compared to the primitive mechanisms of the tiller.

Did you know?

The car is an elaborate puzzle of parts! Estimates show that the average car has over 30000 parts and it takes about 19 hours to assemble in a factory. The assembly systems encompass thousands of employees on shift work in combination with robotized machines. A normal production day yields about 1,450 cars!

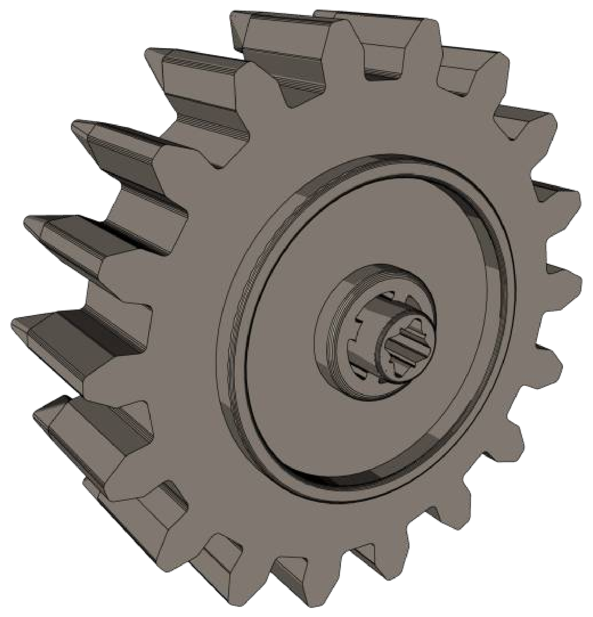
Production line in a car factory

Driver's cabin

The cabin of the car is important for its **comfort and functionality**. On the driver's feet there are pedals for controlling the acceleration and braking of the car. In the middle there is a gear stick that controls gearing and driving modes. In front of the driver, the dashboard provides information about speed, covered distance and fuel level. The steering wheel has also levers that control lights, rain wipers and radio.

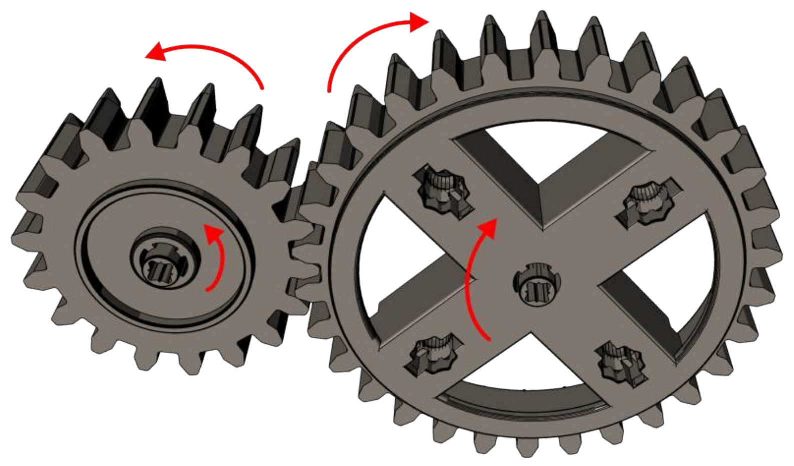
Gears

Gears are wheels with teeth around their circumference, enabling them to mesh with each other. They belong in the category of simple machines which means they can increase the applied force and have a mechanical advantage. Gears can be found in almost all machines that have moving parts and we use them if we want to: transfer motion from one position to another; reverse the direction of rotation; increase or decrease the speed of rotation; change the axis of rotation; decrease or increase the force of a machine.



The Engino's medium size gear

A gear isolated can not really do anything! It has to be connected with other gears in order to transfer power. Gears have teeth that connect them and this type of connection is called meshing. The gear that is rotated by a motor or in general by any power source is defined as the "driver" gear and the other gear that follows is the "driven". If more than two gears mesh in a more complex system this is called gear train.

