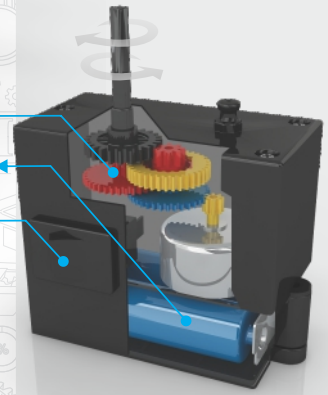
Engino®

CREATIVE™ engineering maker Master

60 IN 1 motorized MODELS

- **2** models — printed instructions (included)
- **58** models — online 3D instructions



⊕ MOTOR POWER

Product code:
CE601MM-A

Online theory & activities

Theory

What we will learn

A motorcycle is a bike with two or three wheeled motor vehicle. A motorcycle is designed for different purposes, like for a long distance travel, and for sports including racing, cruising, off-road riding and etc. Do you know the types of motorcycles? Are you familiar with the historical flashback of motorcycle? Do you know the equipment you need to ride a motorcycle? The booklet of "***Motorcycles***" contains a great deal of useful information and amazing facts, so that you will learn all about motorcycles. Read through the pages of this booklet to discover the types of motorcycles and the equipment you need to ride a motorcycle. Follow the bulding instructions, contained in this booklet to build exciting models such as a **trial bike**, an **off roader** and **scooter**. Enjoy this journey of acquiring new information on different types of motorcycles.

Riding on a sunny day is a joy

The History of Motorcycles

The history of the motorcycle begins in the second half of the 19th century. Motorcycles are descended from the "safety bicycle", a bicycle with front and rear wheels of the same size and a pedal crank mechanism to drive the rear wheel. A motorcycle was often called a bike, motorbike, or cycle which was a two or three-wheeled motor vehicle.

Historical Flashback of the Motorcycle

1920 Gottliemb Daimler built a motorcycle to test engines and that was the reason for the birth of the motorcycle. In the next century there has been rapid progress in design, strength and performance.

1930 During the Great Depression, the target changed and motorcycles were developed more in terms of appearance, performance and became affordable to citizens.

1940 As the world was in war, the development of motorcycles was interrupted.

1950 While cars were still a luxury, simple two-wheeled motorcycles were still the obvious choice and the scooters were on the rise.

1960 The rise of the car hit hard the motorcycle industry and new markets included scooters.

1970 Motorcycle models for off-road have been released for adventure enthusiasts in the USA.

1980 Motorcycles were renewed and interest in classic motorcycles also influenced the design of the new models. Motorcycles became more racing and fully equipped.

1990 Elegant and economic scooters have won a new generation of fans due to the increase of price in fuel and congestion.

2000 Motorcycle riders in the new millennium are rewarded with excellent technological advancement, luxury and comfort.

Types of Motorcycles

Sport Bike

Optimized for high speeds and acceleration. They feature higher foot pegs and a longer reach to the handlebars, which is beneficial when riding into the wind at higher speeds. But, at lower speeds, sport bikes can be tiring because they put more weight on a rider's hands and wrists.

Cruiser

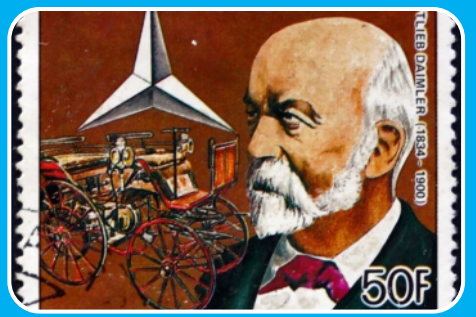
The riding position places the feet forward and the hands are relatively up high, so that the spine is erect or it leans back slightly. During low speeds, cruisers are more comfortable than other styles, but riding for long periods on a freeway can lead to fatigue from pulling back on the handlebars to resist the force of the wind against the rider's chest.

Adventure Tourer

Although any motorcycle can be equipped and used for touring, these motorcycles are specifically designed to excel at covering long distances. Designed for long-distance riding, touring motorcycles have large engines and bigger fuel tanks. They give riders a comfortable, upright seating position and more storage, but their size and higher cost may make them more suitable for experienced riders.

Did you know?

The first motorcycle built by G.D. in 1885 was a motorized wooden bicycle with two small auxiliary wheels. There was a tri-clutch because its lined saddle was like a horse saddle. The vehicle was a carriage rather than a motorized vehicle. The first motorcycle was considered to be modern at the time.



The inventor of the motorbike

Equipment you need to ride a motorcycle

Helmet

The most important equipment you need to have to ride a motorcycle is a helmet. There are a lot of advantages choosing to ride with a helmet. The best significant advantage when you wear a helmet is to protect your head and stay alive. There are six types of helmets such as full face, modular, open face, half helmet, off-road, dual-sport and people choose whatever they want.

