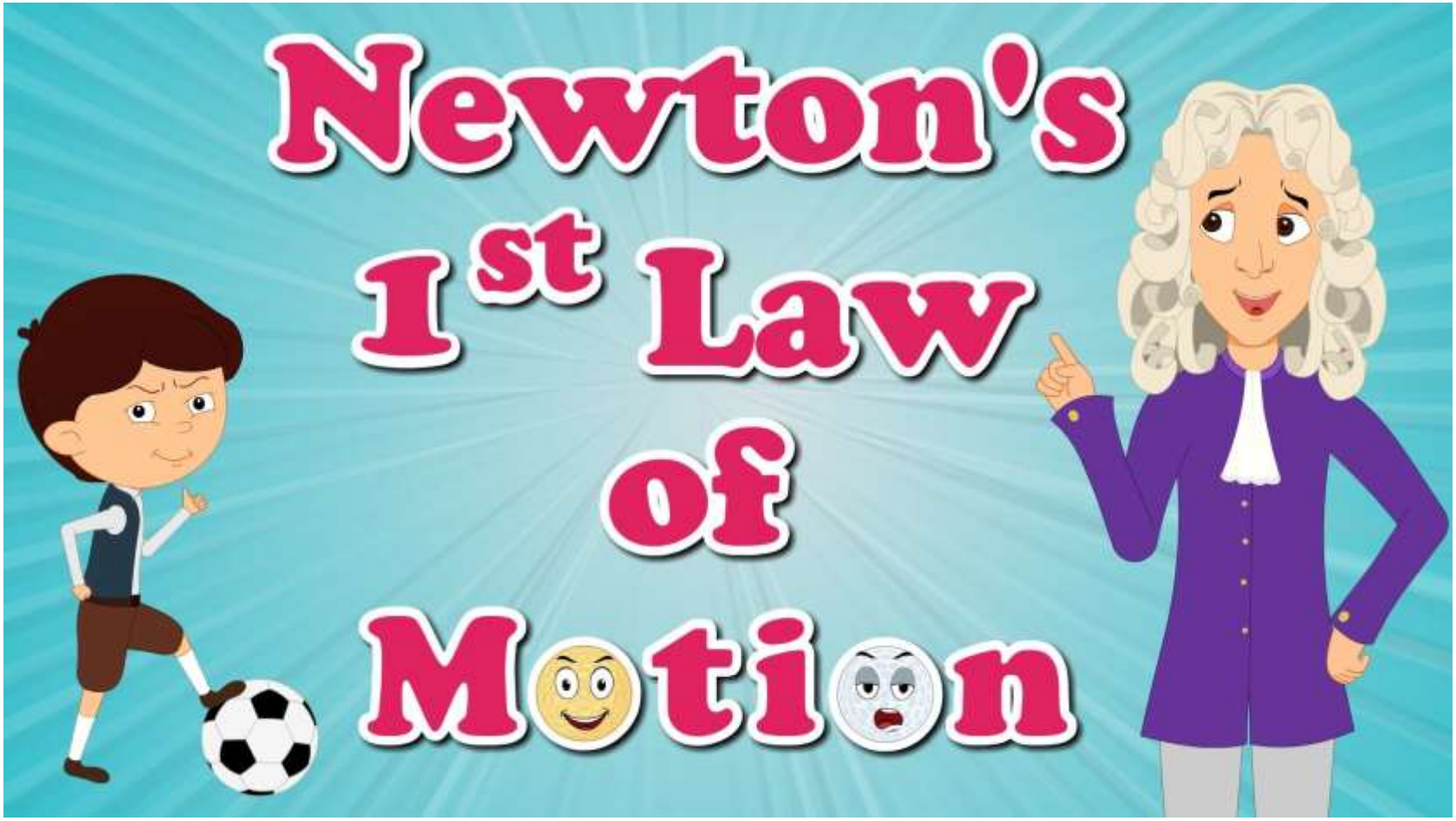
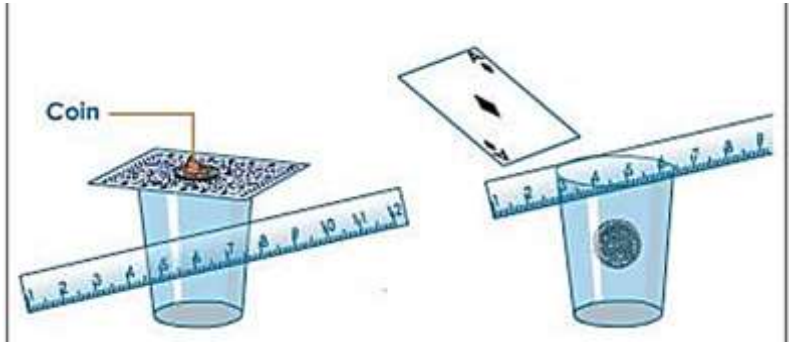

