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DIGITAL LEARNING IN THE FAMILY

Modul IO1B
Children module
Script guide
and experiment instructions

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Introduction

Digital learning in the family

The project "Digital learning in the family" aims to give migrant or refugee parents - explicitly addressing mothers here - the opportunity to further their education in the field of computer and digital media use and thus gain more independence and better chances on the labour market.

In order for these courses to take place, parallel childcare is offered for the children of the participating mothers, which is aimed at younger children between the ages of 5 and 9. The childcare time should be meaningful and interesting for the children, which is why the focus is on experiments from the STEM area (**s**cience, **t**echnology, **e**ngineering and **m**athamatics) and on playful language development in the form of a memory puzzle. The first part of the module - experimentation - will now be discussed in more detail.

Experiments for children?

Children are curious by nature and have a great interest in understanding and comprehending their experienced environment. Even younger children show this curiosity. Small, age-appropriate experiments can awaken their natural curiosity. They can also promote communication, as cooperation is an important aspect of joint experimentation. In addition, they promote independent work, fine motor skills and, last but not least, the children's self-esteem: if an experiment is successful, there is a lot to be amazed about and the joy of successful, own actions strengthens self-confidence.

What is important to pay attention to?

The scientifically correct explanation of the phenomenon should not yet be in the foreground. It is rather the way there - the experimenting itself - that is interesting for the children. Often, explanations only remain on the level of describing what has been observed. However, this is often enough to stimulate the children's curiosity.

When experimenting together with children, experiments should be selected that fulfil the following aspects:

- The experiments are not dangerous.
- The phenomena and materials occur in the children's everyday world.
- They are short and guarantee a sense of achievement.
- They must be able to be carried out by the children.

The selected experiments in this script fulfil these conditions; if there are any restrictions, for example because experiments are carried out with fire, there is a corresponding note in the instructions. Furthermore, despite the harmlessness of the materials, the children must never be left alone while they experiment.

For a suitable supervision ratio, one adult should not supervise more than 4 children at the same time.

For each course day, general and special laboratory rules adapted to the course day must be discussed.

General laboratory rules:

- No eating or drinking during the experiments. This applies in particular to any food, liquids or chemicals used for the experiment!
- There is no running or playing during the experiments.
- No objects or materials are to be touched without permission.
- Hands are washed after experimenting and before eating.

Special laboratory rules should be discussed in advance, for example when experimenting with fire, electricity or sharp objects. Chemicals to be used should also be discussed in advance.

Procedure of a course day

The project comprises 13 course days in which mothers and children are trained and supervised respectively. The course days each deal with a different subject area from the field of STEM education, for example air, water, plastics or plants. The course days are numbered consecutively, but the order can be adjusted. Course days 9 to 13 are more demanding in terms of execution and understanding than the other course days, so starting with these numbers is not recommended.

The experiment instructions are all structured in the same way: first there is a material list, which lists the materials needed for one experiment. This is followed by the description of the experiment; these steps must be worked through one after the other. The question in bold type or the work instructions are intended to encourage the children to observe and describe exactly or to point out an observation. Finally, there is an explanation of the phenomenon behind the experiment. This is primarily intended for the adults and supervisors. Depending on the level of the children, they can of course work towards the explanation together.

A few important tips for safe and exciting experimentation:

- Read through the instructions well in advance and before the course day. It is advisable that you have done the experiments yourself at least once.
- All materials should be available. They can be placed on a table from which the children can take the materials they need.
- Set the mood for the topic at the beginning: For example, if the topic is "magnetism", ask the children what or if they already know something about magnets. The materials can also be discussed in advance.
- Experiment together with the children. Explain the steps one by one (either verbally or by demonstrating the respective step) and let the children work independently. Depending on the supervision ratio, work can be done in small groups or individually. **Attention:** do not let any child experiment unsupervised!
- Do not reveal or explain any results in advance or afterwards. Rather, help the children to come up with a possible explanation themselves by asking questions: "What did you observe?" "Why do you think that is?" "Have you already tried this?"

- Allow your own experiments, as long as they are safe and manageable for you. If children develop questions of their own accord and are curious to investigate further, they should be given the space to do so.
- Give yourself and the children time. Each child should be given the opportunity to carry out the experiment, even several times. Encourage the children to repeat the experiments if they did not work the first time. If something does not work, it can be discussed together, but without assigning blame.
- Cleaning up is also part of experimenting. Involve the children in this as well. In this way, there is a consistent process on each course day, in which the children participate from beginning to end.
- Despite all the care and repeated testing, it can happen that an experiment does not work. Sometimes it helps to read the instructions or the notes again carefully; often you overread something or do not read it correctly. Therefore, it is important that you have done the experiments yourself and already know them when you do them with the children. This way, you can recognise sources of error early on and act if something should go wrong.

Sample protocol of a course day

Module: Magnetism

Introduction (10 – 15 minutes)

Meeting the children

Explanation of lab-rules: do not run, be careful, do not eat or drink while experimenting…

Introducing the topic: magnetism

What do you know about magnetism? Where can I find it? (showing some materials)

Experiment phase (45 minutes)

1. What is magnetic/ What objects are attracted to the magnet?
2. Attract and repel of magnetic poles
3. Toys with magnets (playing together, talk to each other)
4. How does a compass work? (for older children, optional)

Included **break** for eating and drinking **(15 – 20 minutes)**

Memory puzzle to repeat vocabulary

Conclusion (10 minutes)

Clean up

What did you like? What did you learn?

Put on jacket/ returning to mothers

Module: Magnetism

Experiment 1: Attract and repel of magnetic poles

Materials:

- 2 bar magnets

That's how you do it:

- Place both magnets on the table next to each other.

Try the following:

What happens when the magnet sides face each other with the same color?

What happens when the magnet sides point to each other with different colors?

Explanation: Magnets have two poles - north pole and south pole. Equal poles repel each other, different poles attract each other.

Module: Magnetism

Experiment 2: Building your own compass

Materials:

- Needle
- Magnet
- Little bowl
- Little piece of wood or cork

That's how you do it:

- Stroke the end of the magnet 20 times in one direction over the needle.
- Check with a paper clip if the needle is now magnetic.
- Put the needle on a piece of wood or cork and let it swim

What happens? In which direction is the needle pointing?

Explanation: By repeatedly stroking the needle over the magnet, the needle becomes magnetized. If you let it float, the needle aligns itself along the magnetic field of the earth; it always points to the north.

Module: Magnetism

Experiment 3: Toys with magnets

Materials (examples):

- Fishing game
- Wooden train
- Magnetic bricks (e.g. “Geomag”)
- Letter magnets

Explanation: Magnetic toys offer a playful approach to the subject. The toys can also be used to explore phenomena such as the attraction and repulsion of magnets to each other.

Module: Magnetism

Experiment 4: What is magnetic?

Materials:

- Different materials
- Magnet
- 2 little bowls

That's how you do it:

- Find out which materials are attracted to the magnet.
- Sort the materials.

Explanation: Objects made of iron, nickel or cobalt are attracted to magnets. A copper coin is therefore only attracted if the coin has an iron core.

Module: Air

Experiment 1: Dry jelly fruit diver

Materials:

- Jelly fruit
- Tea light cover
- Big bowl or tub
- Drinking glass
- Water

That's how you do it:

- Fill the bowl with water.
- place the fruit gum in the tealight shell.
- let the fruit jelly float.

The gummy bear wants to dive to the bottom of the water-filled tub without getting wet. How can you do this?

Explanation: To achieve this, a glass is placed over the gummy bear with the opening facing down and the gummy bear is now carefully pushed to the bottom of the tub. It is important that the glass is held straight. The glass is filled with air. If we now press it straight into the water, the air cannot escape. Therefore, there is no space for the water under the glass. The water cannot get into the glass and the gummy bear remains dry.

Module: Air

Experiment 2: Making foam

Materials:

- Various pieces of kitchen sponges
- Shower gel or liquid soap
- Straw
- Drinking glass
- Needle

That's how you do it:

- Poke a hole in the straw **several times** with the needle at different positions.
- Pour water and some soap or bath foam into a glass and mix the soap carefully with the water.
- Now hold the straw in the water and blow **gently** until foam appears. **Do not swallow the water!**
- Then put a piece of sponge into the front of the straw.
- Blow through the straw again. **Can you tell the difference?**

Try to answer the following questions:

What happens if you use a different sponge?

Is there a difference between liquid soap and shampoo?

Which bubbles burst faster? Small ones or big ones?

Can you make foam with soap only?

Can you make foam with water only?

Explanation: If you blow into the mixture through a sponge with a large pore size, large bubbles are created and vice versa. The air blown in is enveloped by the water-soap mixture in small portions and cannot escape. The soap in the water increases the surface tension so that the bubbles do not burst immediately. The smaller the portions of air blown in, for example through many small pores, the smaller the resulting bubbles. Larger portions can stretch the water-soap skin further, hence the formation of large bubbles.

