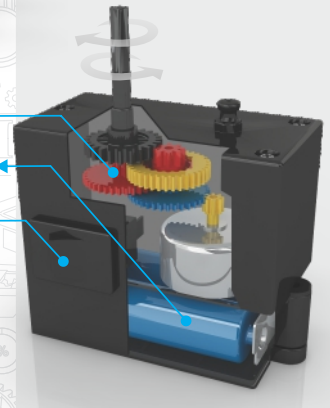
Engino®

CREATIVE™ engineering maker Master

40 IN 1 motorized MODELS

2 models printed instructions (included)

38 models online 3D instructions



⊕ MOTOR POWER

Product code:
CE401MM-A

Online theory & activities

Theory

What we will learn

One of the most exciting type of racing competition is the drag race! Cars which participate in these races are called dragsters and are heavily modified in order to achieve the best possible acceleration along with the highest top speed. When the lights go out, powerful engines launch the cars while roaring and shaking the ground. Rules are rather simple: the car that gets first to the finish line wins the race! Winning though, demands the perfect combination of driving skills with excellent car performance. Have you ever wondered why dragster cars are so fast? What special skills do these drivers have? Read through the pages of the booklet of "***Dragster***" to gain useful information and amazing facts about these racing cars. Folllow the building instructions, contained in this booklet, to build your own model. Finally, take the quiz to test your newly acquired knowledge.

Wheel burning is common when a dragster launches

History of drag racing

Ever since the invention of the motor car, drivers have been obsessed with speed. The lust for the ultimate fast ride in a short distance, led young drivers to compete with their cars proving their braveness. Such battles date back to 1950's. With increasing popularity, the sport began to take its shape a decade later. Scheduled races on double lane tracks began, while dragster cars were modified to be more powerful.

Dragster races

Traditionally, dragsters are long and narrow cars with a single seat for the driver. The rear tires are wider and larger compared to the front. Super-modified engines are used for maximum acceleration and optimum high speed. The track length is usually around 300m and it is covered in less than 4 seconds! A race is actually made from a series of knockouts, with the winning car qualified to the next round. When only two cars are left in the race, the fastest car of the final sprint is the overall winner!

Skilful drivers

It may look easy to just launch a car and keep it on a straight line for a few seconds only. However, drivers need to have excellent control of the car. Due to the enormous ignition power, the car will tend to go either left or right, thus keeping the wheels straight is really hard. Moreover, the reaction time of a driver should be very fast when the start is signalled. Drivers with lightning reactions gain an initial advantage right from the start of the race!

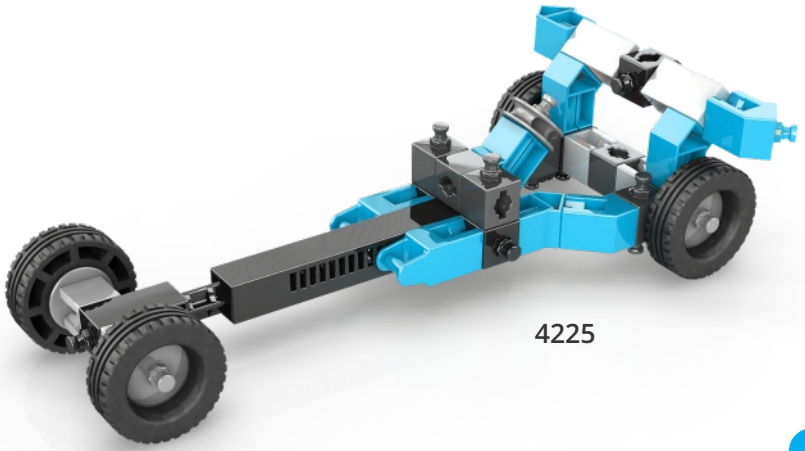
Did you know?

Cars which participate in the class of "*Top Fuel*" achieve a speed near 500 kilometres per hour! In order to stop before reaching the track lane limits, they use a parachute for breaking. The parachute is attached folded to the rear of the cars and is deployed just after the driver crosses the finish line. This is one out of many mandatory equipments that these dragsters have to carry for safety reasons.

Parachutes are used for breaking

Speedsters - Dragster

The drivers are warming up their cars before the race begins. This will heat the tires and set the vehicles ready to race. Racing is right about to begin and the two drivers are placing their cars at the starting line. They have to wait until the amber lights turn to green, before they launch the car! Who is going to react faster? Who has the faster car? Who will eventually hit the finish line first? Follow the building instructions and build your own dragster model. Get ready for this challenge and feel the adrenaline rush!



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Quiz

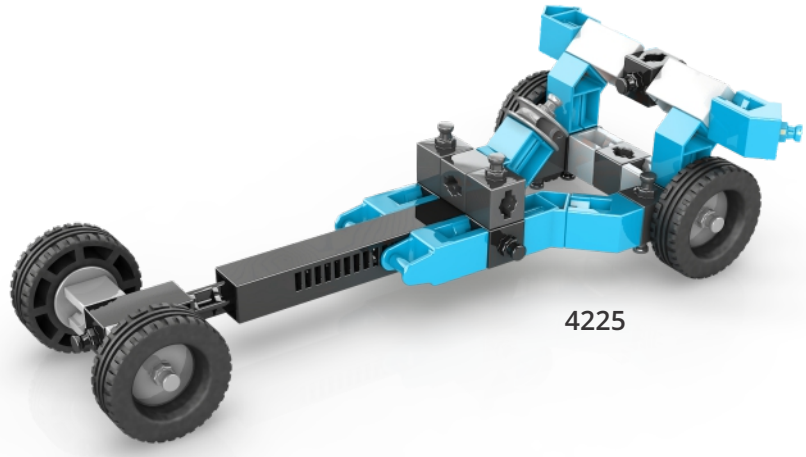
Fill the gaps of the following paragraph using the correct words from the box.

qualified, acceleration, dragster, driving skills, drag race, eliminated,

A race contest between two cars over a ranged distance from 300m to 400m is called ..... . The loser of the battle is ..... from the race, whereas the winner is ..... to the next knockout round. A ..... is designed in order to achieve maximum ..... and high speed. Apart from a powerful machinery, ... are essential to win the battle.