Leather Gloves

The second most important piece of equipment is gloves. Gloves are able to protect your hands if you fall off the motorcycle. There is nothing to protect them, so you can break or even lose your fingers. They also protect your hands against the wind if you get weatherproof gloves or you can find gloves that are more aimed towards keeping you cool in the summer months.

Motorcycle Jacket

A motorcycle jacket is a piece of safety gear, mainly because it keeps you warm in the cool weather and you also look cool to others. However, wearing a jacket might increase your temperature and cause you to sweat a little, but if you do end up in a crash, you will be thanking yourself since your skin will stay intact because of its thick textile.

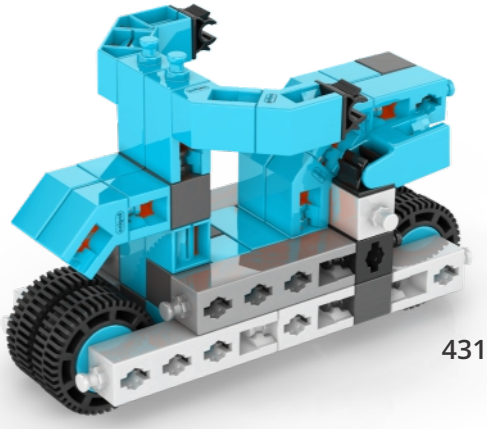
Motorcycle Boots

Another part of motorcycle gear is motorcycle boots. Motorcycle boots look great, but they also provide you with traction and protect the small bones in your feet in the case of a crash. The main rules when it comes to motorcycle footwear are to make sure they are strong and they offer protection over the ankle.

Models

Scooter

A scooter is a type of motorcycle with step-through frame and a platform for the rider's feet. The global popularity of scooters dates from the post World War II introducing Vespa and the Lambretta. Scooters are popular for personal transport, partly due to being more affordable, easy to operate and convenient to park and store. A motor scooter is a motorcycle similar to a kick scooter with a seat, a floorboard and small or low wheels.



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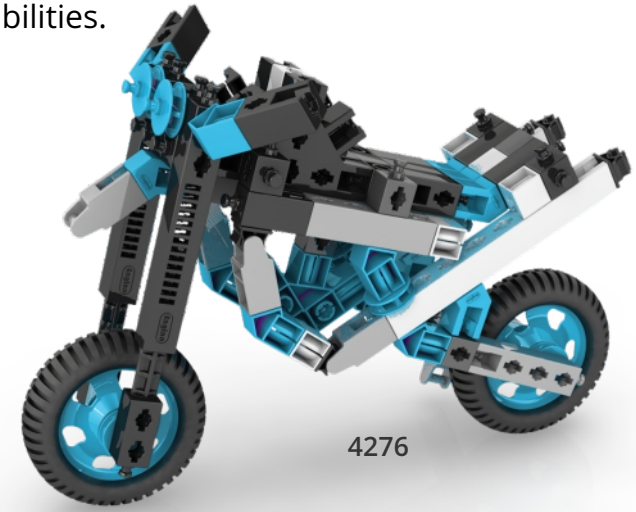
Trial Bike

Modern trial motorcycles are distinctive because they have evolved to become extremely lightweight, they lack seating and have suspension travel that is short, which is relative to a motocross. The trial bike motorcycle is all about balance and the ability to make a motorcycle defy gravity, so bikes need to be built and be as light as possible. A lightweight, small bike is thus much more suited to be ridden over obstacles compared to a motocross bike. Trial bikes are built for one single purpose. That is to ride over incredibly difficult terrain and push the rider to the limits of his physical and athletic abilities.



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Off Roader

There are various types of off-road motorcycles, also known as dirt bikes, especially designed for off-road events. The term off-road refers to any drive on surfaces which are not conventionally paved. These are rough surfaces, often created naturally, such as sand, gravel, a river, mud or snow. These types of terrain can only be traveled with vehicles designed for off-road driving or vehicles that have off-road equipment. The off-road machines are simpler and lighter, having long suspension travel, high ground clearance and rugged construction with little bodywork and no fairings for less damage in spills.

