SUPERHERO LAB EXPERIMENTS

15 Hands-On Activities for Young Children to Explore Sustainability Through Science

Co-funded by the European Union

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Superhero Lab Experiments: 15 Hands-On Activities for Young Children to Explore Sustainability Through Science

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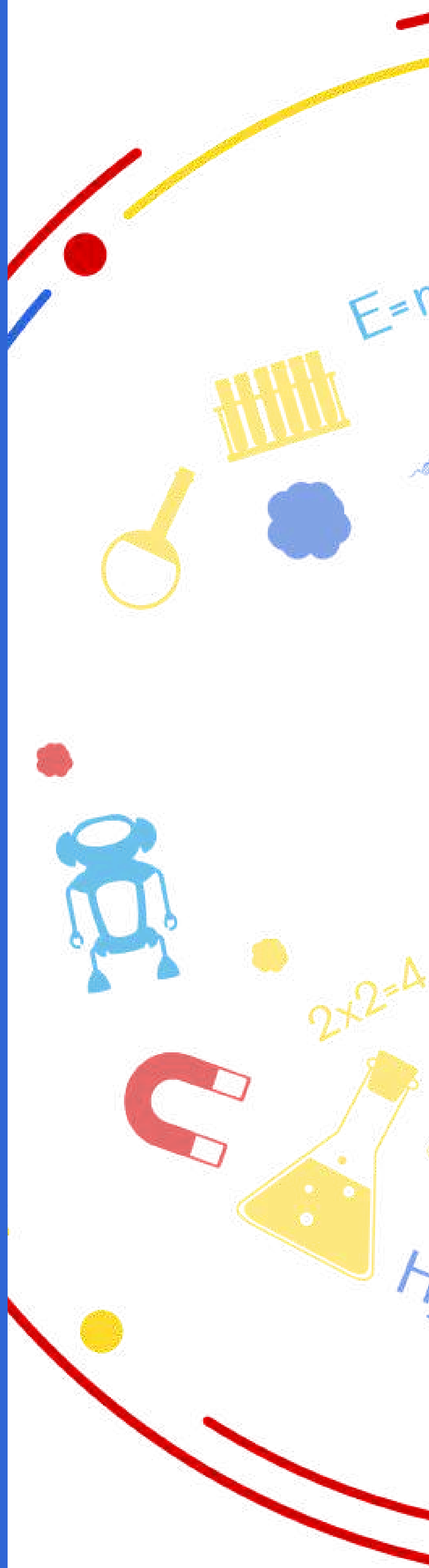
WELCOME



Introduction

Welcome to the Superhero Lab Handbook, aimed at helping preschool educators with the practical implementation of hands-on experiments with kindergarten children. This handbook equips you with fifteen inquiry-driven experiments that combine STEM and sustainability, uncovering the areas of science, technology, engineering and mathematics embedded in the objects children know from their everyday life. From testing whether muddy “puddle water” can be cleaned and potable to exploring how a paper rocket gains lift, each activity transforms the classroom into a living laboratory where questions, and not ready-made answers, set the agenda.

To guarantee smooth implementation in your classroom, every lesson plan is accompanied by a concise, professionally filmed video tutorial for the experiment, available on the YouTube channel and linked to each experiment in this handbook. Videos enable you to preview the procedure during planning, and together with the written protocol, form a dual-format professional learning tool that allows all teachers, experienced or not, to implement high-impact STEM exploration with confidence and fidelity.

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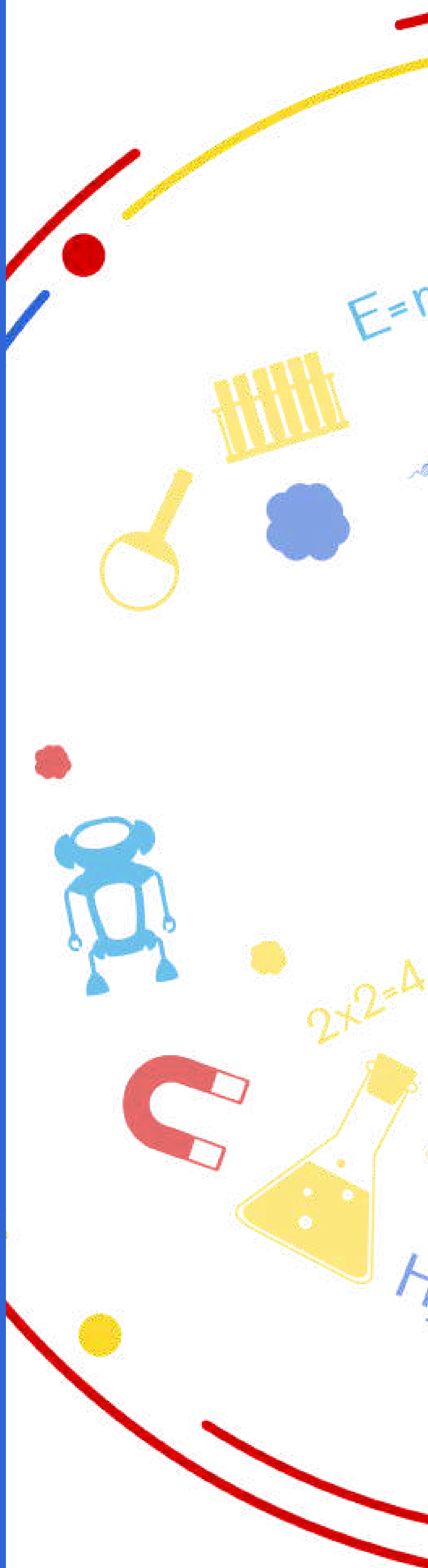
HOW TO IMPLEMENT THE EXPERIMENTS IN THE CLASSROOM



Quick guidelines on how to implement a SuperHeroLab lesson plans

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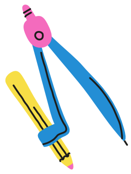
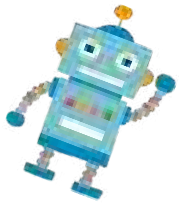
What are Superherolab experiments?

Superherolab experiments are **hands-on experiments**, written in an **exciting and age-appropriate way**. The aim is for children to actively participate in the experiment, rather than merely observe the process. Experiments are **simple, safe, and stimulating** for young minds, allowing them to experience the scientific process first-hand.





One of the core objectives of these lesson plans is to **bridge the gap between the experiment and children's everyday lives**. Each lesson plan provides key points and guidelines for teachers on how to spark the interest in children before the experiment and guide them after experimentation in reflecting on what they learned and how it applies to their surroundings, using open-ended questions.

The lesson plans integrate varied pedagogical approaches, from **problem-based and inquiry-based learning, STEM-oriented scientific reasoning, to the engineering design process**, each adapted for young children and anchored in the foundational themes of sustainability and the natural sciences. All lesson plans have been designed with clear learning objectives, curriculum alignment and connection with the Green-comp framework to provide you with a comprehensive, ready-to-use structure.

STEP-BY-STEP GUIDELINES

Plan the session

Analyse the lesson plan in advance, isolating the disciplinary core ideas, science and engineering practices and cross-cutting concepts that frame the activity. Try to find any procedural steps that may be tricky or inappropriate for your group of young learners.

Try the experiment yourself. This enables you to sequence tasks logically, calculate realistic time-on-task and preempt safety concerns.

Differentiate the cognitive demand: 3-year-olds might explore simple variables, whereas 5-6-year-olds can record quantitative data and interpret simple bar graphs.

Younger children:

- 1 simple question
- Materials: big pieces, some parts already assembled
- More preparation needs to be done by teachers

Older children:

- More questions (2–3)
- Materials: small elements for assembling
- More steps are done independently

Classroom setup

Choose a setup that lets children move around freely while you keep an eye on them.

Safety must come first. Whenever a protocol involves sharp tools, hot water, or liquids that must not be tasted, decide whether to supervise the step or perform it yourself in advance

- *For wet, messy chemistry (Lemon bubbly experiment), set up wipe-clean tables in the centre so you can reach spills quickly;*
- *For large building projects (Three little pigs and Sustainable houses experiment), clear an area on the floor;*
- *For rocket launches (Paper rocket experiment), choose the playground or a long corridor.*

Give roles to each child in a group.

Choose from the list below or add some more of your own options for the experiment:

- Materials manager
- Designer
- Building engineer
- Test engineer
- Data recorder
- Safety controller
- Time watcher

Collect and organize materials

Materials should be simple to find, preferably **recycled or everyday objects** that children are familiar with. Doing science with everyday objects shows children how valuable reuse is and keeps costs low.

When you prepare for a lesson, work through the **checklist in the lesson plan**.

Prepare enough material **for all participants**. Think about how children will work on the experiment: in small groups, individually...

Include a few extra items if something breaks or goes wrong in the experimenting phase.

To save some time in class implementation, place everything for one group or pair into **a box** and give them the prepared materials when you come to the experiment itself.

Use what children know already.

They can bring materials from home – plastic bottles, cups, old paper, cardboard tubes, old fabric pieces...

Stimulate recycling and reusing!

Spark curiosity

Involve a real problem, relevant and known to children
Every Superhero Lab lesson plan opens with a short introduction that places a real problem centre stage: perhaps an oil spill happens at sea, or we want to learn about rockets. The story ends on a driving question—“How can we clean up the oil spill?” or “Can a rocket fly without an engine?”—that invites genuine curiosity.

Let them familiarise themselves with the materials they will use
Show materials to the children and pass them around so they can look closely, touch surfaces and even have a whiff of what they smell like. Ask, “What do you notice?” and resist the temptation to supply answers; give them space to form their own answers.

Start the experiment by forming the hypothesis or research question. Encourage every child to predict what might happen next and write their thoughts on a large sheet or board where everyone can see them.

*In this way, the lesson follows the true rhythm of **inquiry learning**: children’s questions lead the exploration, and you act as their guide, offering just enough support for them to test, adapt and deepen their thinking.*

Guide the investigation

Circulate as the groups work. Echo and extend any science words you hear so vocabulary grows naturally.

When something jams—a clogged filter or a rocket that won’t lift—avoid fixing it; instead, ask, “What just changed?” or “What could we adjust?” These brief questions keep ownership with the children and turn every misstep into useful data, modelling the engineer’s habit of redesigning until a solution works.

Every child must have the chance to touch, explore, and experiment, not just observe the teacher perform the activity.

Talk about findings

After the hands-on work, gather everyone for a discussion.

- Compare results with earlier predictions,
- Sketch a quick chart,
- Ask why outcomes differed, linking answers to real issues.

Confirm (or not) the hypothesis children chose in the starting phase of the experiment.

Jot down key children's comments made during experiments on sticky notes. Include the comments in discussions.

Remember, every lesson plan is flexible—anything can be adjusted when a teacher chooses to adapt.

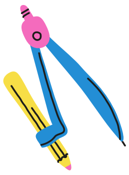
Adapt to different ages

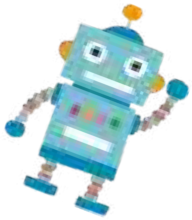
Keep scientific learning bite-sized: introduce only a few new ideas per session so young minds stay focused. For three- and four-year-olds, simplify the set-up and replace written tables with picture cards; five- and six-year-olds can handle more complex tasks.

If an experiment feels too long, spread it over two mornings. Curiosity lasts, and children return with fresh energy, sharper focus, and longer attention span.

Keep the spark alive!

Balancing quiet “thinking moments” with lively bursts of hands-on action will make children more engaged. A surprising image, a dramatic story hook, putting something to work, or a colourful fizz can pull wandering attention back in an instant.





TIPS

ASK QUESTIONS!

Inspire children to ask their own questions and find their own way to answers.

TIPS

Connected to sustainability, the activities aim to build a happier, healthier world for us all.

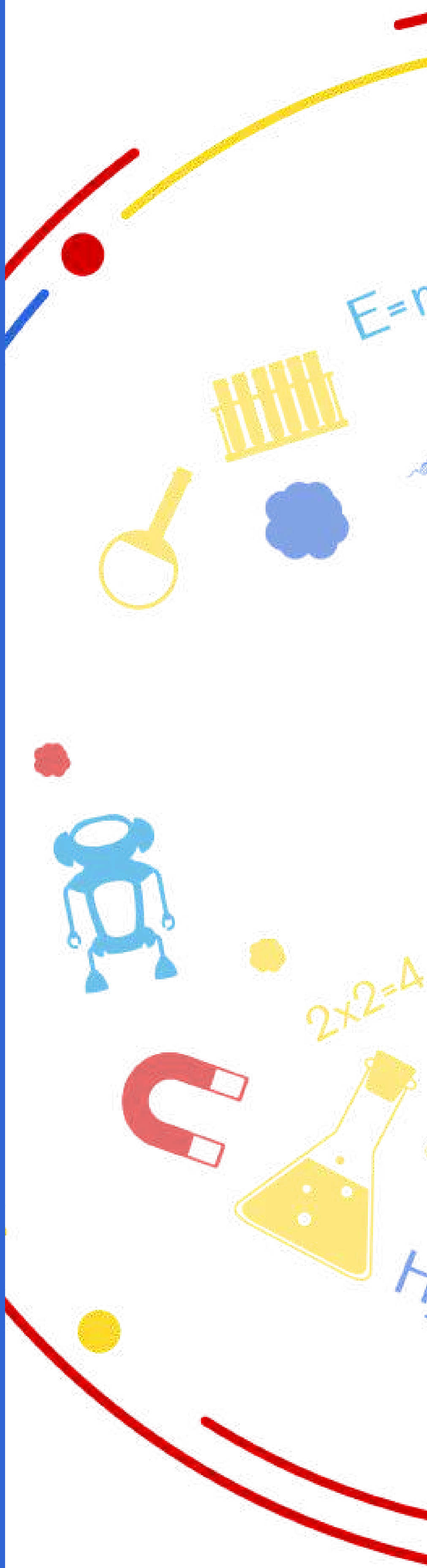
Because every Superhero Lab activity links to a real sustainability issue—clean water, renewable energy, and reducing waste—children see that science is not only exciting but also useful for caring for our planet.

In such a classroom, you shift from being the person who provides answers to the one who loves good questions, encouraging children to test ideas, look for evidence and try again.

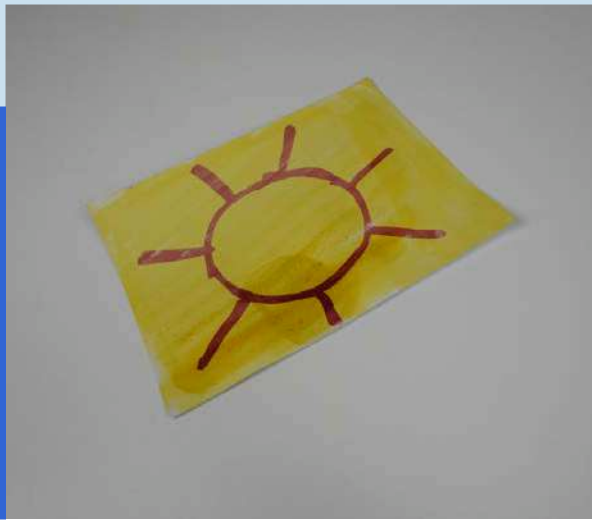
The habit of asking why and checking facts is the true superpower you are passing on.

03

15 HANDS-ON EXPERIMENTS



SECRET DRAWINGS WITH INVISIBLE INK



TOPIC: Recycling, reusing

AGE RANGE: Ages 3-6

OVERVIEW

Children will use baking soda to draw invisible images on paper and then reveal them with turmeric. This experiment introduces basic chemistry concepts and the creative use of natural materials.

MATERIALS FOR THE EXPERIMENT

- ☐ Baking soda
- ☐ Water
- ☐ Turmeric powder
- ☐ Cleaning alcohol
- ☐ 1 teaspoon
- ☐ 2 containers
- ☐ Cotton wool
- ☐ Cotton swab
- ☐ White paper

SUMMARY

Keywords	Ink, invisible, drawing, natural material
Activity duration **Lesson plan duration**	30 minutes 60 minutes
Class organisation	**Individually**
Learning objectives	Children will: • understand how an acid-base reaction works in a simple and visually engaging way. • learn using the scientific method through observation and discussion, and practise making predictions, observing changes, and explaining their findings in simple terms. • be encouraged to be curious about everyday science using everyday items in creative and scientific ways. • learn how natural materials can be used, promoting awareness of environmentally friendly alternatives to synthetic chemicals.
Curriculum alignment	• **Science:** Introduce children to the concept of chemical and acid-base reactions. Understand how substances can behave differently under various conditions. • **Sustainability education:** Highlight the use of natural materials instead of synthetic chemicals, emphasising to always look for natural alternatives. • **Art and creativity:** Allow children to practice drawing as they create their invisible ink images, along with introducing basic science concepts.
GreenComp connection	Promoting nature (1.3), Critical thinking (2.2), Individual initiative (4.3)

INTRODUCTION

Introduction	The teacher starts with an introduction. When asking the children open-ended questions, wait for their answers: *What are the things that we can draw with?* *Colouring pencils, pencils, pens, stones, charcoal, brick, chalk, natural colours - blueberries, green leaves, turmeric...* *What about baking soda and water? Can we draw with it?* *We can, but we cannot see what we draw when the liquid dries. Baking soda is white, and paper is also white.* *So it's a secret image. Do you know if invisible ink exists? Can we draw with it and then, after some time or after doing something, make the image visible?*
Research question and hypothesis	Can we write a message with a baking soda mixed with water and see it? YES/NO

EXPERIMENT

Materials	**For each child:** • 2 containers • Turmeric powder • Alcohol (medicine or cleaning alcohol) • Baking soda (sodium bicarbonate) • 1 dcl of water • Teaspoon • Cotton swabs or paintbrushes • 1 sheet of white paper • Cotton wool
Step-by-step instructions	1. Children prepare the ink in the first container. They add 2 teaspoons of baking soda and 7 teaspoons of water and mix. 2. Children prepare the revealing liquid in the second container. They add 1 half of a teaspoon of turmeric powder and 4 teaspoons of alcohol and stir well. 3. They now draw the image. Before starting to draw, they need to gently mix the ink (white-transparent solution) in a container with a cotton swab. Then, dip a cotton swab into the ink and draw on the white paper. 4. Set the papers aside to dry completely. Encourage patience among children by discussing what they think will happen: *Will your drawing be seen in colours? Will you be able to see your drawing when the paper dries? What can you do to reveal your image?* 5. Once the paper is dry, children place their image on the table. 6. They take a piece of cotton wool and gently dip it in the turmeric mixture and spread it over the paper with their image and observe what happens. As the paper is covered with the turmeric solution, the invisible writing will become visible.

