

FROM MOLECULES TO FLIGHT



Nuestra Señora de los Ángeles (El Esparragal-Murcia) Fourth and Fifth Classrooms



Esta experiencia se ha llevado a cabo en las clases de 4º y 5º de Educación Primaria del CBM Nuestra Señora de los Ángeles de El Esparragal (Murcia)
Proyecto realizado por:

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FROM MOLECULES TO FLIGHT

CAN YOU EXPLAIN HOW BIRDS CAN FLY? _____

CAN YOU EXPLAIN HOW HOT AIR BALLOONS CAN FLY? _____

CAN YOU EXPLAIN HOW HELICOPTERS AND AEROPLANES CAN FLY? _____

WHAT FORCES DO YOU THINK ARE IMPORTANT TO FLY ? _____

DO YOU KNOW ABOUT ANY SCIENTIST RELATED TO FLIGHT? _____

WORK IN PAIRS AND WRITE YOUR ANSWERS IN YOUR NOTEBOOKS

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First Session Photos



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FIRST SESSION

WHAT DO YOU KNOW ABOUT THE FLIGHT?

We start the lesson by questioning our students about what they know about how things such as airplanes can fly (slide 3).

Experiments:

1º Acting out states of matter.

2º Bag and straw. Blowing through the straw we will inflate the bag and it lifts the objects we put on it.

3º Two balloons, one of them with air, the other without (empty). We will see how the balloon with air is heavier than the other.

4º We will put a metal container with ice and we will see how drops of water are visible on the surface of the container.

Conclusions: Air is a mixture of different gases and water vapor.

After that, as a final activity, we will classify things that can fly and things that can not fly. (wing shape)

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First session material

- ▶ **Material:**
- ▶ Notebooks
- ▶ Worksheet (Annexed 1)
- ▶ Bags
- ▶ Straws
- ▶ Ruler
- ▶ Balloons
- ▶ Metal glass
- ▶ Ice

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First Session Conclusions

- ▶ All this experiments show us that AIR is a mixture of gases and it weights and it occupies a space.
- ▶ Conclusions: Matter is everything you touch, see, smell and feel. There are three states of matter (act out solid, liquid and gas). We are going to focus our attention on gases. Our objective is to make sure students understand that air occupies a space, has weight and it contains water vapor.

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Second session photos



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SECOND SESSION PLANNING

We are surrounded by air. There are things that can fly such as helicopters, plane, balloons, etc....and some animals can fly, too. There are things that cannot fly. Let's concentrate on the objects that can fly such as a hot air balloon:

- 1° We will use a toaster to heat the air underneath a plastic bag with the help of a rolled cardboard.
- The bag is lighter than the air and it can fly. This is aerostatics: the science that studies gases that are not in motion, or gases in equilibrium.
- 2° Gases can expand and occupies more space and there are less molecules inside the plastic bag, we can demonstrate this by means of the next experiment: an empty can of cola with a balloon on the heater. The heat of the radiator will make the molecules inside of the balloon move faster.
- 3° Helium experiment. We will fill with helium one balloon and another with normal air. We will try to look for the balance of the two balloons
- With this experiment, our students will notice the balance among the forces that interact which each other to get the equilibrium of the different gases.
- 4° We measure the force by using the digital balance and the empty can of cola.

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Second session material

Material

- ▶ Internet
- ▶ Notebook
- ▶ Can of cola
- ▶ Toaster
- ▶ Cardboard
- ▶ Plastic bag
- ▶ Helium
- ▶ Balloons
- ▶ Digital balance

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Second Session Conclusions

- ▶ Conclusion: We have been experimenting with gases in equilibrium (aerostatics).
- ▶ We have seen that an object lighter than the air can fly influenced by different forces.
- ▶ What happens with the objects that are heavier than the air???

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THIRD SESSION PHOTOS



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Third session planning

We start the lesson by summarizing what we know about the flight: Air is a mixture of gases and we have learned that aerostatics is the science than studies gases in equilibrium. The objects that are lighter than the air (or have less pressure) can fly influenced by different forces: lift, weight, air pressure, etc.

Experiments:

- 1st Experiment: Wrapped paper and a sheet of paper
- Let them fall and we will see what happens: the wrapped paper falls faster than the sheet. There is a force that resists the object's fall (in this case, a sheet). This the first force that appears in air in motion (friction). If there is no air, there is no friction.
- 2nd Experiment: Let's make a helicopter. Weight makes the helicopter go down, but the air speed makes it to fly (lift force) action-reaction (Newton's 3rd law)
- 3rd Experiment: Let's make a parachute. The air pressure inside/outside of the parachute must be in balance. We will use a hole at the top of the parachute. The pressure is in equilibrium. The lift force is the opposite force (action-reaction)
- 4th Experiment: Two sheets, let them fall. The sheets fall down in straight line. Then we will fold one of the sides of the sheets and we will show our students how the sheet spins. We have changed the center of gravity and our sheets can fly longer.