4318

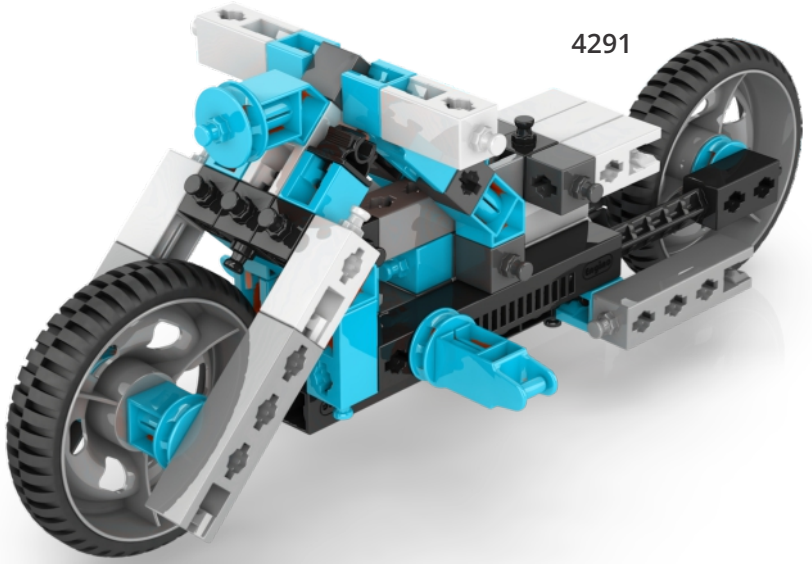
Quiz

Can you discover the following words inside the box? Search horizontal, vertical and diagonal to find them!

MOTORCYCLE, TRIAL BIKE, OFF ROADER, SCOOTER, HELMET, CRUISER

A	M	R	B	J	A	E	Y	Z	T
S	O	A	C	R	U	I	S	E	R
P	T	F	E	X	S	A	B	N	I
E	O	H	F	U	C	P	U	F	A
C	R	Q	I	R	O	H	G	C	L
N	C	Z	D	T	O	X	U	S	B
F	Y	S	G	Y	T	A	K	V	I
I	C	K	A	S	E	I	D	Q	K
D	L	X	Y	C	R	B	V	E	E
Q	E	T	H	E	L	M	E	T	R

Experiment with the motordrome



As you have already learned a motorcycle is a wheeled motor vehicle used for multiple purposes like for transportation, for sports and for many other occasions. Different extreme sports with motorcycles demand high speeds in a curvy or circular paths. There is a specific speed limit a motorcycle should have in order to stay in its circular orbit. This limit depends on different elements such us the corner apex, the motorcycle wheels and the road surface. Motorcyclists should be careful not to exceed this limit since it may cause a motorcycle derailment and motorcyclist fatal injuries too.

- Which factors affect the derailment of a motorcycle?
- Will a lightweight motorcycle derail less or more?

Are you ready to discover how high speeds assist a motorcycle to achieve a circular motion?
Let's perform the next page's experiment to find out the answers for all these questions!
Get ready to discover what centrifugal force is and which factors affect it.

Learning about: **Centrifugal Force**

Motordrome

Motordrome is an extreme sport. Motorcyclists ride around the inside of a vertical wall, rather like a huge cylinder barrel, at high speeds. Perform the experiment below to observe this happening.

Discover:

- What is centrifugal force?
- Which factors affect the centrifugal force?

Level Of Difficulty ★★★☆☆

Materials Needed:

- Engino® (ce601mm-a).
- A4 paper, scissors, stapler or glue.
- String (about 50cm long)

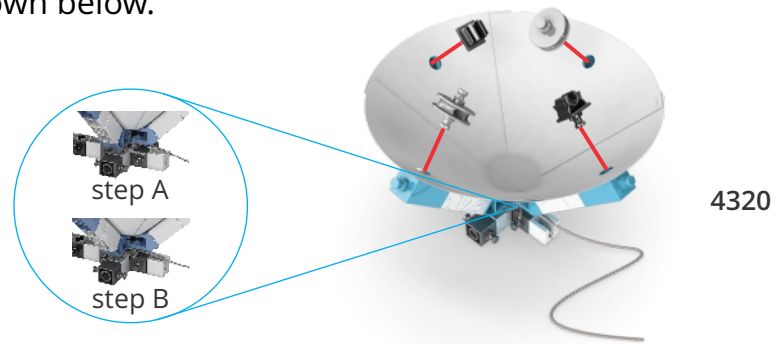
Procedure:

1. Find the instructions and build the **Motordrome** model.

2. **Print** the last page and follow the instructions to create a conical cavity. Then do **exercise 1**.

3. Place **mass A** in the conical platform. Hold the model from the edge of its base and use your finger to apply a force in order to rotate the conical platform. Do **exercise 2**.

1. a) Place the conical cavity onto the model, **b)** use your pen to make four holes on the paper and **c)** tie the one end of the string around the pulley as it is shown below.



2. Is Mass A spinning around the conical platform or does it stay still on the base of it? Why is this happening?

Mass A

.....

.....