Module: Air

Experiment 3: Paper airplanes

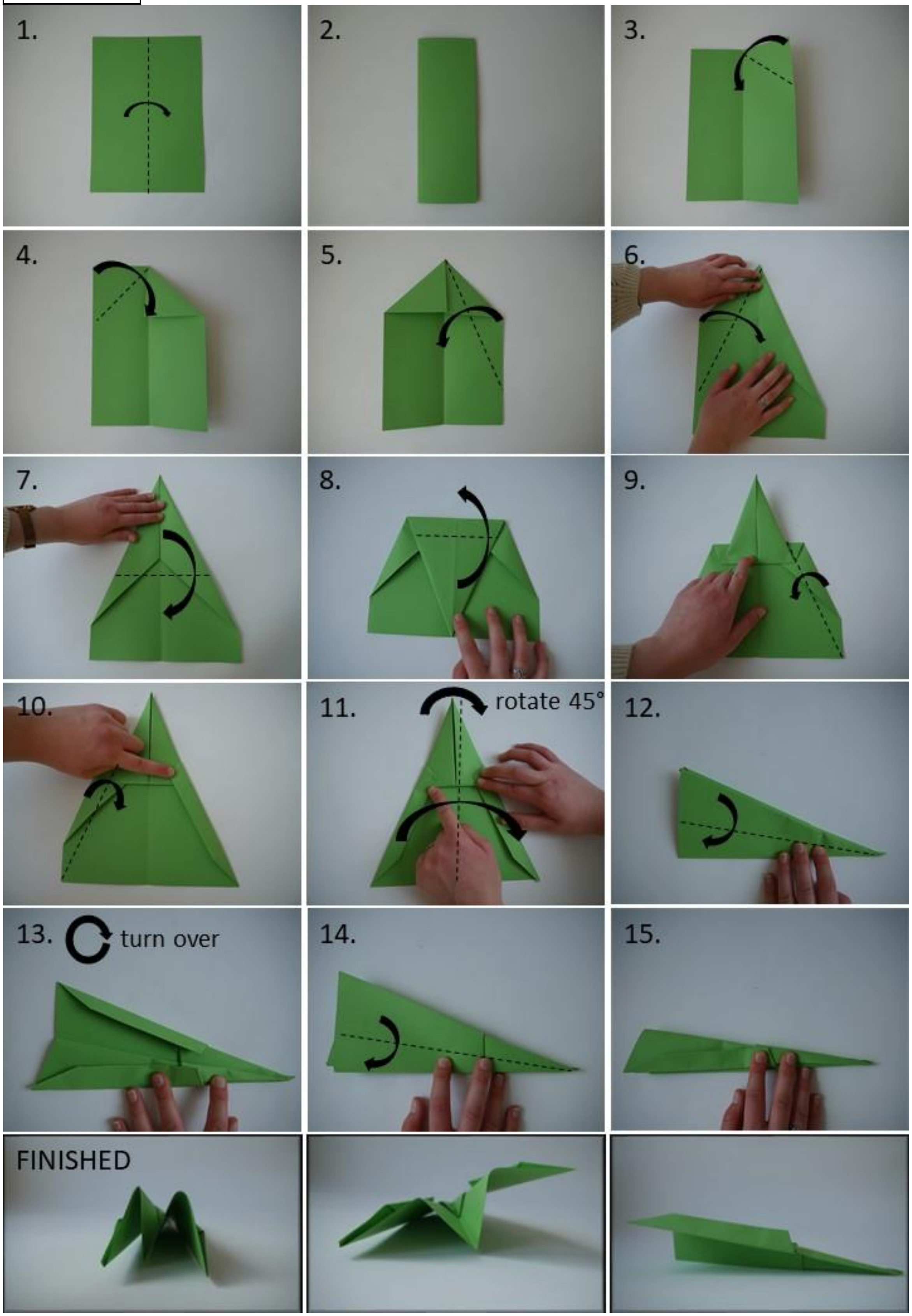
Materials:

- Paper
- Folding instructions (see following pages)

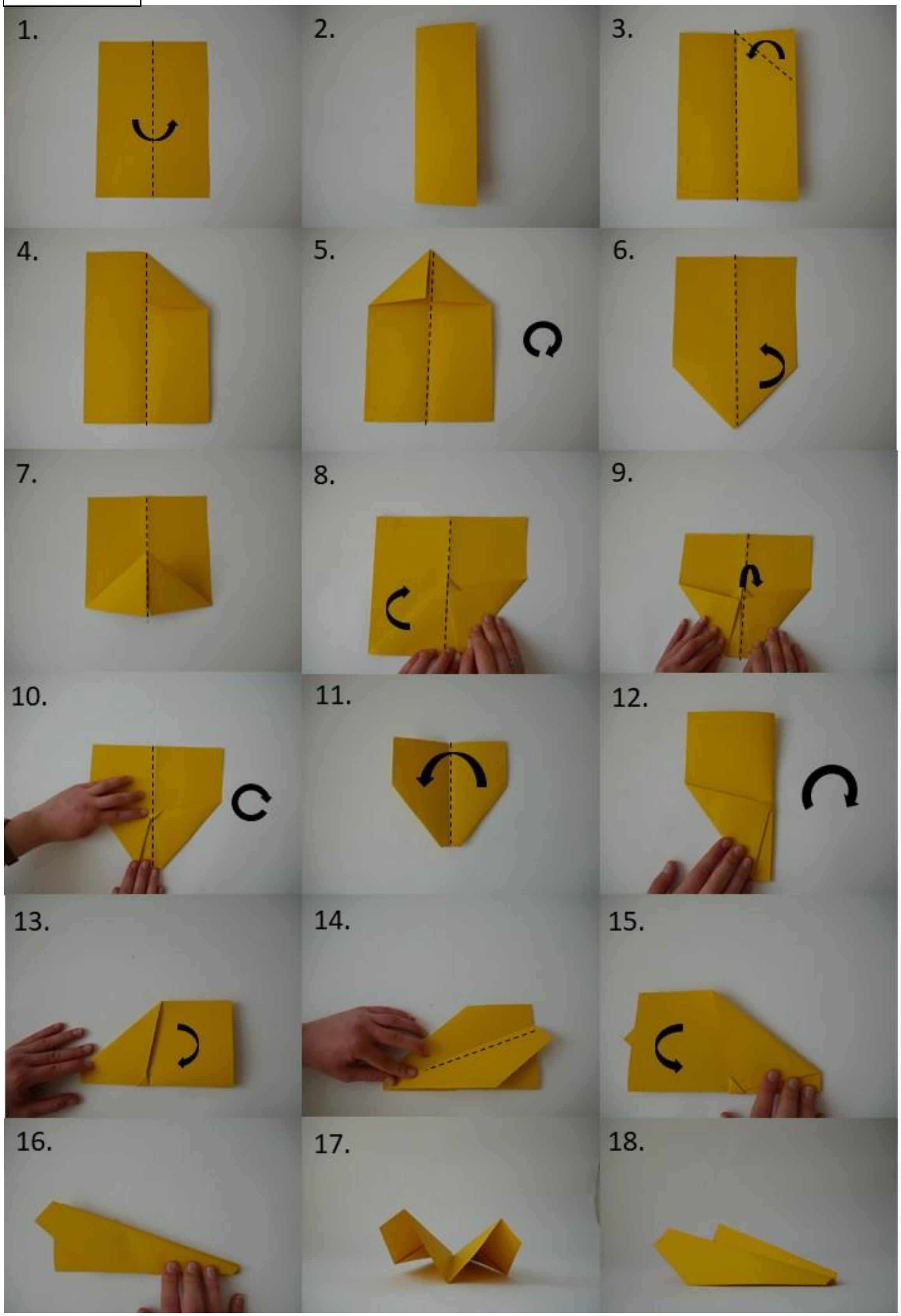
Explanation: Each paper aeroplane has different flight characteristics. While one paper plane glides very far, the other paper plane can do somersaults. The flight characteristics depend, among other things, on the shape and width of the wing.

Important note: First have the children do a few exercises in which they can practise folding accurately. Not every child is able to do this. The paper planes vary in difficulty; start with the easiest instructions.