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Third session material

- ▶ Newspapers
- ▶ Sheets
- ▶ Helicopters photocopies
- ▶ Parachutes
- ▶ Thread
- ▶ Bags
- ▶ Scissors
- ▶ Cello tape

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Third Session Conclusions

- ▶ Conclusions: Aerodynamics is the study of the motion of air particularly as interaction with a solid object (paper, helicopter, parachute). The first force that appears in air in motion is friction. A reaction of this force is the opposite force: lift force. In this experiment we have investigated the equilibrium of these two forces.
- ▶ Question: Having said that: How a plane can fly?

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FOURTH SESSION PHOTOS



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Fourth session planning

- ▶ We will start the lesson by summarizing what we learnt the last day: There two main forces in aerodynamics. Aerodynamics is the study of the motion of air particularly as interaction with a solid object. The first force that appears in air in motion is friction. A reaction of this force is the opposite force: lift force. We have investigated about the equilibrium of these two forces.
- ▶ We continue experimenting with Aerodynamics
- ▶ Bernoulli's Principle
- ▶ 1st Experiment: Blow a sheet above and underneath. In both cases the sheet is going up (motion, air pressure, lift)
- ▶ 2nd Experiment: Straws a glass of water. We blow through the straw (in this way we make air pressure lower in this area) The water will occupy the space helps by lift force.
- ▶ 3rd Experiment: Two sheets, blow between them. When we blow, we make the pressure lower and the two sheets will join.
- ▶ 4th Two cans of cola. The same process
- ▶ 5th Two balloons. The same process
- ▶ These experiments show us the Bernoulli's Principle. Less air pressure (air in motion) and the high pressure will put these objects together.
- ▶ 6th Experiment: Straw and ping pong ball
- ▶ 7th Experiment: hairdryer and pin pong ball.
- ▶ *We will read the text about Bernoulli (Annexe 2)

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Fourth session material

► Material

- Sheets
- Empty cans
- Straws
- Water
- Balloons
- Ruler
- Hair dryer
- Pin pong balls

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Fourth session conclusions

- ▶ Since air behaves exactly like a fluid, Bernoulli's principle applies. Any time the wind is blowing or a fan blows air, the pressure of the moving air becomes less than it would be if the air wasn't moving. Lift and air pressure are determinant but they are not alone. There are more forces and effects that make the flight of a plane possible.
- ▶ **We will learn about “The Coanda Effect” in the next session.**

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FIFTH SESSION PHOTOS



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Fifth session planning

- ▶ Any time the wind is blowing or a fan blows air, the pressure of the moving air becomes less than it would be if the air wasn't moving. Lift and air pressure are determinant but they are not alone. There are more forces and effects that make the flight of a plane possible.
- ▶ But there is other effect called "The Coanda Effect"
- ▶ If air is a kind of fluid like water. So, Does the air behave in a similar way??
- ▶ Experiment:
- ▶ 1st Spoon and water/cup and water
- ▶ 2nd Can and candle
- ▶ The tendency of a fluid jet to get attached to a convex surface is the Coanda effect.
- ▶ All the forces we have mentioned and experimented with (Friction, Lift), air pressure and effects (Bernoulli / Coanda) interact each other and make flight possible (objects that are heavier than the air).
- ▶ Let's build a wing...

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Fifth session material

- ▶ Cans and candles
- ▶ Spoons
- ▶ Cups
- ▶ Water
- ▶ Plastic containers
- ▶ Cardboard
- ▶ Cello tape
- ▶ Felt tips
- ▶ Digital board
- ▶ Ppt
- ▶ Internet

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Fifth session conclusions

- ▶ Conclusions:
- ▶ *A moving stream of fluid in contact with a curved surface will tend to follow the curvature of the surface rather than continue traveling in a straight line.*
- ▶ All the forces we have mentioned and experimented with (Friction, Lift), air pressure and effects (Bernoulli / Coanda) interact each other and make flight possible (objects that are heavier than the air).

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FINAL TASK

► Using different material build
Something that can fly.

As final task, students will build a
flying machine. They will have a
week to do it.

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CONCLUSIONS

- ▶ *A moving stream of fluid in contact with a curved surface will tend to follow the curvature of the surface rather than continue travelling in a straight line.*

All the forces we have mentioned and experimented with (Friction, Lift), air pressure and effects (Bernoulli / Coanda) interact each other and make flight possible (objects that are heavier than the air).

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RECAP



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FINALLY

- ▶ We answer all the questions that we got at the beginning of the project.
- ▶ We will present our flying object.

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