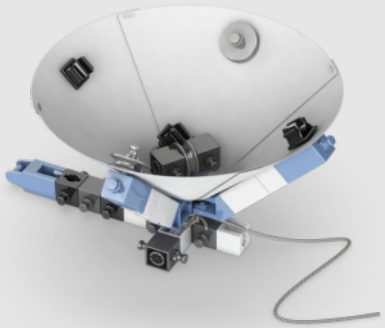
.....

Procedure:

4. Note that **mass A** should be placed in the conical platform for every trial. For **cases 1**, **2** and **3** turn the string around the pulley **1, 2** and **3 times** respectively by holding the other end of the string stretched. For each case hold the model from the edge of its base and pull the string. Do **exercise 3**.

5. Place **mass B** in the conical platform together with **mass A**. Turn the string around the pulley **3 times**. Hold the model from the edge of its base and pull the string. Repeat the same **3 times** and observe which mass escapes first. Then, complete **exercises 4** and **5**.

Mass B



3. a) In which case does mass A escape from the platform? Which factor do you change when rotating the string more times around the pulley?

b) Why do you think the mass escapes from the conical platform?

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4. Put a tick ✓ in the appropriate cell of the table regarding which mass escaped first.

	Mass A	Mass B
1st trial		
2nd trial		
3rd trial		

5. Which mass escapes first? Why do you think this is happening?

.....

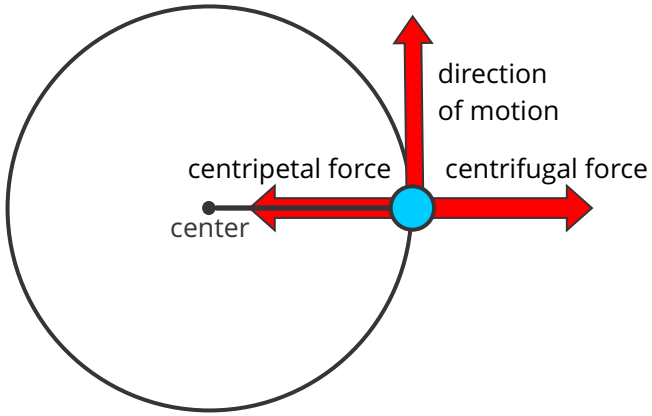
.....

Theory

Circular Motion

Circular motion is defined as the rotation about a point following a circular orbit. Whatever the object is, if it moves in a circular path, there is some force acting on it causing it to change from its straight-line path, accelerate inwards and move along a circular path. The 2nd law of Newton is introducing the 3 key concepts, Force, Mass and Acceleration, which describe the motion of objects. For circular motion, we will introduce equivalent terms which are specifically used for such cases. An example of circular motion is a race motorcycle turning through a curve in a race track.

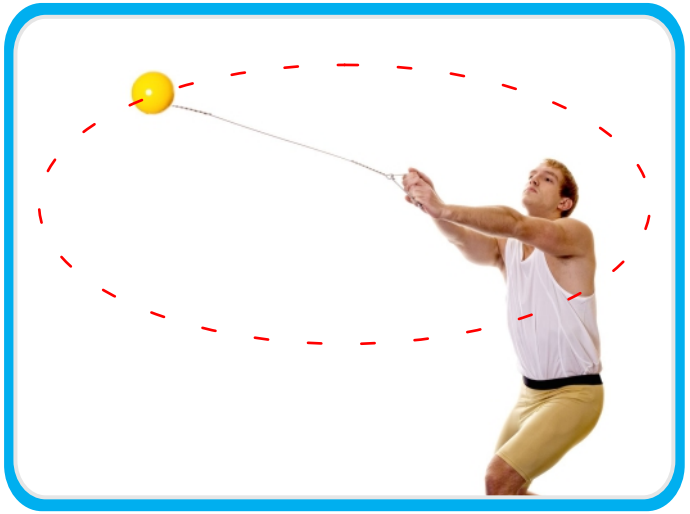
Centripetal and Centrifugal Force



Any object moving in a circle experiences a **centripetal force**. This force is pushing or pulling the object towards the centre of the circle, the point about which it is rotating. Another force that is important in circular motion is the **centrifugal force**, which acts in a direction contrary to centripetal force and it causes the body to be driven away from the centre of the circle. It is labelled as “pseudo force”, because it is only an artefact of inertia (the property of objects to resist any change in their motion). The centrifugal force is equal in magnitude and in opposite direction to the centripetal force when the object is in circular path.

Newton’s 2nd law of motion

Newton's Second Law states that **the sum of forces acting on an object is equal to the mass of the object multiplied by its acceleration** (increase or decrease in speed) **of the object.** If a boby is in circular motion the net force is equal to the **centripetal force**. Force, mass and acceleration are interrelated! We could state the relationship in two ways: (a) for the same mass, the bigger the force the bigger the acceleration and (b) to achieve the same acceleration, the bigger the mass the more force is needed.



