Science

Book of Experiments

"Teaching Through Discovery"

COLABORATIVE WORK THROUGH DISCOVERY

The ultimate aim of this project was the inclusion of disadvantaged pupils within the school, within society and, ultimately, within Europe. Similarly, we aimed to foment in all the people involved in the project a high degree of tolerance and respect towards all human beings, however much they might differ from us.

Some of the objectives of this project were:

- To promote collaborative teaching-learning amongst pupils from different countries so as to add a greater dimension to the collaboration.
- To promote the development of critical thinking through the use of the experimental approach in Science.

This methodology was designed to help them become responsible citizens in the future. To achieve it, based on observation, we asked ourselves questions which had to be answered with a reasoned hypothesis. Through the use of experimentation, pupils tested their hypotheses and then analysed them so as to draw a valid conclusion. Besides, fostering critical thinking by teaching science through an experimental method ensured that children with disabilities, language or social disadvantages and other learning difficulties were able to acquire scientific competence at the same level as the rest of the students.

To reach these objectives we chose five topics on which to base our work. One of them was science. This topic was not chosen at random but rather, because science puts us on an equal footing. We all started from scratch and grew together. Besides, we were able to work following the methodological principles:

- Collaborative work: by working in mixed groups, pupils and teachers came to realise that they were helped by what others did and inversely and what they did helped the group.

- Peer teaching: we all had something we could teach and something we could learn from the rest.

The specific methodology for Science was:

“Teaching through discovery." There is no better way of learning science than that of following in the footsteps of scientists, facing the same problems and coming up with the same solutions. The steps taken were: observation, formulation of hypothesis, designing an

experiment to check the hypothesis, analysing the results and reaching a conclusion. In this experimental method, children need to learn concepts, construct models, develop cognitive skills, logical reasoning and solve problems. All of this had to take place in a context of social inclusion, ensuring that everyone had the chance to learn science.

To work in a collaborative way, we selected five scientific subjects: sound, air, water, recycling and magnetism. First, in each school we encourage the children to talk about these subjects and ask questions based on observations. Second, we shared the questions on line. Then, each country suggested an experiment to help the rest to find an answer. Finally, all the schools did the proposed experiments, analysed the results and drew proper conclusions that could be generalised.

To organize the activity, each subject was assigned to a different school: **Sound (Spain), Air (Portugal), Water (Latvia), Recycling (The United Kingdom), Magnetism (Slovakia)**

Sound (Spain)

Air (Portugal)

Water (Latvia)

Recycling (The United Kingdom)

Magnetism (Slovakia)

Question 1: Can we see sound?

The answer came from school **CEIP Narciso Alonso Cortés** - Valladolid (Spain) with the following experiment:

Experiment: SEEING SOUNDS

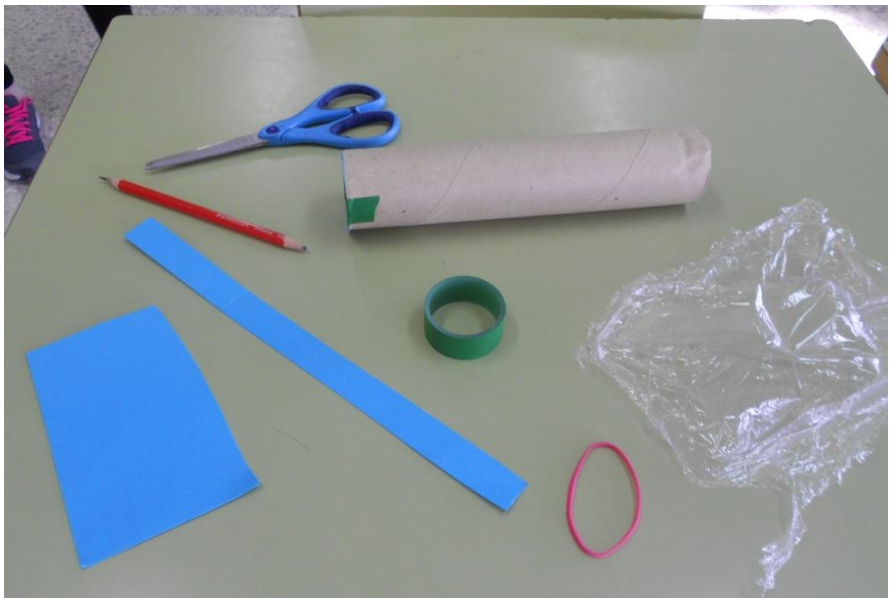
Question: Can we see sounds?