Observation and discussion	The hidden drawing can be uncovered by using turmeric solution. Drawing with a baking soda solution creates an invisible image (as the solution you use for drawing is white as paper) that becomes visible when we apply turmeric mixed with alcohol. The teacher can explain, using the following text and questions: *Now we know there's nothing magical about invisible ink—it's all about using the right chemical reaction to reveal the message. Pure science!* *What happens to your drawing when we apply the turmeric solution?* *Why does the invisible ink appear?* *If we used yellow colour instead of turmeric, would it work the same as our invisible ink?* *When the paper dries again, would the drawing still be visible?*
Science background (for the teacher)	This experiment demonstrates the principles of **acid-base chemistry** using everyday materials. Baking soda (sodium bicarbonate) is a **base**, and when it dries on the paper, it becomes invisible because the solution leaves only a thin residue, white in colour. Turmeric, a natural dye derived from plants, acts as a **pH indicator**. When exposed to a base, turmeric changes colour, typically turning red or orange, revealing the invisible writing. The **reaction** occurs because turmeric contains curcumin, a compound that reacts to **pH changes**. In this experiment, the dried baking soda solution on the paper has a basic pH. When turmeric solution is applied, the curcumin in the turmeric interacts with the baking soda, causing the visible colour change that reveals the hidden message.

Relevance to real life	We uncovered hidden drawings in a very sustainable way, as all substances you used for colouring are natural. To write hidden messages, you can also use lemon juice, milk, apple juice or sweet water. The message can be revealed by exposure to heat (use an iron or other heat source). The acids, proteins and sugars can change the colour due to different reactions when exposed to heat, which will make your drawing visible. What about other drawing materials? Drawing materials come from two main sources: natural and man-made. Natural materials like charcoal, graphite (pencils), chalk, and natural dyes are derived from wood, minerals, plants, or even insects. They are eco-friendly, biodegradable, and have been used in art for centuries. For example, charcoal is made by slowly burning wood, and natural dyes come from plants like indigo or minerals like ochre. Man-made materials like crayons, markers, acrylic paints, and synthetic dyes are created using industrial processes. Crayons are made from paraffin wax (a petroleum byproduct), and markers use synthetic pigments and plastic casings. These materials are durable and vibrant but often non-biodegradable, contributing to waste unless sustainably made. Choosing natural or eco-friendly materials helps reduce environmental impact while creating art.

Conclusion	The teacher can conclude the lesson with the following text: *People used invisible ink for hundreds of years to share secrets!* *Now you know how to share your secret messages with your friends, while learning something new about different natural products (bases and acids) and that some of them create a chemical reaction when mixed together.*
Other information	Propositions for extending activity: ◦ Introduce natural pH indicators, explaining acids and bases based on real life examples. ◦ Introduce some other invisible inks, child-appropriate - for example, using lemon juice, vinegar, milk, apple juice, sugar water in combination with heat. ◦ Make a natural red colour by mixing baking soda, alcohol and curcuma powder.

Watch the video tutorial!

LINK

NOTES

A PIRATE'S FATAL MISTAKE – OIL SPILL

TOPIC: Earth pollution, waste management

AGE RANGE: Ages 4–6

OVERVIEW

With this experiment children learn how water pollution affects the lives of plants, animals, and humans. They test possible methods for cleaning oil spills and understand how hard it is to clean oil from the water.

MATERIALS FOR THE EXPERIMENT

- ☐ Modelling clay
- ☐ Water
- ☐ Plastic container
- ☐ Vegetable oil
- ☐ A spoon
- ☐ Dishwashing liquid
- ☐ Paper towels
- ☐ Water toy
- ☐ Soap and water sink to clean the toys and children's hands

SUMMARY

Keywords	Oil, pollution, cleaning oil spills, sea animals and nature
Activity duration **Lesson plan duration**	45 minutes 90 minutes
Class organisation	**Individually or in pairs**
Learning objectives	Children will: • Learn the terms related to oil and water, oil spill pollution, cleaning, and waste disposal, • become familiar with a research approach (formulating research questions, hypotheses, procedures, understanding results) and a hands-on way of working. • raise their awareness of responsibility for a clean environment and their role in it, and • explore the density principle and learn the basic behaviour of substances having different densities.
Curriculum alignment	• **Science**: To explore the properties of water and oil, learn about the density principle and compare the differences between substances to each other. • **Sustainability education**: To gain experiences on how people impact nature and how society can actively contribute to the protection and preservation of the natural environment.
GreenComp connection	Systems thinking (2.1), Problem framing (2.3), Collective action (4.2)

INTRODUCTION

Introduction	The story of Pippi's Longstocking's father for teacher's introduction: *Captain Efraim Longstocking, Pippi Longstocking's father, is sailing to India. One night, high waves catch the ship in a storm. A barrel full of oil is swept off the deck. The next day, when the storm calms down, the captain notices an oil slick on the surface of the sea. He wonders what to do. How can we help him?*
Research question and hypothesis	What happens when oil spills into the water? NOTHING/WATER IS DIRTY/OIL FLOATS ON THE WATER/... Can we clean oil out of the water? YES/NO How can we remove the oil slick from the surface of the sea? STIR IT/TAKE IT AWAY/ADDING SPECIAL SUBSTANCES Which material is best for cleaning up oil spills? SOAP/SPOON/PAPER/...

EXPERIMENT

Materials	**For each child:** • 30 g of modelling clay per container • water • plastic transparent container (approx. size 20 cm x 14 cm) • 2 tablespoons of vegetable oil • optionally oil food colouring • plastic water toy animal • paper towels • 1 tablespoon of dish soap • spoon
Step-by-step instructions	1. Inside of the container children create the environment - landmasses on the edges of the container, with the clay. Create a space with land and water, as oil spill would take place on the water, presenting the sea. 2. Children pour the water into the container, filling it approx. until 5 cm of height. Afterwards, they add two tablespoons of oil into the centre of the water and observe the oil for a few minutes. (Optional, the oil can be coloured beforehand with the oil-based food colouring in a separate cup to make a bigger colour difference between the water and the oil). 3. The teacher asks children: *What is happening with the oil in the water?* and wait for their answer. 4. In the next step, children put the water toy (if available, use an ocean animal toy) into the oil spill. Observe what happens. The teacher leads the child with possible questions: *What is happening to the animal coated in the oil?* 5. Put the animal out of the water. Ask: *What can we do to save the animal? How can we clean the animal, covered with oil?*

Step-by-step instructions	6. After children saved the animal (cleaned it properly, with the help of warm water and soap), the oil spill is still there in their ocean. 7. Now the teacher asks the children: *How can we clean the water? What can we use for cleaning?* 8. They try to use dish soap to clean the oil out of the water. Observe what happens. *Did we finally clean up the water? Where is the oil now?* 9. Clean all the materials used. Discuss which is the best way to clean the oil-stained objects.
Observation and discussion	During the experiment, the children observe what is happening with the oil when they try to clean it and what happens with the animal when is added to the water with oil. Questions for the discussion: *How can oil hurt sea animals and birds (in the water and on the landmasses)? How can they be saved?* *What impact can an oil spill have on the shoreline habitat of many plants, animals and fish?* *Did we remove all oil spills when we used the dish soap?* *Is it clean after using dish soap? If not, why?*

Science background (for the teacher)	
Science background (for the teacher)	**Oil** is a thick, dark brown or greenish low-flammability liquid located in the upper layers of some parts of the Earth's crust. Today, it is important **source of energy and raw materials**. **Plastics** for plastic bottles, soles on sneakers, polyester for clothing, waxes in tetra packs, fertilisers and many other things are made out of oil. **Oil spills** are the release into the environment due to human activity and are a form of **pollution**. Cleaning up an oil spill can take months or years. We saw that taking oil with the spoon was innefective, the same the addition of dishwashing soap which acts as **emulsifier**. These substances break down the oil into small droplets so the oil can disperses in the water but still stays there and cause damage. This means we simply add more chemicals in the water that can be harmful for living organisms. Oil is harmful to **animals and plants**. When such accidents happen, many animals and the plants die. Oil penetrates the structure of bird feathers, birds usually also ingest the oil, which in turn causes damage. Most birds affected by an oil spill often die without human intervention. Marine mammals are exposed to oil spills, which affect them in a similar way. Because the oil **floats on top of the water**, less sunlight penetrates the water, which limits the photosynthesis of marine plants and phytoplankton, which in turn affects the food chains in the ecosystem. Sulfate-reducing bacteria and acid-producing bacteria naturally interact with each other and remove oil from the ecosystem so their biomass replaces other populations in the food chain. Oil-stained objects can be properly cleaned using hot water and dish soap. More about oil spill and cleaning: <u>Click here.</u>

Relevance to real life	If an oil spill were to happen in real life, environmental engineers would come into action to remove the oil from the sea as quickly as possible. First, they tried to **extract oil** from the sea using barriers. The oil was collected in one place and then pumped out of the sea with large pipes. The second way is with the addition of **emulsifiers**. These are substances that break down the oil into small droplets. The oil disperses in the water; it no longer floats only on the surface. We do not want that, because oil still stays there and causes damage, and there are now additional chemicals in the water that harm fish and other animals in the sea. So, they don't do that anymore. Scientists have found that it is best to use **absorbents** - these are substances that absorb oil. The most effective substance that is used in real life scenarios is special **absorbent foam**. The foam picks up all the oil, doesn't sink, floats on the surface and is easily removed from the water. 1 kg of foam can absorb 6 litres of oil and can be reused many times.
Conclusion	Teacher can conclude the story: *Captain Longstocking rescues a bird covered in oil. The bird can no longer fly, cannot find food, and stays with the captain on the ship, who takes care of it.* *Even if the oil is widely used and important for our style of life, water pollution affects the lives of plants and animals, consequently impacting humans as well. Therefore, we must be careful not to pollute the water and properly dispose of waste in designated containers, including oil waste.* The teacher summarises the investigation process and the main findings with the children.

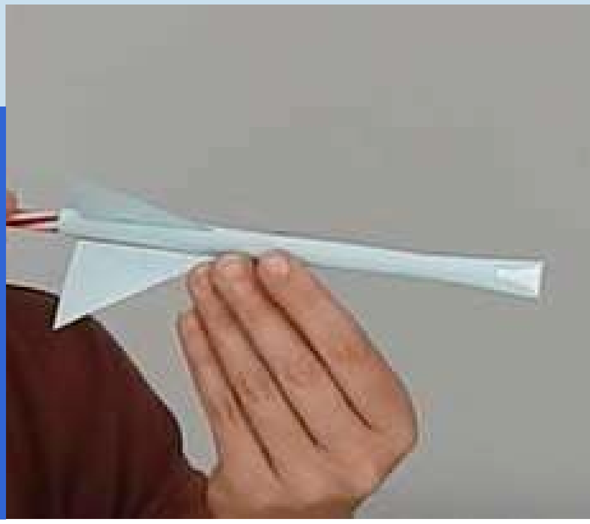
Other information	Follow up activities: • look for the trash container for oil in the proximity of the kindergarten; • use oil for painting; • make an experiment involving the density of water and oil ...

Watch the video tutorial!

LINK

NOTES

PAPER ROCKET



TOPIC: Climate change, green energy

AGE RANGE: Ages 4–6

OVERVIEW

In this experiment, children will build and launch their own paper rockets, learning how air can push objects to move. By blowing through a straw, they create a simple force that propels the rocket into the air. Children will observe how design elements, like fins, affect flight.

MATERIALS FOR THE EXPERIMENT

- [ ]  Sheets of paper
- [ ]  A straw
- [ ]  A pencil
- [ ]  Scissors
- [ ]  A tape
- [ ]  A measuring tape (optional)
- [ ]  A ruler

SUMMARY

Keywords	Rocket, air, movement, fly
Activity duration **Lesson plan duration**	30 minutes 60 minutes
Class organisation	**Individually**
Learning objectives	Children will: • Understand air as a force and energy, and discover that air can push and move objects. • Experiment with simple designs and learn how adding fins can change how a rocket flies. • Practice creativity to build their rockets, adding their personal touches to the rocket design.
Curriculum alignment	• **Science:** Introduce basic principles of movement and force using air. • **Sustainable education:** Introduce basic examples of green energy sources - air (wind for example) as one of them. • **Art and engineering:** Encourage creative expression using the creative design of the rocket and exploring how the rocket flies with different positions of the fins or designs.
GreenComp connection	Exploratory thinking (3.3), Futures literacy (3.1), Individual initiative (4.3)

INTRODUCTION

Introduction	The teacher starts with an introduction: *Have you ever watched a rocket launch on TV or in a video? Rockets blast off into the sky with lots of power! Do you know how they shoot off into space?* *Rockets are launched by burning fuel, which creates hot gas. This gas shoots out of the bottom of the rocket with tremendous force, pushing the rocket up in the opposite direction. This is called thrust.* *Today, we're going to make our very own rockets using paper and a straw. But how will they move? Any ideas?* Wait for the children's ideas. *The answer is: By using air!* *Just like when the force of the gas pushing down helps blast the rocket up and into space, we need to blow through a straw to launch a paper rocket and make it fly!* *Rockets have a unique design. Do you know why?* Example answers: To go faster/slower/higher... *How does the rocket look? Is it important that it has fins? What difference do they make, if any?*
Research question and hypothesis	Can we make a paper rocket fly by using air? YES/NO If we change its design, for example by adding fins, what do you think will happen? NO DIFFERENCE/DIFFERENCE (add details)

EXPERIMENT

Materials	**For each child:** • A paper sheet • Scissors • A pencil • A ruler • A straw • A tape **For the whole group:** • Open space for a launching area (indoors or outdoors) • Measuring tape (optional, for the teacher)
Step-by-step instructions	1. Each child gets a sheet of paper. Using scissors, they cut a strip, approximately 5 cm x 20 cm (they can use a ruler for measuring). They wrap it around a straw and tape it on the side to make a tube. Tape it firmly so that no air escapes! 2. Children take the straw out. They leave one end open (for the straw) and pinch and tape the other end to make the nose of the rocket. 3. Optionally, children can cut out small paper triangles to add as fins on the open end of their rocket, taping them securely. Try to encourage children to have different types of rockets in the group (some without fins, with 1-2 fins, with more fins, fins of different sizes...). The rocket will work without fins, also. 4. Children can decorate their rockets with markers or stickers to make each one unique. Remember to sign it so each child will know which one is theirs. 5. Children put the straw into the open end of the rocket. By blowing through the straw, the rocket can be launched!

Step-by-step instructions	6. Optional: Create a test of the rocket's performance: Each child should take turns standing at the designated launch area and launch their rocket as straight and far as possible. After the rocket lands, measure the total distance it travelled through the air and compare the results among different designs.
Observation and discussion	Ask children to notice how their rockets fly. You can use the following questions: *Do some rockets go farther or higher than others? Do some fly straight forward, while others circulate? What is the reason?* *What makes the rocket move?* *The air pushes it when we blow.* *What happens if we blow harder? Does the rocket go further?* *Can we propel the rocket with something else? Water, sun, electricity?* Optional: encourage children to try adding or adjusting the fins to see how it changes the flight.
Science background (for the teacher)	Real rockets move by pushing gas out of their engines, which creates **a force that propels them forward**—an example of Newton's third law of motion, "**For every action, there is an equal and opposite reaction.**" In this experiment, children create a similar effect by blowing **air** through a straw, which pushes the paper rocket in the opposite direction.

Relevance to real life	Many things, birds and aeroplanes, for example, in the world move because of air and other forces. Birds flap their wings to push against the air, lifting them into the sky, while aeroplanes have special winged shapes that let them glide smoothly. This is called aerodynamics. It's how objects move through the air! Rockets need even more power to fly far into space, so they use strong engines that push gas out. As to our rockets, adding fins or wings helps real rockets and planes stay steady and go straight. It is important for any flying device to stay pointed in the same direction when flying forward, without spinning or tumbling, which could cause them to crash. By learning about movement and energy, we can think of different ways to make things move using cleaner energy, like the air, sun or even water (solar/water/windmill...).
Conclusion	The teacher can use the following questions to conclude the activity: *What did we learn about air?* It can move things, including our rocket, when we push the air through the straw. It can be used as a green, clean source of energy. *How did fins help?* Fins can make rockets fly straighter and further, if they are placed correctly. The design of the object is also important in reaching optimal movement.

Watch the video tutorial!