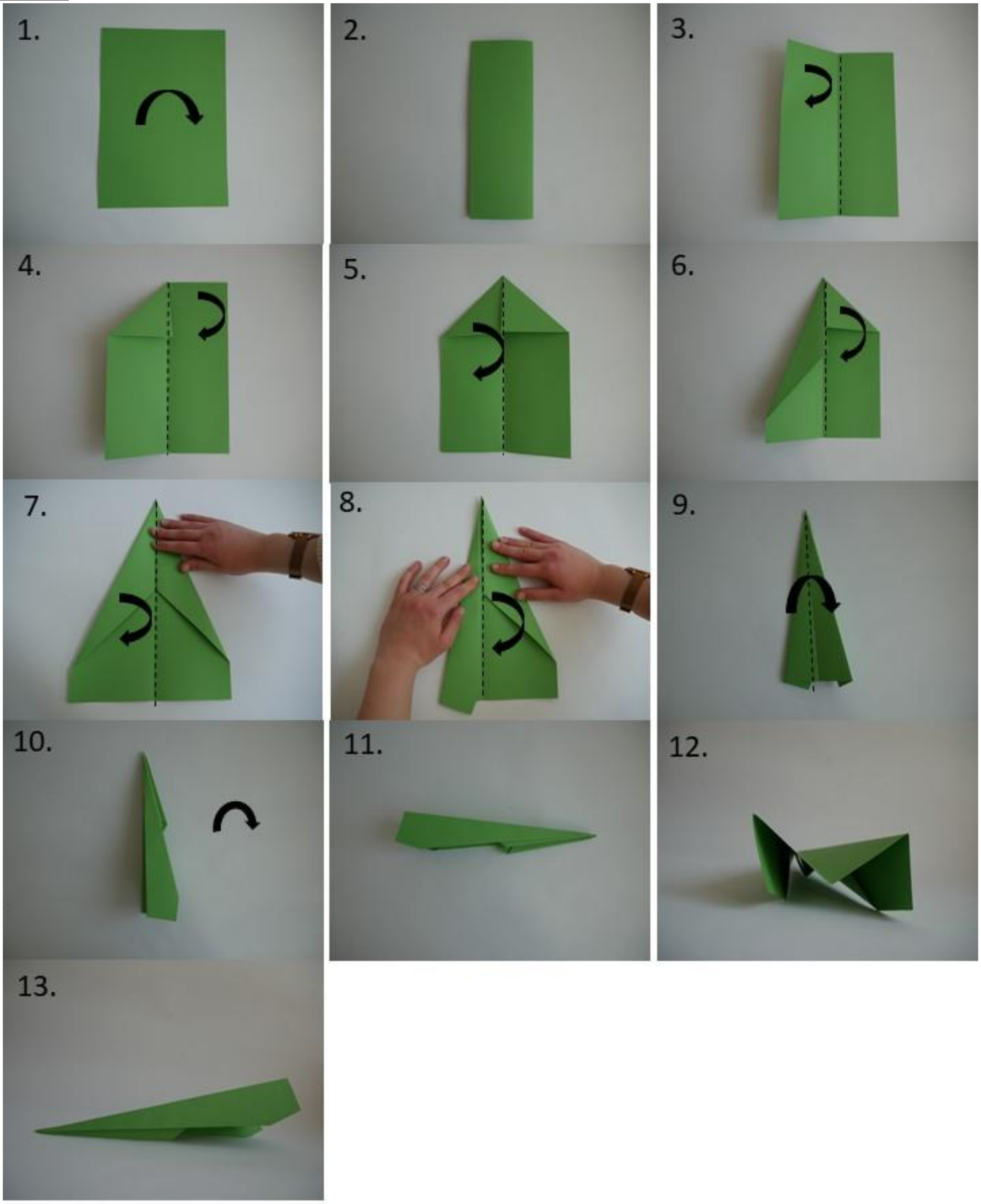
Advance



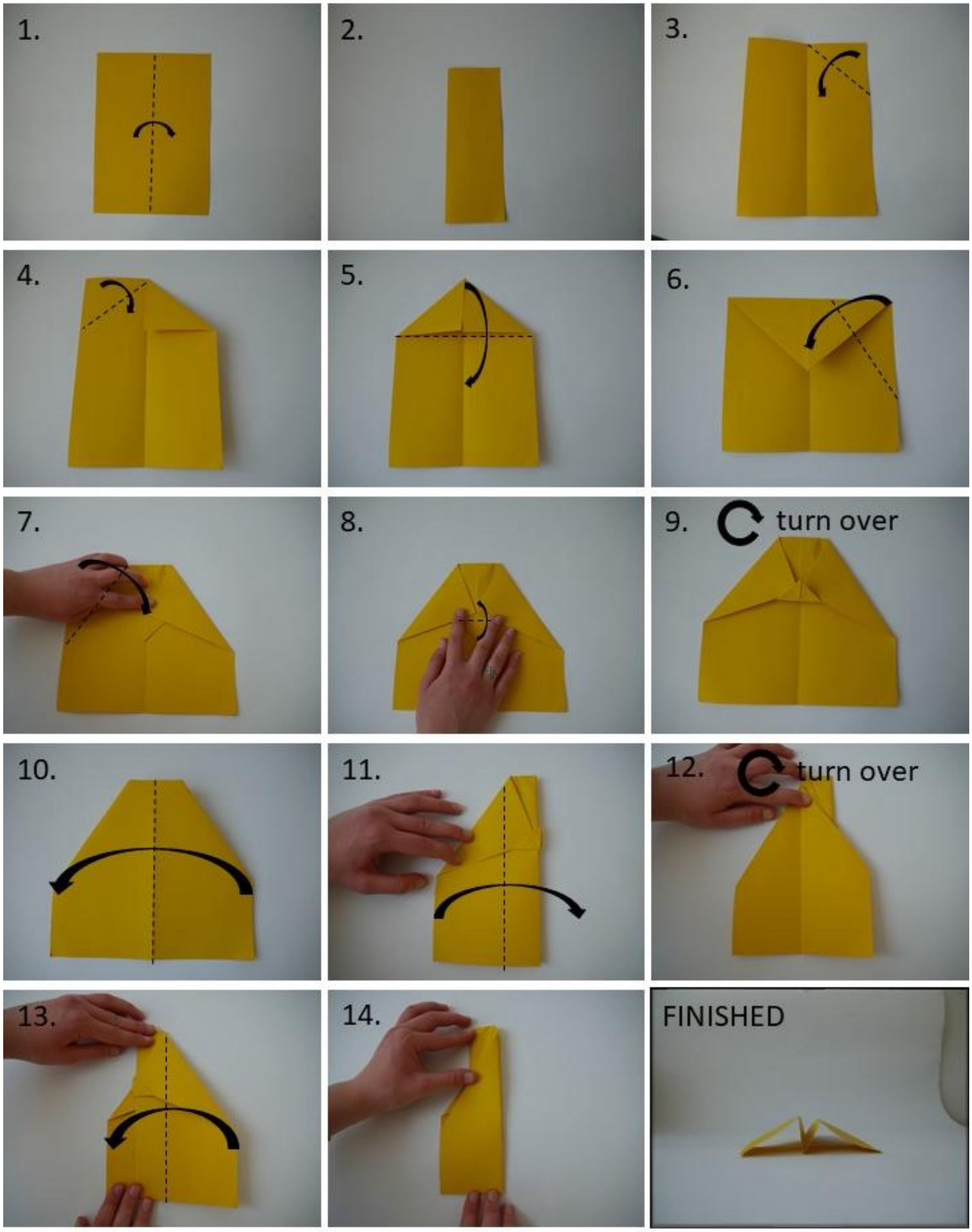
Advance



Easy



Advance



Module: Air

Experiment 4: Tornado in a bottle

Materials:

- 2 PET Bottles (empty and clean)
- Bottle tornado adapter
- Water
- Food coloring (optional)

That's how you do it:

- Pour water in one bottle. Give a drop of food coloring in the water if you want it.
- Screw the adapter on the bottle.
- Put the second bottle on top and screw it tight.

Flip the bottles. What happens?

How does the water get into the lower bottle? Attention: do not squeeze the bottle!

Explanation: The water cannot flow into the lower bottle because the air in the lower bottle blocks the way. The rotation of the bottles creates a vortex. The water is pushed outward so that there is enough space in the middle for the air to enter the upper bottle.

Module: Water

Experiment 1: A boat powered by dishwashing detergent

Materials:

- Bowl
- Template of the boat
- Aluminium foil
- Scissors
- Felt-tip pen
- Water
- Liquid dishwashing detergent
- Toothpick

That's how you do it:

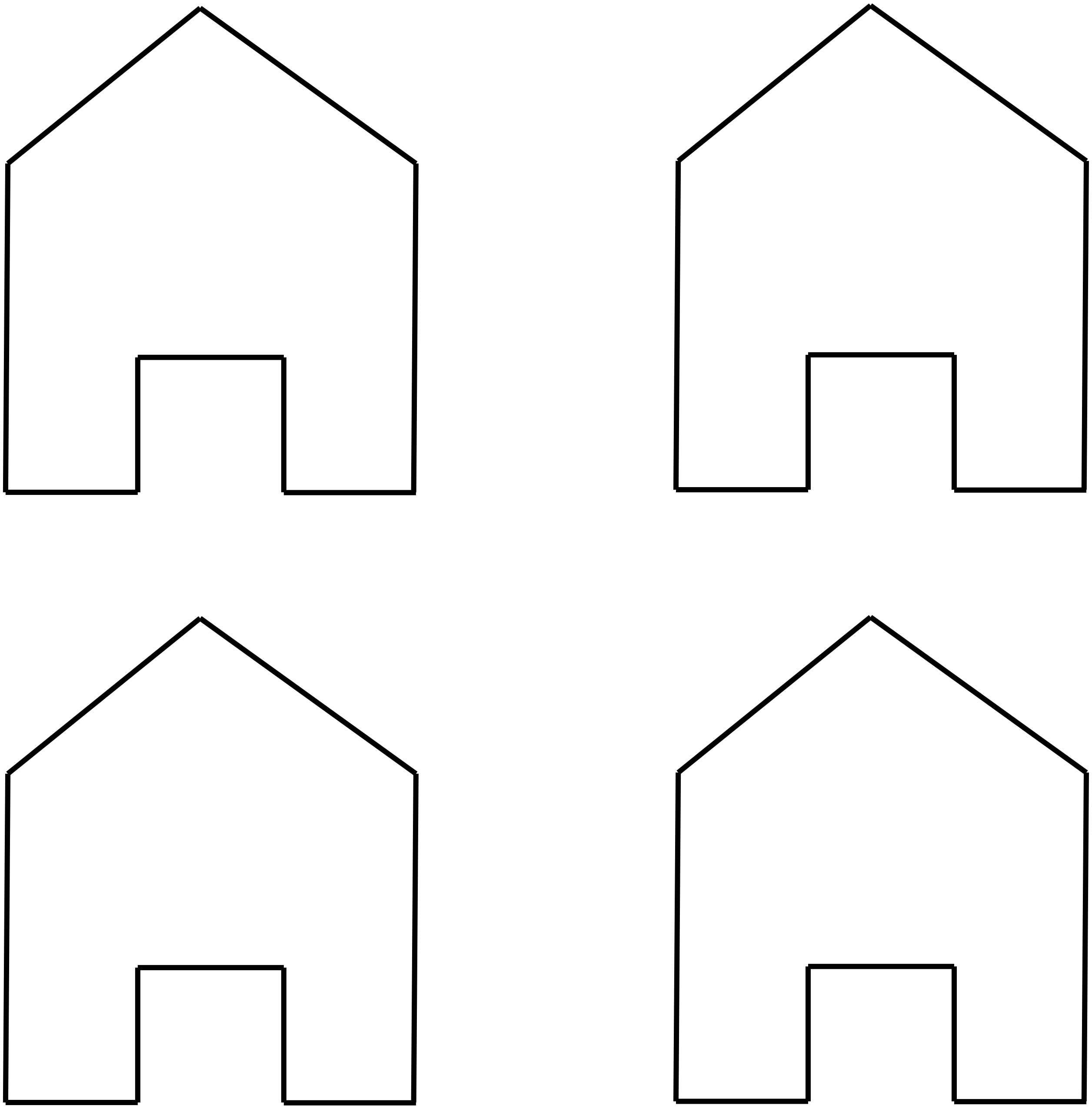
- Fill the bowl with water.
- Using the template, draw a boat on aluminium foil, cut it out and let it swim in the water.
- Dip a tip of the toothpick into the washing-up liquid.
- Dip the toothpick into the water directly behind the boat.