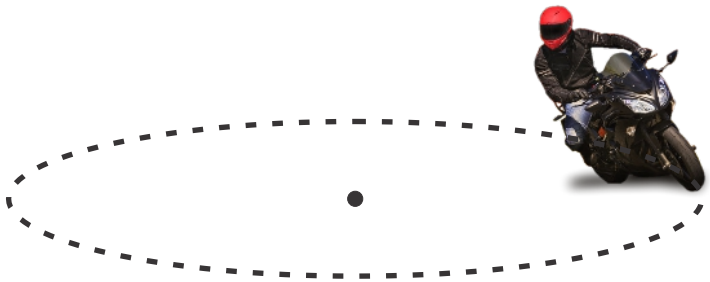
Velocity and Circular Acceleration

In order to understand what acceleration is, we need to understand the notion of velocity first. **Velocity** is the change in distance over time, it shows how fast or slow an object is moving. The velocity of an object in circular motion is continuously changing, since the direction is changing. **Acceleration is the change in velocity of an object**, from slow to fast or from fast to slow. **Circular acceleration** is defined as the rotation about a point following a circular path or a circular orbit. Whatever the object, if it moves in a circular path, there is some force acting on it causing it to change from its straight-line path, accelerate inwards and move along a circular path.

Quiz

Exercise

a) The motorcycle below is in circular motion. Draw the direction of the centripetal and of the centrifugal force?



b) It is given that the centripetal force acting on the motorcycle has a magnitude of 100N while the centrifugal force has a magnitude of 120N. Explain whether the motorcycle will derail or not.

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Knowledge check: check what you have learned.

- [ ] What is circular motion?
- [ ] What is the relationship between centripetal and centrifugal force?
- [ ] What does Newton's 2nd law state?
- [ ] Is velocity constant in circular motion?
- [ ] What is circular acceleration?

Theory

What we will learn

A car is wheeled motor vehicle used for transportation. Most definitions of car say they run primarily on roads, have four wheels and mainly transport people. Cars came into global use during the 20th century and developed economies depend on them. Do you know the evolution of the car? Are you familiar with cars' historical record? Do you know about car safety? The booklet of "***Automotives***" contains a great deal of useful information and amazing facts, so that you will learn all about the evolution of the car. Read through the pages of this booklet to discover significant information as for the cars' historical record. Follow the bulding instructions, contained in this booklet to build exciting models such as a coupe, a hot rod and a single seater. Enjoy this journey of acquiring new information on automotives.

Cars make transportation easy

The History of Automotive

The automobile was first invented and perfected in France and Germany in the late 1800s. Americans quickly came to dominate the automotive industry in the first half of the twentieth century. Henry Ford innovated mass-production techniques that became standard Ford, General Motors and Chrysler emerged as the "Big Three" auto companies by the 1920s.

The evolution of the car

1908 In 1908 the most popular car in the history of automotive is launched. It is the Ford Model T, a four-seated, rear-wheel-drive car with two gears and a reverse. Still, what makes the Model T stand out is its price.

1938 The people's car in Europe is launched in 1938 by Volkswagen. The legendary Beetle has the longest duration of production, since it has been manufactured for over 70 years, and its sales have surpassed 20 million.

1966 In 1966, the Japanese company Toyota presents a car that relies on functionality and ease of handling. It's the Corolla, the most famous car of all times, with sales reaching up to 40 million units.

1978 The company Mercedes-Benz applies the anti-lock braking system (ABS) to the models of the S-Class series and installs airbags in the interior of cars, maximizing passenger safety.

1997 Toyota presents the Prius, the first hybrid car. It operates mainly with a classic internal combustion motor, but it also has an electric motor that helps its operation. During motion, batteries store energy, which is used by the electric motor and thus saving fuel.

2008 Tesla Motors presents and massively produces the Tesla Roadster, the first electric car that is capable of travelling on motorways. Its battery can hold up to 320km, while its final speed reaches up to 200km/h.

2017 Ford has a goal to develop a fully autonomous vehicle by 2021 and it's taking a bold step with the next-generation Fusion Hybrid autonomous development vehicle. New LIDAR sensors have a sleeker design and more targeted field of vision which enables the car to now use just two sensors.

Car historical record

The price of a Lamborghini Veneno reaches €3.5 million. It's a special limited edition that was designed for the 50year celebration of the company. The Veneno is made of very expensive carbon fibers, it has a motor of 6.5 liters that gives it a power of 750hp, an acceleration of 0 -100km in just 2.8seconds and a top speed of 355km.

The Liebherr T 282C is the ultimate monster in automotive at the moment! It is the size of a house and its engine gives 3650hp. It weighs 252tons and can carry up to 400tons.