LINK

NOTES

SOLVING DRIED MARKERS

TOPIC: Recycling, reusing

AGE RANGE: Ages 3-6

OVERVIEW

Children will recycle their markers and make them work again, comparing two different solvents - alcohol and water.

MATERIALS FOR THE EXPERIMENT

- ☐ Markers
- ☐ Water
- ☐ Cleaning alcohol
- ☐ Dropper
- ☐ 2 tall glasses
- ☐ Paper towels
- ☐ Pliers
- ☐ White paper
- ☐ A permanent marker

SUMMARY

Keywords	Markers, dye, solvent, reuse
Activity duration **Lesson plan duration**	20 minutes 45 minutes
Class organisation	**Individually or in pairs**
Learning objectives	Children will: • Learn how chemistry can be very useful in everyday life when recycling • Compare two different solvents: water and alcohol. They will learn that markers need organic solvents that dissolve the dye in them; alcohol dissolves the dye while water does not.
Curriculum alignment	• **Science**: Introduce children to the concept of solubility and how liquids interact with materials like marker dye. Observing how different solvents (water and alcohol) affect the ability of markers to write. • **Sustainability education**: Highlighting the importance of repairing and reusing instead of discarding.
GreenComp connection	Valuing sustainability (1.1), Critical thinking (2.2), Individual initiative (4.3)

INTRODUCTION

Introduction	Teachers start with an introduction: *Imagine you're drawing a picture and suddenly your marker stops working.* *What do you usually do?* *Throw it away?* *What do you think, can we give these markers a second chance and make them work again? Is this possible? How?* *Today, we are going to be like scientists and inventors, bringing old markers back to life! This way, we not only save our favourite markers but also reduce the waste we make.*
Research question and hypothesis	Can we make old markers work again by adding different liquids? YES/NO Which liquid works best in making dried markers work again? WATER/ALCOHOL

EXPERIMENT

Materials	**For each child or pair:** • 2 dcl of cleaning alcohol (or hand sanitiser) • 2 dcl of water • Markers (dried and working) • Paper • 2 tall glasses (2 dcl) • Pliers to open the marker caps • A dropper or syringe (buy at the pharmacy) • Paper towels • Permanent marker
Step-by-step instructions	1. First, children are asked to test all the markers and put all the ones that do not write in one group. 2. Teachers take a non-working felt pen and remove the cap from the back of the marker, using pliers. 3. Spread paper towels on the table, as the ink may run a little through the marker or the alcohol would spill. 4. Take two tall glasses and label them. With a permanent marker, children draw a drop on the first glass. These markers will receive water. Then, they draw dots on the second. These markers will receive alcohol. 5. Using a syringe or dropper, children add a few water drops to the felt-tip pen. They need to hold the pen vertically so the tip is at the bottom. Then they place the marker in a first tall glass with water droplet vertically (with the tip at the bottom) so that the water can run down the marker. Let it stand still for a few minutes.

Step-by-step instructions	6. Repeat the process with alcohol. Using a dropper, put a few drops of alcohol in the other non-working felt-tip pens. Hold the marker vertically so that the tip is at the bottom. Place it in a second tall glass, marked with dots, vertically (with the tip at the bottom) so that the alcohol can run down the marker and melt the dye. Let it stand still for a few minutes. 7. When all felt-tip pens have been filled with liquid, children need to test them. They observe the differences between renewed pens filled with water and pens filled with alcohol. 8. If none of the pens containing alcohol write properly, children can add a few more drops of alcohol. 9. You will see that felt-tip pens with added water as a solvent won't work properly. When they are dry, you can fill them with alcohol. They will write properly again! 10. Finally, teachers place the caps of felt-tip pens back on.
Observation and discussion	Teachers can use the following explanation: *The markers are as good as new! Water does not help, but alcohol does. The felt-tip pens, filled with water, release some colour, but not as clearly and as much as a new one. The one's filled with alcohol, on the other hand, are fully renewed!*

Science background (for the teacher)	Soaking the marker with water will help for a short time. After some time, felt-tip pens will not write as well, because water is not a solvent in this case. **Water is an unorganic solvent**, contrary to **alcohol**, which is organic in nature. Felt-tip pens need **organic solvents to dissolve the ink** in them so the ink can flow. The felt-tip pen writes thanks to the ink and the solvent inside, but when it dries out, it just means that the alcohol has evaporated from the felt-tip pen. There is still undissolved, dried-up ink left in the felt-tip pen.
Relevance to real life	This is useful at home, because it's **a way to save felt-tip pens** that we thought were already consigned to the bin. Children test their accuracy, learn about **useful chemistry** (water doesn't help in felt-tip pens because it doesn't dissolve the dye inside) and **recycle their things by themselves**.
Conclusion	Sometimes it is important to find the right way to fix things before we decide to simply throw them away. Maybe your first idea won't be successful, but **knowing the details how something works is crucial to renew and reuse it**. Sometimes renewing thinks is just as easy as this experiment.

Watch the video tutorial!

LINK

NOTES

DROPLET WATTY

TOPIC: Sustainability and care for your health

AGE RANGE: Ages 4-6

OVERVIEW

Children conduct an experiment to explore the effects of contaminated water on the human body, understand the benefits of clean water, and raise awareness about the importance of preserving water resources and fostering environmental consciousness.

MATERIALS FOR THE EXPERIMENT

- ☐ 2 containers
- ☐ Water
- ☐ Cotton wool
- ☐ Transparent cups
- ☐ A spoon
- ☐ A coffee filter
- ☐ Paper towels
- ☐ Dirt: Soil, pebbles, leaves, wastes...
- ☐ A plate
- ☐ A ladle
- ☐ A funnel

SUMMARY

Keywords	Water, clean, filter, planet Earth, our body
Activity duration **Lesson plan duration**	45 minutes 90 minutes
Class organisation	**Whole class or small groups (3-4 children) and individually**
Learning objectives	Children will: • Understand why clean water is vital for health. • Realise how dirty water can affect the human body and health. • Understand the water purification process. • Recognise the importance of access to clean water. • Learn the importance of protecting natural water resources.
Curriculum alignment	• **Science:** Introduce concepts of filtration, water purification, and exploration of materials, leading to environmental care awareness. • **Healthcare:** Help children understand the importance of access to clean water for their health and the role they can play in protecting water sources by reducing pollution.
GreenComp connection	Systems thinking (2.1), Supporting fairness (1.2), Collective action (4.2)

INTRODUCTION

Introduction	The teacher reads the motivational story to the children about the Adventure of Little Watty: *Once upon a time, there was a tiny drop of water named Little Watty. Little Watty was very happy because she travelled all around the planet, helping plants, animals, and people. One morning, as she flew high in the sky, she looked down and saw a beautiful river. She decided to come down and get to know it better.* *When she got closer, she noticed something strange. The river wasn't as she had imagined. Instead of being clean and transparent, the water was dark and full of trash. She could see plastic bottles, paper, and mud floating on the surface.* *Little Watty felt very sad and asked the river. "What happened here? Why is your water so dirty?"* *Little Watty then met a small fish who told her. "The water used to be clean, and we were all healthy and happy. Now, we can't live well in this dirty water. Can you help us?"* *Little Watty thought. "I need to show people how important clean water is for life!"*

Introduction	*So, she travelled to a nearby town and found many children playing in the yard. She told them the story of the dirty river and how the fish and animals were in danger because they couldn't live in the polluted water.* *"What can we do to help the river get clean?" the children asked.* *Little Watty told them: "You need to learn how important clean water is for our health. I will show you a magical experiment to help you understand what happens when we drink clean or dirty water and how you can help the river and clean the water, to make it clear and safe again."* After the story, discuss it with the children. Here are some questions you can use to guide the conversation: *What do you think clean water looks like? Have you seen dirty water (a river or a lake) in real life before?* *How does the water get dirty? What might dirty water contain?* *What do you think happens to our bodies when we drink clean water?* *What do you think happens to our bodies when we drink dirty water?* *Why is clean water important for people, plants, and animals?* *Can we clean water like Watty wants to do? How?* *What things can we use to make dirty water clean again?*
Research question and hypothesis	Can we clean the dirty water? YES/NO

EXPERIMENT

Materials	**PART 1** **For each group:** • 2 clear plastic containers (5 L boxes, for example) • Clean water • Dirt, leaves, branches, soil, pebbles, packaging, etc. • Paper towels to clean the table **For each child:** • 1 plate • 2 pieces of cotton wool • 1 tablespoon **PART 2** **For each child:** • Transparent cup • Coffee filter (or tea filter) • Dirty water from Part 1 of the experiment • Cotton wool • A ladle • A funnel
Step-by-step instructions	**PART 1 - HOW CAN WATER AFFECT OUR BODIES?** 1. The teacher prepares two containers with clean water for each group. 2. The teacher asks: *How does the water get dirty?* 3. The children now dirty one container with the available materials (pebbles, dirt, soil, etc.) 4. Observe the differences among the containers. The teacher asks them to watch carefully and to smell the two bowls. *Do they smell the same? Which one do you like more?* 5. Each child adds one piece of cotton wool in the container with clear water and sinks it with a spoon.

Step-by-step instructions	6. The teacher can explain: The cotton wool symbolises the organs that absorb water in the human body. What is going on with it? 7. Children observe how well it absorbs water. When the piece is fully absorbed with water, each child gets their piece out and puts it onto a plate. 8. Then, each child dip the second piece of cotton wool in the dirty water. It needs to be fully submerged. 9. They stir gently and observe how the cotton wool absorbs and holds onto the dirt in the water. 10. Then, children take the piece out, put it onto a plate and observe the difference between the pieces. The teacher explains: *When people drink dirty water, their bodies can become "filled" with dirt, bacteria, and other substances that can cause illnesses. Is this good for our health?* **PART 2 - HOW CAN WE CLEAN THE WATER?** 1. The teacher divides the children into two groups. They give each child in one group a clear cup and a coffee filter, and each in the other group a clear cup, a coffee filter and a piece of cotton wool. 2. Then the teacher instructs the groups on how to create the filter. Each child creates their own filter, depending on which group they are in. - 1st group: Children place the coffee filter on the cup. - 2nd group: Children place the coffee filter on the cup and in it some cotton wool. 3. Now it's time to filter the dirty water! The teacher asks the group to take dirty water from the containers they have on their desks with a ladle and try to clean it. They slowly pour the dirty water into the top of the filter and watch as the water flows through their filter. If the filters are not stable, children can add the funnel before the coffee filter (to create a harder base for the filter).

Step-by-step instructions	4. Children from both groups now list their results and observations. The teacher can use the following questions: *Is the water in the cup different from the dirty water in the container?* *Is the water from the group with a cotton filter any clearer than in the group with the filter without cotton?* *What can be the reason that the water is still not totally clear?*
Observation and discussion	To guide the discussion and observation, here are the possible questions for children: *What happened to the dirty water after it passed through the filters?* *Did you manage to clear the water with your filter? Completely or partially?* *Why do you think the coffee filter and other materials helped clean the water?* *Which water would you prefer to drink or swim in, and why?* The teacher can explain that dirty water can cause various diseases, so we need to be careful using it. National health institutions regularly test the water in certain places to check if it is safe for drinking or swimming. Water that is safe for swimming is not always safe to drink, because it might still contain germs or pollutants that are dangerous if swallowed. If water is too polluted, it is neither safe for drinking nor for swimming. *Is the water now potable?* No. Even though the water looks clearer after filtering, it still might have harmful organisms or invisible particles that can make us sick. That's why we boil water to make it safe to drink. Filters like this are just the first step in cleaning water.

Observation and discussion	*Why is it important to have clean water?* We use water for drinking, cooking, and washing. But water is not only important for people; it is also essential for plants, animals, and all of nature. Water is essential for life – no living organism can survive without it.
Science background (for the teacher)	Water filters can help us **clean the water**, which is naturally or artificially polluted by various substances. They work like sieves, trapping tiny particles such as dirt, rust, and other impurities that may be present in tap water. They also help eliminate unpleasant smells, like **chlorine**, a chemical used to disinfect water but sometimes noticeable in its scent (similar to a swimming pool). Advanced filters can also block harmful **microorganisms** such as bacteria and viruses, which is essential for maintaining health. For properly filtered water, it is important that water flows through the filter. Filter media, which actually do the filtering, consists of materials that performs different types of filtration (depending on our needs). For water filtration, the common types of **filter media** include: ▪ Activated carbon: Used for removing chlorine, bad tastes, and odours. ▪ Ceramic: Effective at filtering out bacteria and larger particles. ▪ Sand: Often used in multi-layer filters to trap sediment as part of mechanical filtration. ▪ Diatomaceous earth: Helps remove fine particles and some microorganisms. Only thorough **water quality testing**, including **analysis** of bacteria and chemical substances, can we confirm if water is **safe to drink**. Filtration alone does not ensure potability.

Relevance to real life	Watty discovered during her journey that sometimes pollution can dirty water, but we can use filters to clean it, like we did in our experiment. In real life, scientists and engineers build big **water purification plants** to do this on a larger scale, making sure communities have access to safe, clean water. Water filters can be found in **households** also (on some pipes, filter jugs or as a part of house water system), in special bottles, in aquariums...).
Conclusion	It is important to **protect our water sources** by not polluting rivers, lakes, and streams. Clean water is essential for our health and living, the same as for the whole **ecosystem**, including animals and plants. After completing the experiments, we can see how the water becomes dirty and what we should do to keep the water clean. The dirty water became much cleaner after passing through the **layers of our filter**. The coffee filter and cotton helped to remove the dirt, leaves, and other particles from the water. This shows us that we can use **different materials** to **purify water** and make it safer to use.

Watch the video tutorial!

LINK

NOTES

LEMON BUBBLY EXPERIMENT

TOPIC: Sustainability and care for your health

AGE RANGE: Ages 3-6

OVERVIEW

In this experiment, children mix lemon juice with baking soda to create a fizzy, bubbly reaction. They explore how mixing things can lead to new substances and observe using everyday materials in various ways.

MATERIALS FOR THE EXPERIMENT

- [ ] A tall glass
- [ ] Dishwashing liquid
- [ ] 2 lemons
- [ ] Baking soda
- [ ] A teaspoon
- [ ] Food colouring
- [ ] Paper towels
- [ ] A knife
- [ ] A chopping board
- [ ] A citrus squeezer

SUMMARY

Keywords	Lemon, baking soda, bubbles, cleaning, reaction
Activity duration **Lesson plan duration**	20 minutes 45 minutes
Class organisation	**Individually or in pairs**
Learning objectives	Children will: • Learn what the “reaction” process is and observe how combining different ingredients creates a chemical reaction. • Get to know the variety of uses for everyday items. Lemons and baking soda can be used in different ways - in food-making, for cleaning... • Practice safety and follow instructions when doing hands-on experimentation. They will learn they cannot eat or drink things when doing the experiment, even if they think the items are safe, because they know them.
Curriculum alignment	• **Science**: Introducing basic chemistry concepts, such as reactions and mixing. • **Sustainability education**: Explore the versatility of common household items like lemons and baking soda, emphasising sustainable and practical uses beyond their primary functions. • **Safety and health**: Teach basic safety measures when handling household items by identifying which materials are safe for different uses, like food or cleaning.
GreenComp connection	Promoting nature (1.3), Critical thinking (2.2), Systems thinking (2.1)

INTRODUCTION

Introduction	Optional: the teachers can prepare a few additional lemons, cut into slices for the children to see, smell, and taste (one for each), and some baking soda powder for the children to observe and touch. The best is if the children work individually, but teachers can adapt the activity to their needs. Start with a brief presentation of materials and their uses in our everyday life: *Today, we will explore some things we all know and have at home.* *The first thing we will need today is a lemon.* Teachers show the lemon (or share lemons with children if teachers have enough lemons). *What can you do with a lemon? For example, we can use lemons for making yummy lemonade from a lemon juice. Do you want to taste a lemon?* If you have the option to do so, children can taste the lemon. *Do you have any other ideas about why lemons can be used? To make things smell fresh... do you like the smell of the lemon?* Children can smell the lemon. *And did you know we can use lemons to clean things? We can use it in different ways!*

Introduction	*The next thing we will use is baking soda. We use it for baking cookies! But also, it can help clean things around the house. Do you know what it looks like?* The teachers give the children baking soda, so they can touch it. *Can we eat it? It needs to be cooked, of course... So even if we make cookies with it, we cannot eat it in the way it is now.* Children wash their hands and get ready for the experiment.
Research question and hypothesis	We will mix those two things together. What do you think will happen? NOTHING/ LIQUID/ A ROCK/ BUBBLES/ SOMETHING NEW.

EXPERIMENT

<table>
<tr><td>Materials</td><td>For each child or a pair:

• a tall, narrow glass
• 2 lemons (cut into quarters)
• a baking soda
• a dishwashing liquid
• a teaspoon
• paper towels

• food colouring (optional)
• knife, chopping board and citrus squeezer to squeeze lemons in advance (optional, for teachers)</td></tr>
<tr><td>Step-by-step instructions</td><td>1. Children put one teaspoon of baking soda into a glass.
2. They then add a half-teaspoon of dish-washing liquid.
3. Next, children can add a drop or two of food colouring; they can choose the colour they want.
4. Children now squeeze lemon juice into the mixture (or pour in lemon juice if it was prepared beforehand). When children are stirring the juice into the baking soda and detergent, bubbles will form, starting to push up and out of the glass.
5. Extend the reaction by adding more lemon juice and baking soda. Stir gently before adding more ingredients.</td></tr>
</table>

Observation and discussion	Observing the bubbles, children see that these last for quite some time. Fizzing and foaming are signs of combining two things that react to each other. That reaction is called a chemical reaction. The two things that cause the fizzing in this experiment are the juice of the lemon (citric acid) and baking soda. When these two things are combined, we see fizzing and foaming because by mixing these two substances, we create a new substance. Possible questions and answers you can use with children: *When we end the experiment, what can we do with the rest of the liquid in the glass?* *Can we drink it? No. It has dishwasher soap in it.* *Is it good for drinking?* No. *Why?* It would hurt our stomachs; we can vomit if we drink it. *Can we use it in any other way?* Yes. *How?* We can use it as soap to clean the glasses and plates. Or toys.