What happens?

If you want to repeat the experiment, the water must be changed beforehand.

Explanation: The water molecules hold together very tightly, so that the surface of the water is like a skin. This phenomenon is called surface tension. The surface tension ensures that confetti and other very light things can lie on the water. If the detergent now touches the water, soap molecules detach themselves from the piece and lie between the water molecules, so that the cohesion of the water molecules is destroyed. The aluminium boat remains on the water and is pushed to the edge by the detergent.

Template of the boat (please cut it out)



Module: Water

Experiment 2: How many coins fit in a drinking glass?

Materials:

- Drinking glass
- Many coins or buttons
- Water
- Waterproof base or flat plate

That's how you do it:

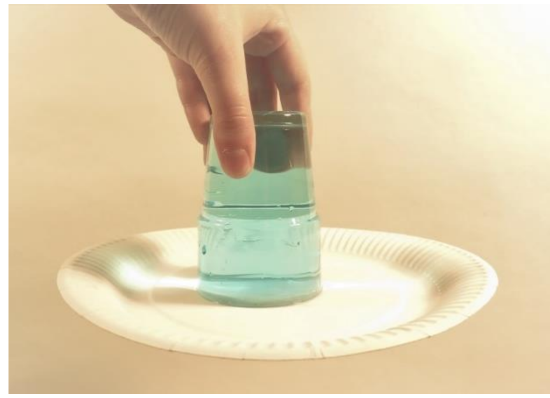
- Fill the glass to the brim with water.
- Start sliding coins into the glass (without splashing!) and count how many coins you can put in until the first drop of water flows out of the glass.

How many coins can you count?

Explanation: The more coins that are dropped in, the higher the water rises. The surface of the water even curves outward beyond the rim, forming a mountain of water. The surface tension ensures that water droplets and puddles stay together and do not disperse without limit. This phenomenon is Surface tension ensures that water droplets and puddles stay together and do not disperse without limit. In this case, the surface tension of the water makes it possible for the water mountain to form on the glass, because the "water skin" can curve upwards and does not tear immediately. Only when the volume under the water skin becomes too large does the pressure also become too great and the skin tears. The glass overflows.

Module: Water

Experiment 3: Flipped glas of water



Materials:

- Drinking glas
- Coaster or paper plate
- Water
- Waterproof base or bowl

That's how you do it:

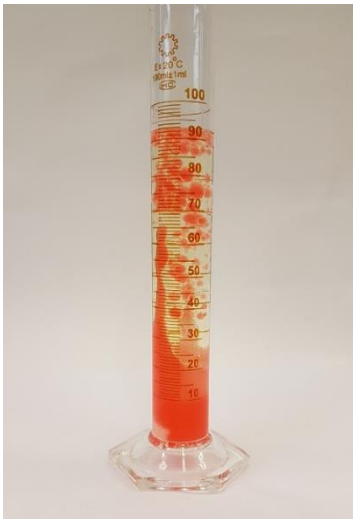
- Fill the glass to the brim with water and press a beer mat or paper plate on top of the glass.
- The entire opening of the jar must be covered and no air must be trapped in the jar.

Now turn the glass upside down. What happens?

Explanation: The water will not flow out for several reasons: on the one hand, because of the forces between the water surface and the cover used, and on the other hand, because of the air pressure. Adhesive forces occur between different materials, including water molecules and cardboard surface. They ensure that these materials attract each other and adhere to each other. The air pressure that surrounds us everywhere is equal to the weight of all the air in the atmosphere bearing down on the earth's surface. The air pressure has so much force that it can hold the water in the glass. This works because the cover provides a surface against which it can push.

Module: Water

Experiment 4: Selfmade lava lamp



Materials:

- High drinking glass
- Cooking oil
- Water
- Food coloring (optional)
- Effervescent tablet
- Measuring cup

That's how you do it:

- Pour 60 ml of water into the drinking glass and color it with food coloring, if desired.
- Then carefully fill 150 ml of cooking oil into the glass.
- Add a small piece of the effervescent tablet to the glass (about a quarter).

What happens?

Explanation: Oil cannot be dissolved in water. Since oil has a lower density than water for this purpose, the oil floats above the water. If the effervescent tablet gets into the water, it dissolves bubbling. This produces carbon dioxide, which rises to the top. In the process, it also takes water up with it. Gas and water pass through the oil layer in the form of thick bubbles. The carbon dioxide continues to rise into the air at the surface and the water sinks back down through the oil.

Module: Water

Experiment 5: Sinking and swimming objects

Materials:

- Different objects
- Big bowl
- Water
- Plasticine

That's how you do it:

- Fill the large bowl ¾ full with water.
- Guess together which of the prepared materials will float and which will sink.
- Then try it out.

Which objects are swimming, floating or sinking?

Try to make plasticine float. What shape must the plasticine take so that it no longer sinks?

Explanation: Materials that are lighter than water will float. Materials of equal weight float and heavier ones sink to the bottom of the container. Whether something can float in water or not depends on its weight and size. Each substance has a specific density. Density is the weight per amount of a substance.

A ball of plasticine is heavier than a ball of water of the same size, so it sinks. If you form a "boat" from this ball, this shape is larger but it is basically filled with air. As a result, this shape is lighter overall than a shape that is exactly the same size and consists only of water. The plasticine boat is then submerged in the water to such an extent that the displaced water weighs exactly as much as the plasticine and the air in it together.

Module: Fire

Experiment 1: A lift for tealights

Materials:

- Tealight
- Lighter
- Deep plate
- High drinking glass
- Water

That's how you do it:

- Fill some water into the plate so that the bottom is covered.
- Place the tea light on the plate.
- Light the tea light and let it burn for a moment.
- Put the drinking glass over the tea light.

What happens?

Explanation: The flame burns the oxygen in the air. Since there is no more oxygen in the glass after a short time, the candle goes out. The very hot flame has previously heated the air in the glass, causing it to expand. If you watch closely, you can see some air escaping from the glass. Once the flame is extinguished, the air quickly cools down again and contracts. As a result, it takes up much less space, the air pressure inside the glass decreases, and a negative pressure is created. The air pressure outside the glass remains the same. Between the air outside and the air inside the glass is the water. Therefore, the air from the outside pushes the water into the glass, thus compressing the air inside until the air pressure inside and outside are equal.

Module: Fire

Experiment 2: Selfmade fire extinguisher

Materials:

- Baking powder
- Vinegar
- Tealight
- Lighter or match
- 2 big drinking glasses
- Spoon or pipette

That's how you do it:

- Pour the baking soda into one drinking glass.
- Place the tea light in the second glass and light it.
- Use the spoon or pipette to drip enough vinegar onto the baking soda so that it starts to foam.
- Carefully cover the glass with the baking soda with your hand and wait until the foaming stops.
- Now hold the glass directly over the second glass with the burning tea light, as if you wanted to pour something from the first glass into the second glass. However, the foam from the baking soda and vinegar **must not flow into the bottom glass!**

What happens?

Explanation: Baking soda and vinegar react with each other. This can be recognized by the strong foaming. This reaction produces carbon dioxide. Carbon dioxide is heavy and therefore remains at the bottom of the glass. If you now hold the glass at an angle, the gas will flow into the lower glass with the burning tea light. The oxygen in the glass is displaced and the flame goes out.

Module: Fire

Experiment 3: Tea bag rocket

Materials:

- Tea bag
- Scissors
- Fireproof plate
- Lighter or match

That's how you do it:

- Separate the tape from the tea bag.
- Cut off the upper end of the tea bag.
- Pour the tea away.
- Unfold the tea bag to form a tube.
- Place the paper tube on the plate.
- Light the top of the tube with a match or lighter.

What happens?

Explanation: The flames heat the air around the tea bag rocket. Hot air rises to the top. As it burns, the weight of the tea bag simultaneously decreases further and further until it has become so light that it is carried away by the upwelling hot air.