The worst traffic jam happened in Beijing, China in August 2012. The cars had formed a line of 100 km long and took them 12 days to clear out.

Did you know?

The most sophisticated cars so far are hybrids that combine contraction technology with electricity. These cars have two engines. They have an internal combustion engine that works with oil and gasoline, but also a small electric motor running on rechargeable batteries. During braking, energy is stored into the batteries, which can be used later by the motor in order to save fuel.

Hybrid cars are the future for saving energy

Car Safety

Seatbelts

The three point seat belt was part of the basic car equipment of the Volvo company in 1959. The use of the seat belt became obligatory in all seats in 1993. Seat belts significantly minimize injuries. Research has shown that in frontal impacts if the back seat passengers do not wear a seat belt, they are ejected and crash on the front seat passengers, increasing the death risk of the front passengers five times.

Airbags

The airbags are a passive safety system. During an impact, the airbags protect the passengers from violent collisions. Ford started offering car models with the option of airbag installation in 1971. Since there was no response from the buyers, their production stopped. In 1980 Mercedes brought the airbags back in the models of the S-class series. Other companies followed in Europe, Japan and America.

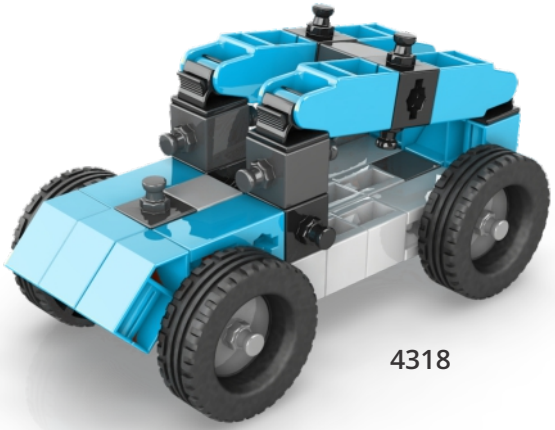
Brakes

The most significant discovery in the evolution of disc brakes is the use of the Anti-lock Braking System (ABS). The system prevents the blocking of the wheels during braking, thus making the car stop in less time. It also gives the driver the opportunity to change the course of the car. Research has shown that ABS minimizes the impact chance in cars by 18%.

Models

Coupe

Coupe is originally a French word (commonly spelled like coupé) which was first used to describe 19th century carriages which had their rear-facing seats removed. The definition of coupe is not completely clear. But generally, the term coupe is used to describe a two-door, hard-top car with a roof that slopes at the rear. There are some coupes offered with four doors rather than two, but these are rare outside of German premium car brands.



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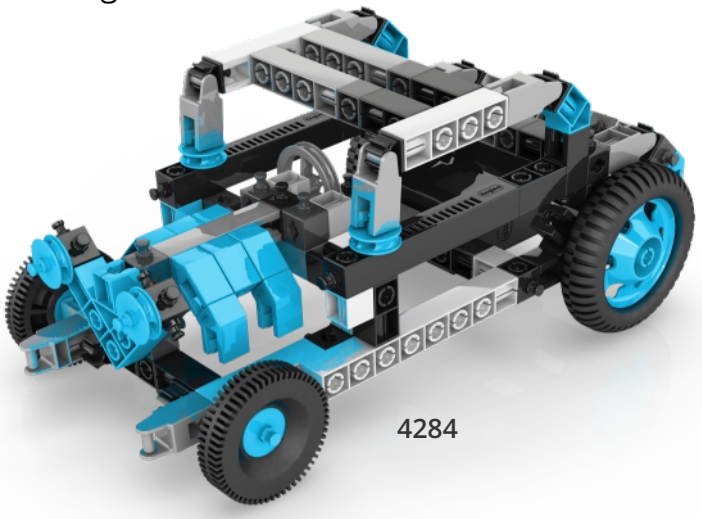
Hot Rod

Hot rods are typically old, classic American cars with large engines modified for linear speed. The origin of the term "hot rod" is unclear. For example, some claim that the term "hot" refers to the vehicle being stolen. Other origin stories include replacing the engine's camshaft or "rod" with a higher performance version. Some automotive historians say that the term originated with stolen vehicles being repaired with another engine and repainted. In the early days of automobile manufacturing there was no identical matching transmission, body frame and engine numbers.