Experiment with the friction car

As you have already learned cars that participate in the class of “Top Fuel” have a parachute attached for breaking! Cars running this race achieve really high speeds. Pressing the brake pedal is not enough to make the car stop in a small period of time. Can you guess how the parachute helps the car to slow down faster? The answer is easy! The parachute increases the resistance acting on the moving car, thus the car is slowing down in a shorter period of time. Consider the case of a simple car where no parachute is attached. In that case, applying the brakes is the only thing used to stop the car.



- What causes the car to slow down and eventually stop?
- Which factors do you think affect that cause?

Are you ready to discover what friction is and which elements affect it?
Perform the next page’s experiment to find out how friction affects the movement!
Get ready to discover how we can increase or decrease the friction acting on an object!

Learning about: **Friction**

Friction car

When we use the brakes on the car, we manage to reduce velocity with the help of a resistance force! Perform the experiment below to find out which is that force and which factors affect it.

Discover:

- What is friction?
- How does friction change between different surfaces?

Level Of Difficulty ★★★☆☆

Materials Needed:

- Engino® (ce401mm-a).
- A large book (with dimensions more than 25cmx8cmx1cm).

Procedure:

1. Find the instructions and build the **Friction Car** model.

2. For **case 1** place the model on the short edge of the book so that it will slide downwards over the long edge. Elevate that side smoothly to create an inclined plane. Observe at which height the model slides down the book. At this case the wheels are locked (they are not free to rotate). Answer **exercises 1** and **2**.

1. Did the car slide down the book as soon as you elevated the book? Can you explain why this happened?

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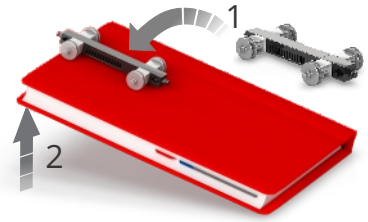


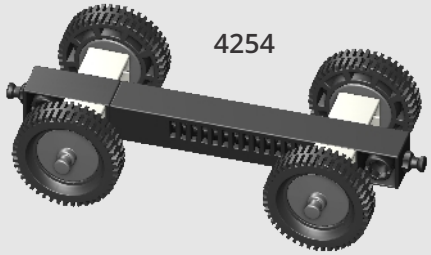
2. Why did the car finally slide down the book? Complete the gaps in the following sentences using the words from the box to find out!

resistance, greater, slides, force

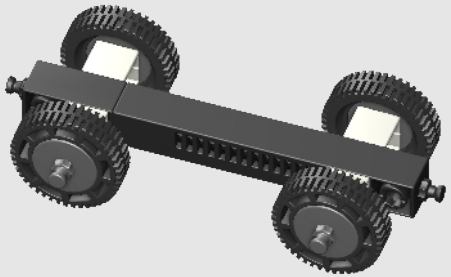
The ..... that didn't let the car slide down the book is called friction! By increasing the height of elevation the car finally ..... down. At this point the ..... that makes the car move downwards is increased. That force is ..... than friction and the car finally slides down the book.

Procedure:

3. For **case 2** add four tyres on the wheels as it is shown below and repeat the procedure of **step 2**. Then, do **exercise 3**. At this case the wheels are locked.



4. For **case 3** reverse each pulley and put it back to the model. This way the rounded connection of the pulley is connected on the model instead of the octagon one and the wheels are free to rotate. Repeat the procedure of **step 2** and do **exercises 4** and **5**.



3. Taking into account the observations of case 1 compare the height the car moved this time. Which factor did you change? Is the friction increased or decreased?

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4. Compare the height the car moved for cases 2 and 3. Which factor did you change now? In which case the friction between the wheels and pivot is greater?

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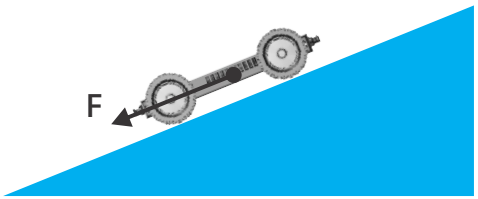
5. Can you draw an arrow to show the friction (**f**) acting on the car? The force that makes the car move downwards is already noted.

F: the force that makes the car move downwards



Theory

Friction

One of the most important factors that influence the operation and overall efficiency of all machines is **friction**. Friction (f) is the force that resists motion and is created when an object is moving (or someone attempts to move it). There are two types of friction between solid objects, depending on whether the two objects in contact are in motion or not. Most of the times, friction is wasted energy, converted mostly to heat and sound. Friction also wears out the rubbing surfaces.

Static friction appears when two objects are in contact, without moving relatively to each other, while an effort is applied in order to move them. For example, when we try to push a box, we have to overcome the static friction between the box and the floor in order for the box to start moving. **Kinetic friction** appears when two objects in contact are moving relatively to each other. For example, when you drag a box on the floor you can feel there is another force resisting your effort coming from the ground. This force is called **friction** and it depends on the surfaces of the touching materials.

Factors that affect friction

Different materials and surfaces lead to different frictional forces. This characteristic of connected surfaces is called **coefficient of friction**. The rougher the surface the greater the coefficient of friction. In addition, when driving on a wet or slippery road low speed is needed, since a longer period of time is needed to stop the car. In this case water decreases the coefficient of friction between the road and the tyres, and therefore the friction! The lower the coefficient of friction the lower the friction. Furthermore, a heavier object leads to greater friction! If a car is stuck in mud or snow place heavy objects onto it in order to escape! This way the weight of the car is increased and thus the friction.

Friction acting as a friend

Many times friction is desirable, acting as a friend. Specifically, when we use the brakes on our bicycle, we manage to reduce the velocity with the help of friction! When we hit the brakes on a car, the wheels stop turning and the car stops due to the force of friction that is created between the road and the wheels. The effects of friction are visible on the wheel marks that are left on the road. Generally, if there was no friction, normal movement of objects could not be achieved (for example driving a car on the road or even walk), as everything would slide!

Quiz

Exercise

a) Complete the boxes below using the words: **low, medium, high** to describe the magnitude of the friction in each case.

b) How can you get your car out when stuck in snow? Note that rescue team is late and you are in a hurry.

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Knowledge check: check what you have learned.

- [ ] What is **friction**?
- [ ] Which are the two **types of friction**?
- [ ] What is the **coefficient of friction**?
- [ ] Which **factors** affect **friction**?
- [ ] How **important** is friction in our life?