Module: Fire

Experiment 4: Tealight under glas

Materials:

- Tealight
- Lighter
- Saucer
- Drinking glass

That's how you do it:

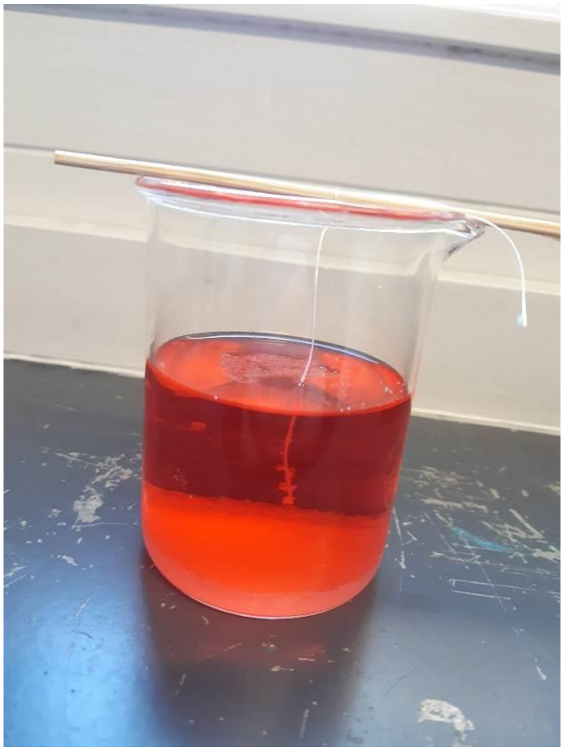
- Place the tealight on the saucer.
- Light the tea light and let it burn for a moment.
- Put the drinking glass over the tea light.

What happens?

Explanation: Fire needs oxygen to burn. If the glass is placed over the tea light, the flame can only burn the oxygen that is trapped under the glass. Once this is used up, the flame goes out.

Module: Crystals

Experiment: Growing crystals



Materials:

- Clean drinking glass
- String
- Scissors
- Toothpick or pencil
- Electric kettle
- Scale
- Measuring cup
- Water
- Spoon
- Thermometer
- Alum (potassium aluminium sulfate-12-hydrate), available at the pharmacy
- Food color (optional)

That's how you do it:

- Boil water and let it cool down to 70°C.
- Weigh 30 g alum and put it into a drinking glass.
- Pour 100 ml of warm water over the alum and stir with a spoon until the crystals have dissolved as completely as possible.
- Cut a piece of string and knot it around the center of the toothpick or pencil.
- Place the piece of wood over the drinking glass and dip the string into the solution. The string should hang in the center of the liquid as much as possible and not touch the rim or bottom of the glass.
- Let everything sit in silence.

Wait a while and then check on your growing crystal. Small crystals should form on the string fairly quickly. If you only want one large crystal on the string, take the string out of the solution and carefully pluck off any excess crystals. Then hang the thread back into the solution. Now let your crystal grow for the next few weeks.

Caution: wash your hands after the experiment!

Explanation: Many solids such as sugar, salt or alum can be dissolved in water. However, water can only dissolve a certain amount of these molecules. When this maximum is reached, it is called a saturated solution. The warmer the water, the easier it is to dissolve the alum molecules. The amount of soluble molecules also increases with temperature. If the water cools down, the solubility decreases again. The alum molecules precipitate again and also attach themselves to the string. Alum molecules regularly attach themselves to each other in a lattice structure. This arrangement in a geometric lattice provides the crystal structure.

Module: Senses

Experiment 1: Auditory sense

Materials:

- Different little objects (for example: stones, needles, coins, crumpled up paper…)
- Small jars, opaque and plastic

That's how you do it:

- Fill two jars each with the same objects and screw the jar shut.
- Shake the jars.

Can you find the pairs of jars that sound the same?

Module: Senses

Experiment 2: Olfactory sense

Materials:

- Different smells (for example: cinnamon, vanilla, peppermint…)
- Small jars, preferably opaque

That's how you do it:

- Fill two jars each with the same odour and screw the jar shut.
- The children should now smell the jars with their eyes closed.

Can you find the pairs of jars that smell the same?

Module: Senses

Experiment 3: Tactile sense

Materials:

- Different little objects (for example; key, fur, rubber, dice…)
- Cloth bag

That's how you do it:

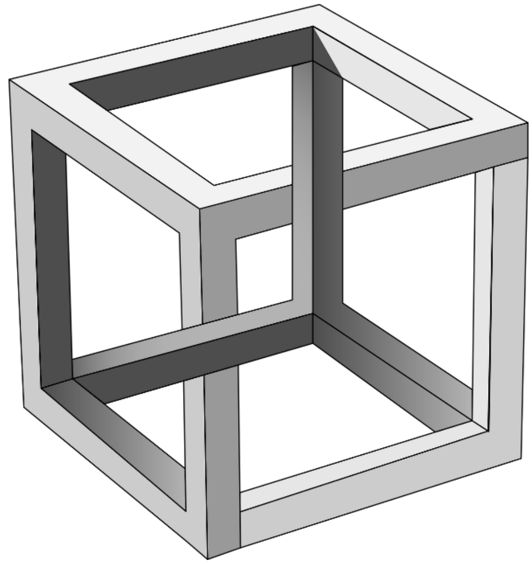
- An adult puts the different objects in the cloth bag.
- Close your eyes and reach into the cloth bag. Take one object.

Can you name the object just with your tactile sense?

Explanation: Our skin contains tactile, heat and cold receptors with which we can perceive pressure, touch, vibration and temperature.

Module: Senses

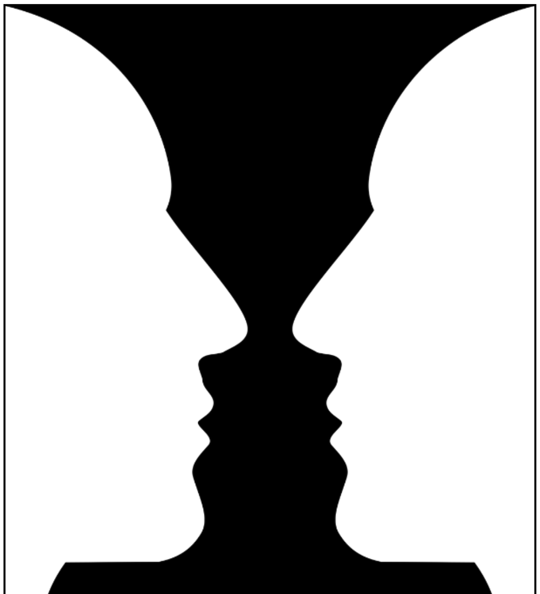
Experiment 4: Different optical illusions



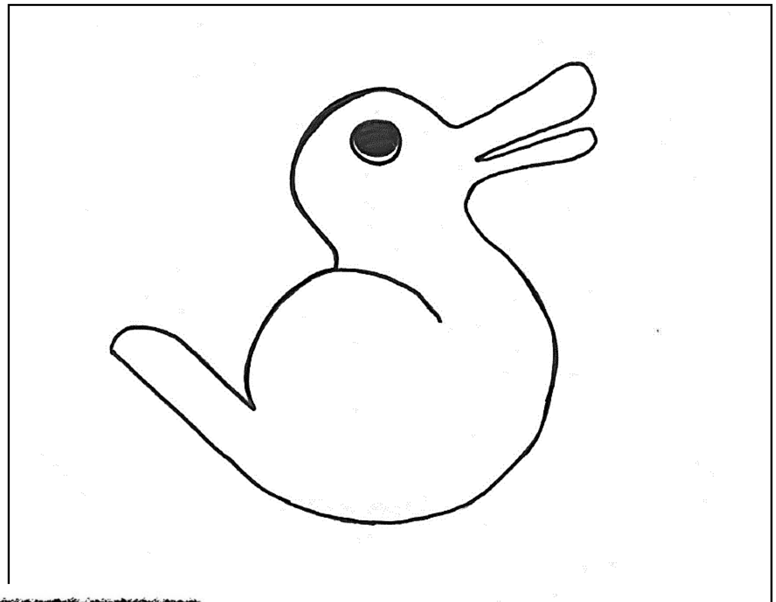
Explanation: Optical illusions are a misperceived visual impression. Our brain processes sensory stimuli on the basis of experiences and memories. For example, our eyes see a small, tousled creature standing on four extremities and our ears hear a sound emitted by this creature. Together, our brain interprets this creature as a "dog" because it has learned in advance to associate this animal with this concept. If sensory stimuli and experiences do not match or are faulty, illusions of things that are not there are created.

Some optical illusions represent objects which, if you look at only a small part of the image, seem logical and correct, but in their entirety are twisted and impossible. Often, on the two-dimensional plane, the structures are correct and connected without gaps, but due to shading, they appear impossible on the three-dimensional plane.

Two faces or goblet?