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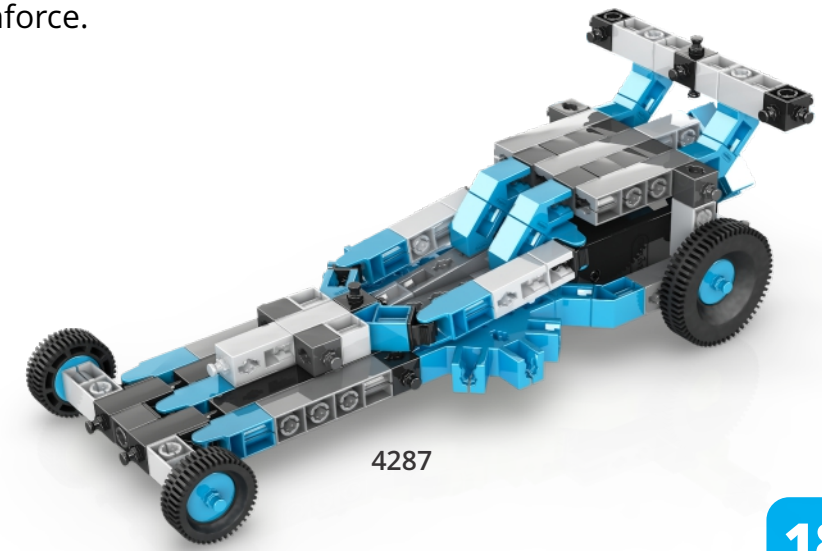
Single Seater - Formula car

A Formula car is a single-seat, open cockpit, open-wheel racing car with substantial front and rear wings and an engine positioned behind the driver, intended to be used in competition at Formula One racing events. They use internal combustion engines and have transmissions, suspensions, wheels and brakes. Formula One car isn't designed for casual driving. Formula One cars are the fastest road course racing cars in the world, owing to very high cornering speeds achieved through the generation of large amounts of aerodynamic downforce.



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Quiz

Can you discover the following words inside the box? Search horizontal, vertical and diagonal to find them!

AIRBAGS, SEATBELT, COUPE,
HOT ROD, FORMULA, BRAKES

H	O	T	R	O	D	A	S	N	I
S	P	Y	C	V	B	P	E	K	P
A	L	E	F	P	J	D	A	U	L
I	B	C	O	U	P	E	T	X	R
R	I	G	R	G	B	O	B	A	C
B	F	O	M	H	W	C	E	H	Z
A	N	J	U	V	O	A	L	Z	J
G	C	B	L	R	E	N	T	W	E
S	B	R	A	K	E	S	R	I	X
X	H	I	B	Y	W	S	D	U	A

Experiment with the inertia car

As you have already learned a car is a vehicle used to transport people. Car safety is vital since car accidents happen every day. An extremely important feature of car safety is the seatbelt, since it crucially minimizes injuries! Seatbelts are used to secure the vehicle's passengers against harmful movement that may be caused by a sudden stop or during a collision. The number of fatal and serious injuries will be decreased as soon as passengers fasten their seatbelts . A lot of people have saved their lives because they have being wearing their seatbelt. Remember to fasten your seatbelt when travelling by car!

- Which physic's law takes place when the car starts or stops suddenly?
- How important is to wear a seatbelt?

Are you ready to imitate an accident and observe the importance of wearing a seatbelt?
Let's perform the next page's experiment to get answers for the above questions!
Get ready to discover Newton's first law.

Learning about: **Newton's 1st Law**

Inertia Car

Did you notice that when the car suddenly stops you move forward? This is because you "want" to continue moving. However, when that car suddenly starts you move backwards, since you "want" to remain idle.

Discover:

- Newton's 1st Law
- The importance of wearing a seatbelt.

Level Of Difficulty ★★★☆☆

Materials Needed:

- Engino® (ce601mm-a)
- ~20cm string
- Small rubber band

Procedure:

1. Find the instructions and build the **Inertia Car** model. Place your model on the side of a table.

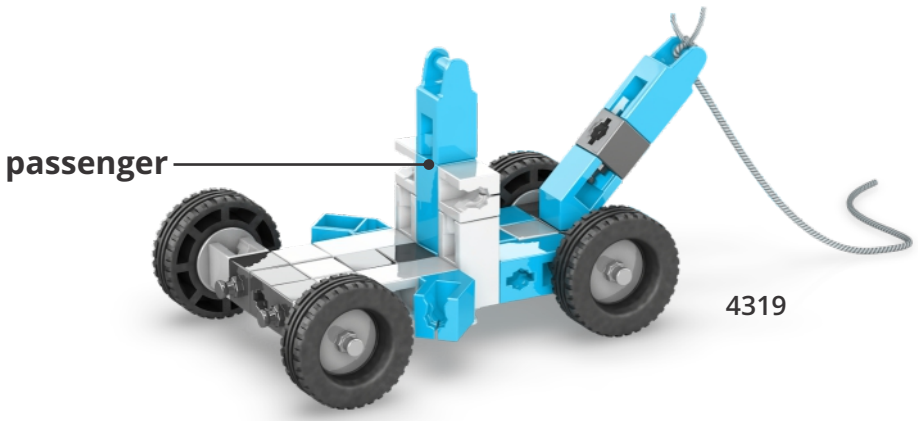
2. **Note** that the passenger should be placed onto the car for **each case**. Tie the end of the string on the orange part of the model as it is shown on the picture on the right.

