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BE-IN: Best Innovative Practices for an Inclusive and Emotional Education to face early school leaving in Europe

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Unit Framework

Physics

Age: 12 - 17

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1) MOTIVATION

Start a short conversation about action movies. Do they like them? Why int are they interesting for them – or why not? What makes a scene exciting? What does danger mean to them?

Watch the scene from a movie:

https://www.youtube.com/watch?v=4EZ1ldqz8Wc&ab_channel=AndreiLumen after the movieclip: short conversation with the students about their feelings and experiences:

- What kind of feelings did you have watching the clip?
- Did you find it exciting? Why?
- Is it dangerous to jump out from a running train? Why?
- What happened to the bodies, when they jump out from a moving vehicle? Why? - etc.

(A vocabulary scaffold can be provided)

2) INPUT PRESENTATION

Isaac Newton was a scientist born in the 17th century in England. He was widely recognised as one of the greatest mathematicians and physicists of all time and among the most influential scientists. He was a key figure in the philosophical revolution known as the Enlightenment. His book Philosophiæ Naturalis Principia Mathematica (Mathematical Principles of Natural Philosophy), first published in 1687, established classical mechanics, the branch of applied mathematics dealing with motion and forces producing motion. Newton also made significant contributions to optics. In his work, he wanted to understand and explain basic phenomena of the environment. He put forth a variety of laws that explain why objects move (or don't move) as they do. These three laws have become known as Newton's three laws of motion.

Now we are focusing on Newton's first law of motion – which is referred to as the law of inertia. “An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an external force.”

There are two clauses or parts to this statement:

- one that predicts the behaviour of stationary objects and

- the other that predicts the behaviour of moving objects.

The behaviour of all objects can be described by saying that objects tend to "keep on doing what they're doing" (unless acted upon by an external force).
activity 1- Link the words with their meaning

Enlightenment	a forecast
optics	resistance to change

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stationary object	the scientific study of sight and the behaviour of light
external force	the branch of applied mathematics dealing with motion and forces producing motion
prediction	Philosophical revolution started in the 17. century
inertia	a force that acts from the outside
mechanics	Something that is not moving

activity 2 - Complete the text with the words written below

object - laws - “Philosophiæ Naturalis Principia Mathematica” – Enlightenment - England - motion and gravity - force

“Isaac Newton is best know for his theory about the law of gravity, but his book …….. with its three ….. of motion greatly influenced the philosophical revolution called ……. in Europe. Born in 1643 in …., Sir Isaac Newton began developing his theories on light, calculus and celestial mechanics while on break from Cambridge University.

Years of research culminated with the landmark work that established the universal laws of ….. ……... Newton’s first law of motion state that every …… in a state of uniform motion will remain in that state of motion unless an external …….. acts on it.”

3) FOCUS

activity 3 – experiment: The water relay race

Ask students to put one or two tables into the middle of the room so they can walk around them. Fill a baking dish to the rim with water and ask kids to walk around the tables on an oval track making an attempt to complete a lap in the least amount of time. Pay attention to where they loose the water!

Give students (in pairs or small groups) this picture, and ask them to predict, where they will spill water!

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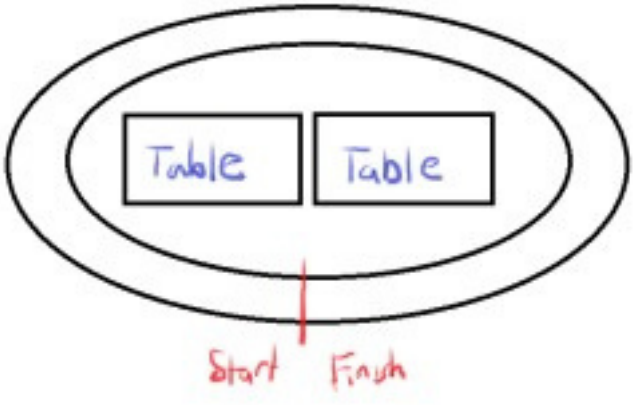
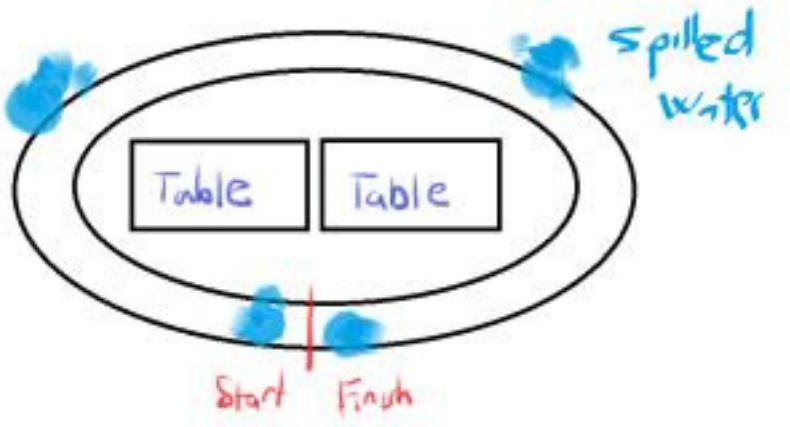


The water will have a tendency to spill from the container during specific locations on the track. In general the water will be spilled when:

● the container is at rest and you attempt to move it (at the start)

● the container is in motion and you attempt to stop it (at the finish line) ● the container is moving in one direction and you attempt to change its direction



activity 4 – true or false

Students in pair or small groups have to indicate whether the statements are true or false:

	T	F corrections
The water remained at rest whenever the state of motion of the container is changed.		The water spills whenever the state of X motion of the container is changed.
The water tended to "keep on doing what it was doing."	X	
When the container was forced to move in a different direction to make it around a curve; the water kept moving in the same direction and spilled over its edge.	X	

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The behaviour of the water during the *lap around the track* can not be explained by Newton's first law of motion.		The behaviour of the water during the *lap around the track* can be explained by Newton's first law of motion. X
Water has inertia – the tendency to offer resistance to a change in the manner in which it is moving.	X	

explanation: The water spills whenever the state of motion of the container is changed. The water resisted this change in its own state of motion. The water tended to "keep on doing what it was doing." The container was moved from rest to a high speed at the starting line; the water remained at rest and spilled onto the floor. The container was stopped near the finish line; the water kept moving and spilled over container's leading edge. The container was forced to move in a different direction to make it around a curve; the water kept moving in the same direction and spilled over its edge. The behaviour of the water during the *lap around the track* can be explained by Newton's first law of motion.

4) PRACTICE

activity 5 - Find the correct answer (in pairs or small groups)

- Imagine you are sitting in a car, with a cup of coffee in your hand. What happens to the coffee, when the car starts moving?
  a) The coffee “keeps doing what it is doing”, and stays at rest and remains in the cup.
  b) While the car accelerates forward, the coffee remains in the same position; subsequently, the car accelerates out from under the coffee and the coffee spills in your lap.

- The car takes a turn to the right. What happens to the coffee?
  a) The coffee “wants to keep moving straight forward” and so it spills to the left.
  b) The coffee spills to the right, following the direction of the car.

- The car takes a turn to the left. What happens to the coffee?
  a) The coffee stays at rest in the cup.
  b) The coffee “wants to keep moving straight forward” and so it spills to the right.

- The car brakes from a state of motion. What happens to the coffee? a) The coffee continues forward *with the same speed and in the same direction*, ultimately hitting the windshield or the dash.
b) The coffee spills in your lap.

5) LANGUAGE

activity 6 - Complete the text with the words written below

Where do you use a)“external force”, when do you use b) “motion”?

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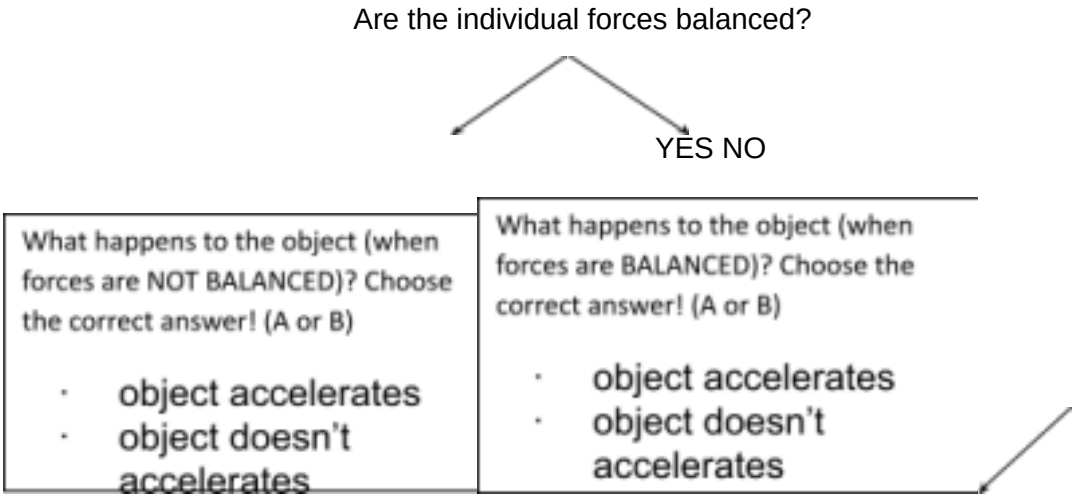
Have you ever experienced inertia (resisting changes in your state of motion) in an automobile while it is braking to a stop? The force of the road on the locked wheels provides the …. to change the car's state of ……., yet there is no …….. to change your own state of …….. Thus, you continue in ……., sliding along the seat in forward ……. A person in ……. stays in …….. with the same speed and in the same direction unless acted upon by the ……. of a seat belt. Yes! Seat belts are used to provide safety for passengers whose …….. is governed by Newton's laws. The seat belt provides the ……. that brings you from a state of ……. to a state of rest. Perhaps you could speculate what would occur when no seat belt is used.

FOLLOW UP

activity 7 – underline the correct answer in red



6) TEST : answer the questions (a scaffolded version should have choose between the two options part)

1) You are on a moving bus. Which direction will your body move
   a) when the bus takes a turn to the left?
   b) when the bus takes a turn to the right?

2) Why can the window break, when suddenly shut?

3) You are riding on a descending elevator, when suddenly the elevator stops. Why does the blood rush from your head to your feet?

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4) The head of a hammer can be tightened onto the wooden handle by banging the bottom of the handle against a hard surface. Why?
5) How can the headrests placed in cars prevent whiplash injuries during rear-end collisions?

6) While riding a skateboard (or wagon or bicycle), you fly forward off the board when hitting a curb or rock or other object that abruptly halts the motion of the skateboard. Why?

7) Which football has more inertia? The one which is dry or the one which is soaked with water?

8) What happens to the body, when jumping out from a moving train?

(based on: Fizika – Dr Zátonyi Sándora 7. éfolyam számára

https://www.physicsclassroom.com/class/newtlaws/Lesson-1/Newton-s-First-Law)

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