Hypothesis:

Materials:

-Cardboard tube
-Thin plastic
-A piece of cardboard
-A thin strip of paper
-Sharp pencil
-A rubber band
- Sticky tape
- Scissors

(pictures of the materials)



Instructions:

1. Draw a circle around the tube on the cardboard.

2. Cut out the circle from the cardboard.

3. Use the sharp end of the pencil to make a small hole in the centre of the circle.

4. Tape the circle to one end of the tube.

5. Using the rubber band, fix the plastic over the other end.

6. Fold the paper strip and tape it to the top of the table.

7. Point the end of the tube with the hole at the paper strip.

8. Tap the plastic heading the hole towards the strip.

Observations:
Tapping the plastic causes sound vibrations to travel down the tube. These vibrations make the air move and it shakes the strip.
You can do it also with the flame of a candle.

Conclusion:
Sound is an energy that travels through the air like sound vibrations. Sound vibrations can move light things.

Additional information (optional)

The energy in sounds can cause an avalanche when ice and snow crash down the side of the mountain. Sound waves from a loud noise disturb the snow and start it moving.

Question 2: Can sound travel through solids?

The answer came from school **CEIP Narciso Alonso Cortés** - Valladolid (Spain) with the following experiment:

Experiment: Bouncing balls	
Question: Can sound travel through solids?	
Hypothesis:	
Materials: - A piece of kitchen foil - A piece of thread - A wine glass - A spoon	
Instructions: 1. Screw up the kitchen foil into a ball and tie a piece of thread around the foil. 2. Put a wine glass on the table. Hold the thread so that the foil ball just touches the glass. 3. Gently tap the other side of the glass with a spoon. What happens to the foil?	

Observations:

The ball jumps away from the glass.

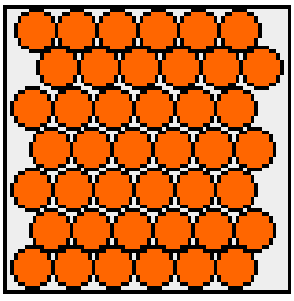
As you tap the glass, it vibrates and makes a noise. The vibrations from the noise make the ball move.

Conclusion:

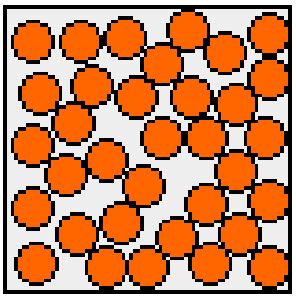
Sound can travel through solids because sound vibrations make the particles of the solid vibrate as well.

Additional information (optional)

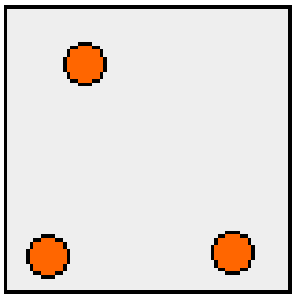
When sound travels through solids it does it faster than in any other states of matter because particles in solids are closer each other than in liquids or gases.



solid



liquid



gas

Question 3: How does the balloon with water in resist breaking in a flame?

The answer came from school **Pāles pamatskola** - Pale (Latvia) with the following experiment:

Experiment: Fireproof Balloon

Question: Why does the balloon with no water break in the flame? How does the balloon with water in it resist breaking in the flame?