Science background (for the teacher)	When mixed together, the **sodium bicarbonate** from the baking soda (**a base**) reacts with the **citric acid** in the lemon juice (**an acid**) to form **carbon dioxide** gas and **sodium citrate**. As the chemical reaction forming carbon dioxide gas is created, fizzing foam starts to erupt from our glass with sodium bicarbonate and lemon juice. The dish soap adds a deeper effect by making the reaction milkier and thicker, causing a bigger reaction!
Other	Other citrus fruit juices work too, but lemon juice seems to work best. If you do not have citrus, you can use vinegar or already-made lemon juice from the store. Teachers can decide to cut the lemons or even squeeze them beforehand, depending on the children's ability to do it by themselves. In this way, children will experiment with the lemon juice instead of squeezing lemons in the glass.

Relevance to real life	We use the **lemon**, which we normally eat, and see that it can be used for **different purposes** - from cleaning, as an air freshener, or lemonade. When children taste the lemon, they may notice that it is sour and **acidic**. Other acids children may know are vinegar acid, or Vitamin C (that keeps them healthy), and lactic acid (found in milk and milk products). All acids will react the same with baking soda and create **bubbles**. Sodium bicarbonate or citric acid are powerful tools for **cleaning**, but only until they are mixed. Then, the reaction occurs, and a new substance is created, which is not effective for cleaning.
Conclusion	Learning to use the things we already have for **different purposes** is a smart way of taking care of our planet. When we find new ways to use things, we don't have to buy as much, and we create less waste, particularly when we can use natural, eco-friendly ingredients.
Other information	Follow-up activities: Try to make a natural liquid cleaner by mixing baking soda and water or lemon (vinegar) and water. Observe if any bubbles will occur and discuss why. Pour the liquid cleaner into a bottle with a spray and use it in the classroom. Children will enjoy using their own homemade detergent to clean the tables or toys in their kindergarten.

Watch the video tutorial!

LINK

NOTES

DIAPER ABSORBENT

TOPIC: Sustainable food and nutrition

AGE RANGE: Ages 3-6

OVERVIEW

Children discover what it is in the diaper that makes it absorb liquid so well and explore where the absorbents can be used towards sustainable goals in food production and agriculture.

MATERIALS FOR THE EXPERIMENT

- ☐ Scissors
- ☐ 2 bowls
- ☐ A napkin
- ☐ A diaper
- ☐ 2 glasses
- ☐ 1l of water

SUMMARY

Keywords	Absorbent, diaper, liquids, plants
Activity duration **Lesson plan duration**	20 minutes 45 minutes
Class organisation	**Individually or in pairs**
Learning objectives	Children will: • explore and compare the properties of different materials. • learn about the differences between natural and man-made materials, their uses, and how they affect our lives and the environment. • investigate absorbent materials, understand where they are used in everyday life, and why they are important for sustainability. • learn how absorbent materials can be used in farming to conserve water, improve soil health, and ensure food security in dry regions.
Curriculum alignment	• **Science:** Explore and compare the properties of different materials (e.g. absorbency, durability, environmental impact, natural/man-made). • **Sustainability education:** Highlight the importance of using biodegradable materials to reduce waste. Additionally, learn how innovative materials, such as absorbents, support sustainable farming practices and ensure access to nutritious food.
GreenComp connection	Critical thinking (2.2), Problem framing (2.3), Valuing sustainability (1.1)

INTRODUCTION

Introduction	The teacher starts with an introduction: *Do you know what diapers are? Why do we need them? Who uses them?* *How do they work? What do they contain that absorbs water/liquids so well?* *How can we find out what it is? Can we take this out and test it?* Have children express their opinions and share their knowledge about diapers.
Research question and hypothesis	What is in the diaper that absorbs water so well? LIQUID/POWDER/CUP/PAPER/TISSUE/... Can we extract this material and test it? YES/NO

EXPERIMENT

Materials	**For each child or a pair:** • A diaper • Scissors • 2 bowls • A kitchen napkin • 1 l of water • 2 glasses
Step-by-step instructions	1. Children cut the diaper with scissors on one end and open them up. They remove the inner cotton layer. At the bottom, they can find a white powder. The teacher can help with cutting if needed. 2. Children prepare the first bowl. They gather the white powder (carefully wrinkle the diaper to the powder doesn't fall out) in it. 3. Children prepare the second bowl and place in it a folded kitchen napkin. 4. Children take the water and fill both glasses to be equally full. Each glass will be used for each bowl. 5. First, children carefully pour the water from the first glass into the bowl with the napkin until they observe that the napkin is filled with water and the water remains in the bowl. Test this by taking out the napkin from the bowl and see if the water is dripping out of it. Place the glass with the remaining water beside the bowl. 6. Now, children test the absorbents from the diaper. They carefully pour the water from the prepared glass and wait for 1 minute. Try with the kitchen napkin if the surface is still wet. If it is dry, children can add some more water. If they add all the water from the glass, they can fill the glass again and keep pouring it until the surface becomes wet. 7. Observe and compare how much water the napkin and the absorbent from the diaper absorb. Check how much water remains in both glasses.

Other information	Instead of using absorbents from diapers, you can buy the absorbent powder in shops with technical supplies. Teachers can prepare the absorbent from the diaper in advance if children are not able to do it by themselves (cutting the diaper).
Observation and discussion	Possible questions for teachers to use when guiding the observation and discussion with children: *What did you find in the diaper?* *What happened with the diaper's particles? How would you describe the compound made?* *How much water remains in the first glass (for the napkin) and in the second (for the diaper absorbent)? What does this prove? Which material can absorb more water?* *Where can absorbents be used, instead of diapers?* *Are absorbents in diapers natural or man-made? Are degradable? What does this mean for the environment? Do we know natural absorbents?* *Do you think we could use materials like this to help plants grow in very dry areas? How else can we help plants grow when there is not much water?*

Science background (for the teacher)	The particles in the cotton layer of a diaper are made up of a chemical called **sodium acrylate**. If you add water to these particles, a chemical reaction occurs. Particles make a sticky gel, which should not flow out of the cup. Water forms bonds with polar molecules of substances. This enables them to absorb water or dissolve in water, what indicate the **hydrophilicity** of a substance. In the contrary, if the particles of the substance do not form bonds with water, the substance repels water and does not soak or dissolve – it is hydrophobic. Absorbents in diapers are typically man-made, often composed of **synthetic polymers** like sodium polyacrylate, which are highly effective at absorbing large amounts of liquid, but are not biodegradable. Absorbent materials, such as hydro-gels and water-retaining polymers, are increasingly **used in agriculture** to improve water efficiency and support plant growth in dry regions. These materials act like sponges, holding water near plant roots and releasing it slowly, which reduces the amount of water needed for irrigation. This technology helps conserve water, especially in areas where it is scarce, and ensures crops have consistent access to moisture, improving yields and food security. Providing consistent food sources supports communities and reduces the need for transporting food over long distances, cutting down on carbon emissions. For sustainability, **natural or biodegradable absorbents**, like those derived from starch or cellulose, are preferred over synthetic polymers, which can pollute the soil if not managed properly. These natural absorbents also improve soil health by breaking down over time and adding organic matter, making them an eco-friendly solution for sustainable farming practices.

Relevance to real life	**Some materials love water and soak it up easily**, like the special particles inside a diaper that can hold more water than they weigh. These materials are very useful, not just for **keeping things dry**, as the diaper that keeps a baby dry, but for **helping plants grow in dry areas** also. In farming, absorbent materials can act like tiny sponges in the soil, holding water near the roots of plants. This is especially helpful in places where water is hard to find. These materials allow plants to stay hydrated for longer, helping farmers grow more food with less water. We need to think carefully about the materials we use. Using **natural or biodegradable absorbent materials**—like those made from plant starch or organic matter—ensures we do not harm the soil or environment. We can assure enough water for farming also with other actions, like collecting rainwater or planting drought-resistant crops.
Conclusion	Exploring absorbent materials shows us how something as simple as water-holding particles can help plants grow in dry areas. These materials play an important role in **water conservation**, reducing the amount of water needed for farming. When made from natural, biodegradable materials, they also **help improve soil health and avoid pollution**. It's important to combine this technology with other eco-friendly practices to prevent overuse and protect the environment, meaningfully connected to **growing and using food responsibly**.

Watch the video tutorial!

LINK

NOTES

FROM RAIN TO FLOOD

TOPIC: Care for nature and green areas

AGE RANGE: Ages 4–6

OVERVIEW

In this experiment, children learn how rain travels across different surfaces and why green areas, like grass and soil, help water drain properly. By observing how water moves on various materials, children will see that plants and open spaces absorb water better than hard surfaces, helping prevent floods.

MATERIALS FOR THE EXPERIMENT

- ☐ 2 big transparent containers
- ☐ Concrete blocks
- ☐ Natural materials
- ☐ A cup (2 dcl)
- ☐ A watering can
- ☐ Water
- ☐ 2 model houses
- ☐ 2 crafted clouds (optional)

SUMMARY

Keywords	Nature, ground, rain, permeability
Activity duration **Lesson plan duration**	90 minutes 2 days ionally
Class organisation	**Groups (4-5 children)**
Learning objectives	Children will: • Understand water flow and drainage, observe how water moves across different surfaces and learn why some areas drain better than others. • Recognise the importance of green spaces, how plants and grassy areas help absorb rainwater, preventing flooding. • Explore basic problem-solving, seeing how simple changes can make a big difference in controlling water flows. • Develop environmental awareness, seeing the importance of how natural areas play a role in water management, and building an early understanding of environmental protection.
Curriculum alignment	• **Science:** Introduce basic concepts of water flow, drainage and the role of the green spaces for natural environment. • **Sustainability education:** Care for the green spaces as crucial step to preventing floods in urban areas.
GreenComp connection	Systems thinking (2.1), Futures literacy (3.1), Adaptability (3.2)

INTRODUCTION

Introduction	The teacher starts with an introduction: *Have you ever wondered where all the rain goes when it falls from the sky?* *Imagine if rainwater didn't have anywhere to go—it might start to pile up and even cause a big flood!* *What about puddles? Why are they created? And where? Always in the same place? They are really big in some places, and tiny in others... Why do you think this happens?* *Do you remember the floods?* *Floods happen when too much rain falls and the ground cannot soak it up fast enough, so the water starts to collect and cover streets, fields, and even homes. Imagine if a big puddle kept growing until it covered everything around. Floods can make it hard for people and animals to stay safe and dry.* *Today, we will conduct an experiment to observe where a flood is likely to begin more quickly.*
Research question and hypothesis	Which material - stone/concrete or the soil/green area -can drain the water better? CONCRETE/SOIL Where do floods begin more quickly? ON CONCRETE SURFACE/SOIL SURFACE

EXPERIMENT

Materials	**For each group:** • Two big transparent boxes • A cup (2 dcl) • Watering can • Water • Concrete slab • Natural materials (leaves, branches, pebbles...) and soil (children can go to the forest beforehand and collect the needed materials) • 2 houses (made by children beforehand, from recycled materials) • 2 clouds for the top (made by children beforehand)
Step-by-step instructions	**PART 1 - Beforehand, crafting the cloud and the houses:** 1. Craft the clouds for the top of the box (from cotton wool and cardboard). 2. Craft the houses (from paper boxes or wood pieces). Houses should be max. 10 cm height. **PART 2 - Experiment with concrete** 1. Place the concrete pieces condensed together in the first container or 1 large, thick piece of concrete, which should be of similar dimensions to the box. 2. Put 1 house on the concrete. 3. Put 2 dcl of water in a watering can (use a 2 dcl cup for measuring). Let it rain: pour the water on the cloud, which is on top of the box. Water is flowing from the clouds down to the house and the land, presenting rain. 4. Fill it again with 2 dcl of water, pour it into the box and observe where the water goes. Can you see any puddles? 5. Observe and count how many times you need to fill and pour 2 dcl of water until the house is flooded or until the first puddle can be seen. Write this down.

Step-by-step instructions	**PART 3 - Experiment with natural materials** 1. Take the second container. Build a landscape with natural materials. 2. Place the house on top of the created land. 3. Test with water as in the second part of the experiment, raining from the cloud (steps 5, 6 and 7). 4. Observe what happens and where the differences are between both lands, concrete and natural. Note: The experiment can also be done by two groups or in turns: Pour 2 dcl of water into the box with concrete, and then repeat the process in the box with soil, and observe what happens. In the next step, add another 2 dcl of water to the box with concrete and 2 dcl of water to the box with soil, and so on. This will help you observe which landscape floods quicker.
Observation and discussion	The teacher can use the following questions and guide the discussion when children give their answers: *Which material can drain the water better?* *Why is it important for us and nature to have green areas and efficient drainage systems?* *How can we solve problems connected to flooding?*

Science background (for the teacher)	Flooding occurs when large amounts of rain fall in short periods of time and the ground or manmade environment cannot absorb the water quickly enough. Surfaces like **concrete, asphalt, and stone** are **impermeable**, meaning water cannot pass through them. Instead, water collects on these hard surfaces, increasing the risk of flooding. In contrast, **soil, grass, and other natural ground** are **permeable**, allowing water to soak into the ground. **Green areas**—such as gardens, parks, forests, and fields—play a crucial role in managing rainwater. They act **as a buffer and slow down water runoff**, which helps to **reduce flooding**, **recharge groundwater**, and **protect ecosystems**. When cities lose green areas due to construction, the risk of flooding increases significantly. This experiment helps children understand how **different surfaces manage water** and highlights the importance of **urban planning** that includes green spaces and proper drainage systems. It also introduces early concepts of **environmental responsibility** and **sustainable living**, showing that simple, nature-based solutions can help us protect our communities from extreme weather events.
Other	Children must know the water cycle. Consider discussing this beforehand if they are not familiar with it. If you have the availability, children can craft the cloud and their own houses beforehand. The experiment can also be done without a crafted cloud (just with a watering can or a simple cup), and instead of a crafted house, you can use a toy, a house from Lego, a simple stone or a small wooden box.

Relevance to real life	Ask children open-ended questions: *Sometimes, after heavy rain, streets and houses can flood because the water has nowhere to go. Have you seen any such events before? Do you remember where and when?* Talk to the children if they have ever experienced a flood or if one has happened in their area. What can happen when a flood occurs, and what are the possible reasons for flooding? Find some pictures and show them to the children. *How can floods affect animals or plants?* Animals lose their habitat, and they can become trapped, so we need to help them if we can. Plants can be destroyed by floods (if they are covered by water for a long time), or they can be washed away, including trees. *What can we do with rainwater? How can we use it?* This question can lead to conversations about rain collection, gardening, and water conservation.
Conclusion	Preventing rain from accumulating in built-up areas is therefore really important. That's why green spaces, like parks and gardens, are also needed in urban areas to help soak up rain naturally. We can also collect rainwater and use it in gardening or for other purposes, and keep clean water for drinking and personal hygiene.

Watch the video tutorial!

LINK

NOTES

PAPER RECYCLING

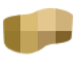
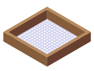
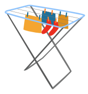
TOPIC: Recycling, reusing

AGE RANGE: Ages 4-6

OVERVIEW

Children learn how to recycle used paper by creating new sheets of paper from old scraps through a hands-on process of soaking, blending, and drying paper pulp. They discover the importance of recycling for reducing waste and conserving resources.

MATERIALS FOR THE EXPERIMENT

- [ ]  Used paper
- [ ]  A sponge
- [ ]  Framed sieve
- [ ]  A bucket with water
- [ ]  Cloths (size of the frame)
- [ ]  Blender
- [ ]  Space for drying
- [ ]  Plastic container

SUMMARY

Keywords	Recycling, paper, production
Activity duration **Lesson plan duration**	90 minutes 3 days
Class organisation	Small groups
Learning objectives	Children will: • Learn that paper can be recycled and turned into new paper. • Be involved in the process of making new paper, and familiarise themselves with the paper production process. • Be able to tackle real-world problems, answering questions like "What if we run out of drawing paper?" and "How can we solve this problem by reusing what we have?".
Curriculum alignment	• **Sustainability education**: Introduce the concepts of recycling, reusing, and reducing waste, focusing on how these actions help protect natural resources and reduce the need for new materials. • **Science**: To explore different materials and their properties, and observe how they can change form.
GreenComp connection	Valuing sustainability (1.1), Individual initiative (4.3), Collective action (4.2)

INTRODUCTION

Introduction	The teacher starts with an introduction: *Children, imagine this: We do not have any more drawing paper for free time activities. And you really want to draw...* *How can we solve this problem?* The teacher finds some used paper and turns side back (maybe it's still blank). *Is this useful? What do you think? Do you have any other idea where to find some blank drawing paper?* The teacher waits for children's answers, encouraging them to give more ideas and guiding them to the goal of our activity: Can we make new paper from scraps? The teacher continues: *How is new paper made?* The teacher waits for the answers. Then, watch the video with children (remember that the teacher needs to be prepared to explain the process to the children while the video is playing): <u>How is Paper Made</u>? At the end of the video, the teacher asks the children: *We saw two methods on how to make paper. Can we repeat any of the method ourselves?*
Research question and hypothesis	Can we make our own paper? YES/NO

EXPERIMENT

Materials	**For each group:** • Used paper, newspaper, egg cartons and toilet paper cores... • A bucket filled with water • Blender • Framed sieve • Plastic container • Clothes or fabric scraps (the size of the frame) • Sponge • A place to let paper while drying
Step-by-step instructions	DAY 1 1. Children tear paper products into small pieces. 2. Soak all the paper in a bucket filled with water for at least 8 hours. Make sure all the paper pieces are covered with water. DAY 2 1. With the teacher’s help and using a blender, blend all the pulp together. 2. Hold the sieve steady above an empty plastic container. Carefully pour the pulp-water mixture slowly and evenly over the sieve. 3. Using your hands, gently press over the pulp and evenly distribute it on the frame. 4. Carefully, with a piece of fabric or sponge, remove excess water from the sieve. 5. After a few minutes, when the excess water drains into the container, flip the mixture onto the fabric. 6. Leave the new piece of paper on the fabric to dry completely (at least 24 hours). DAY 3 1. Peel the new paper from the fabric. 2. Use the new paper.