Theory

What we will learn

A racer is a four wheeled motor vehicle which is used in car racing competitions. When racing demands high levels of traction and extra power to cross the rough terrains, a dune buggy is the absolute winner. Lightweight design along with mechanical modifications are their key features which provide supreme off-road performance and breathtaking excitement to spectators. Due to their great off-road performance, the army and police are also equipped with buggy vehicles. Are you interested in learning how these extreme cars are designed? why do the police and army need such vehicles to deliver their goals? Read through the pages of the booklet of “Racer” to gain useful information, amazing facts about buggy vehicles. Follow the building instructions and build your own buggy model. Enjoy this journey about racers and answer the quiz which follows.

Buggy car in off road racing

The History of Buggy

As soon as automobiles were invented, race competitions began to be organized. These events attracted large masses of people and originally served as exhibitions of new machines and designs. The competition among machine makers pushed racing events into bizarre and rough territories. The birth of a dune buggy vehicle is estimated around 1950 when a race held on the sandy beach of California.

Buggy design

Buggy is a modified car optimized for off-road challenges. The prime modification is the significant reduce of the total weight by removing doors and bodywork. It is a lightweight automobile with one or two seats. A second key change is the increase of the machine's power which enables climbing steep paths. Also, large and wide wheels are attached to the vehicle for easier drive on dunes, beaches, or deserts. A buggy vehicle carries only the accessories it needs.

Special Uses

When fast actions are required in locations which are normally inaccessible, off-road buggy vehicles are the best option. Security forces, such as the police and army, are equipped with such cars. They can be used in survival operations and to quickly take control over threatened remote areas. They are sometimes called sandrails, as their design aims to achieve the best performance in sandy locations.

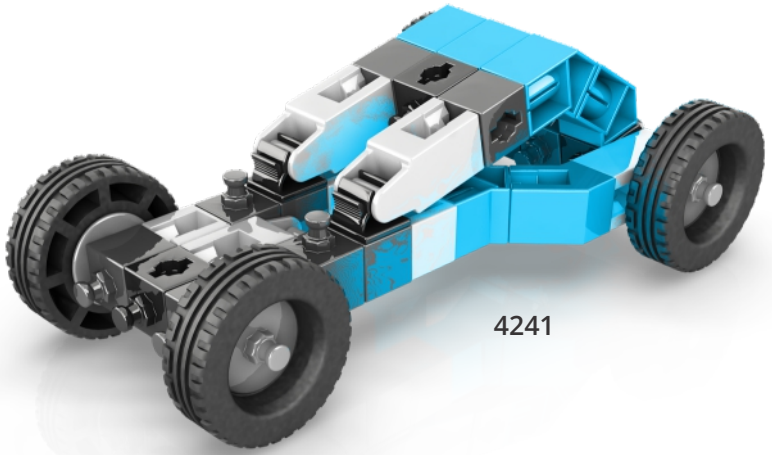
Did you know?

The first vehicle sent to space was a buggy car. The astronauts of the last 3 Apollo missions had the opportunity to drive a rover on the rocky surface of the Moon. Their dune buggy was named *"Lunar Rover Vehicle"* and allowed exploration to sites almost 8 kilometres away from landing place. It used electricity for power and could attain a maximum speed of around 13 kilometres per hour.

Buggy used for Moon exploration

Speedster- Racer

Racing cars can be found in many forms. One exciting type is the buggy car, a recreational motor vehicle often created with open top and sides. It is mainly designed for use on sand and to overcome obstacles in rocky terrains. Spectators are always amazed and excited by the huge clouds of dust they create! Exploration in remote and difficult landscapes becomes a joy thanks to their reduced weight and their smart mechanical design. Find the instructions and build your own buggy model. Test it on different terrains and unleash its unrevealed performance.



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Quiz

Do you know the answer of these questions? Write a ✓ into the correct box.

1. Where is a buggy racer suitable for competition?

☐ Street ☐ Ice ☐ Off-road

2. Which famous beach is known for the birth of the first buggy vehicle?

☐ California ☐ Cote d'Azur ☐ Miami

3. Unnecessary bodywork, doors and windows are removed from a buggy car in order to reduce

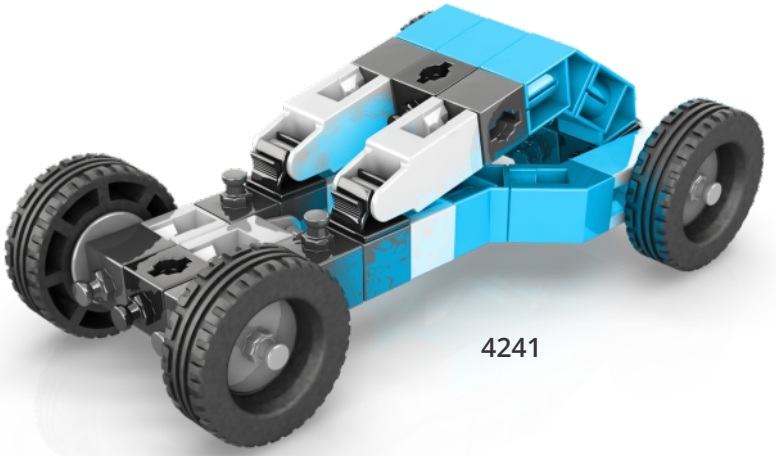
☐ Power ☐ Weight ☐ Cost

4. Buggy cars can be used from the police when they have to go for

☐ Rescue ☐ Control Traffic ☐ Holidays

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!

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:

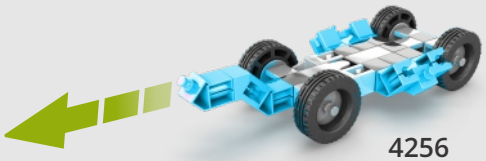
- Engino® (ce401mm-a).

Procedure:

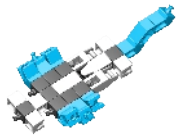
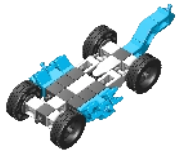
1. Find the instructions and build the **Carrying Cart** model until **step 2** .

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.