Hypothesis:

Materials:
- 40-60 ml water
- 2 balloons
- candle
- matches
- safety glasses

Instructions:
1. Blow up a balloon and tie it off.
2. Light a candle and place it in the middle of the table.
3. Put on your safety glasses.
4. Hold the balloon over the top of the flame and slowly move the balloon closer.
5. Let's repeat the experiment. Fill the balloon with water (~40-60 ml) and then blow it up with air. Just tie off the balloon and get ready for the next step.
6. Hold the water-filled balloon at the top while you slowly lower it over the candle. Everyone knows that it's going to pop, but in this time it doesn't.

7. Remove the balloon from the heat and carefully examine the soot on the bottom.	

Observations:

1. If we move the balloon (filled only with air) over the top of the flame it pops.
2. If we move water-filled balloon at the top close to the flame, the balloon didn't pop.

Conclusion:

Water is a great substance for soaking up heat. The thin latex balloon allows the heat to pass through very quickly and warm the water.
As the water closest to the flame heats up, it begins to rise and cooler water replaces it at the bottom of the balloon. This cooler water then soaks up more heat and the process repeats itself.
The exchange of water happens so often that it keeps the balloon from popping until the heat of the flame is greater than the water's ability to conduct heat away from the thin latex and the balloon pops.
But if you turn the balloon so that the candle flame is close to the side of the water balloon, the balloon will pop because the water is not conducting the heat away from the surface of the balloon. At least the water will help put out the fire!
The soot on the bottom of the balloon is actually carbon.
The carbon was deposited on the balloon by the flame, and the balloon itself remains undamaged.

Additional information **(optional) Remember!** Safety is very important! This science activity uses matches, which means you need to do it together with adult.

Question 4: Can a piece of paper stop water running out of the glass?

The answer came from school **Pāles pamatskola** - Pale (Latvia) with the following experiment:

Experiment: Magic with water

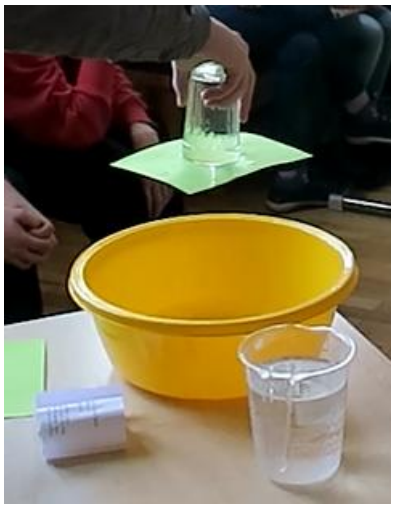
Question: Can a piece of paper stop water running out of the glass?

Hypothesis: A piece of paper can't stop water.

Materials:
- a glass of water
- a piece of paper (not very thin)
- an empty wash-basin

Instructions:
1. Fill a glass with water to the brim.
2. Put a piece of paper on the brim and hold it with your palm.

3. Tip over the glass while holding the piece of paper.

4. Release your hand from the paper.	

Observations:

The glass is upside down, the paper holds to the brim and water doesn't run out of the glass.

Conclusion:

Atmospheric pressure works on paper also from below, it is bigger than water gravity force, so the piece of paper sticks to the brim and the water doesn't run out of the glass.

Additional information (optional)

Question 5: Can we make a steel paper clip fly in the air?

The answer came from school **Základná škola** - Zvolen (Slovakia) with the following experiment:

Experiment: Floating paper clip

Question: Can you make a paper clip appear to float in the air?

Hypothesis:
We can make a paper clip appear to float in the air using magnetic force to make it float.

Materials:
- String
- Magnet
- Scissors
- Paper clip
- Scotch tape
- Glue /optional/
- Clear glass jar with a metal lid

Instructions:

1. Cut the string about the length of the jar from top to bottom.
2. Tie the paper clip to one end of the string.
3. Tape the other end of the string to the inside bottom of the jar.
4. Tape or glue the magnet to the inside of the lid.
5. Show your friends the jar with the paper clip lying at the bottom of the jar.