Observation and discussion	Here are some questions to guide the observation and discussion with children: *What is paper made of?* *Where in everyday life do we use paper?* *What are the consequences of overproducing paper?* *How can we reuse it?* *How long will it take to dry?* *Will it be usable?* *What colour will it be?* *Can we make white recycled paper?*
Science background (for the teacher)	To produce **1 kilogram of paper,** about **300 litres of water** is needed (water is used in various stages, such as pulping, washing, and drying the fibres), **0.02 of 1 tree** (a mature tree can produce around 50 kg of paper) and **energy**, which is about the same as running a large refrigerator for a day (for pulping, pressing, and drying the paper). These show why **recycling paper** is crucial for conserving resources. Recycling 1 kg of paper **saves up to 100 litres of water, reduces energy use by about 60%, and helps protect trees** from being cut down for new paper production.

Science background (for the teacher)	Paper was invented by a Chinese court official named Cai Lun in 105 AD. He combined materials like mulberry bark, old fishnets, hemp, and rags to create the first sheets of paper. Legend says he was inspired by watching wasps build their nests using chewed-up wood fibres—a natural form of "pulp"! Early paper production spread from **China** to the Middle East, then Europe, where it eventually became a popular and essential material for **writing** and communication. In ancient Egypt, a material similar to paper was made from **papyrus** plants, which grew along the Nile River. This is where we get the word "paper," but papyrus was technically not paper as we know it; it was made by layering and pressing strips of the papyrus plant. Paper can be used for writing, drawing and printing to **packaging**, wrapping, and **cleaning**. It is biodegradable, so now it is used for a variety of eco-friendly products and alternatives to plastic. Today, most paper is made from **wood pulp** extracted from trees. Trees are chopped down, ground into tiny fibres, and mixed with water to create a mushy pulp. This pulp is then pressed and dried to form paper sheets.

Relevance to real life	By creating new paper from used scraps, we reduce the demand for new raw materials, such as wood, and help preserve forests and biodiversity. Useful products can be made from everyday waste materials without the need for special equipment. We just need to know the process to do it. Even simple actions—like reusing paper—can play an important role in reducing our ecological footprint. The type of paper being recycled affects the final product. For example, recycling newspapers creates a softer paper, while adding colourful scraps can give recycled paper unique colours and textures.
Conclusion	The teacher concludes: *We have the opportunity and the materials needed to make our recycled paper, which is simple to do and helps the environment by reducing our need for new paper.* *What are the properties of paper as a material? Is it strong? How does it behave when exposed to water?* *What else can be done with recycled paper instead of paper sheets? Can we make paper plates, bowls...?* Wait for their ideas, maybe the next hands-on activity involving paper will present itself.

Watch the video tutorial!

LINK

NOTES

DISCOVERING SOW BUGS AND THEIR HOMES

TOPIC: Care for nature and green areas

AGE RANGE: Ages 4-6

OVERVIEW

Children observe sow bugs and explore how they choose their environment. They test different environments (dry, wet, dark, light) to see which conditions sow bugs prefer. This activity introduces children to biodiversity and the importance of creating safe spaces for animals in nature.

MATERIALS FOR THE EXPERIMENT

- ☐ A jar with sow bugs
- ☐ Transparent container (petri dish)
- ☐ Water
- ☐ Paper plate
- ☐ A spoon
- ☐ Scissors
- ☐ Paper towels
- ☐ A tape
- ☐ Piece of cardboard
- ☐ Piece of sandpaper
- ☐ 2 zip-bags

SUMMARY

Keywords	Habitats, ecosystems, biodiversity, sow bugs
Activity duration **Lesson plan duration**	45 minutes 90 minutes
Class organisation	**Small groups (3-4 children) with individual hands-on tasks**
Learning objectives	Children will: • learn that different animals have specific needs and preferences for their habitats. • practice making predictions and recording results by observing sow bug behaviour. • foster empathy and see the importance of caring for small creatures and respecting their natural habitats.
Curriculum alignment	• **Science:** Introduce concepts of animal behaviour and their specific needs. • **Sustainability education:** Encourage children to protect animal habitats and nature, showing them the importance of environmental care to create a healthy environment for all living organisms.
GreenComp connection	Promoting nature (1.3), Systems thinking (2.1), Critical thinking (2.2)

INTRODUCTION

Introduction	The teacher starts with an introduction and asks the children: *Do you know what a sow bug is?* If they do, let them answer the question. If they don't, you can show them the box with live sow bugs that you have prepared for the experiment. Optionally, if you have bug-viewer, you can put one of the sow bugs in the bug-viewer and children can observe its features more closely: what they look like, how they move... When all children have observed the sow bugs, ask them: *Have you ever seen a sow bug in nature? Do they have any other names you know?* (As sow bugs are widespread and can be found in almost every forest, they may have different names in different places in your country.) Encourage children to tell you if they call them by other names. *If you have seen them in nature before, can you tell us where? On the street, in the backyard, in the forest, in the water...?* Wait for the children's answers.

Introduction	*Today, we will become scientists. Remember that we will work with live animals. As scientists, we have to do our best not to hurt, let alone kill them. After our experiments, we will release all the animals safely back into the wild.* *How shall we go about it? What would be our research question? How can we test where they like to live?*
Research question and hypothesis	Do they like it wet or dry? WET / DRY Do they like dark or bright? DARK / BRIGHT Do they like rough ground or smooth ground? ROUGH / SMOOTH Do they like cold or warm? COLD / WARM Children should try to think about the bugs' preferred environment. Then choose some ideas for experiments, if you have the materials to test them. If the questions are quite different from "ours" and we don't have the material, we try to "sub-categorsie" our questions somehow. Let them choose their answer (hypothesis). The children can work in pairs or on their own (the mentor decides before the lesson).

EXPERIMENT

Materials	**For each group:** • 1 pickling jar with culture medium (soil, wood, leaves) and 3-4 live sow bugs (covered with transparent plastic film with holes for the air) • a transparent container or Petri dish to serve as a testing habitat • a plastic plate • a spoon • a tape • scissors • paper towels • optional: bug viewer **Material for testing:** **Experiment 1:** • paper towels • water • scissors **Experiment 2:** • a sheet of non-transparent paper - cardboard • a light source (can also be ceiling lights in the room) **Experiment 3:** • a piece of sandpaper • scissors **Experiment 4:** • 2 zip plastic bags • water, hot and icy cold, 2 dcl of each • heat source (radiator, etc.), optionally, to substitute the water

Step-by-step instructions	1. Each group will be given a jar with a lid to hold our animals (show the jars). Children put the medium with the animals on the plate. 2. Each group take their bugs (4 or 6, depending on the availability) and puts them in the container or petri dish. Children help themselves with the spoon or with their hands. Remind them to be gentle as they are working with living animals. 3. It is important that sow bugs are evenly spaced before the experiment starts. For example: 2 sow bugs on one side and 2 on the other. Then it is easier to see how they move and get the right results. 4. According to the children's research questions, they start with the experiment: **Experiment 1: Do they like it wet or dry?** Cover half of a petri dish bottom with a dry paper towel and fill the other half with a wet paper towel. Make sure towels are not touching each other in the petri dish. Transfer the animals into the petri dish and leave them for 1-2 minutes. If the children "handle it", they can observe for up to 5 minutes. Have they moved anywhere? Why? **Experiment 2: Do they like dark or bright?** Children darken a part of the petri dish with non-transparent paper and wait for a few minutes. Are animals moving anywhere?

Step-by-step instructions	**Experiment 3: Do they like rough ground or smooth ground?** Children cover the petri dish halfway with a rough substrate (let the children choose, e.g. sandpaper). They must stick the sandpaper to the bottom of the petri dish with the tape; otherwise, sow bugs will crawl underneath. Leave the other half empty, as the petri dish is smooth. Children transfer the animals into the petri dish and leave them for a few minutes. Have they moved anywhere? Why? **Experiment 4: Do they like warm or cold?** Prepare two zip bags, in one put the hot water and in the other the icy cold water. Close them tight. Put the bags close together so they are touching each other. Place the animals into the petri dish and add them to the upper side of the bags. Half of the petri dish needs to be on the hot water bag and half of it on the cold water bag. Instead of bags with water, you can use radiators (if turned on), and place the petri dish with animals near them. Observe where the sow bugs will rest. On the side with the hot water bag, where it is warm, or on the side of the cold water bag, where it is cooler? Why? After observation, children finish by placing the growth medium back in the jar, including moist soil, pieces of wood and beech leaves. Then transfer all the animals into the jars. We then release the animals back into the wild.

Observation and discussion	Watch how the sow bugs move and where they settle. The teacher can guide the discussion and observation using the following questions: *Do they gather in one area or explore around? What does that mean? Was the hypothesis you chose at the start of the experiment correct?* *Do you think they feel safe in the dark or in the light?* *Why might they like wet areas better than dry ones?* Discuss different observations if groups of children perform the same experiment. If they perform different experiments, let them share their observations with other children in the group. Expected results are as follows: They like moist surfaces as they need moisture to live. They prefer the darkened part as they live mostly in the dark. They moved to the rough substrate because it is similar to their living environment. They do not like warmth, because they live in the damp and often cold ground, so they prefer the cold side.

Science background (for the teacher)	
Science background (for the teacher)	**Porcellio scaber** are also called sow bugs or woodlice. They are small ground animals that live close to human homes. They live in dark, damp and cold places in the ground, which we could see in our experiment. They are crustaceans like lobsters, or shrimps, but they are the only **land crustaceans**. This species cannot curl up into a ball. sow bugs are **safe to work with** as they do not bite or sting, nor do they carry disease. The common sow bug is flat and elliptical in shape (to make it easier to move under leaves, bark and decaying foliage). The body is made up of seven links, with one pair of legs on each link. They can grow up to 20 mm. Their body has an outer skeleton but no waxy layer, so they mainly stay in damp, dark places to prevent them from drying out (as they are crustaceans, they need a moist environment). They **feed mainly on plant debris or decomposing organic material**, which has high concentrations of microorganisms. They also have symbiont bacteria in their digestive tract, which allow them to **break down cellulose**. Sow bugs are ideal laboratory animals. Millipedes are the most suitable **model organism for toxicity studies** (bioaccumulation of metals from soil into organisms living in soil, as they can accumulate high concentrations of metals). They are well-studied and easy to breed in the laboratory. Metal concentrations in animals depend on metal concentrations in the soil, so they can be a good **indicator of heavy metal contamination in the soil**.

Other	Optional: children can also test other options, for example: • Do the saw bugs prefer a wet surface or a dark place? Cover one part of the petri dish with a wet cloth and the other part with a dry one. Cover the dry side with paper to make it dark. Observe their preferred location. • Do they detect the food? Put one-half of the food in the petri dish. Observe how quickly they go to it. Or, which food do they prefer? E.g. bread, apple, carrot, potato, beech leaves, etc. You can also measure time using a stopwatch. • Do they like a specific colour? Use paper of different colours and observe which colour is their favourite. Discuss the possible reasons. The teacher can decide if all groups of children experiment on their own accord, or the teacher decides for them. The teacher can also choose just some of the experiments, according to the availability of testing materials and children's skills or motivation.

Relevance to real life	Sometimes we encounter **animals that may cause disgust** in someone. It is a feeling that prevents us from grasping something even if it is not dangerous. Some people get this feeling when they see ordinary sow bugs. However, even though we may be disgusted by the animal, **we do not need to kill or injure it**. These animals also perform an **important function in nature**. The sow bug, which is the only terrestrial crustacean, feeds on e.g. dead plant remains. This means that it eats plants and then turns them into soil. This is very important for the **cycling of matter in nature** and it is an important part of nature's ecosystem.
Conclusion	Just like us, animals like sow bugs need **a safe and comfortable home** to live in. By learning what they need, we can help protect their habitats. It teaches us to care for small animals and **respect their needs** in nature, which are as important as ours.

Watch the video tutorial!

LINK

NOTES

SOLAR PIZZA OVEN

TOPIC: Green energy

AGE RANGE: Ages 3-6

OVERVIEW

Children build a solar oven out of a pizza box and learn about the benefits of solar energy. They try to cook without a typical kitchen oven.

MATERIALS FOR THE EXPERIMENT

- ☐ A pizza box
- ☐ A wooden stick
- ☐ A ruler
- ☐ Glue
- ☐ A sheet of black paper
- ☐ Aluminium foil
- ☐ Transparent PVC foil
- ☐ A utility knife
- ☐ Sticky tape
- ☐ A pencil
- ☐ Cooking materials:

SUMMARY

Keywords	Upcycling, solar energy, nature, sun
Activity duration **Lesson plan duration**	60 minutes 1 day
Class organisation	**Small groups (max. 5 children) with individual hands-on tasks**
Learning objectives	Children will: • Learn how sunlight can be transformed into heat energy and used to cook food. • Explore how different materials (foil, black paper, plastic wrap) can reflect, absorb, and trap heat. • Observe and describe the changes caused by heat in a real life context (melting, softening). • Understand that solar energy is a renewable, clean source of power and realise its benefits.
Curriculum alignment	• **Science and technology:** To understand heat transfer through reflection, absorption, and insulation, explore the concept of renewable energy sources like solar radiation. • **Environmental education:** To introduce solar energy as a sustainable alternative to fossil fuels, highlight how natural resources like the sun can be used. • **Engineering:** Hands-on learning through designing and constructing a working model.
GreenComp connection	Futures literacy (3.1), Individual initiative (4.3), Adaptability (3.2)

INTRODUCTION

Introduction	The teacher starts with an introduction: Where can we cook? What do we use for cooking? *Our food can be cooked on the stove, in the oven, on the fire, with electricity...* *We need some energy to make a fire or heat. We can use gas, wood, oil, electricity...* *How about the sun? Can we cook using the sun? What do you think?* Now we ask children if they know what s'mores are. Children get the chance to explain to other children what this is and how you make it (for example, over a fire or in the oven). Then, explain to the children that with the materials they will be given on the table, we can make an oven. They will try to prepare the s'mores with the help of the sun.
Research question and hypothesis	Is the sun strong enough to cook our s'mores? YES/NO

EXPERIMENT

Materials	**For each group:** • A pizza box • A wooden stick • A ruler • Glue • A sheet of black paper • A utility knife (used by adults only!) • Aluminium foil • Plastic wrap • Sticky tape • A pencil **For each child:** • S’more cooking materials: a cracker, piece of chocolate, a marshmallow
Step-by-step instructions	1. On the top of the pizza box's lid, children draw a square that is at about 2 cm distance inward from each edge. 2. With the teacher’s help, use a utility knife (and the ruler as a straightedge) to carefully cut along each side of the square you just drew, except for the side that runs along the hinge of the box. 3. Children fold the flap back slightly along the attached side. 4. Children line the inside of the cardboard flap with aluminium foil. Fold the edges of the foil over the flap to help hold the foil in place, and glue the foil onto the flap. Keep the foil as smooth as possible. 5. Children cover the opening made by the flap (in the lid) with a layer of plastic wrap. They attach the plastic wrap to the opening's edges using tape. Make sure there are no holes in the plastic wrap and that all of its edges are completely closed onto the lid.

Step-by-step instructions	6. Children line the inside of the box with aluminium foil so that when they close the box, the entire interior is coated with foil. It is easiest to do this by covering the bottom of the box with foil, and then covering the inside part of the lid (going around the plastic-covered opening) with foil too. Glue the foil in place. 7. Children glue a sheet of black paper to the centre of the bottom of the box. 8. Children use a wooden stick and tape it to prop the solar oven's lid up, at about a 90-degree angle from the rest of the box. 9. To cook a s'more, children need to break a cracker in half and place a marshmallow and a small piece of chocolate between the cracker halves. They place the prepared s'more on a small square of aluminium foil (slightly larger than the s'more — this will serve as a tray) and put it in your solar oven, on top of the black sheet of paper. 10. Put the solar oven outside in direct sunlight for at least 30 minutes, and keep the oven turned so that the flap faces the sun. When the marshmallow is soft, the s'more should be ready to eat and enjoy!
Observation and discussion	Possible questions to ask children while they are constructing their ovens: *Why do you think it is important to make sure the plastic wrap completely seals the lid's opening?* *Why did you coat the inside of the box with aluminium foil?* *What would happen if we didn't have the foil inside?* *What do you think would happen if there were a hole in the plastic wrap?* Ask the children to observe and feel (without touching the hot parts) how the inside of the box gets warmer. Observe the marshmallow and the chocolate to see how they begin to melt over time, and ask them why they think this is happening.

