

TRANSFORMATION OF ENERGY: BALLOON RACE FOR FACILITATORS

AGE	SKILLS	SPACE	TIME	MATERIALES	DIFICULTY
10-12 years	Physics	Spacious, it can be either an open space or an enclosed space (classroom).	1.5h	Few	Low

BEFORE STARTING

Through this experiment, children can work on the following skills:

- ▶ **Newton's Laws**
 - ▶ Forces
 - ▶ Action - reaction
- ▶ **Air pressure**

ABOUT THE EXPERIMENT

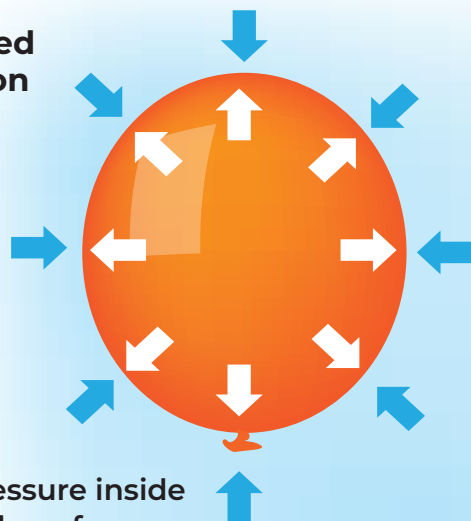
Newton's First and Third Laws explain why balloons (and other objects) move due to the intervention of various forces.

Newton's First Law states that objects remains in a state of rest or uniform, rectilinear motion if no force is applied to it. For example, in space, since there is no gravity, if a body is in motion, it will maintain this motion until infinity or until a force is applied to it in the opposite direction (Newton's Third Law). In our case, when the balloon is inflated and we do not exert any force, it will remain motionless.

Newton's Third Law or the action-reaction principle states that every action has a reaction in the opposite direction. To inflate a balloon, we must blow to increase the pressure inside the balloon. Gradually, the pressure of the air molecules inside the balloon (reaction) increases and becomes equal to the pressure of the air outside (action) exerted on the walls. These two pressures allow the balloon to take its shape. As soon as we stop blowing or release the balloon, the molecules inside the balloon can escape through the nozzle, as a result of the air pressure on the balloon walls. The force with which the air escapes from inside the balloon is what allows the balloon to move.

Inflated balloon

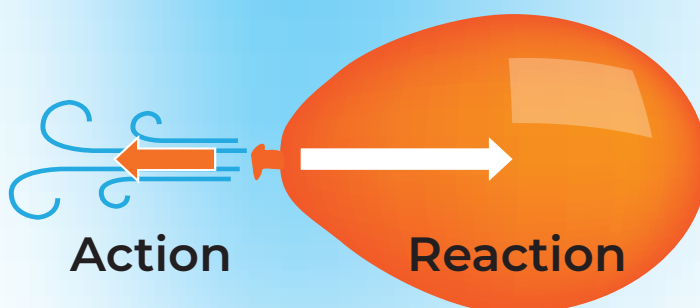
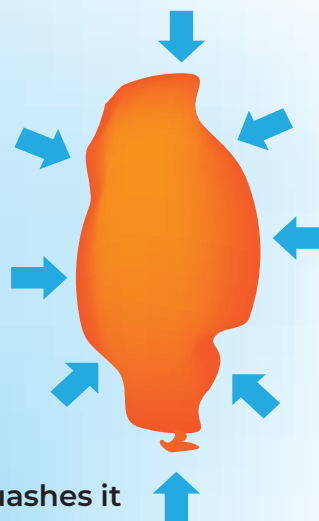
The pressure inside the balloon faces the pressure of the atmosphere.



Deflated balloon

There is nothing to resist the pressure of the atmosphere.

The pressure squashes it and its volume decreases, so it no longer displaces enough air to stay afloat.