6. Place the lid on the jar and turn it upside down so that the paper clip hangs from the string. 7. Carefully turn the jar right side up so that the paper clip is being pulled by the magnet.	

Observations:

It appears that the paper clip is floating in the air. This is due to the fact that the string is preventing the paper clip from being pulled flat to the magnet.

Conclusion:

The paperclip is made of metal and is attracted to the magnet. The string is preventing the paper clip from being pulled flat to the magnet making it appear to float in air.

Question 6: Which items will be attracted by magnets and which ones won´t be?

The answer came from school **Základná škola** - Zvolen (Slovakia) with the following experiment:

Experiment: Magnet painting

Question:
Which items will be attracted by magnets and which ones won´t be?

Hypothesis: Not all items will be attracted to magnets

Materials:
-a piece of magnet
-various metal items like nails, pins, iron dust..
-various non-metal items like buttons, plasticine, little piece of wood..
-a sheet of glass, wood or a plastic tray
- coloured paints
- a sheet of paper

Instructions:

1. Place a sheet of paper on a glass, wooden or a plastic tray.
2. Pour some drops of various paints on the paper
3. Put some metal and non-metal items and some iron dust on the paper.
4. Hold magnets underneath




the sheet of glass or the plastic tray. 5. Try moving the magnets to make the items move on top of the paper. 6. Make a piece of art ☺	

Observations:

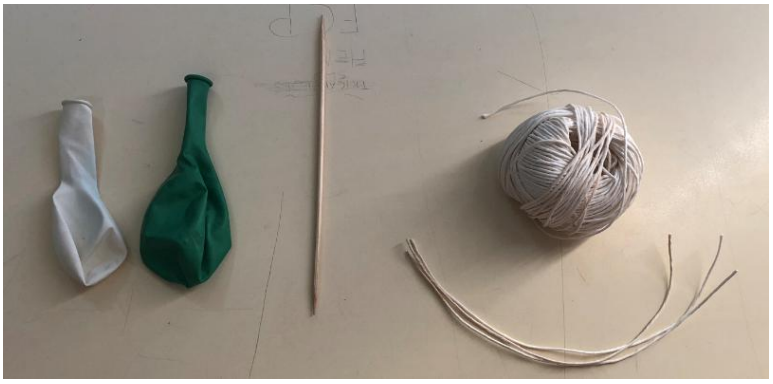
When we moved the magnets underneath the glass, wood or plastic, some items were attracted to the magnets and they moved.
When we spilled the iron dust on the paper, magnetic lines of force were visible.

Conclusion:

The items that were attracted to the magnets are made of ferromagnetic materials and they painted coloured lines when they were dipped in the paints on the paper.

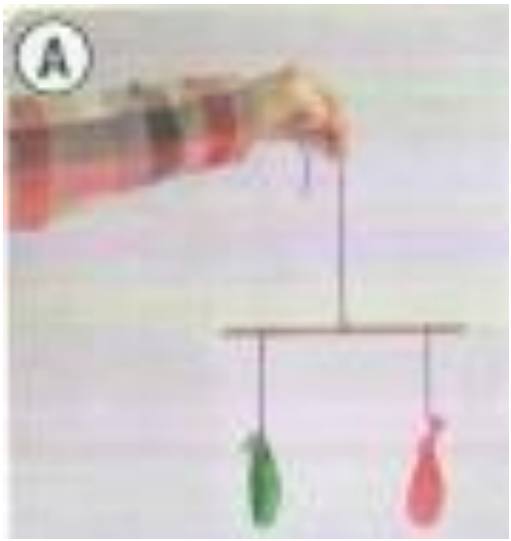
Question 7: Does air have mass?