Observation and discussion	Encourage them to think about how the materials in this solar oven work together to make it heat up inside, like a simple version of how solar energy can be used for cooking or heating. Discuss how the foil reflects the sunlight inside the box, directing more heat toward the food, while the black paper absorbs heat to keep it inside the box. The plastic wrap acts as a seal to trap the heat in, like a small greenhouse.
Science background (for the teacher)	The solar oven works by **using sunlight to create heat** and trap it inside the box, allowing us to melt the chocolate and soften the marshmallow. The **foil** on the flap and inside the box reflects sunlight toward the food. This directs light and heat into the box, raising the temperature inside. The **black paper** at the bottom absorbs the sun's heat. Black surfaces don't reflect much light, so they heat up quickly. This **heat** helps cook the s'more. The **plastic wrap** seals in the warm air, trapping heat inside the box. This keeps the temperature high enough to melt the ingredients. Solar energy, as green energy, derived from the sun's radiation, is a renewable and sustainable resource increasingly employed to power homes. By installing photovoltaic (PV) panels on rooftops, households can convert sunlight directly into electricity. Beyond electricity generation, solar thermal systems can be utilised to heat water and interior spaces, enhancing overall energy efficiency. In recent decades, Europe has witnessed a significant surge in residential solar energy adoption. As of 2023, renewable energy sources constituted 24.5% of the European Union's final energy consumption.

Other	All the food is suitable for consumption, but be aware of possible allergies in children. When using knives, adult supervision is mandatory. You can also do the experiment without marshmallows (just with biscuits or crackers and chocolate). The solar oven works best on a sunny day in the summer season. If you try it on a sunny day in autumn or spring, consider some extra time for cooking.
Relevance to real life	The same as we can **cook** using the sun, which provides the heat for us, we can use the sun's energy to keep **homes or our sanitary water warm**, or even **power** certain tools. The sun provides energy that can be converted into heat or electricity. It is a **renewable energy source**, meaning it doesn't run out or produce pollution. You can see solar panels or solar thermal panels on the roofs of buildings, which use the sun's energy to create electricity or heat.
Conclusion	By using the foil, black paper, and plastic wrap, we are trapping the sun's heat inside the pizza box, which makes it warm enough to melt the chocolate and soften the marshmallow.

Watch the video tutorial!

LINK

NOTES

FABRIC DETECTIVES

TOPIC: Overconsumption, fast fashion

AGE RANGE: Ages 5-6

OVERVIEW

Children explore different types of fabrics through hands-on activities, testing properties like warmth, strength, and water absorption. Furthermore, they learn about the properties of materials and understand that materials should be chosen according to their use.

MATERIALS FOR THE EXPERIMENT

Testing materials:

- ☐ Fleece
- ☐ Cotton
- ☐ Nylon
- ☐ Wool
- ☐ A spray bottle with water
- ☐ Ice cubes
- ☐ A zip-bag
- ☐ Graphics
- ☐ A sandclock

SUMMARY

Keywords	Fabric, properties, warmth, strength, recycling
Activity duration **Lesson plan duration**	45 minutes 90 minutes
Class organisation	**Small groups (3-4 children)**
Learning objectives	Children will: • Explore fabric properties with testing and observing different fabric characteristics such as absorption, strength, and warmth retention. • Understand sustainability in materials and learn why natural or recycled materials can be better for the planet.
Curriculum alignment	• **Science:** Explore and compare the characteristics of different fabrics to understand their real-world applications. Furthermore, develop the ability to observe and describe material properties, connecting them to real life uses. • **Sustainability education:** Discuss the impact of fabric choices on the environment, including the pros and cons of natural, recycled or synthetic materials. Highlight the importance of thoughtful consumption.
GreenComp connection	Critical thinking (2.2), Valuing sustainability (1.1), Adaptability (3.2)

INTRODUCTION

Introduction	The teacher starts with an introduction: *Now it's winter, and we're feeling a little chilly. What do we need? A nice, warm blanket!* *But where can we find the materials for it?* Wait for the answers from children. *Maybe we could recycle some things, like old fabric or clothes we already have at home.* *Are all fabrics the same? Which material should we use?* *All fabrics are the same, so we need to figure out which material would be best for a cosy blanket.* *Should it be soft, warm, or maybe even a little stretchy? Waterproof?* *Let's put different fabrics to the test and find out which ones would make the perfect winter blanket!*
Research question and hypothesis	The fabric, suitable for a winter blanket, needs to be: • warm YES/NO • strong YES/NO • waterproof YES/NO

EXPERIMENT

Materials	For the whole class: • Small squares (30 cm x 30 cm) of fabric, different types (cotton, wool, nylon, fleece, paper, etc.), 1 different for each group For each group: • Sandclock or stopwatch (optionally, time can be checked with teachers' help, using smartphones) • Spray bottles with water for testing absorption • Ice cubes in a zip-bag for testing warmth • Graphics to show the properties of materials (hot/cold, strong/weak and waterproof/soaky).
Step-by-step instructions	1. Each group get one type of fabric (cotton, wool, nylon, paper, etc.) to focus on. 2. Ask the children to notice the look and feel of their type of fabric. 3. Ask each group to describe what they see and feel. Is it soft, rough, or smooth? Would it work well as the fabric for the blanket? All tests are done by children themselves, if they feel comfortable. Teachers can help and guide the process, but do not do the experiment for them. **Test 1: How warm is the fabric?** 1. Place a few ice cubes in a zip bag on top of the fabric for about 30 seconds. Measure the time. 2. Remove it. Each child can touch the fabric to feel if it has become cold or not. 3. The group choose the graphic, if they feel cold touching the fabric or not (graphic for cold if they feel it and for warmth if they do not).

Step-by-step instructions	**Test 2: How strong and stretchy is your fabric?** 1. Gently stretch or tug on the fabric square. Use light force and avoid ripping, but observe if it stretches easily or holds firm. 2. Test if the fabric feels strong or does it stretch easily. 3. The group chose the graphic, whether the fabric is durable and strong or not. **Test 3: Waterproof test** 1. Use a spray bottle to place a few droplets of water on the fabric square. Observe if the water soaks in or stays on top of the fabric. 2. Check by touching the fabric from the downside. If the downside is wet, the fabric absorbs water. If it is dry and the droplet can be moved around, the fabric is waterproof. 3. After the test, use the property graphics waterproof or soaky to label the fabric according to the findings.
Observation and discussion	Children present their observations. Discuss with children all types of fabric, their properties, and if is this property is needed for our cosy winter blanket. You can use next questions: ◦ Did your fabric cool? ◦ Was it stiff or did it stretch? ◦ Did it soak up water or stay dry? ◦ Would this material be suitable for a blanket? Why? Children need to answer teachers' questions about testing, observing one material at a time, so make sure to allow enough time for this part of the activity. They can help themselves with the chosen graphics.

Science background (for the teacher)	Different fabrics have unique properties that make them ideal for **various uses**. **Cotton** is soft, absorbent, and breathable, perfect for T-shirts, towels, and bed linens. **Wool** provides warmth and insulation, commonly used in sweaters and blankets to keep us cosy in cold weather. Wool has fibres with natural air pockets that trap warmth, making it an ideal insulator. **Polyester** is durable and quick-drying, making it great for athletic wear and jackets. **Nylon** is lightweight and water-resistant, ideal for raincoats and umbrellas. **Silk** is smooth and luxurious, often found in scarves and high-quality bedding. **Denim** is strong and thick, used in jeans and workwear. **Fleece** is soft and warm without added weight, popular in blankets and winter clothes. Wool and fleece are both commonly used for warmth, but they achieve it in different ways. Wool is a natural fibre, while fleece is synthetic. Fleece traps warmth because it is woven in a way that creates a thick, insulating layer, similar to wool. This makes fleece a lightweight alternative for warmth, even in wet conditions. **Natural materials**, such as cotton, wool, and silk, come from plants and animals. They are biodegradable, breathable, and often more comfortable, making them ideal for clothing and bedding. **Manmade materials**, like polyester, nylon, and acrylic, are synthetic fibres created in factories. They are typically more durable, water-resistant, and quick-drying, suitable for items like athletic wear, raincoats, and outdoor gear. While natural materials are **environmentally friendly,** manmade materials are often chosen for their strength, versatility, and resistance to wear and tear.

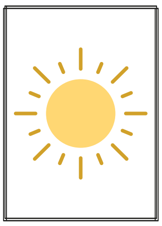
Other	Instead of ice cubes, you can use hot packs and check if warmth seeps through the fabric. Children can work in groups or individually when testing materials. Each group can test one type of material or more. The teacher can decide this in line with children's skills and interest, or the available time for the activity.
Relevance to real life	In this experiment, we explore three key fabric properties—warmth, strength, and water resistance—that affect how we use materials in everyday life. These properties help determine the best fabric for specific purposes, like blankets, jackets, or towels. **1. Warmth** Fabrics that retain warmth trap heat close to the body, which is ideal for cold-weather items. Materials like wool and fleece have structures that retain warm air, making them excellent for keeping people warm in winter. For children, understanding warmth in fabrics explains why we wear certain clothes, like sweaters and fluffy jackets, in cold weather. **2. Strength** Strong and tightly woven fabrics are essential for items that need to last, such as blankets or jackets. Strength is important in children's lives for items like backpacks or outdoor clothes, which need to withstand play and movement. **3. Water Resistance** Water-resistant fabrics are suitable for items like raincoats, while absorbent fabrics are essential for towels. Water resistance keeps items dry in wet conditions, while absorbency is useful when we want materials to soak up moisture.

Conclusion	**The goal is to decide which is the best fabric for a blanket.** Based on experimentation findings, discuss which materials might work best for a cosy blanket. Encourage children to think about why warmth, strength, and water resistance might matter in choosing the right fabric. The teacher wraps up by explaining that fabrics have different properties, and learning about them helps us make smart choices for things we use every day, like blankets, clothes, and more. When you all agree about materials that can be suitable for a blanket, ask the children if they want to make one. In the coming days, children can bring old suitable fabric from home, and together you can make a up-cycled cosy blankets for your kindergarten.

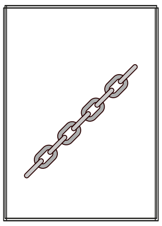
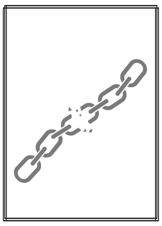
GRAPHICS

Labels should be printed beforehand and given to each group before the testing starts. You can draw the images on paper if you do not have a printer.

TEST 1
WARMTH




TEST 2
STRENGTH

TEST 3
WATER ABSORPTION


Watch the video tutorial!

LINK

NOTES

SLEEPING DAISY

TOPIC: Care for nature and green areas

AGE RANGE: Ages 3-6

OVERVIEW

The experiment focuses on observing the plant's day and night cycles, emphasising the connection with sleep needs for all living organisms, including humans.

MATERIALS FOR THE EXPERIMENT

- ☐ Daisies
- ☐ 3 pots
- ☐ A scoop
- ☐ A magnifying glass
- ☐ A watering can
- ☐ Water
- ☐ Soil
- ☐ A camera
- ☐ A printer

SUMMARY

Keywords	Nature, day and night cycle, light, flower
Activity duration **Lesson plan duration**	45 minutes 2 days (or more) for observation
Class organisation	**Individually or in small groups**
Learning objectives	Children will: • Observe a daisy, learning about its parts and the essential life needs (water, light, habitat...). • Get to know why plants have flowers, what happens when it is raining, when it is dark, when it is windy... • Understand how a plant's behaviour can change (or not) if the plant is placed in another habitat or exposed to different conditions. • Understand the day-night cycle, which is essential for all living organisms. • Develop patience, respect and care for all living things, together with environmental responsibility.
Curriculum alignment	• **Science:** Get basic knowledge about plants and their behaviour, such as day and night cycles, responding to different conditions (light, water...). • **Observation:** Encourage children to make careful observations. Foster patience and curiosity as children wait to observe changes over time. • **Sustainability education:** Importance of caring for green spaces - even the smallest plants that we take for granted have a crucial impact on natural habitats.
GreenComp connection	Promoting nature (1.3), Systems thinking (2.1), Critical thinking (2.2)

INTRODUCTION

Introduction	The introduction to the experiment can be done a few days before the actual experiment. 1. Take the children for a walk outside in the morning to observe flowers in nature. When you see daisy, ask them if they think a daisy's flower is always open or not. Observe other flowers. Are all open, or do some of them have closed flowers? 2. On the same day, take the children for a walk outside in the afternoon. Observe the daisies- Are they still open? The teacher can discuss with children: *Early in the morning, flowers are usually open and bright. But when we come back in the afternoon, some of them look different. Have you noticed how some flowers close up later in the day? Are they preparing to go to sleep? What do you think, why do they close their flowers at night? What about if the weather changes and rain comes, are flowers still open?* *You will do the experiment to find out what happens with daisies during the day or at night, and see how they behave if we bring flowers inside, to the classroom.*
Research question and hypothesis	Does the daisy go to sleep at night and close its flower? YES / NO Do all daisies close their flowers at the same time, no matter where they are (outside or inside, in the dark or in the light)? YES / NO

EXPERIMENT

Materials	For each child: • 1 daisy • 1 flowerpot • Soil • Magnifying glass for closer observation (optional) For the class: • Shovels • Watering cans with water For the teacher: • A camera (or smartphone) • A printer for photos • A place to display the photos
Step-by-step instructions	1. Start with the introduction activity a few days before the experiment. 2. Go for a walk with children, find a place with daisies. Don't forget shovels and pots for each child. 3. Using shovels, children scoop out the daisy and put it in the flower pot. Children themselves transport the pot with their daisy. 4. Optional: If your kindergarten is near to where daisies grow, find a daisy in nature near your playroom. Take a photo of the "outside" daisy. 5. Children choose where to put their daisy pot - inside or outside the classroom. Optionally, you can choose different conditions to observe your daisy - light/dark, daylight/dark, warm/cold, etc. Observe and document accordingly. 6. Select from each environment the daisy you want to test. We choose one in the pot inside in the light, one in the pot inside in the dark, and one in the pot outside in the light.

Step-by-step instructions	7. Using a camera or smartphone, take a photo of selected daisies immediately when they are placed in their position. 8. The teacher prints or saves the photo, marks the date and time when the photo was taken and puts it beside the daisy if it is printed. Repeat the process for all selected daisies. 9. Document daisies with a photo in a period of two hours until the evening. The teacher can select hours appropriate to their work process. Set a reminder on your phone and let the children know you've done so. 10. In the meantime, children use a magnifying glass to observe their daisies. Observe flowers - petals, sepals, stamens, carpels, leaves, stem, outer layer of the plant ("flower's skin")... 11. The next day, continue your morning observations and document them every 2 hours as the day before. 12. Mark the time when children notice the daisies: • opening of the flower, • fully open flower, • closing the flower, • fully closed flower. Mark the time for the daisy growing in the wild. This would be the daisies' cycle. You can select just 1 or 2 events to mark, depending on the time of observation. 13. At the end of the second day, check the photos of all daisies and discuss their behaviour. Children can describe how the daisy was opening and closing its flower. Were there any differences according to where the daisy was placed? Did all the daisies behave similarly or not? 14. Take your test subjects (daisies) back into nature.

Observation and discussion	Guide the children to observe how the daisies open and close throughout the day, both inside and outside. Encourage the children with the following questions: *Can you see when the flowers open and close?* *Is there a difference between the flowers growing inside and outside?* *When did the flowers start to close or open?* *Why do you think the flowers behave differently inside and outside?* *What is different?* Explain to them how indoor conditions (constant temperature, lower humidity) and outdoor conditions (light, morning dew) might affect the flowers. *Why do flowers like daisies need to open and close their petals?* *Why is it important for flowers to open during the day and close at night?* *Do all of the plants have the same night and day cycle?* *Are there any plants that open their flowers at night instead of during the day?* This is related to energy conservation and attracting pollinators, which is crucial for flowers. The insects that pollinate flowers are mainly active during the day, which is when the flowers are usually open. There are some plants, pollinated by nocturnal insects, which open their flowers at night and close them during the day.

Other	The activity is longer, so make sure to allow enough time for implementation. You can implement it on several different days. Try to pick suitable weather conditions for going outside. For presenting photos, instead of printing, you can use a phone camera, or show them with a projector or computer. Adapt this part of the activity to the equipment available in your classroom. You can also consider documenting just 1 daisy on an hourly basis; others can be documented by children themselves when they open or close their petals. In addition to observing the daisies in pots, we can also observe a cut daisy's flower placed in a vase with water. This allows us to observe how the behaviour of the cut flower differs compared to the potted daisies. Typically, a cut daisy's flower will open and close more readily than those that are potted. The reason may be that the cut flower has access to more moisture, which is necessary for the daisy's flower to fully close. Additionally, children can compare daisy's day-and-night cycle with other flowers, observing when they open and when they close their flowers. Try to observe the dandelion or some other flower you have access to in nature.