Newton's
1st Law
of
Motion

MASS AND INERTIA

Inertia is the property of an object that resists changes in its motion.An object at rest tends to stay at rest. An object in motion tends to keep moving at a constant speed in a straight line.

When a bus accelerates forward, the passengers are thrown back into their seats. If a bus brakes abruptly, the passengers are thrown forward.



When the cardboard is pulled away quickly, the coin falls into the glass. The inertia of the coin maintains its state at rest. The coin falls into the glass due to gravity.

This implies that a mass tends to stay in the state of motion it was in before the force acted on it. The reaction of a body to change in its states of motion (acceleration) is inertia.

Inertia is proportional to mass. The greater the mass of a body, the less it accelerates under the action of an applied force. Mass is a scalar quantity that obeys the rules of ordinary arithmetic. Mass is an intrinsic characteristic of a body – that is a characteristic that automatically comes with the existance of the body. The mass of a body is the characteristic that relates a force on the body to the resulting acceleration.

The SI unit of mass is the kilogram (1 kg).

- An object with large mass has a large inertia
- When a large mass is in motion it is hard for it to stop
- it is harder to initiate the movement of the object

- An object with small mass has a small inertia.
- An object with small inertia is much easier to stop then one with a large inertia.
- it is easier to initiate the movement of the object

Bowling

- A bowling ball has a large inertia compared to a bowling pin
- therefore when you throw a bowling ball down an ally it doesn't want to stop when it hits the pins, so it carries through the pins, knocking them over

Which have more inertia

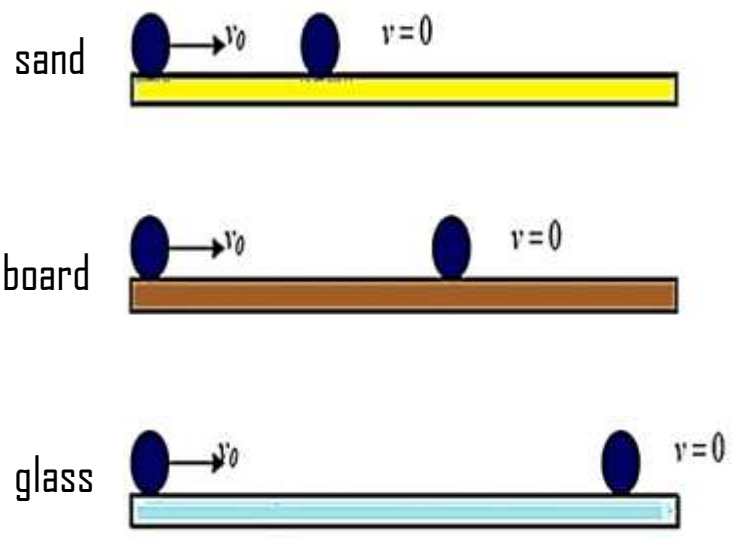
tennis ball or

bowling ball or

basket ball

NEWTON FIRST LAW

Consider a ball lying on a substrate. Obviously, the ball remains at rest if left alone..Now imagine pushing the ball with a horizontal force great enough to overcome the force of friction between the ball and the substrate, setting the ball in motion. Because the magnitude of the applied force exceeds the magnitude of the friction force, the ball accelerates. When the applied force is withdrawn, friction soon slows the ball to a stop.