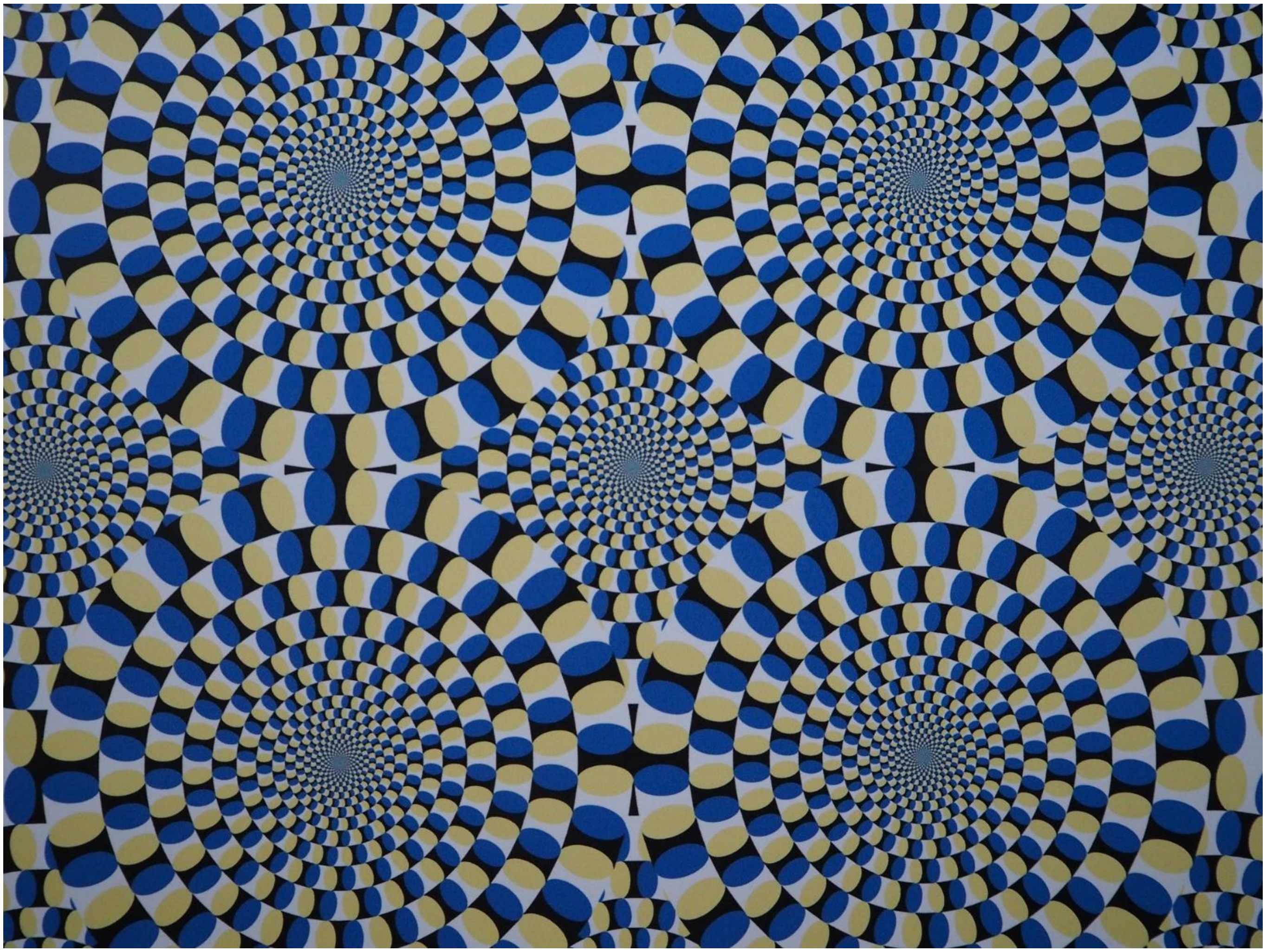


Rabbit or duck?



Can you see the face or the fishes?

Explanation: Some images sometimes allow several interpretations of what is shown. Depending on the angle of view or the focus of a section of the image, different objects can be recognized. To recognize both shown figures at the same time is impossible. What one tends to discover first is also often related to the experiences our brain can fall back on. If you own a rabbit as a pet, you might recognize it first. If we have recently fed ducks in the park, we may interpret what we see as a duck.



Explanation: Images start spinning when we look at something with complex patterns and contrasts for a long time or out of the corners of our eyes. The different contrasts and patterns are transmitted to the brain and processed at different speeds. If many stimuli arrive in the brain in quick succession, they are processed incorrectly. The result: the pattern appears to move.

Module: Colours

Experiment 1: Colours of red cabbage

Materials:

- Red cabbage juice (simmer a red cabbage for a longer time)
- Small drinking glases or test tubes
- Pipettes or spoons
- Lemon juice, vinegar, sodium bicarbonate, washing powder, water

That's how you do it:

- Dissolve some bicarbonate of soda and some washing powder in 50 ml of water each in different glasses.
- Pour some red cabbage juice into 5 glasses.
- Add a spoon or a pipette full of lemon juice to the red cabbage juice in the first glass.
- Add spoonful or pipetteful of vinegar to the second glass.
- Divide the remaining ingredients among the remaining glasses in the same way: sodium bicarbonate, washing powder and water.

What can you observe? What happened with the colours of the red cabbage?

Explanation:

When lemon juice or vinegar is added, the solution turns bright red to pink. With sodium bicarbonate and washing powder, the liquid turns blue or yellow. When water is added, the red cabbage juice remains purple.

The dye of red cabbage belongs to the anthocyanins, a group of plant dyes that change colour depending on the pH of the surrounding liquid. Anthocyanins are reddish in the acidic range and greenish-yellow in the basic range. Thus red cabbage juice is a pH indicator.

Module: Colours

Experiment 2: Drawing with magnets

Materials:

- Paper box
- Strong magnet
- Small iron ball
- paints, for example acrylic paints or finger paints
- paper

That's how you do it:

- Place the sheet of paper in the box.
- Place the iron ball on the sheet of paper and hold the magnet against the box from below so that the iron ball is attracted to the magnet.
- Place colour blobs on the paper.

Now move the iron ball through the paint using only the magnet under the box. Draw a picture as you like.

Explanation:

The magnetic force also works through objects, for example here through the cardboard and the paper. If the distance between the iron ball and the magnet is small enough and the magnet is strong enough, the iron ball can be used like a brush to spread the paint on the paper.

Module: Colours

Experiment 3: Mixing light

Materials:

- Flashlights with red, green and blue filter
- Pencil or other object
- Dark room
- White wall or white table

That's how you do it:

- Darken the room
- Turn on the flashlights and point them at the table or a white wall.

Try it out:

What happens when you hold two differently colored light cones on top of each other? What happens when you cross all three cones of light?
Hold an object or your hand in the cone of light. What happens to the shadow?

Explanation:

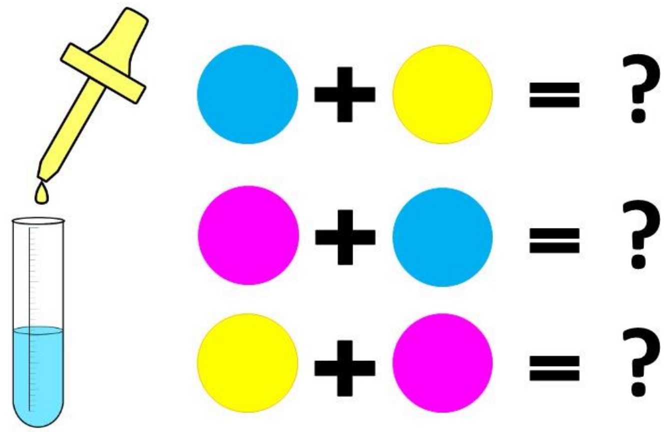
When light of a certain wavelength hits the receptors in our eyes, they are stimulated in a certain way and intensity. This stimulus is interpreted in our brain as color (see also the explanation of the experiment "mixing watercolors").

In contrast to watercolors, where a new color impression was created because more wavelengths were absorbed by mixing the pigments, colored flashlights reflect a new combination of wavelengths, which then hit our eyes. The receptors are stimulated differently, giving our brain a new color impression. When all three flashlights are combined, the reflected light contains almost all wavelengths of the visible wave spectrum - this combination is perceived as "white light."

This color mixing is called additive color mixing.

Module: Colours

Experiment 4: Mixing water colors



Materials:

- crepe paper (yellow, cyan, magenta)
- pipette or spoon
- several glasses
- water
- watercolors and brushes (optional)

Preparation: Put one piece of crepe paper in each drinking glass and add water. After a short time, the water should have taken on the respective color of the paper. The discolored paper can be removed.

That's how you do it:

- Look at the color scheme above.

What happens if you mix the colors shown in a glass?

Further experiments: Mix different colors from the watercolor box.

Explanation:

The colors used here are made of pigments. The color impression is created because these pigments "swallow" different wavelengths of light and do not reflect them back. White light contains wavelengths of different lengths. Objects absorb certain wavelengths and reflect the rest, which then hit our eye and trigger a certain color impression in our brain. **Example:** Leaves appear green to us because they absorb all wavelengths and reflect only the lengths that are perceived as "green". If these now meet our eye, our color receptors are stimulated in a certain way and intensity by these wavelengths. This stimulus is passed on to the brain, which interprets the incoming stimulus as "green". If different pigments are now mixed together, a different color impression is created, since combined wavelengths are now absorbed. If all color pigments are mixed together, almost all wavelengths are also absorbed - our brain interprets "black" in this case. This type of color mixing is called "subtractive color mixing".

Module: Bricks and bridges

Experiment 1: Bridge constructions

Materials:

- Paper (DIN-A4)
- Light weights
- Wooden blocks of the same shape
- 2 tables

Task 1:

Push two tables a little bit apart (about 20 cm). Build a stable bridge out of paper across the gap between the tables. Your bridge should be stable enough to hold a weight on its centre for 10 seconds.