The answer came from school **Agrupamento de Escolas de Vila Cova** - Vila-Cova (Portugal) with the following experiment:

Experiment: Properties of air	
Question: Will have the air weight?	
Hypothesis:	
Materials: -improvised scale with a pencil, a hanger and three wires with the same measure; - two equal rubber balls.	
Instructions: 1. Construct the scale as Figure A. 2. Balances the balance by moving the center wire. 3. Attach each of the empty balloons to each of the end wires of the scale. Record what you observe.	

4. Take out one of the balloons carefully, fill it and re-attach the wire. Record what you observe.

5. Compare the two observation logs.



Observations:
When there is only one balloon full of air, it tilts down.

Conclusion:
With this activity we checked that the air has weight.

Additional information (optional)

Question 8: Does the air occupy space?

The answer came from school **Agrupamento de Escolas de Vila Cova** - Vila-Cova (Portugal) with the following experiment:

Experiment: The air occupies space

Question: Does the air occupy space?

Hypothesis:

Materials:
- glass;
- glass tin;
- water;
- Paper tissue.

Instructions:
1. Put water in the glass tin
2. Press the paper tissue and put it on the bottom of the glass.
3. Reverse the glass and dive it in the glass tin.
4. remove the glass without leaning it.

Observations:

Conclusion:
The air occupies space.

Additional information (optional)

Question 9: What should I do about my cardboard waste?

The answer came from school **Instituto Español Vicente Cañada Blanch** - London (United Kingdom) with the following experiment:

Experiment: RECYCLING PAPER

Question: What should I do about my cardboard waste? REUSE REDUCE RECYCLED

Hypothesis:

Materials:

Instructions:

1. Scrapping. Tear scrap paper into small pieces

2. Stirrer. Stir the pulpy water to make sure is mixed well.

3. Dipper. Holding your frame with the deckle on top, dip it into the bowl and move it backwards and forwards till the frame is covered in pulp. Lift it out of the water and let it drain while you count to 20, then give it to the flipper.

4. Flipper. Lay the blue cloth on the table. Place the frame and deckle over the edge of the blue cloth. Take the deckle of

the frame. Wrap the blue clothe over the top of the frame. Then flip the whole thing over onto the table.	
5. Sponger. Press the sponge onto the back of your frame while it is on the cloth. Do this a few times and squeeze the water back into the bowl. 6. Mover, take the frame carefully off the cloth, leaving your piece of paper on the cloth. Then flip the cloth onto a magazine paper. 7. Peeler. VERY CAREFULLY peel the cloth away from your piece of paper, leaving it on the newspaper.	

Observations:

Conclusion:

Did you know…

-Making recycled paper creates 73% less air pollution tan making new paper

-We use 12.5 millions tonnes of paper and cardboard every year.

-The average person gets through 38 kg of newspapers every year.

-You need 24 trees to make 1 tonne of newspaper.

Additional information (optional)

Question 10: How can we increase the strength of paper?

The answer came from school Instituto Español Vicente Cañada Blanch-London (United Kingdom) with the following experiment:

Experiment: PAPER LIKE METAL

Question: What should I do about my paper waste? REUSE REDUCE RECYCLED

Hypothesis:

This activity consists of using material in an unusual way. Our material is paper, not known for its strength. We will test the limits of this material.

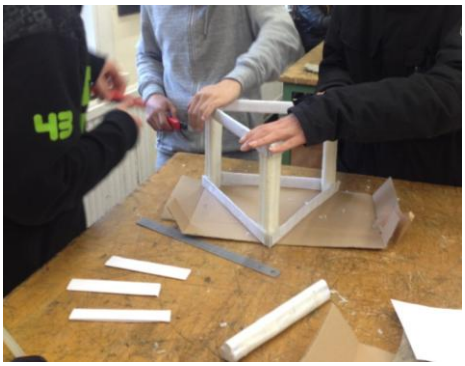
Materials:

1-Newspaper or recycling paper.
2-Tape
3-Pencils

BUILD A NEWSPAPER STRUCTURE STRONG ENOUGH TO HOLD HEAVY BOOKS.