Effect of different substrates on motion

We will consider three different substrates:

- If the ball is pushed across the sand, it will travel a short distance in the first case.
- If the ball is pushed across the board, it will travel a longer distance in the second case (the same initial speed). Force of friction between the board and ball is less than force of friction between the sand and ball (it is easier to roll a ball on a board than on the sand).
- Even more will reduce friction when the ball is pushed across the glass substrate, (it is easier to roll a ball on a glass than on the board). It will trevel a much longer distance in the third case.

If there is no friction (there would be no force of friction slowing down motion when two object rubbed against one another), the ball will roll infinity along a substrate.

Before about 1600, scientists felt that the natural state of matter was the state of rest. Galileo, however, devised thought experiments—such as an object moving on a frictionless surface, as just describe-and concluded that it's not the nature of an object to stop, once set in motion, but rather to continue in its original state of motion.

This approach was later formalized as **Newton's first law of motion**: An object will stay at rest or move with a velocity that is constant in magnitude and direction, unless acted upon by an unbalanced force.

- If the forces acting on an object are equal in the all direction we say the forces are **balanced**.

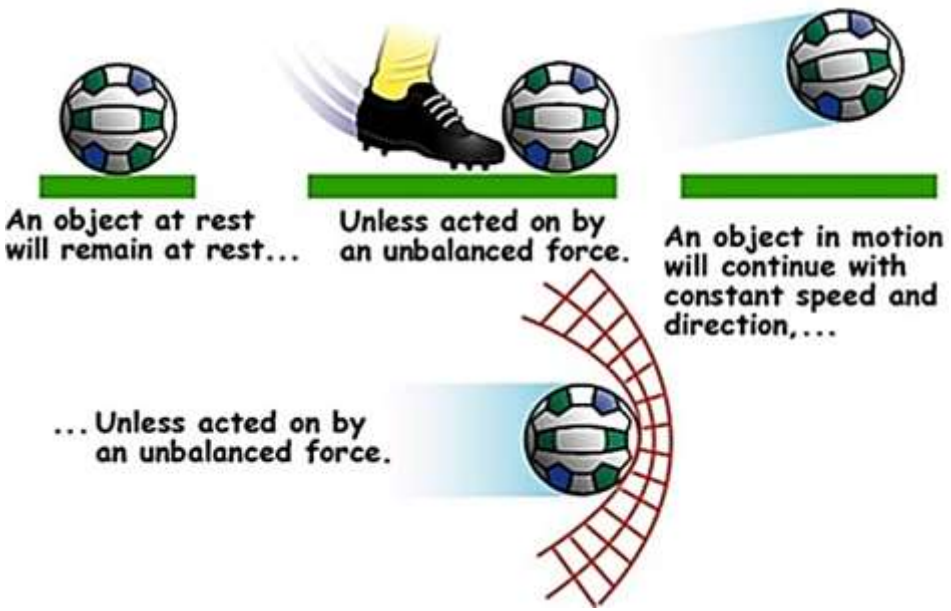
For an object with balanced forces:

- If it is moving it stays moving with constant speed
- If it is moving it stays moving with same direction
- Its shape does not change
- If it is stationery it stays stationary
- Resultant force on an object iz zero

- If the forces acting on an object are not equal in all direction we say the fores are **unbalanced.**

For an object with unbalanced forces:

- If it is moving its speed could increase or decrease
- If it is moving its direction could change
- Its shape could change
- If it is stationery it will start to move
- Resultant force on an object iz not zero



Examples of balanced and unbalanced forces in sport (football)

A consequence of the first law is the feasibility of space travel. After just a few moments of powerful thrust, the spacecraft coasts for months or years, its velocity only slowly changing with time under the relatively faint influence of the distant sun and planets.