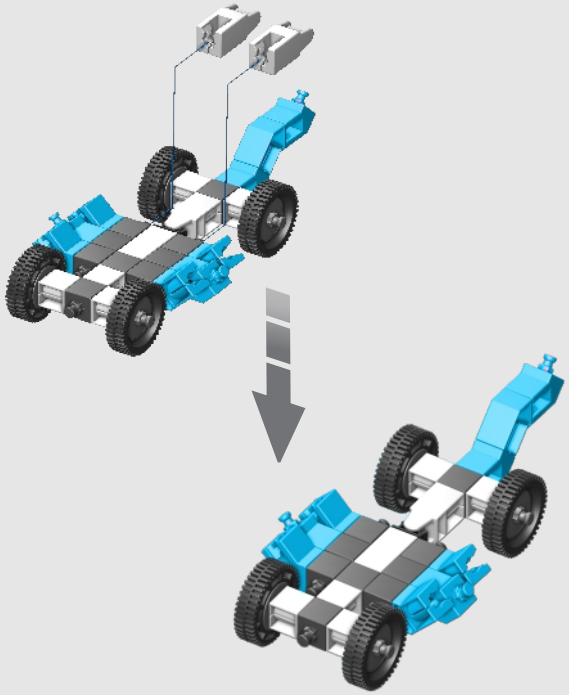
wheels, big, small

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.

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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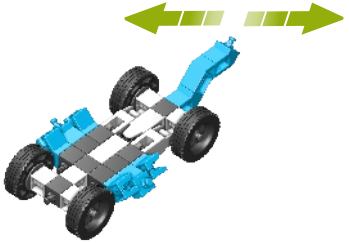

4. What do you observe now? Can you easily make the model turn into a sharp corner? Compare the behaviour of the wheels this time.

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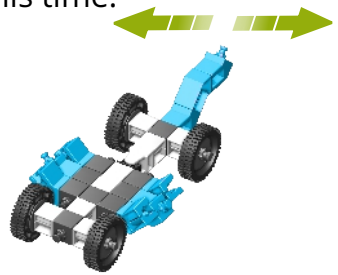
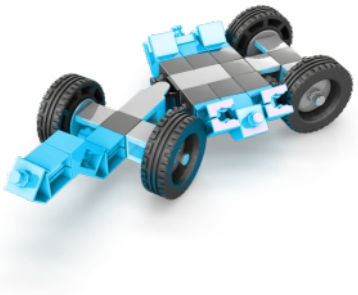


5. Put a ✓ into the correct box to state whether the statement is true or false.



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

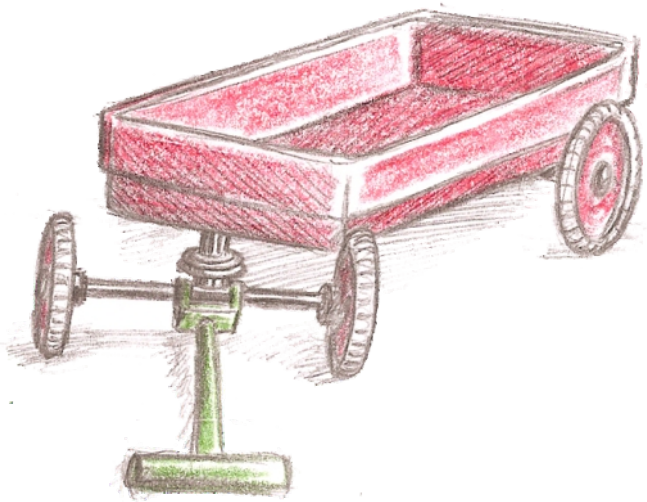
Wheel and axle

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

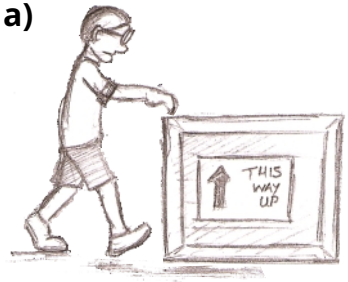
One of the most important factors that influence the operation and overall efficiency of all machines is **friction**. Friction is the force that resists motion and is created when an object is moving. There are two types of friction between solid objects, depending on whether the two objects in contact 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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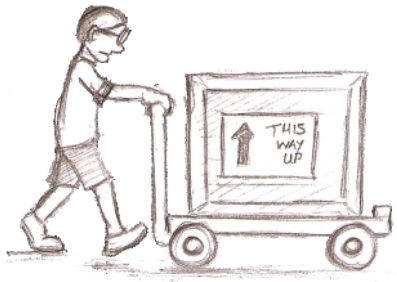

☐

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**?

Theory

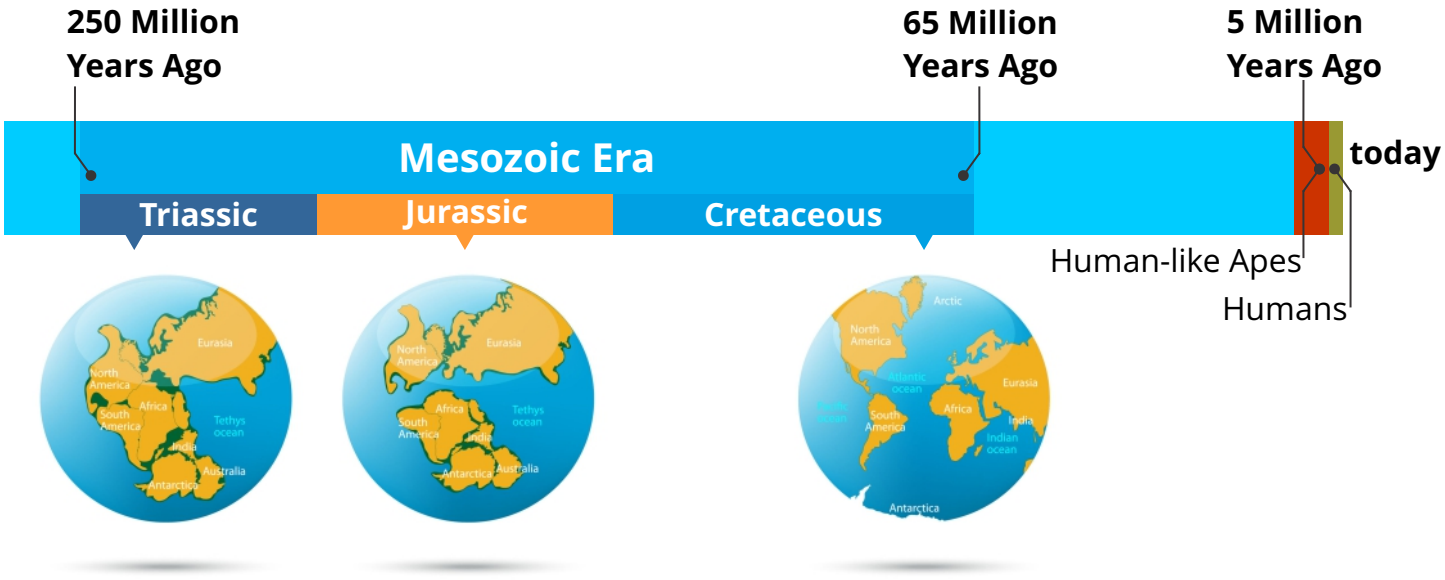
Dinosaurs were the biggest and probably the scariest animals that have ever lived on planet Earth. Some were small, but others were gigantic. Some were fed by plants and had long necks, and others had sharp teeth to eat meat. This extraordinary group of animals, dominated our planet for almost 200 million years and came to a mysterious sudden vanish. Have you ever wondered what types of dinosaurs existed? How was Earth during their era? What are fossils and what is the job of a paleontologist?