Instructions:

Organize students into teams.
Explain the challenge.
Students will be able to use only newspaper and tape to build a structure at least 30cm tall that can support books. Distribute paper and pencils for the planning phase. Give teams time to sketch some ideas. Tell them that they can build any way they



want, so long as they meet the constraints of the challenge.

1- Distribute materials and instruct students to build their structures

2- Testing

As each structure is ready for testing, place a heavy book on it. Tell the teams to observe carefully so that they can see the problem(s) if their structure collapses. If the structure collapses after one book, tell teams to redesign and rebuild for a new test.

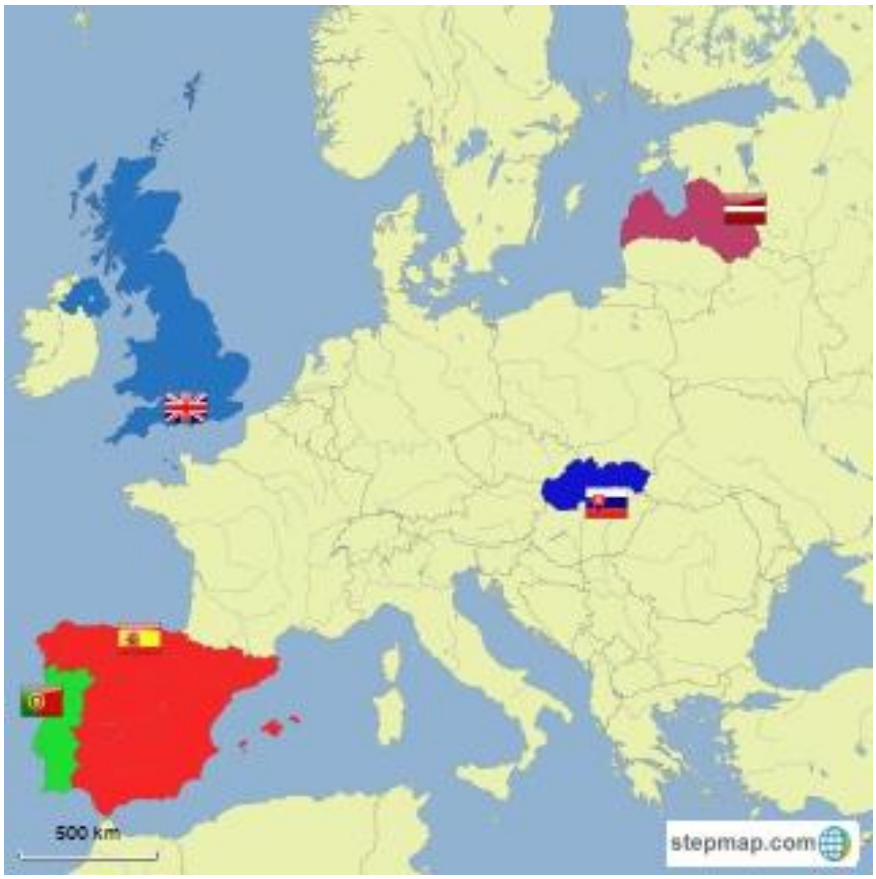
Observations:

- Tightly rolled tubes are a strong shape because they distribute weight, which pushes on every part of the paper, not just one spot.
- If you make a rectangle or square out of newspaper tubes and press on it, the weight pushes down on just one side. This section can weaken and collapse.
- If you make a triangle out of newspaper tubes and press on it, the weight is distributed equally on each side. This even distribution makes a triangle stronger and more stable than a rectangle or square.

DID YOU KNOW…

-A piece of newspaper only weighs a gram or two, yet when it's rolled up it can help support a heavy book. Strength is created by rolling paper into cylinders. Cylinders are incredibly strong because they disperse stress evenly throughout their entire shape.

-Engineers think about load distribution when they build structures such as buildings and bridges. They need to make sure there are no weak sections. Engineers incorporate triangles, arches, and domes into their structures to distribute weight evenly, and make them strong and stable.



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