Task 2:

Build a bridge out of 7 wooden blocks. Check if your bridge can support a small weight.

Additional task:

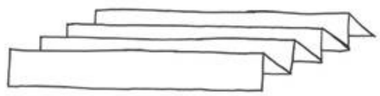
Build a bridge out of 7 wooden blocks that does not need any supports. Again, check the stability with a weight.

Explanation:

Task 1: If a sheet of paper is folded lengthwise several times like an accordion, a stable **beam bridge** is created (see 1). The zig-zag profile makes the bridge more resilient and it can no longer bend.

Task 2: The wooden blocks can also be used to build a **beam bridge**, this time with supports (see 2).

Additional task: To build a bridge without supports, the blocks have to be arranged in an overlapping way. This creates what is known as a **cantilever bridge** (see 3a). The counterweights at the ends of the bridge are important here. These increase the load-bearing capacity (see 3b).



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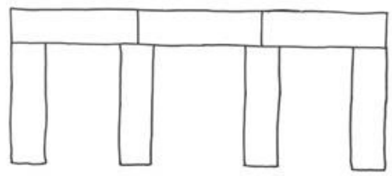

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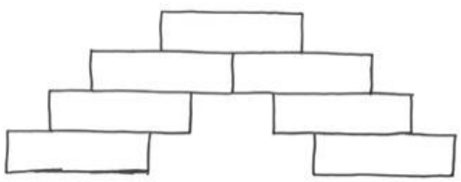

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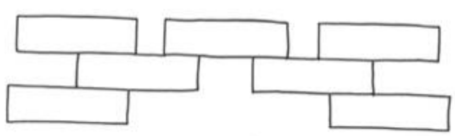

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Module: Bricks and bridges

Experiment 2: Building with KAPLA bricks

Materials:

- KAPLA bricks (or other flat blocks)

That's how you do it:

- Build different constructions from the wooden blocks: a spiral staircase, a castle, a bridge or a tower... there are no limits to your imagination.

What do you have to pay attention to so that a tower or a tall house remains stable and doesn't fall over?

Explanation:

KAPLA bricks are small plates made of pine wood, which can be placed on top of each other and assembled into various constructions. Alternatively, domino stones or other flat wooden blocks can be used.

https://www.flickr.com/photos/kath-kirche-vorarlberg/43540257562
https://commons.wikimedia.org/wiki/File:Escalier_kapla_1.JPG

Module: Plants

Experiment 1: What do cress seeds need to grow?

Materials:

- Cress seeds
- 3 small bowls e.g saucer
- Cotton wool
- Water

This is how you do it:

- Fill all the bowls with cotton wool. Label the trays from 1 to 3.
- Spread the cress seeds on the cotton wool.
- **Proceed with the bowls as follows:**
- Bowl 1: Drizzle some water on the cotton wool until it is moist and place the bowl on a sunny windowsill. Keep the cotton wet for the next few days!
- Bowl 2: Drip some water on the cotton wool until it is moist and place the bowl in a dark cupboard. Keep the cotton wool moist for the next few days!
- Bowl 3: Leave the cotton wool dry and place it next to bowl 1 on the windowsill.

Wait a week. Don't forget to regularly moisten bowl 1 and 2 with water! What can you observe after a week?

Explanation: Cress seeds need light and water to germinate and for healthy growth. The cress seeds in the dark cupboard may also have germinated, but the seedlings are yellowish and have grown much faster.

The plant is thus trying to get to a light source as quickly as possible so that it can then grow healthily there. Therefore, a lot of energy is put into length growth for a short time and the formation of chlorophyll is largely absent. This phenomenon is called "yellowing".

Module: Plants

Experiment 2: How does a bean sprout?

Materials:

- Large drinking glass
- Cotton wool or plant granules (e.g. “Seramis”)
- Scarlet runner bean (*Phaseolus coccineus*)
- Water

This is how you do it:

- **Before the experiment starts:** soak a scarlet runner bean in water overnight.
- Fill the glass with plenty of cotton wool or plant granules.
- Place a scarlet runner bean at the edge of the glass so that it can be seen from the side.
- Moisten the cotton wool or plant granules.

Wait at least one week. Make sure that the contents of the jar are always moist!

Explanation: After a few days you can observe how the bean germinates: the roots, the shoot and a first pair of leaves develop. Botany distinguishes between two types of germination: epigeic (above-ground) germination and hypogeic (below-ground) germination. The seed itself contains the so-called cotyledons. In epigean germination, the cotyledons are pushed upwards on the shoot and unfold on the surface. In hypogeous germination, the cotyledons remain in the seed and the shoot, which pushes up to the surface, bears a fully developed pair of leaves. In the case of the scarlet runner bean, hypogeous germination is thus present.

Module: Plants

Experiment 3: Identify plants and create a herbarium

Materials:

- Identification key (e.g. as a book or as an app, see also notes below)
- Various plants (outside)
- Paper sheets
- Heavy books
- Sellotape

This is how you do it:

- Look around outside for flowering plants: You can also look for trees.
- Identify the type of plant.
- **Now make a herbarium**: If possible, take the entire plant (for small, herbaceous plants) and press it between sheets of paper. For trees, take a complete leaf that has not been chewed by insects.
- Don’t forget to write down the name of the plant!
- Weigh down the paper with several books. Let the plants dry like this for at least a week.
- Then glue them to a new sheet of paper and label it with the name of the plant – your herbarium is ready!

Important notes:

To identify the plants, use either plant guides with pictures or apps such as "**Pl@nt Net**" or "**PlantNet**" (available free of charge for Android and IOS). When identifying plants, pay attention to small details. Often different species look very similar and differ only in small details such as leaf shape, size or arrangement of leaves or flowers.

A good period for creating a herbarium is **April to August**. Since different plants flower at different times, you can always work on the herbarium in between.

Moreover, **no ornamental flowers** should be used. **Protected or poisonous species** should also not be collected for the herbarium! Therefore, it is important to identify the plant on the spot before picking to ensure that harmless and only non-endangered species are taken from the environment.

Module: Plants

Experiment 4: How do things look under the magnifying glass?

Materials:

- Various objects from nature (e.g. plants, sand, tree bark, seed mix…)
- Strong magnifying glass

This is how you do it:

- Look outside for interesting objects that you would like to take a closer look at.
- You can also look for small insects. **Caution**: be careful with the creatures! Catch them carefully in jars and release them again when you have looked at them. **Let an adult help you!**

How do things look under the magnifying glass? Describe them!

Explanation: The stronger the magnifying glasses, the more details you can see: Grains of **sand** are not uniformly round or all the same colour. **Nettles** have fine, transparent thorns on their stems, the so-called stinging hairs. **Plant seeds** can also look very different. **Woodlice** can also be looked at more closely with a magnifying glass. Another tip: let a **snail** crawl along the inside of a glass. If you look closely, you can observe the muscles in the snail's body, which move through the body like waves. Anything can be examined and looked at more closely that is **harmless and not poisonous**.

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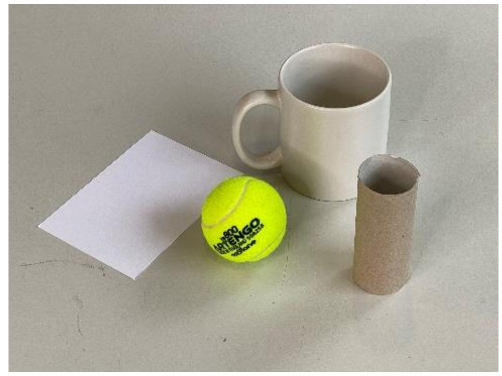
Module: Mechanic

Experiment 1: An inert tennis ball

Materials:

- Cup
- Solid Postcard
- Toilet paper roll
- Tennis ball



That's how you do it:

- Build a tower with the materials (from bottom to top: cup, postcard, roll, ball)

How do you make the tennis ball fall into the cup without touching the ball?

Explanation: If you quickly pull the postcard away from the cup, the paper roll tilts in the opposite direction. The tennis ball falls into the cup directly under it. A body (here the tennis ball) remains at rest as long as no external forces act on it. The greater the mass of the body, the greater the force required to accelerate this mass. This is the principle of inertia. The quick jerk on the postcard and paper roll is not enough to overcome the inertia of the tennis ball. It is not moved vertically, but falls down due to the effect of gravity.

Module: Mechanic

Experiment 2: Keep the balance!

Materials:

- Broom
- Your index finger

That's how you do it:

- Stand up straight.
- Balance the broom on your two index fingers.

Find the center of gravity of the broom by pushing your fingers together.

Explanation: When the broom is balanced, it can be balanced on one finger without tipping to one side. At this point, all the forces acting on the body cancel each other out.

Module: Mechanic

Experiment 3: Levers and seesaws

Materials:

- Narrow wooden board
- A small cylindrical object (e.g. a piece of pipe, a small can, a thick glue stick or felt-tip pen)
- Rubber band
- Objects that serve as weights

That's how you do it:

- Use the materials to build a seesaw as shown in the picture.
- Draw marks on one side of the seesaw.
- Place a weight on the outermost mark.
- Lift the weight by tapping the other end of the seesaw with your finger.

Try different positions for the weight. What do you notice? Which position is the easiest for you to lift the weight with the seesaw?