Dinosaurs dominated the Jurassic Earth

This booklet of **JURASSIC EARTH** contains a great deal of useful information and amazing facts, so that you will learn about dinosaurs and the science of palaeontology. Follow the **building instructions**, contained in this booklet and also online, to build exciting dinosaurs models such as **a stegosaurus, a triceratops, a brontosaurus, an ankylosaurus, and a pterodactylus**. Get on board in this journey to the prehistoric Earth.

The Era of Reptiles

Any event or fact that happened before humans appear on Earth is called **prehistoric**. In fact, our planet has a very long history of about 4 billion years. Dinosaurs lived a long time ago, during a period named as **Mesozoic Era.** It is also called the "age of reptiles", and lasted about 250-65 million years ago. Earth characteristics such as climate, landmass and animals have undergone drastic changes during this time.



Dinosaurs lived very long time ago. During their era Earth's continents changed to the current shape.

Triassic Period

The first of the Mesozoic period was the **Triassic** period, in which the whole landmass of Earth was contained in one single continent, called the **Pangea.** The continent was mostly dry like a desert with water sources to the coasts. The first dinosaurs appeared in this epoch and began to challenge primitive reptilians and amphibians.

Jurassic Period

The second period was the **Jurassic** period. It was the most active epoch in terms of dinosaur's growth. During the Jurassic period, dinosaurs diversified greatly and spread out to occupy land, sea and air, dominating the whole animal kingdom. Some of the most famous and gigantic species lived during this epoch such as the Brachiosaurus, the Stegosaurs and the Ankylosaurs.

Due to the geological activity of tectonic plates, Pangea split in two main lands: Laurasia and Gondwana. The climate in that period was tropical, with moisture-laden winds from the ocean. Dense forests were covering wide areas.

Cretaceous Period

The third and last period of the Mesozoic era was the **Cretaceous** period. During this time, Earth began to look alike the planet we know today. The movement of tectonic plates formed some of the mountain ranges of today, such as the Appalachians in North America and the Alps in Europe.

Did you know?

The word Dinosaur means a terrible lizard. It comes from two Greek words. The word "dino" which means terrible or causing suffer and the word "saura" which means lizard. Hence, dinosaur means a terrible lizard or a lizard that causes the other to suffer. This word is coined to Sir Richard Owen, when he assigned uncategorized bones to a totally new species called "dinosauria" in 1841.

A gigantic dinosaur could spread terror

Become a paleontologist

No one has ever seen a true, living dinosaur so all information and characteristics are based on fossils and bones and not on direct observation. A **palaeontologist** is the scientist who works on collecting and analysing fossils.

Fossils

The only direct way we have of learning about dinosaurs is by studying **fossils**. Fossils are the remains of ancient animals and plants. They have been found on every continent on Earth, maybe even near where you live! Fossils are excavated from sedimentary rock layers.

How are fossils formed?

The process of forming a fossil is called **fossilization,** and is done under specific and special conditions. The following steps must happen for the creation of a fossil.

1. Once a living animal or a tree dies, it must be covered by sand and soil pretty quickly.
2. Since bones and teeth will not rot soon like its organic parts, they will be encased in deep layers of land.
3. Over long time and gradually these body parts will begin to decay, and create holes and cavities.
4. This cavities shall be replaced with minerals from water, forming a replica of the bone or teeth but made by materials within the rock.

Therefore, a fossil of a bone doesn't have any bone in it! A fossilized object has the same shape as the original object, but it is more like a rock.

This process is not so favourable, so most animals simply decayed instead of fossilize. Paleontologists estimate that only a small percentage of the dinosaur genera that ever lived has been turned to fossils. That's why finding a dinosaur fossil is precious.

Extreme dinosaurs

The most fearsome

In 1997 the most fearsome predator was made known to the scientific community, called **Giganotosaurus.** It had the sharp teeth abound 25cm long and a skull of 2m. Lived 95 million years ago, this 8 metres tall monster was spreading fear and terror to its nearby preys.

The biggest in water

Dinosaurs dominated the ocean too! The largest marine dinosaur that lived during the Jurassic period was the **Liopleurodon.** This marine reptile measured more than 6m in length. It was one of the top predators around. Its jaws alone are believed to have been over 3 metres long – roughly the distance from the floor to the ceiling!

Did you know?

Dinosaur reproduction is achieved through eggs. Fossils of their eggs have been found at over 200 different sites around the world. The largest egg was up to 60 cm, while the oldest known dinosaur eggs and embryos are from a dinosaur which lived during the Jurassic period, about 190 million years ago. Some scientists suspect that the extinction of dinosaurs can be explained if other animals could attack their nests and eat the eggs, reducing their reproduction rate.

Fossilized dinosaurs eggs

The biggest on air

Among the avian dinosaurs, **Quetzalcoatlus** was the largest. With wings wide open it could have wingspan up to 10m ! It shares a similar genealogic tree just like Pterodactylus.

The biggest on land

The largest dinosaur ever known is the **Argentinosaurus**, who could be as long as 35 meters from head to tail. This gigantic creature could weigh up to 100 tons! This is like 20 elephants.

Extinction of dinos

Dinosaurs disappeared suddenly from Earth by the end of the Mesozoic period. Along with the dinosaurs more than 50% of the species who lived on Earth were also vanished. When such large numbers of species undergo global extinction in a short period of time, scientists call it as a **mass extinction** event. Some drastic and catastrophic events should happen to cause such dramatic changes of earth's fauna. The dinosaur extinction is named as the **K–T extinction** event, however the exact reasons are still unknown to scientists. This mysterious event is challenging paleontologists and geologists to seek for facts in old rocks and fossils.

