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® (STEM09).
- Measure tape.

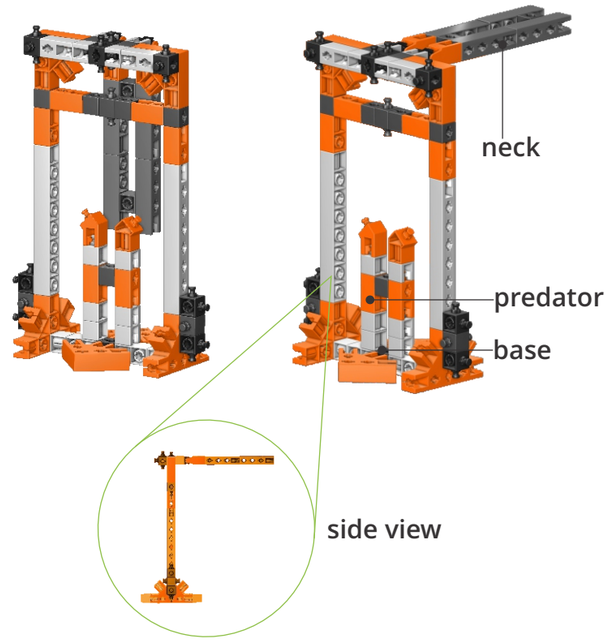
Procedure:

1. Find the instructions in **pages 18-19** 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.

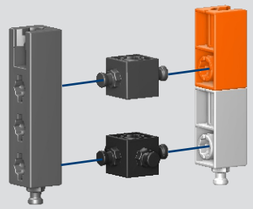


1. a) How much distance did the predator travel?
b) Complete the gaps in the sentences in order to explain your observations using the words: **stops, lost, moves, predator**.

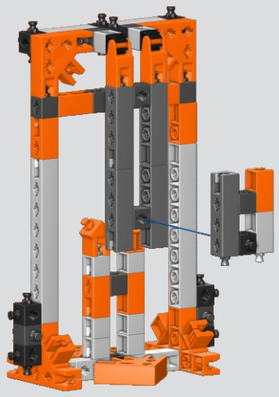
a) Predator's travelled distance = ... *6* ..... cm

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

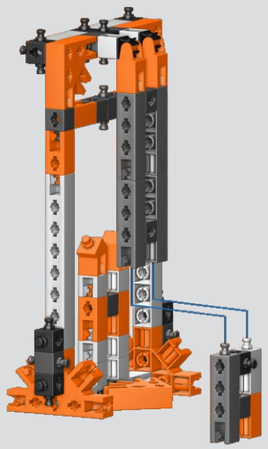
Procedure:
5. Build an additional mass as it is shown below.



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 = ...*8*.....cm

b) Comparing the two cases we can conclude that,

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

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

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

the .....*momentum*..... it 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 = ...*10*.....cm

b) *In all three cases, the momentum of the neck is transferred to the predator, but it is not the same amount. In case 2, it increases compared to case 1 because the mass of the neck has increased. And in case 3, is increased again due to higher velocity.*

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

The momentum of an object is directly proportional to the mass of the object and its velocity. In order to calculate it, we simply need to find the product of mass and velocity, thus using the formula: momentum = mass x 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?

The cue ball is hit with the cue stick with high force, thus gaining high velocity, in order to break the pack of the coloured balls. Its momentum is transferred to the pack, causing the balls to move.

The bowling ball is thrown with high velocity on to the pins. Due to its velocity and big mass, its momentum becomes high. So, when it is transferred on the pins, it causes them to fall down.

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 = *1500* x *20*

momentum = *30000* 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**?