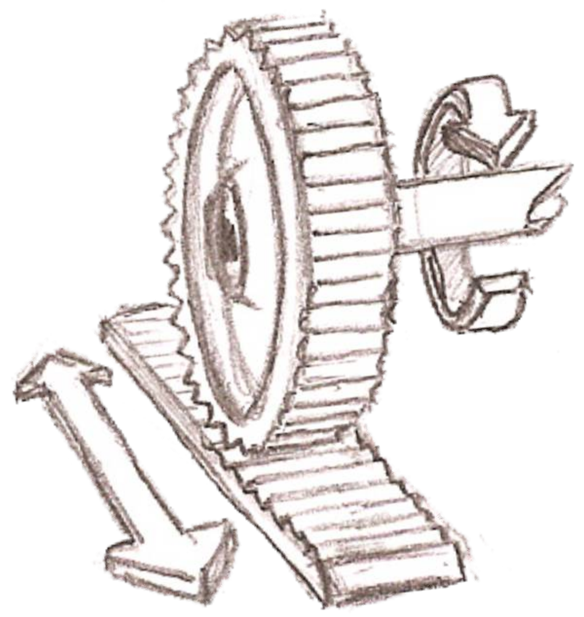


Two gears rotating in reverse

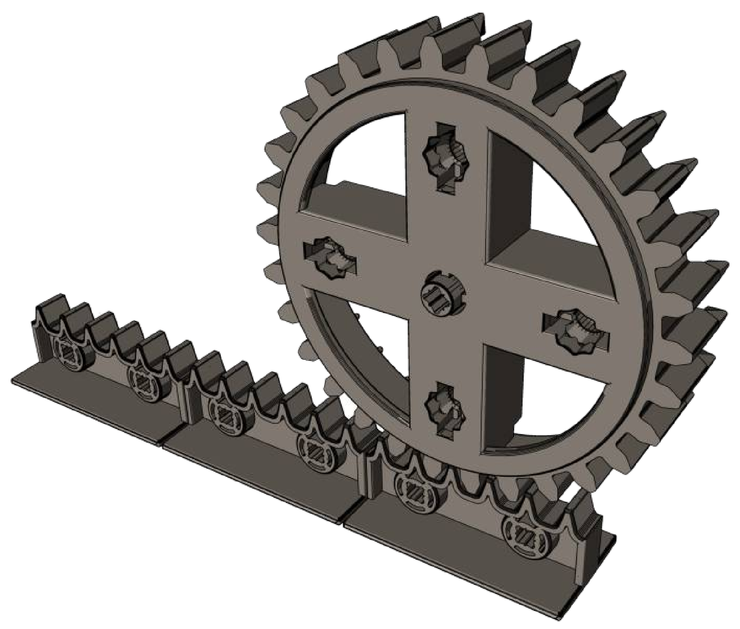
The teeth of the gears are the most essential elements and their design will determine the efficiency of gear transmission. As we have seen in ancient times, gear teeth were made of wooden beams and were big and bulgy. Later on, during the Hellenistic times, when the "antikythera mechanism" was created, gears were made of bronze with high precision. Nowadays, gears have very complex shapes to minimize friction and optimize performance, depending on the application.

A close up of standard gear teeth

Rack and pinion



The rack and pinion gear system



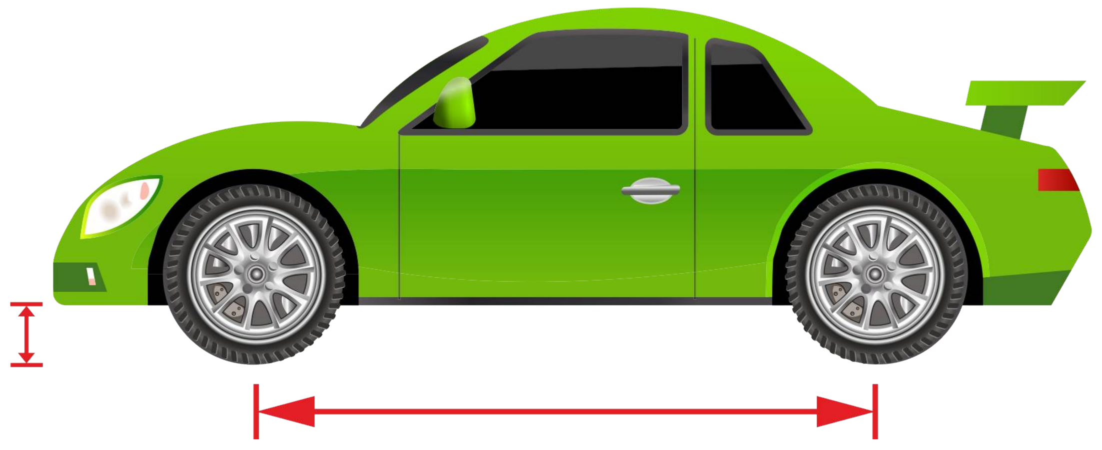
The Engino's rack and pinion gear system

In many machines there is a need to convert rotational motion to linear, that is in a straight line movement. Other machines can do this as well such as the crank or the cam, even linkages, however, gears can do it with precision allowing full control at any position! These gears are called rack and pinion.