Impact theory

One explanation is the theory of a large **asteroid** hitting the Earth. Such an impact could have created dramatic changes to the atmosphere and global climate. Huge dust clouds could cover the Sun for months, blocking sunlight and disturbing the vital function of photosynthesis. Temperature could drop significantly while terrible infernos could last for years.

Volcanic eruptions

Another explanation can be the intensive volcanic activities that occurred on Earth during those times. One of the largest volcanic features on Earth are the **Deccan Traps,** located in India. Geologists estimate that those gigantic "mountains of lava" were formed at the same time when the K–T extinction occurred. Such enormous eruptions could have created deadly conditions on Earth. Toxic gases should have made the atmosphere poisonous, and causing a significant blocking of sunlight.

Did you know?

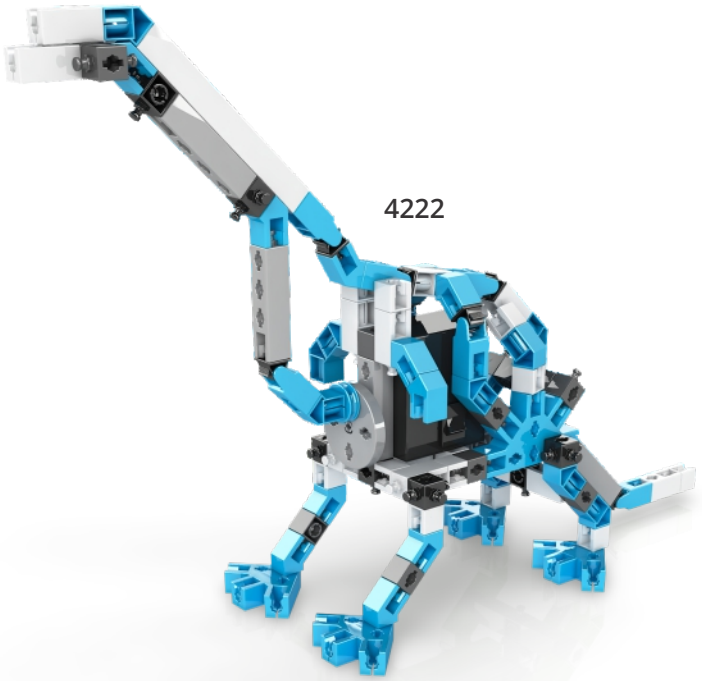
A total of five mass extinctions have been recorded by studying fossils. Each one vanished more than 50% of the living species and plants on Earth. The Tardigrade, is a tiny animal which survived from all extinction events! It is so small that it can only be seen through a microscope. It can sustain extreme temperatures and pressures, and can live without food or water for more than 30 years!

The tardigrade has survived all 5 mass extinctions

Models

Brontosaurus

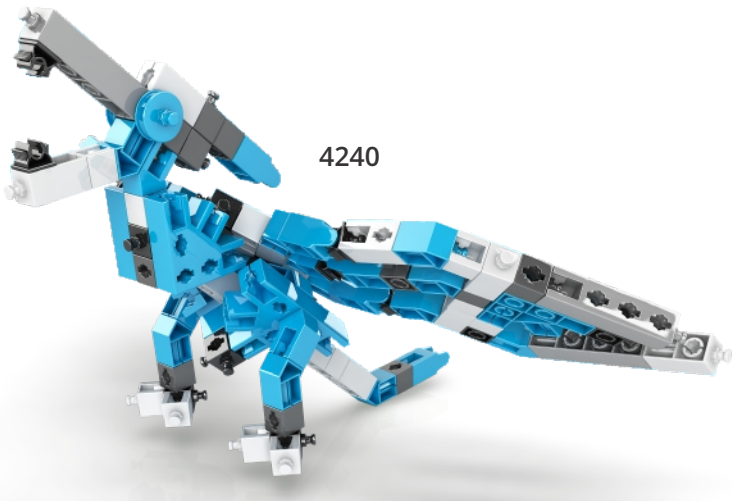
One of the most iconic dinosaurs who lived during the Jurassic period is the brontosaurus. It was a gigantic dino, weighing up to 17 tons and measuring up to 22 metres long from head to tail. It had a long neck which was used to knock down trees in search for its food.



It also had a very long tail, used for balance and to whip its predators. To support its heavy weight, Brontosaurus had four very thick legs. For years, paleontologists confused this kind with another dinosaur, called Apatosaurus, because they both share similar characteristics.

Pterodactylus

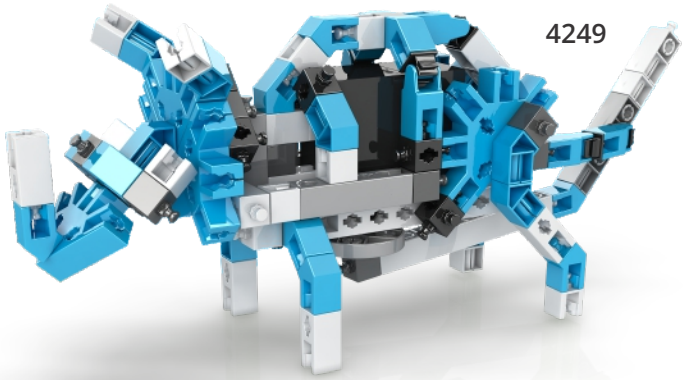
Pterodactylus was a member of the pterosaurs family, while its name means “winged finger”. It lived in the later Jurassic period and is one of the most studied flying dinosaurs. More than 30 different fossils have been found belonging to this creature. Pterodactylus may lived on small islands, in lagoons or on the coasts.



It had wings formed by a skin and muscle membrane stretching from its elongated fourth finger to its hind limbs. It was not as huge as other dinosaurs as its wingspan was about 1 meter. It was a carnivore animal and probably preyed upon fish and other small animals.

Triceratops

Triceratops is one of the most easily recognizable dinosaurs due to its large body, unique frill and the three horns. Its name comes from the Greek words, '*tri*' meaning three '*keras*' meaning horn and *'opsi'* meaning face. So, a triceratops literally means a three horned face.



Triceratops is well distinguished by its very large skull, being longer than 2 metres sometimes. It also had between 400 and 800 teeth, however despite its large number of teeth triceratops was a plant eater.