Science background (for the teacher)	Daisies (Bellis perennis) exhibit a plant's behaviour where they open their flowers during the day and close at night, a process known as heliotropism. This cycle allows them to align with the activity patterns of pollinators and protect themselves from herbivores. The petals of the daisy are brightly coloured, attracting pollinators like bees and butterflies during the day. At night, the flower closes, making it harder for nocturnal herbivores such as tortoises to find and feed on them. When the flower closes, the lower part of the petals blends with the surrounding greenery, helping the daisy camouflage and protect its reproductive parts. And during the day, when the flower opens, it is more visible and accessible to pollinators, increasing the chances of pollen transfer. Pollination enables the fertilisation of the flower's ovules, which later develop into seeds. The daisy's flower is composed of several important parts: • Petals: The colourful parts that attract pollinators and form the corolla. • Sepals: Small, leaf-like structures that protect the flower bud before it opens, collectively known as the calyx. • Stamens: The male reproductive parts, which consist of the anther (where pollen is produced) and the filament (the stalk that holds the anther). • Pistil (or Carpel): The female reproductive part, including the stigma (where pollen lands), style (the tube connecting the stigma to the ovary), and ovary (which contains the ovules that will become seeds after fertilisation). The process of opening and closing flowers is influenced by both environmental factors and the plant's internal biological rhythm.

Relevance to real life	The teacher can use the following text as inspiration: *When we observe daisies opening and closing their petals at different times of the day, we see how plants protect themselves and their pollen. Daisies open their petals during the day to attract helpful insects, like bees, that carry pollen from one flower to another. By closing up at night, the daisy keeps its pollen safe from animals that might damage it and from weather that could wash it away. Other flowers may have similar or different cycles; some stay open all day and night, while others close at night like the daisy.* *When it rains, many daisies close their petals to protect their pollen and keep it dry. Just as we use umbrellas or stay inside to keep from getting wet.*
Conclusion	The experiment showed that daisies open their petals during the day and close them at night. Many animals have similar routines, with some being active during the day and others at night. These natural rhythms help all living things, including us, have the energy and protection we need to grow and thrive each day. The day-night cycles are influenced by numerous factors. For plants, light and heat affect their cycles, while for us, our daily routines, like eating, playing, and resting, shape how we feel. That's why it's important to take care of our health by making sure we get enough rest and sleep.

Watch the video tutorial!

LINK

NOTES

THREE LITTLE PIGS ARE BUILDING SUSTAINABLE HOUSES

TOPIC: Earth pollution, waste management

AGE RANGE: Ages 4-6

OVERVIEW

Children learn how to build houses from waste materials. They explore the properties of these materials and test their strength by using a fan and the force of gravity (with the help of toys). They learn that not all materials are suitable for construction, but they can be used in other ways.

MATERIALS FOR THE EXPERIMENT

- ☐ 4 cardboard tubes
- ☐ 4 plastic bottles
- ☐ 1 m of plastic wrap
- ☐ 4 newspaper sheets
- ☐ 4 equal wood pieces
- ☐ Glue
- ☐ Sticky tape
- ☐ Scissors
- ☐ A hammer
- ☐ Nails
- ☐ A fan
- ☐ Toys for weights

SUMMARY

Keywords	Sorting trash, materials properties, recycling, reusing
Activity duration **Lesson plan duration**	Activity: 90 minutes Lesson plan: 2 days Day 1: Introduction and house building Day 2: Testing and discussion
Class organisation	**Whole class** **Min. 3 groups (max. 4-5 children)**
Learning objectives	The children will: • learn terms related to recycling and waste management. • learn about materials. • become familiar with a research approach (formulating research questions, hypotheses, procedures, and understanding results) and a hands-on way of working. • become aware of their responsibility for a clean environment and their role in it when reusing materials.
Curriculum alignment	• **Science:** Explore material properties, practise various technical tasks, and develop technical creativity. Learn about the scientific work process and develop organisational skills. • **Sustainability education**: Develop an understanding of waste generation and the importance and ways of recycling.
GreenComp connection	Exploratory thinking (3.3), Systems thinking (2.1), Collective action (4.2)

INTRODUCTION

Introduction	The teacher starts by introducing the story of the Three Little Pigs (English traditional fairy tale): *The Three Little Pigs decided to each build their own house. The first pig builds a house of straw, the second of sticks, and the third of bricks. In the end, all three little pigs live in the brick house, but it is too small for them. Therefore, the pigs decide to rebuild their houses. They need to find suitable materials. But instead of using just anything they could find, they had to think about how to use already existing materials and recycle waste to build a solid and sustainable house. They do not have any money to buy new materials.* Encourage children to think about which different materials the pigs should use to build three houses. Remember, you can not buy any materials; look around. The teacher should guide children to the materials that will be used in the experiment. For example, we use paper, wood and plastic in our experiment. Also, the children should think about how to test which house is the most durable, strong, and best for living purposes. In our experiment, we will use two tests, with wind and weights.
Research question and hypothesis	Which house will be most wind-resistant? PAPER/PLASTIC/WOODEN Which house will be the strongest when adding weights? PAPER/PLASTIC/WOODEN Which house will be most suitable for living? PAPER/PLASTIC/WOODEN

EXPERIMENT

Materials	**Basic materials for the houses (all recycled) - one group builds one house:** 1st house: • 4 paper tubes from paper towels • 4 sheets of newspaper paper 2nd house: • 4 plastic bottles • 1 m of plastic wrap (bubble wrap, nylon sheet...) 3rd house: • 4 equal square wooden blocks or wood off-cuts **Additional construction materials:** • White glue • Sticky tape • Scissors • A hammer • Nails **Equipment for testing:** • A fan (to simulate wind) • Weights (e.g., toys, books...) to test stability; more items of the same size and weight
Step-by-step instructions	1. We divide the children into three groups (from 3-5 children) based on the material they will use to build the house out of paper, plastic, and wood. 2. We give each group the needed materials for their house, and to all three, the additional materials for construction. 3. Each group of children builds the house from specific materials. Each house needs to have a rooftop and doors. 4. During construction, we encourage the children to think about and determine the properties of the materials used. Help them with open-ended questions.

Step-by-step instructions	5. Teachers observe the dynamics within each group and record their statements about the exploration of materials and the construction process. 6. When the children finish building the houses, line up the houses. Each group now presents their building method. 7. Children need to think, how to test the house's stability. Ask the children: *How would you test the stability of the house?* *Can you tell when the house will collapse?* *How can we check this in the classroom?* 8. Write down the children's suggestions and start testing. TEST 1 - WIND: Ask the children what will happen to the houses if the wind blows. Teachers use the fan. The children make hypotheses, and the teachers write them down. Place the fan 0.5 m away from the houses and switch it on (the highest level). Expose all houses to the fan at the same time. If the wind is not strong enough, you can place the fan closer and observe which house is affected the most and which house collapses first. TEST 2 - STRENGTH: Ask children what will happen to the houses if we put some weight on their roofs. Use the toy figures or books of the same size for all houses. Children make hypotheses, and the teacher writes them down. Children place weights on each rooftop and observe what happens. Use more and add them on the roof gradually.

Observation and discussion	After the experiment, we reflect on the findings and confirm the hypotheses together with the children: *Which house was the strongest and why?* *Which one collapsed first and why?* *Which of these three materials is the most suitable for building houses?* We found that the strength of the houses depends not only on the materials we use but also on the design of the building. More questions to inspire further inquiry: *Remember that we built the houses from waste materials (paper, plastic, wood). We reused the materials; therefore, we recycled them. What materials can be recycled, and what can be made from them?* The teachers record the children's suggestions about recycling materials and encourage them to think about where they would dispose of the materials for reuse. *What is the quality of the materials we used to build the houses?* *Which of the three houses the pigs built is the most durable?* *Which is the most environmentally friendly?* *Can we test something else that is important for an effective and safe house (water, fire,...)?*

Science background (for the teacher)	This experiment introduces children to **basic material science** by testing the **strength and stability of different materials**—paper, plastic, and wood. Each has unique properties: paper is light and flexible but weak, plastic is more durable, and wood is strong and stable, making it ideal for construction. Through building and testing, children observe how materials react to wind and weight, practising early **scientific thinking** and problem-solving. The activity also supports sustainability education by encouraging the use of recycled and reused materials. Children learn that items often considered waste can be valuable building resources. This teaches them about **waste reduction, resource conservation, and making thoughtful choices** for a more sustainable future. Here are some examples of homes, created from waste materials: Plastic bottle houses (link), Shipping container homes (link), Earthship sustainable homes (link) or paper and cardboard homes (link).
Relevance to real life	The three little pigs discover that wood waste is suitable for building houses, while paper and plastic can be reused for other purposes, such as jewellery, toys, clothes... Through the experiment, we learned the **importance of recycling and reusing materials**, thus contributing to a clean environment.

Conclusion	The teachers summarise the investigation process and the main findings with the children. In our experiment, the wooden house proved to be the most durable. But if we were to face heavy rainfall, might one of the other houses be more resilient? Every material has its strengths and weaknesses, so we need to understand them well before deciding how best to use each one.
Other information	Caution during the experiment: the use of nails, hammers, and a fan needs to be done with adult supervision. If you want to work with 4 groups or more, you may consider doing additional houses from different materials, or more groups can do houses from the same materials and with different designs. Try to build houses from different materials: glass, cardboard, natural materials (stones, soil, mud...). You can also consider running or discussing different tests to determine which house is the most durable in wet conditions, or discuss how fire-resistant the houses can be. Children can bring waste materials from home, and also encourage them to find as many different materials as possible that they can use.

Watch the video tutorial!

LINK

NOTES

GIVE NEW COLOURS TO OLD CLOTHES

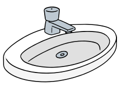
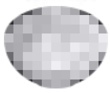
TOPIC: Overconsumption, fast fashion

AGE RANGE: Ages 3-6

OVERVIEW

Children learn how to use natural materials for colouring old clothes, exploring how plants can be used as natural dyes instead of chemicals. This experiment introduces children to sustainable practices and encourages creativity.

MATERIALS FOR THE EXPERIMENT

- ☐  2 fabric pieces
- ☐  Sink and water
- ☐  A ladle
- ☐  A stove
- ☐  Salt
- ☐  2 pots
- ☐  2 bowls
- ☐  A wood spoon
- ☐  A spoon
- ☐ A natural dye of choice:

SUMMARY

Keywords	Natural dyes, plant pigments, fabric dyeing, and recycling
Activity duration **Lesson plan duration**	90 minutes 120 minutes
Class organisation	**Small groups (3-4 children) with individual hands-on tasks**
Learning objectives	Children will: • learn that natural colours exist, like dyeing colours from plants, such as beets, spinach, and turmeric, or from animals (scarlet colour). • recognise that natural dyes are eco-friendly alternatives to chemical dyes, reducing pollution. • learn that dyeing can provide us with an option to turn something old into new. • practice working with materials and express creativity by choosing colours or patterns for their fabrics. • see the process of dyeing - how natural colours are transferred to fabric or used for colouring, understanding plants as a valuable resource.
Curriculum alignment	• **Science:** Exploring plants, its pigments and usefulness in our lives. • **Sustainability education:** Introduce basic concepts of natural resources, learning about eco-friendly practices. • **Art:** Encourage creative expression using natural dyes and teach basic dyeing techniques.
GreenComp connection	Valuing sustainability (1.1), Individual initiative (4.3), Promoting nature (1.3)

INTRODUCTION

Introduction	Teachers start with an introduction: *We have so many clothes, old t-shirts, … What do you think we can do with them to make them feel new again?* *Children may suggest sewing them, making a bag, new clothes, dyeing them…* *This we will do today! We will dye them and make them new! Where can we find the dye?* Children may suggest: In the store/at home/we can use felt-tip pens… *But we really want to use something natural. Do you have any idea what we can use? Maybe plants or other things from nature? Because flowers and leaves have beautiful colours, we can use plants like beets, spinach, and turmeric to dye clothes naturally!* *What colours do you think we can make with different plants?* *How do you think natural colours might work on fabric?* *If we could dye clothes using plant materials, would it be as bright or different from regular dyes?*
Research question and hypothesis	Can we change the fabric's colour using plants and other natural materials instead of chemical dyes? YES / NO Is there any difference if we dye natural fabric materials, as cotton, or manmade, as polyester? YES / NO

EXPERIMENT

Materials	For whole class: • Stove • Water • Sink and water For each group: • 1 plant-based dye material (e.g., turmeric powder, onion skins, optionally chopped beets, spinach leaves, blueberries...) • 1 pot for boiling • 1 pot for preparing colouring liquid • 1 l of water • A wooden spoon • A ladle • Plastic table covers for easy clean-up For each child: • 2 white or light-coloured pre-washed fabric pieces (you can use old T-shirts), approx. 20 x 20 cm squares, 1 from cotton and 1 from polyester • 2 bowls • 0.5 l of water • Salt (2 spoons) • A spoon
Step-by-step instructions	1. Each child takes the bowl and pours in 0.5 l of water. Add 2 spoons of salt and stir well. 2. Add both pieces of fabric to the water and soak them in a solution of water and salt for 30 minutes. This will help the dye to hold. 3. In groups, children prepare the pot, adding approx. 1 l of water to it. Then they place their dye material (e.g., turmeric powder, spinach, etc.) in the pot. Stir gently with the wooden spoon; all parts need to be covered with water.

Step-by-step instructions	4. Teachers take the pots to the stove and heat them until boiling. Simmer the mixture for another 10-20 minutes to extract the colour (depending on the material you use). Children stir gently a few times when cooking. 5. Then, leave the pots to cool slightly (10-20 minutes). 6. Teachers carefully pour the coloured water in the second pot (each dye separately). 7. Teachers give the pots with coloured water to each group. Children (or teachers) add some coloured water to the child's empty bowl using a ladle. 8. Optional: Children can use different techniques to create colour patterns on the fabric (using elastics to create circles, for example), before colouring. 9. Each child places their pieces of fabric into their dye bath, pressing gently with the spoon to soak up the colour. Let sit for 10–30 minutes, depending on the desired colour intensity. 10. Each child removes the fabric pieces from the mixture and rinses them in the sink with cold water until the water runs clear. Remove elastics if you used them. 11. Let it air-dry.
Observation and discussion	Here are some possible questions to guide the discussion with children: *What colours did we make using plants?* Discuss which materials created which colours and how each dye turned out on the fabric. Discuss whether there are differences among different fabrics (cotton, polyester...). *Why do you think we used salt or vinegar?* These are fixatives and help the colours stay on the fabric longer.

Observation and discussion	*How is using plant dyes better for the environment?* Talk about how natural dyes are less harmful than chemical dyes, which can pollute rivers and harm wildlife. Renewing old clothes with natural colours can prevent over-consumption. *What will happen to the dyes in a month or two?* Because they are natural, they will become lighter, which is normal and happens with all natural dyes.
Science background (for the teacher)	Natural dyes are derived from **different parts of the plants (vegetables, fruits, flowers...), insects**, and other natural sources, using pigments that don't harm the environment. These dyes are an eco-friendly alternative to synthetic dyes, which often contain harmful chemicals. Common plant-based dyes include **beets (red/pink), turmeric (yellow), onion skins (orange/brown), and spinach (green)**. Using natural dyes dates back thousands of years, as early cultures used plants and minerals to add colour to fabrics.

Science background (for the teacher)	Natural dyes work by releasing pigments that bond with fibres. To make these colours last, we use a **fixative** (like salt or vinegar) that helps the dye stick to the fabric. Using natural dyes reduces the demand for synthetic dyes, which can be toxic to the environment. Encouraging children to use plant-based colours promotes creativity while supporting eco-friendly choices.
Other	To make better real life relevance for children, before the implementation of the activity, you can visit a grocery store or a farm, where they give you some plant material that can be used for your colouring. Also, children can bring the materials from home (onion peels, beetroot juice...). Instead of salt, you can use vinegar as a fixative to help the dye stay in the fabric. Use the 0.5 dcl of vinegar in the same way as the salt in the experiment. As the dyes can be strong and can colour the children's hands and clothes, consider using protective shirts, coats, or gloves during colouring. You can decide how to implement the experiment. Children can choose their favourite colour or various coloured liquids can be used by each child. Adopt it to your needs and children's skills.

Relevance to real life	Using colours from plants isn't just for clothes. You can make **natural watercolours** to paint your favourite pictures! Or make your **coloured Easter eggs**. Natural colours can be used on paper, canvas, and other materials to create eco-friendly art projects. Plants like beets, turmeric, and blueberries often create strong, vibrant colours. Natural colours are different from regular paints—they can **become lighter over time**. So, if you paint with plant-based colours, you might notice your artwork changes as the colours fade slightly. Different parts of the plants, like leaves or roots, give **different colour results**. Roots (like turmeric) and fruits (like beets and berries) usually give more intense colours, while leaves may create lighter shades.
Conclusion	Children learned that **nature gives us beautiful colours** that can be used for clothing and fabric, without needing chemical dyes. By using natural dyes, we help protect nature and keep our planet cleaner.