MATERIAL DESCRIPTION

**A: Indicates those steps where the presence of an adult is required.*

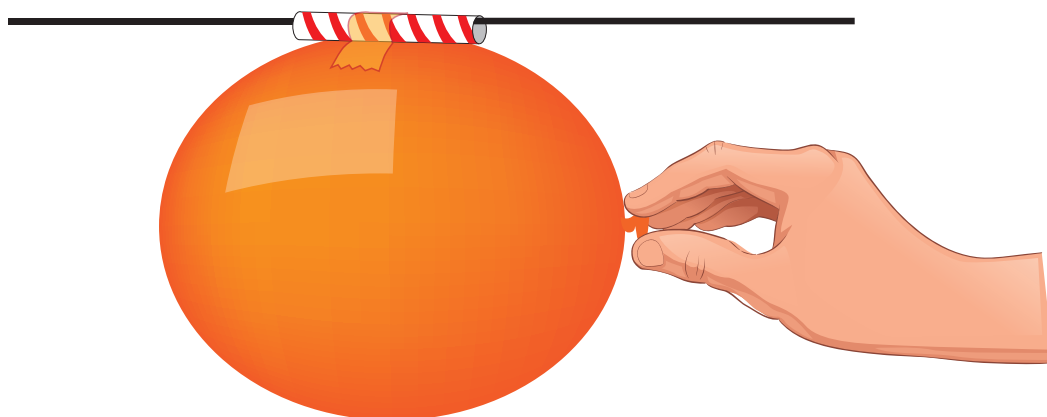
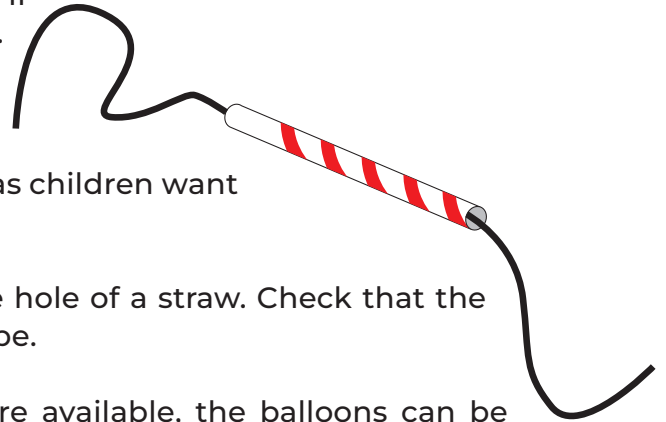
- ▶ **Balloons (*A):** Coloured or white. As many as children are going to do the experiment.
- ▶ **Permanent markers (optional).**
- ▶ **Thin string or thick thread:** preferably use unravelled thread to generate as little resistance as possible so that the balloons move easily. It can be wool.
- ▶ **Straws.** They can be plastic or paper.
- ▶ **Adhesive tape.** Can be plastic or paper.
- ▶ **Scissors.**
- ▶ **Bag clips.** As many as children are going to do the experiment. Alternative: These tweezers will be used to close the inflated balloons, they can be replaced by adhesive tape to close the balloons.

TRANSFORMATION OF ENERGY: BALLOON RACE

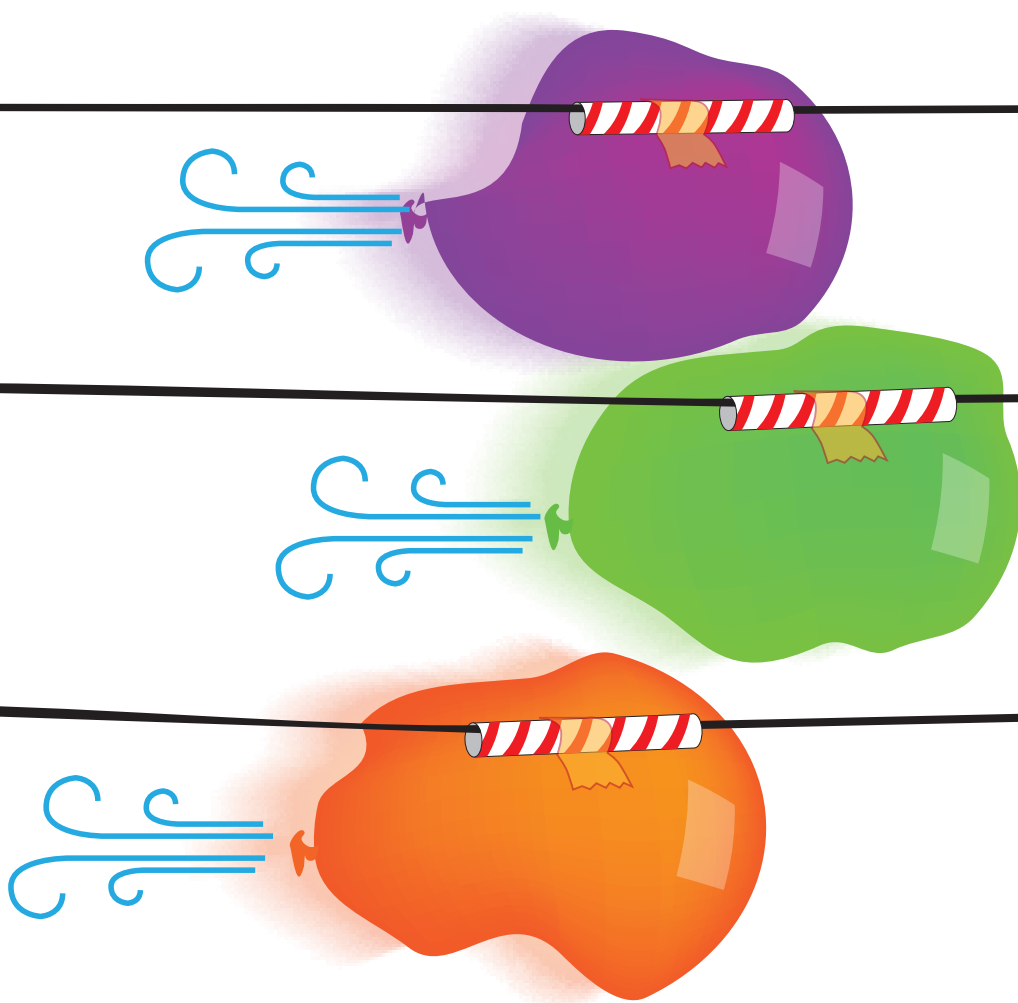
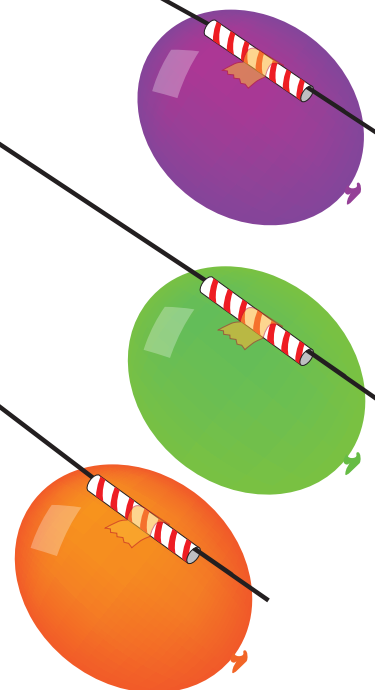
EXPERIMENT STEP BY STEP