Stegosaurus

Another legendary dinosaur who lived during the Jurassic period was the Stegosaurus. Large and heavy, Stegosaurus is one of the most easily identifiable dinosaurs, due to its double row of kite-shaped plates. The plates were rising vertically along the rounded back and a pair of spikes extended at the end of its tail. The largest plates were found over its hips and could measure up to 60 cm.

Stegosaurus is also known for having the smallest head in respect to its total size. Its brain is estimated to be no more than 80 grams! The fact that such a huge animal, weighing around 5 tons, had such a tiny brain contributed to the popular old idea that this was probably the dumbest dinosaur that walked on Earth!

Ankylosaurus

Ankylosaurus was one of the last dinosaurs remaining before the large extinction event that occurred at the end of the Mesozoic Era. The prominent feature of Ankylosaurus was its armour. It consisted of knobs, plates and spikes of a bone embedded in its skin.

Those extended bones could vary in size and shape, estimating to be up to 35 cm long. Similar body armour is found on crocodiles and armadillos today. Ankylosaurus was fed from low-lying plants while its small teeth were not designed to completely grind large amounts of leaves. However, it had a sort of fermentation digestive system to break down the un-chewed plants.

Did you know?

Not all dinosaurs died! Birds are considered to be the closest relatives to dinosaurs. There are many bones of present birds which look alike the old pterosaur and their skeleton structure shares similar characteristic. Some avian dinosaurs were able to survive the K-T extinction event and after a long evolution they became much smaller. Hence, birds can be considered as modern dinosaurs!

Birds are descendants of dinosaurs

Quiz

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

REPTILES, JURASSIC, DINOSAUR, PANGEA, EXTINCTION, FOSSIL

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

Experiment with the dinosaur's neck

As you have already learned by reading the booklet, one of the most iconic dinosaurs who lived during the Jurassic period is the brontosaurus. It was a gigantic dino with very long tail and neck which were merely used for balance.

Due to its huge and massive size, Brontosaurus could not hide anywhere or run fast from its predators. In order to protect itself against predators, Brontosaurus used its long neck to keep its head away from shorter predators. It also used its tail as a whip to make a huge sound to scare off its predators.

On many occasions though, its long neck and tail were used to attack and whip its predators. For instance, its large neck was filled with a system of air sacs that helped in fighting its enemies. All of its strength was concentrated on these body parts.

Are you ready to find out the reason why brontosaurus had very long and massive neck and tail?
Lets perform the next page's experiment to get answers for the above questions!
Get ready to discover what momentum is and which factors affect it.

- Why do you think brontosaurus' long neck was helpful to whip predators? What would happen if its neck was shorter?

- Do you think that the mass of the neck affected the impact? What would happen if its neck was lightweight?

Learning about: **Momentum**

Dinosaur's neck

Some dinosaurs used their sharp teeth to fight their enemies or their predators! Brontosaurus was not one of them! Perform the following experiment to discover which of its strengths it used to fight its predators.

Discover:

- What is momentum?
- Which factors affect momentum?

Level Of Difficulty ★★★☆☆

Materials Needed:

- Engino® (ce401mm-a).
- Measure tape.

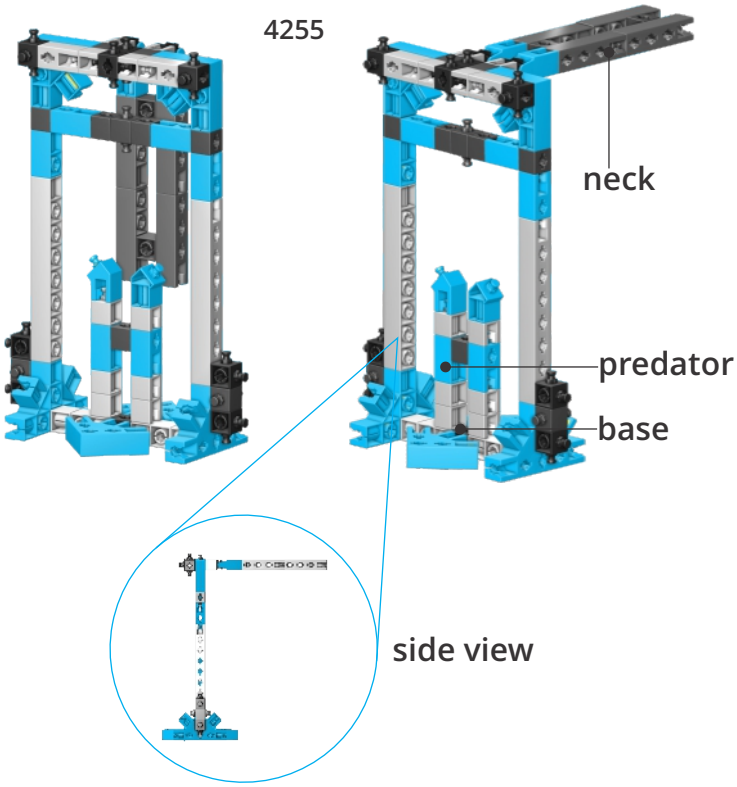
Procedure:

1. Find the instructions and build the **Dinosaur's neck** model.

2. For safety reasons it is better you conduct the experiment at a spacious place and make sure no one is standing in front of the model.

3. For each case you need to hold the model from the top with one hand and elevate the neck **horizontally** with the other one. For each trail the **predator** should be placed on the center of the **base** (see the picture on the right)**.**

4. For **case 1** lift the neck up and let it hit the predator. The gained velocity is due to the gravitational pull of the Earth. Use the measure tape to find the distance that the predator travelled. The distance should be measured from the center of the base until the closest point of the predator. Write your observations on **exercise 1** and try to explain them.



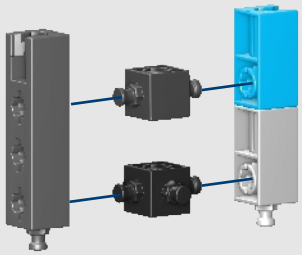
1. a) How much distance did the predator travel?
b) Complete the gaps in the sentences in order to explain your observations using the words: **stops, lost, moves, predator**.

a) Predator's travelled distance = ...cm

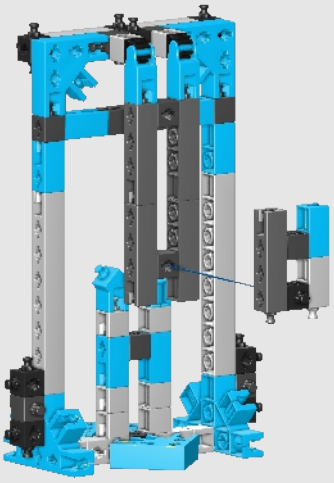
b) The neck loses velocity and ..... while the predator gains velocity and ..... . This is what we call momentum. Momentum is transfered from the neck to the ..... . The momentum ..... by the neck is gained by the predator.