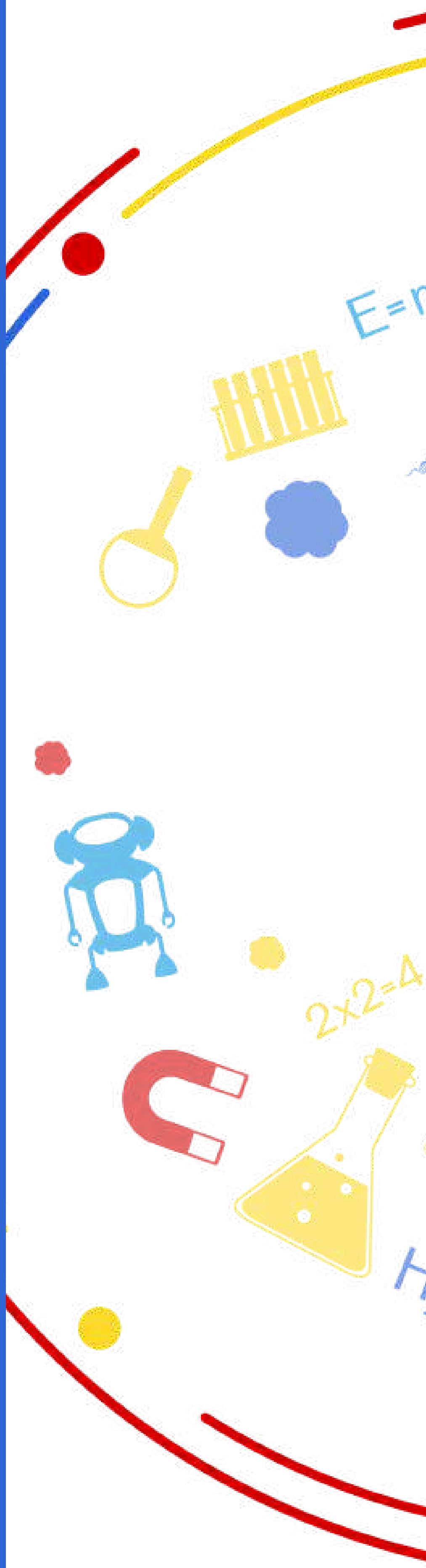
Watch the video tutorial!

LINK

NOTES

04

INTEGRATING STORYTELLING AND SCIENCE EDUCATION



The power of storytelling in early science education

Kindergarten educators involved in the Superhero Lab project were inspired by the possibilities of engaging children in meaningful activities within the playroom. They explored how hands-on experiments could be integrated with the curriculum while enriching the learning experience through connections to other topics. Motivated by this approach, one educator wrote a story that creatively connects the experiments with storytelling, demonstrating how science, language, and imagination can come together in a playful and educational way.

Connecting storytelling with hands-on experiments in early childhood education makes learning more meaningful, engaging, and memorable. Stories create a familiar emotional context that captures children's imagination and curiosity, making abstract scientific concepts more relatable. When a character like a little owl wonders how rockets fly or why flowers close at night, children naturally share that curiosity and are motivated to explore their answers through experimentation.

In the following pages, we share the story and show how it relates to the experiments, offering a practical example of how storytelling can be integrated into scientific exploration in the kindergarten classroom.

The Little Owl

Written by Sonja Pollheimer

The little owl loved to fly at night, and one evening she glanced up at the sky. Suddenly, very quietly, she stopped. Out of the corner of her eye she had seen something ... something very special.
What could it be? Had she really seen it, or was it only her imagination?
She flew back to her secret place at the top of the mountain. From far above she could see it again. And as she watched, something stirred inside her: a thirst for adventure.
The glow and the flashing light were so beautiful. Now she was certain:
She wanted to see it up close.
But how could she ever manage that?

The little owl gathered all her courage and all her strength. Would she be able to fly all the way up? One, two, three, four, five, six, seven, eight, nine, ten ... and on and on it should go, higher and higher into the sky. (1)

Her wings beat up and down as she tried again and again. (2)

She climbed higher and higher. For a while she kept going. But then her eyes slowly began to close, and her wings longed for rest. She looked up once more. The beautiful glow was still far, far away.
Today was not her lucky day for flying.
Slowly, she glided back down to earth.
Back in her tree, she settled down and soon fell fast asleep. (3)
Even in her dreams, the glow and the twinkling lights were just as marvellous. (4)

But wait, what was that? In her dream she saw something rising swiftly and effortlessly into the sky. The next morning she woke up full of excitement, wondering about the large, mysterious flying machine she had seen.

What could be so fast and powerful that it could soar so high with such ease?
After a long and thoughtful ponder, she finally realised: It must be a rocket! (5)

It took a very long time before she managed to book a ride on a rocket. But at last the great day arrived, and she was overjoyed as the rocket lifted off. (6)

She could hardly believe her eyes. What a sight from up there!

The Earth and the stars shone bright and beautiful. From space, the Earth sparkled like a jewel.
But soon it was time for the little owl to return home.
When she arrived, a beetle came to visit her. Excitedly, the owl told him about the shining Earth.

The beetle could not understand this at all. The Earth was beautiful, yes, but to him it was a dark hole into which he crawled. How could it sparkle so brightly in the darkness?
Underground, he had never seen such splendid light. Sometimes, he explained, it was damp and cold below the surface, because water leaked down from somewhere above. (7)

The little owl did not quite know what to say, and so a long discussion began. Before long, they both realised that the Earth could be seen in two very different ways. (8)

From far up in space, it was huge, round, colourful and bright. But for many creatures, the world beneath the ground was just as important. (9)

The little owl and the beetle were very happy. Their friendship grew stronger and stronger, and they always had so much to talk about. Not to mention the many adventures they shared in the sky and underground.

One day, as they sat close together, the beetle said, “Little owl, you never told me your name.”
“What is a name?” she asked. “I have only ever thought of myself as Little Owl.”
They thought about it for a long time, but choosing a name was not easy.

After a while, the beetle disappeared. The little owl soon found a piece of paper lying nearby. The note was blank, and she was very surprised. What was that supposed to mean? And why had the beetle left so suddenly?

Next to the note stood a strange little bottle filled with tincture. The owl fluttered curiously around it, and suddenly knocked it over by accident. The liquid spilled onto the paper. That gave her such a fright! (10)

To her astonishment, letters slowly began to appear on the page. But she could not understand them. What was this sorcery? The letters seemed scrambled and made no sense at all. Feeling rather sad and alone, she sat in her tree and looked down at them from above. (11)

Then she noticed a tiny hole in the ground. Slowly, the little beetle crawled out of it. The owl was delighted and fluttered excitedly around her friend. (12)

“I must know,” she said. “What do these letters mean?”
The beetle laughed gently. “You can make your name from them.”

Together they rearranged the letters, laughing as they read out all the different possibilities. (13)
Then suddenly they saw it. They looked at one another in amazement. Why had they not thought of it sooner?

From that day on, the little owl was called Rufus.
As Rufus, she spread her wings and set off on her travels.

Though they had to say goodbye, the two friends knew they would soon meet again, and would have plenty to talk about when they did. After a long hug, the beetle crawled back into her hole, and Rufus lifted her wings and soared high into the sky.

She flew happily for a long while, immensely proud of her new name. In fact, she even hooted it aloud: “Rufus!” (14)

On and on she flew, over meadows and fields, across vast forests. Suddenly she caught the scent of something wonderful, though she could not tell from which direction it came. (15)

She kept her beak and eyes wide open, hoping to discover its source. (16)

The scent grew stronger, as though it were calling to her.
Then she saw it: a magnificent tree standing before her, filled with blossoms. The tree was alive with many small creatures moving among its branches. (17)

Rufus wanted to take in the spectacle properly, so she settled in the meadow beside it. There was much to discover there too. Tiny white flowers stretched their heads up towards the sun.
She loved sitting in the meadow by the great tree. (18)

But by evening, her eyes grew heavy after the long journey. Rufus flew up to a branch and noticed how the flowers changed at dusk. They seemed to grow tired as well, gently closing their petals as night fell. (19)

The next morning, rain poured from the sky, and the grass around her was soaked. Rufus smiled when she noticed a small hole in the damp soil. She remembered what her beetle friend had told her.
Was the rain falling into this very hole?

Rufus longed to tell her friend what she had discovered. She wanted to understand the path of the water.
And now she wondered: Where does the rain truly come from?

LEARNING EXTENSIONS

Activities, games and experiments

1. Counting to 10: Practice number sequences by omitting numbers: Which one is missing? What comes before or after?

2. Fluttering wings: Explore opposites and movement: forwards–backwards, up–down.

3. Falling asleep: Take a dream-themed fantasy journey or guided relaxation.

4. Shining and blinking: Create starry skies using aluminium foil and flashlights on dark paper.

5. Flying machines: Discuss and build things that can fly.

6. Rocket launch: Act out a countdown, try a movement game, and do the rocket experiment.

7. Seeing from above: Look at pictures of space and Earth from a distance.

8. Earth from angles: Play with words that have double meanings or perspectives.

9. Underground creatures: Explore which animals live underground and try a corresponding experiment.

10. Spilled tincture: Conduct the invisible ink experiment.

Seeing from above:
- Pictures from distance
- Systems thinking, understanding Earth as a shared ecosystem where everything is connected.

Shining and blinking:
- Create the sky with stars
- Encourages awareness of natural phenomena (stars, night sky) and introduces topics like light pollution

Earth from different eyes:
- Words with multiple meanings
- Helps children appreciate diverse life perspectives. Encourages empathy and respect for all life forms and habitats

Creatures underground:
- Direct link to biodiversity and the role of soil-dwelling creatures in various ecosystems

LEARNING EXTENSIONS

Activities, games and experiments

11. Letters on the page: Practice recognising, naming, and matching letters, especially the first letters of names.

12. Excited fluttering: Create an obstacle course or movement station with balance and coordination games.

13. Rufus: Arrange letters to spell and read Rufus' name.

14. Rufus' song: Compose or sing a simple song using the owl's name.

15. Scents in the air: Play a scent guessing game using herbs and plants.

16. Keen eyes and ears: Use a detailed picture of a tree and challenge children to find specific elements (e.g. a hidden bird, a curled leaf). Combine this with directional listening activities where children follow sounds to identify their source or respond to auditory clues.

17. Life in a tree: Discuss and explore animals that live in and around trees.

18. Explore the meadow: Name and categorise things found in meadows (flowers, insects, animals, herbs).

19. Changing flowers: Conduct a Sleeping daisy experiment to observe natural changes.

Little owl sees a glowing light in the sky and dreams of flying:

- Paper rocket experiment
- Explore thrust and air pressure with straw rockets

The beetle talks about wet underground burrows:

- Droplet watty (water filtering)
- Learn about clean vs. dirty water and filtration

Little owl finds a secret tincture and letters appear:

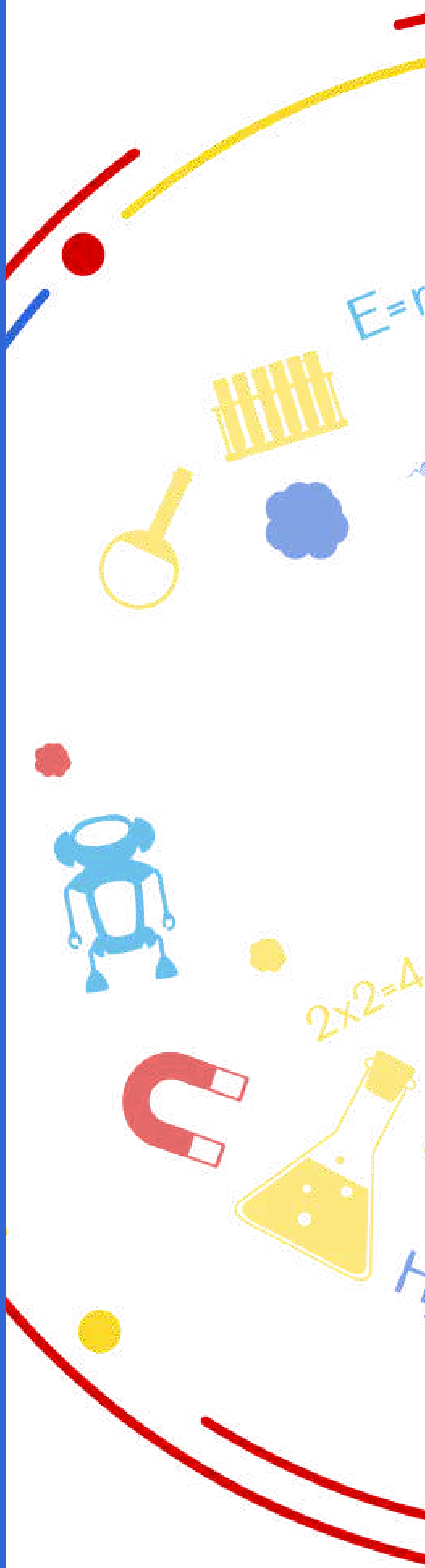
- Secret drawing with invisible ink
- Introduce acid-base chemistry with natural indicators

Little owl notices flowers close at night:

- Flower reaction (colour change)
- Explore plant behavior & response to light or water

05

CONCLUSION



Conclusion

At the heart of the Superhero Lab project lies a simple philosophy: **children should be the ones conducting the experiments,** not merely watching a teacher demonstrate them.

When children take part in hands-on experiments, they do more than learn scientific facts. They develop confidence, problem-solving skills, and critical thinking. They begin to understand the world by testing it for themselves, asking questions, and exploring possible answers.

To support this, all experiments in the Superhero Lab use **everyday**, **low-cost materials**. This ensures that kindergartens can carry out activities without needing special equipment or added expenses.

The **15 experiments** presented in this handbook were co-created by kindergarten educators from across Europe. Each experiment is designed to support early childhood learning goals and is connected to the GreenComp framework for sustainability education. The experiments encourage observation, inquiry, and reflection in a way that fits naturally into the kindergarten environment.

To make implementation easier, each experiment includes a **theoretical background, step-by-step instructions, and a short video tutorial**. We are pleased to share these resources with educators and invite you to use them, adapt them, and share your own experiences.

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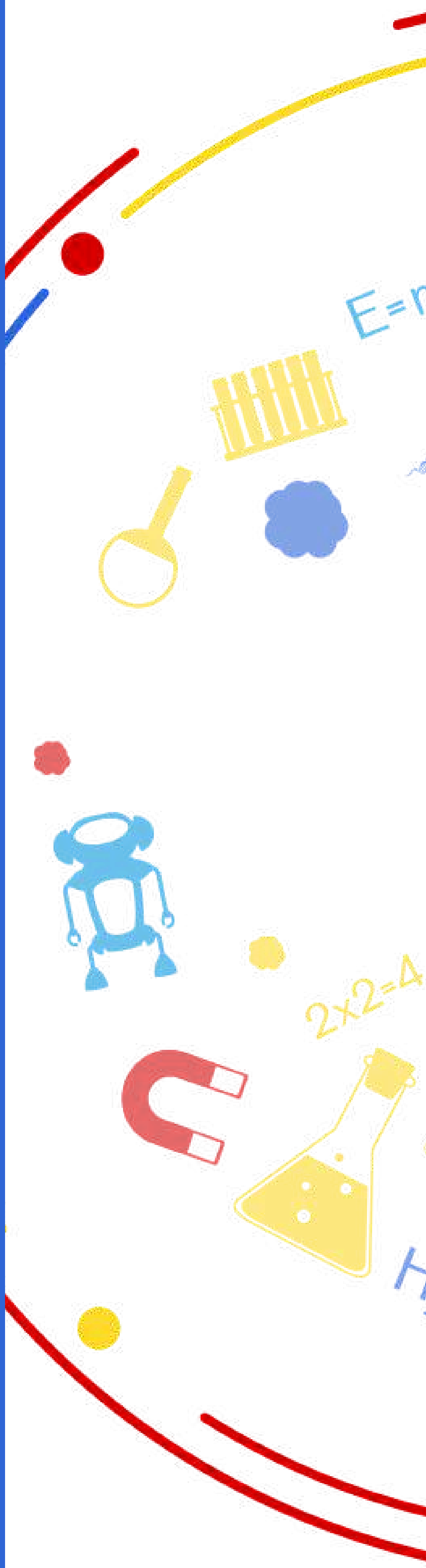
ABOUT THE SUPERHERO LAB



About the Superhero Lab

Engaging Children as Scientists to Explore Sustainability

The Superhero Lab Project is an Erasmus+ partnership that brings together dedicated organizations from Lithuania, Sweden, Germany, Austria, Slovenia, and Greece. United by a commitment to sustainability education, these partners believe that children learn best about sustainability through hands-on activities, which allow for meaningful exploration and personal engagement with the topic.

However, fostering sustainability isn't just about children; it's also about supporting teachers with resources and presenting them with opportunities to explore sustainability education. Under the Superhero Lab framework, we've created a range of materials and learning experiences to empower teachers alongside their young students.

Partners:

- Die Brücke, kindergarten teacher training organization from Germany;
- Primera - Zentrum für pädagogische Fortbildung Wien, teacher training association from Austria;
- GoINNO, developer of STEM activities for educators from Slovenia;
- K&R Education, teacher training organization from Sweden;
- E-School, accredited VET provider from Greece;
- Šiauliai, local government from Lithuania;
- Žiedelis, kindergarten from Lithuania.

Associated kindergartens: Zwergenland (Germany), Schmetterling (Austria), Solkan (Slovenia), The 21st Kindergarten of Larissa (Greece), Kindergarten of Stefanovouno (Greece), Rockaden Landskrona (Sweden), Jelgava Local Municipality (Latvia), MLA Viimsi Lasteaiad (Estonia).

Project's Results

Sustainability education best practice handbook

This is the first handbook of the Superhero Lab project, created by kindergarten educators to offer tested, practical guidance on integrating sustainability into early learning. It showcases 19 sustainability education examples from 10 different European countries.

Collection of hands-on experiments

The resource you are currently reading includes a series of experiments designed for young learners aged 4-6, accompanied by video tutorials and lesson plans for teachers. The goal is to move beyond simple demonstrations and actively engage children in scientific exploration.

International training opportunities

This project offers international training, webinars, and conferences for educators to share best practices, develop experiments, and promote sustainability education across Europe collaboratively.

Join us

www.superherolab.eu
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