**A: Indicates those steps where the presence of an adult is required.*

1. Preparation of the environment: First of all, prepare the environment. Clear the area where the balloon races are to be held and identify the places where the rope is to be attached. These places can be between two tables, two chairs, two trees, etc.
2. OPTIONAL: If time is available, additional decoration can be generated such as start and finish marks, metre lines on the ground.
3. Cut pieces of rope to the length you want to make the race (*A) Risks: be careful when making the cuts if children are involved in this process. You can make as many "lanes" with ropes as the conditions of the environment allow, being able to make from 2 lanes to as many lanes as children want to participate.
4. Tie one end of the rope.
5. Put the end of the rope through the hole of a straw. Check that the straw can slide freely through the rope.
6. Tie the second end of the string.
7. OPTIONAL: If permanent markers are available, the balloons can be decorated with the children's names or drawings at this stage.
8. Inflate the balloons (*A) Risks: Special care should be taken because of the risk of suffocation. Explain that there is a possibility that the balloons may burst when blown up. This way, if it happens, children will not be so frightened.
9. Close the nozzles of the blown-up balloons with a bag clip. If you didn't get bag clips, you can tape them shut.
10. Tape the inflated and closed balloon to the straw of the race track.



11. Place the balloons attached to the straws on the starting line.
12. The stroke will start when the nozzles are released to release the air.
13. Once the race is over, the balloons can be exchanged for other children's balloons by peeling off the deflated balloons and sticking on the new inflated and closed balloons. The process can be repeated as many times as desired. *A. Risks: Special care should be taken if the balloons are re-inflated, as they are more prone to bursting after being fixed with adhesive tape. In addition, once children have realised that the more inflated they are, the greater the distance travelled when the air is released, they will want to inflate the balloon as much as possible. This will increase the likelihood of the balloons bursting due to over-inflation.



SUPPLEMENTARY MATERIAL

Key Questions and suggested answers

- **What would happen if we inflate the balloons too much, and too little? Which balloon will go further, the one that is more or less inflated?**

How inflated a balloon is will allow it to reach a higher speed and therefore travel further.

- **What happens when the outside pressure is higher or lower?**

When the pressure from outside is higher than the pressure inside the balloon, the balloon cannot inflate fully or the difficulty is greater, as our lungs cannot fight against the pressure of the outside air. If you want to experience what it is like to inflate a balloon to a higher pressure, try inflating a balloon inside a bottle.

On the other hand, when the pressure inside is much higher than the pressure outside, the balloon can easily burst, as the rubber walls cannot withstand the pressure.

- **What happens if the weight of the balloon is different?**

If the balloons weigh different weights, the speed of movement will also be different. The heavier the balloon, the slower the speed. We must not forget that on planet Earth we have a force called gravity. Gravity is a force that causes bodies to be attracted by another body of greater mass.

- **Can we modify the air speed?**

Yes, we can modify it by closing or opening the balloon nozzle. For example, using a clothes peg.

DID YOU KNOW...

- ▶ There are three Newton's Laws.
 - ▶ The first law says that an object that is at rest will continue at rest and an object in motion will continue in motion until a force acts on it.
 - ▶ The second law is very important for the motion of objects and says that the force to be applied is proportional to its weight.
 - ▶ Newton's third law is known as the Law of Action/Reaction and is the best known law. According to this law, every action has an equal and opposite reaction. If one body exerts a force on another (action), the latter will exert another force on the former of equal modulus and direction, but in the opposite direction (reaction).
- ▶ Rockets work in the same way as these balloons, but instead of inflated balloons they use large reactors.
- ▶ Isaac Newton got the idea of gravity when an apple fell from a tree and hit him on the head.