Explanation: The seesaw is a two-sided lever. This means that there are lever arms on both sides of the pivot point. The side that carries the weight to be lifted is also called the load arm. The side on which you apply the force to lift the weight is the power arm. The closer the weight (or load) is to the pivot point, the easier it is to lift that weight. Or to put it another way: the longer the power arm, the greater the leverage and the easier it is to lift the load.

Module: Mechanic

Experiment 4: Pick up a coin

Materials:

- A partner
- A coin
- A wall

That's how you do it:

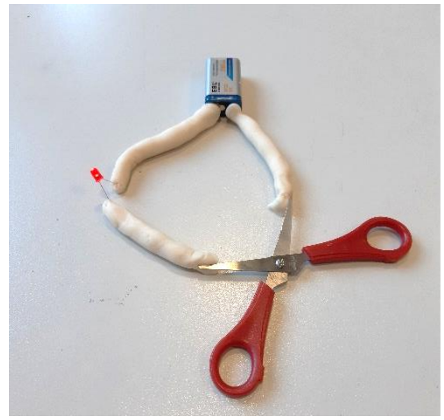
- Stand up straight against a wall. Your heels and buttocks must touch the wall!
- Your partner places a coin on the floor in front of you.
- Add a small piece of the effervescent tablet to the glass (about a quarter).

Now try to pick up the coin. Can you do it?

Explanation: If we stand straight against a wall and try to pick up the coin, we will quickly fall forward while trying. By leaning forward, our center of gravity shifts in front of our feet. This results in tipping forward.

Module: Electricity

Experiment 1: Good and bad conductors



Materials:

- Different materials (e.g. different metals, fabric, rubber, plastic…)
- Conductive plasticine (self-made, see below)
  250 ml Water, 200 g flour, 70 g salt, 9 tablespoon lemon juice, 1 tablespoon cooking oil
- 9 V battery
- light emitting diode (5 mm diameter)

That's how you do the plasticine:

- 150 g of flour and all the remaining ingredients are put together in a pot.
- Heat the mixture, stirring constantly, until it thickens.
- Let it cool down.
- Now add the remaining flour and knead everything until the dough has the consistency of dough. Add a little more flour if necessary.
- The dough can be stored in an airtight container in the refrigerator for a few days.

That's how you do the experiment:

- Form two 1 cm thick cables from the plasticine.
- Connect one pole of the battery to one end of each cable. **Caution:** The cables must not touch at any point! Pay particular attention to the battery itself!
- Lay the cables in a circle and leave a small gap. Bridge this gap with an LED. If it does not light up, insert the pins the other way around. **The pins are of different lengths**: the long pin points to the positive pole of the battery, the shorter pin belongs to the negative pole.
- If the light emitting diode is plugged in correctly, split one wire in two parts.
- Leave this gap open. Compare with the example picture.

Try to bridge the gap with different objects. With which objects does the LED light up?

Explanation: Materials have varying degrees of conductivity. Metals in particular are good conductors, but carbon or graphite also conduct electricity well. Therefore, a pencil lead will also conduct the current. **Also amazing**: when we close the circuit with our slightly moistened fingers, the LED also glows weakly. The voltage that is passed through us is not noticeable and completely harmless. Objects made of rubber, wood or fabric, on the other hand, are such poor conductors that the LED will not light up.

Module: Electricity

Experiment 2: Build an electric circuit

Materials:

- Conductive plasticine (self-made, see experiment *good and bad conductors*)
- 9 V battery
- light emitting diode (5 mm diameter)

That's how you do it:

- Form two 1 cm thick cables from the plasticine.
- Connect one pole of the battery to one end of each cable. **Caution:** The cables must not touch at any point! Pay particular attention to the battery itself!
- Lay the cables in a circle and leave a small gap. Bridge this gap with an LED. If it does not light up, insert the pins the other way around. **The pins are of different lengths**: the long pin points to the positive pole of the battery, the shorter pin belongs to the negative pole.

Build different electric circuits:

Use 4 pieces of wire and 3 LEDs.

Is there a way to make all three LEDs shine strongly?

Explanation: For current to flow, the circuit must be closed.

If several LEDs are built into the circuit one after the other, they will shine weaker, because the total resistance is increased by the LEDs connected in series. If, on the other hand, the LEDs are installed in parallel, several small circuits are created so that the resistances do not add up. The LEDs shine brightly again. Possible circuits for series connection and parallel connection are shown schematically on the next page.

Module: Plastic

Experiment 1: Where do you find plastic in your everyday life?

Materials:

- Sticker “Plastic!” (see template)

This is how you do it:

- Look around: which objects in your environment are made of plastic? Distribute the "Plastic" stickers.
- Think: which plastic objects can you replace so that they are no longer made of plastic?

Explanation: It is often easy to find a plastic-free alternative for everyday items. But sometimes going completely plastic-free is more difficult or involves higher purchase costs. The cost factor in particular is an argument in many families for continuing to use the cheaper plastic option. Nevertheless, it is important to teach children to be more aware of plastic and to introduce them to alternatives. In addition to plastic alternatives, the improved use of existing plastic should also be discussed, for example, using plastic bottles or cans more than once. The aim should be to teach the children a conscious and sustainable use of plastic and to show them sensible alternatives to plastic, but not to portray the child's previous behaviour with plastic negatively, so that a change in behaviour is achieved through a "guilty conscience". What is more desirable is an active rethinking of the children's attitude towards plastic.

Plastic!

Plastic!

Plastic!

Plastic!

Plastic!

Plastic!

Module: Plastic

Experiment 2: Destroy a plastic bag!

Materials:

- A plastic bag

Destroy a plastic bag, but only with the "power of nature":

- Blow hard on it.
- Tear it apart with your hands.
- Pour water over the bag.
- Grind it between pebbles.
- Trample on it or drive over it.

What happens to the plastic bag? Consider what would happen to a bag outside in nature. Does the bag break down or does it rot?

Explanation: The children notice that the degradation of a plastic bag in nature does not take place at all or only very little. In this way, they learn that it is extremely important to let as little plastic waste as possible get into the environment. A plastic bag takes about 20 years to completely decompose, a polystyrene cup 50 years and a PET bottle even takes up to 450 years to decompose. Plastic gets smaller and smaller over time, but it is not possible to break it down completely.

Module: Plastic

Experiment 3: Make a shopping bag yourself

Materials:

- A t-shirt you no longer wear
- Ruler
- Pen
- scissors

This is how you do it:

- Turn the shirt inside out and cut the sleeves and neckline along the seam.
- Using the ruler, draw a horizontal line 10 cm from the bottom hem of the shirt.
- Cut the fabric from both sides from the edge to the line into strips about one centimetre wide. Cut the first and the last strip also on the side so that you have two pairs of strips.
- Pull the strips lengthwise and then knot the overlapping strips of the front and back of the shirt with a tight double knot.

When you're done, turn the shirt right side out again and your fabric bag is ready!

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Module: Food

Experiment 1: Cornstarch and water

Materials:

- Cornstarch
- Water
- Small bowl
- Tablespoon

That's how you do it:

- Add 2 heaping tablespoons of cornstarch to the bowl.
- Then add 1 to 2 tablespoons of water and stir the mixture. It should not be too liquid.

What do you notice? Can you quickly dip your spoon or finger into the mixture? What happens if you try the same thing again slowly?

Take some of the mixture in your hand and try to form a ball.

Explanation: The mass is a "non-Newtonian fluid". Normally, substances can dissolve in water in such a way that the individual molecules of the substance are enclosed by the water molecules and remain mobile. If pressure is now exerted on the water surface or, for example, a finger is dipped into the water, a corresponding amount of the solution is displaced and pushed to the side, so that hardly any resistance is felt. Food starch is a long-chain sugar molecule that does not dissolve in water. If you try to dip a finger or object into this solution quickly, the liquid hardens. If you quickly apply pressure to the mixture, the long molecule chains of the food starch will interlock. The mass becomes solid. Only if you dip your finger into the mass slowly and with little pressure can the molecular chains move apart and make room.

Module: Food

Experiment 2: Ice cream without ice cream maker

Materials:

- Ice cubes
- Salt
- Milk
- Cocoa powder (for drinking chocolate)
- Vanilla sugar
- Cream
- Large plastic bowl
- Pot
- Measuring cup
- Tablespoon
- Thermometer

That's how you do it:

- Measure 250 ml of milk and put it into the pot.
- Add 200 g of cream.
- Add 4 packets of vanilla sugar (or altermatic 20 g cocoa powder for chocolate ice cream).
- Weigh out 100 g salt and add it to the plastic bowl together with the ice cubes.
- Now place the pot with the cream-milk mixture in the middle of the bowl with ice cubes.
- Stir your ice cream mixture constantly. Keep scraping the rim and bottom of the bowl to loosen the solidifying ice cream.
- Add more salt if you feel that the ice/salt mixture is no longer cold enough.

Measure the temperature of the ice cream with a thermometer and observe how the temperature changes.

When everything has set, you can eat your ice cream.

Explanation: The freezing point of water is 0°C. If you add a lot of salt, the freezing point of the mixture will drop. When the salt crystals come into contact with the thawing ice cubes, the salt is dissolved in the thawing water. This process requires energy and this energy is obtained from the water and ice itself in the form of heat. Heat is thus extracted from the ice cubes, which is why the salt-ice mixture becomes even colder. This cold mixture can get as cold as -15°C; enough to make ice cream.