Procedure:

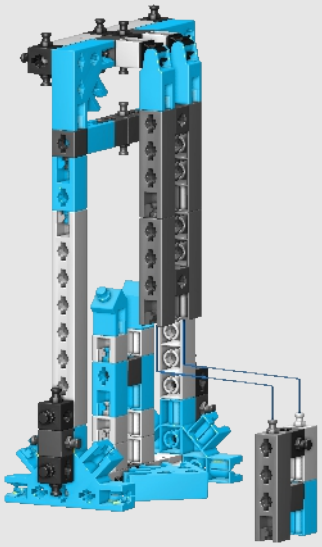
5. Build an additional mass as it is shown below.



6. For **case 2** place the additional part to the neck (see the picture below). Then repeat the procedure to whip the predator and do **exercise 2**.



7. For **case 3** switch the additional mass from the neck to the position shown below. In that way you are actually increasing the length of the neck, so that greater velocity is gained just before the collision. Let the neck hit the predator and write your findings on **exercise 3** and **4**.



2. a) Note the predator's travelled distance.
b) Fill in the gaps in the sentences using the words from the box to compare the two cases.
You may use a word more than once.

momentum, distance, increased, mass

a) Predator's travelled distance = ...cm

b) Comparing the two cases we can conclude that,

when the mass of the neck is ....., the

predator's travelled ..... is also increased. So,

the greater the ..... of an object is, the greater

the ..... can transfer.

3. a) Measure and note how much distance the predator travelled.
b) Compare the results for the three cases.
Note that the mass for case 2 and 3 is the same.

a) Predator's travelled distance = ...cm

b)

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4. Which is the relationship between momentum and velocity (increased length)?

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Theory

Mass

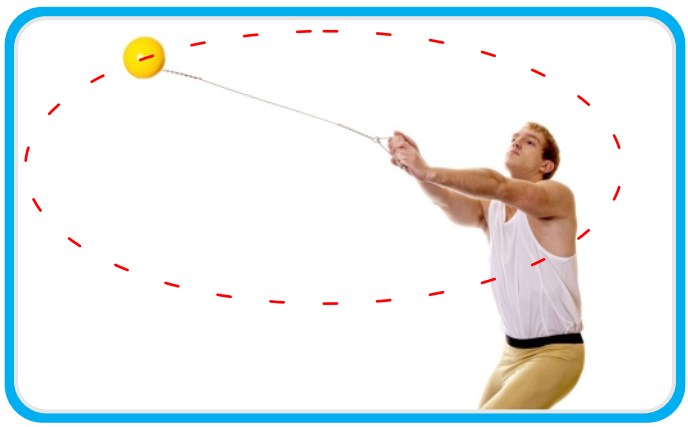
Mass is the quantity that tells the amount of matter in an object. It is measured in kilograms in the International System of units (SI). You may often come across different units, such as grams, which are commonly used for small objects i.e an apple. Also, tones is a unit used for huge objects like a ship for example. To measure the mass of an object we use the instrument called balance. A body's mass is considered to be constant no matter its location. For instance, a 2kg object on Earth, will have the same mass on the Moon!

Velocity

Any moving object has velocity. Velocity is the change in distance over time. In simple terms, if you are able to cover more distance in less time then you have a higher velocity. Many times velocity is referred to as speed. In reality velocity and speed have different meanings in physics. Actually, speed is defined as the travelled distance per unit of time. Velocity and speed are equal when the object is moving in one direction, otherwise they differ.

Velocity in Circular motion

Circular motion is defined as the rotation about a point following a circular path or a circular orbit. If an object moves in a circular path, there is some force acting on it causing it to change from its straight-line path. An object moving in a circular path has two different velocities, the linear velocity and the angular velocity (rotational velocity). The linear velocity of the object moving in a circular path is directly proportional to the angular velocity and the radius of the circular path. In other words, if the angular velocity is constant and the **radius is increased** the **linear velocity will be increased** too!



Momentum

When an object is in motion, thus it has velocity, it generates **Momentum**. The idea of momentum was introduced by the French scientist and philosopher Descartes. He was experimenting on objects moving after collisions. Momentum is commonly denoted by the letter **p,** and is calculated by multiplying the **mass (m)** and the **velocity (v)** that an object has. Hence, the bigger the mass of an object the bigger the momentum. Likewise, the greater the velocity it has the greater the momentum. In case that the object is not in motion, hence its velocity is zero, it will not carry any momentum since the product between mass and velocity is zero!

Advanced information:

From the formula (see on the right) it is obvious that momentum, mass and velocity are interrelated! As a matter of fact, momentum is directly proportional to mass and velocity. In other words, the bigger the mass of an object the bigger the momentum. Likewise, the greater the velocity it has the greater the momentum.

$$p = m \times v$$

p = momentum
m = mass
v = velocity

Formula for calculating Momentum

Conservation of Momentum

One of the most important physics laws is the **conservation of momentum**. This means that in a closed system, when objects collide with each other the total momentum remains unchanged! The only thing that happens is a transfer of momentum from one object to the other and the momentum lost by one object is gained by the other one. A game of billiard is a fine example. When the cue ball (white colour) hits another ball, we observe that the second ball moves, while the cue loses velocity.

Quiz

Exercise 1

Can you briefly describe the following pictures in relation to the notion of momentum and the law of conservation of momentum?

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Exercise 2

A car has a **mass** of **1500 kg** and is moving at a constant **velocity** of **20 m/s**. Using the formula: **momentum = mass x velocity** calculate its momentum**.**

momentum = mass x velocity .....

momentum = x .....

momentum = kgm/s .....

Knowledge check: check what you have learned.

- [ ] What is **momentum**?
- [ ] Which are the two **factors** that affect **momentum**?
- [ ] How does **mass** affect **momentum**?
- [ ] How does **velocity** affect **momentum**?
- [ ] What is the **conservation of momentum**?