3. Obviously it does not move by itself. Explain why in **exercise 1**.

1. The model is not moving. Why do you think this is happening?

.....

.....

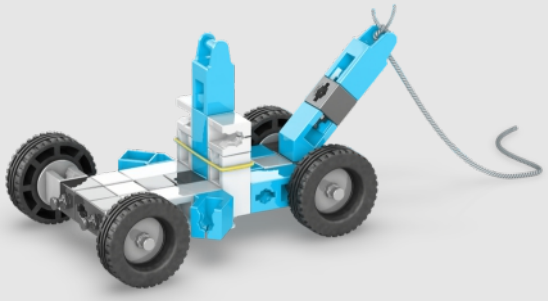


Procedure:

4. Hold the string and pull the model **smoothly** for **case 1** and **sharply** for **case 2**. Write your observations on **exercise 2**.

5. For this step you are going to imitate an accident. Place a strong obstacle in a small distance in front of the model. Pull the model **smoothly** with an increasing speed until it hits the obstacle **sharply**. Then do **exercise 3**.

6. Repeat the procedure of **step 4** but for this case place the rubber band on the model in order to hold the passenger tightly (see the picture below). This way you will create a seatbelt. Answer **exercise 4**.



2. Complete the sentences using the words from the box below.

rest, moving, falling, change, sharply

The passenger has a different reaction in each case. In fact, in case 1 the passenger is ..... with the car while in case 2 he is ..... from the car. This is happening because the ..... of motion is caused in a different way. In addition, for the 2nd case the change of motion was caused ..... . The passenger was at ..... and he wants to remain at rest. He is falling in order to remain in the same position.

3. How is the passenger moving this time? Explain why.

.....

.....

4. What do you observe? Why is it important to fasten your seatbelt while travelling inside a vehicle?

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Theory

Forces

We cannot see forces, but we can understand their effects when they are applied. When we pull a rubber band we can see that it stretches. A can is squeezed by the force applied from our hand. Generally, in order to change the shape of an object, temporarily or permanently, a force must be applied on it. Forces also cause objects to change their motion. In order to make an object move we must apply a force. The same applies if we want to reduce the speed of an object or change its direction of motion. One of the foremost scientific intellects of all time, Sir Isaac Newton, studied forces.

Newton’s 1st law of motion

Newton's First law of motion states that every object remains at rest or continues to move at a constant velocity, unless acted upon by an external force. In other words, if the total force acting on an object is zero then the object is at rest or it is moving at a constant velocity. Simply, in order to alter an object’s velocity, a force should be applied. If the force is in the same direction of movement, then the object will accelerate. If it is in the opposite direction, the object will decelerate. If the force is applied at an angle then the object will turn! Newton’s first law is also called Law of Inertia and it is more observable in objects with big mass (e.g. a big ship).

Sometimes we observe the opposite effect, for example if we are on a bicycle and gain some speed, once we stop pedaling (meaning that we stop acting force) then pretty soon the bicycle will stop on its own. This is caused by friction. You may not see friction or realize it but it is always present, and unless we counterbalance friction by an opposite force the object will inevitably stop. In fact, the bicycle stops instead of keep moving because Newton's 1st law is in effect! Air resistance and friction between rotating parts are acting opposite to the direction of motion and decelerate the bicycle.

Inertia

The ability of a bicycle to keep moving even after we stop pedaling, is called Inertia. It is defined as the property of objects to resist any change in their motion. If an object is moving, then it will "want" to continue moving; if it is idle then it will "want" to remain idle. This "unwillingness" of objects to move is what we call Inertia. What if instead of a bicycle we had a car, or even a truck! The latter would be more difficult to start or stop moving. Inertia depends on the mass of an object, the bigger the mass the higher the inertia. This is what you feel when you are in a car and the driver applies the brakes or what pushes you back to the seat of the plane when it takes off! Therefore you must always wear your seatbelt when you are in a car, as to avoid the risk of injury.

Quiz

Exercise

a) Put a tick ✓ to indicate which of the following objects has **greater inertia**.

b) The car on the right is at rest. Estimate the total force acting on it.

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Knowledge check: check what you have learned.

- [ ] What is force?
- [ ] What does Newton's 1st law state?
- [ ] How much total force is applied on an object at rest?
- [ ] What is inertia?
- [ ] Which objects (heavier or lighter) have more inertia ?