Automobile design

Wheelbase

The distance between the **front** tires and the **rear** tires is called wheelbase. It is measured from the centre of the wheels and it is a very crucial parameter for categorizing a car's size.



Cars with long wheelbase are considered to be more luxurious since they have a more spacious interior. They offer a pleasant ride and feel more stable while driving in high speed. On the other hand, cars with a relatively short wheelbase have a smaller cabin. However, such cars are very handy for city usage due to their compact design which requires significantly less space for parking, allow turning in narrow streets and generally have less impact on traffic jams.

Ride height

The distance between the **bottom of a car (chassis)** and the **road** is called ride height. It also known as “ground clearance” and is a critical factor for several characteristics of a vehicle. In fact, the ride height has an impact on the car's centre of gravity, and thus plays a major role in the overall behaviour of a vehicle. Deciding the correct ride height of a car is a trade-off among practicality and handling.

Lowering the ride height brings the car closer to the ground, making it more stable and provides better handling. In addition, the aerodynamic performance of a car with low ride height is more effective as it generates greater downforce. However, a car with low ride hight is not practical for driving in uneven roads since the chances of damaging the bottom of the chassis are high. Therefore, SUV and off-road cars have a taller ride height.

A supercar and a truck have different ride height

Ramp angles

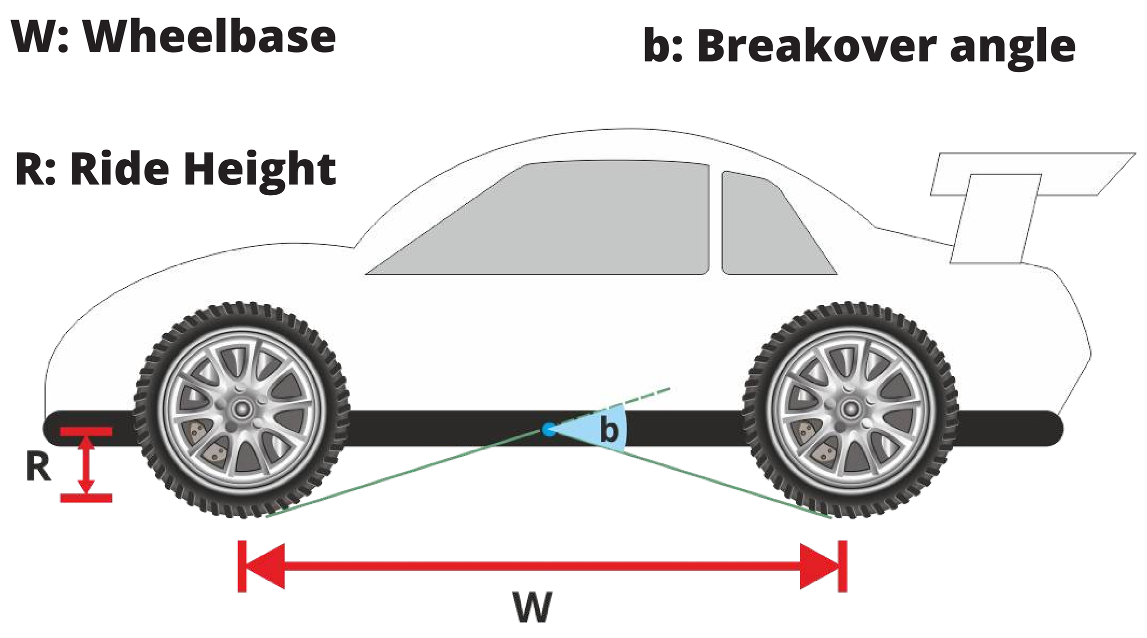
The ability of a car to move up ramps, uphill and ride over steep obstacles is determined by two angles, known as ramp angles. The "approach angle" determines the **ability to ascent over an obstacle**, and is defined by the length between the front edge of a car and its front wheels.

On the other hand, the maximum angle from which the car can descend without damage is called "departure angle".

A car with high approach angle can overcome steeper ramps and move over bumpy roads.

Breakover Angle

The breakover angle determines **the ability of a car to ride without the floor of its body scraping the ground**. An SUV car will be more appropriate for riding uphill and uneven terrain, since it has a high breakover angle.



Breakover angle is determined by the **ride height** of a car and of its **wheelbase**. The larger the ride height, the greater the breakover angle. On the other hand, by increasing the wheelbase of a car, the smaller the breakover angle it gets.

Quiz

Exercise: The image shows a close-up view of a car and its mechanical parts. Can you name the parts using the words from the box below?

suspension, brakes, gearbox, engine