SciTeach Center

Université du Luxembourg

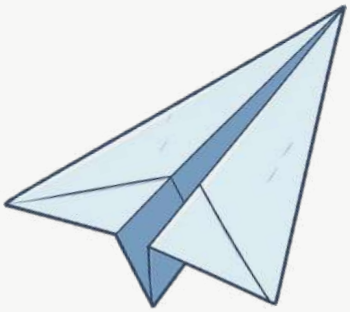
INSTITUT DE FORMATION DE L'ÉDUCATION NATIONALE

Fondation Veuve Emile METZ-TESCH
ACCOMPAGNER, AIDER, ÉDUQUER

The SciTeach Center

Flying & Gliding

Teacher Guide



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Special thanks to the teachers who collaborated on the EarlySTEAM project: David Moos, Fabienne Schintgen, Nora Kneip, and Sandy Heinericy; and all the participants of the SciTeach Center's STEAM workshops.

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Funding by Fondation Veuve Emile Metz-Tesch.

Contents

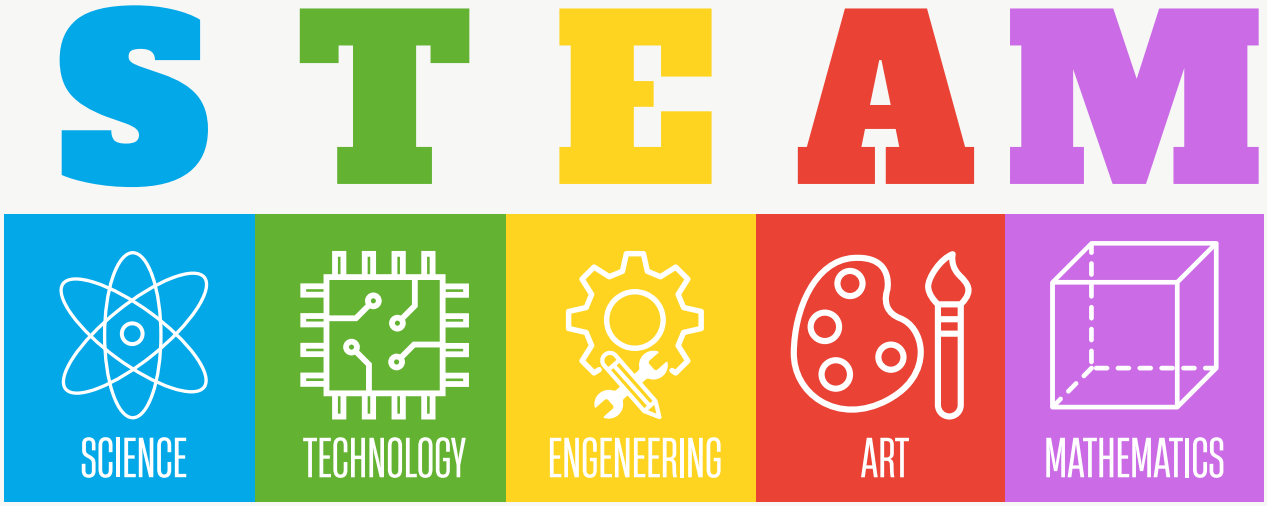
Introduction

What is STEAM?

STEAM is an interdisciplinary approach to teaching and learning that integrates science, technology, engineering, arts and mathematics education through authentic investigations and project-based teaching. STEAM cultivates children's curiosity about the world and supports their learning.

Why use STEAM?

Research findings highlight that STEAM-centered practices are especially appropriate for early childhood education, as they support children's natural exploration, inquiring, and sense-making in and out of school. Moreover, STEAM integrates design principles with arts practices and opens possibilities for children to learn through inquiry and collaboration. This way, it fosters creativity and critical thinking, sparkling children's imagination and supporting key curricular competencies related to language, mathematics, discovery of the world, and transferable skills.



Teachers and researchers agree that STEAM is beneficial to students' learning. However, the big question is: ***How to implement the STEAM approach at the early childhood level?*** One might wonder about how to get started, how to integrate such broad disciplines, and how to guide children through exploration and open-ended inquiry.

With this in mind, the SciTeach Center developed a set of EarlySTEAM resources with teachers to support practitioners in implementing STEAM in early childhood settings. Resources include a series of teacher guides and related multimodal inspirations, collaboratively designed by the SciTeach Center team and primary school teachers in Luxembourg, who shared examples from their teaching practice and co-taught a series of professional development workshops on STEAM for other primary teachers.

Each guide is accompanying a materials kit available for loan at the SciTeach Center. The EarlySTEAM teacher guides and our kits were designed to inspire teachers to explore science topics from an inquiry-based, child-centered stance. We present some suggestions as openings for investigations with your students, and these can be modified according to your needs and your context.

Happy exploration!

The SciTeach Center Team

Approaching this guide

When adopting activities from this guide, consider your context and who your students are: their age, interests, and abilities. Here are some things to consider to make the activities more inclusive and culturally relevant to your classroom.

ADAPT TO YOUR CLASS

What makes sense to your class and what will meet your needs? You may want to pick and choose only a few activities or explore all of them. Depending on children's questions and interests, you may want to extend an inquiry for weeks or explore it for a shorter period.

CONSIDER GROUP ARRANGEMENTS

Consider working with a smaller group of children at a time for certain activities, depending on how much support they will need. While some activities can be done as a whole group, others will work better if you break the class into stations or smaller teams.

EMBED DIFFERENT ENTRY POINTS FOR LEARNING

Consider how you can adapt activities to create entry points for students of diverse profiles, so everyone can participate and contribute with their expertise. For instance, if drawing is too challenging for one child because of their developing fine-motor skills, they might demonstrate their ideas using large building blocks or other materials.

BRING IN STUDENTS' RESOURCES

Find ways to bring your students' resources into the inquiry. For example, when using imagery, make sure to represent people from diverse backgrounds. When facilitating discussions, allow for translanguaging and keep a word-wall with key words in different languages.

CONNECT WITH FAMILIES

Family members might add value to the inquiry by sharing their expertise. For example, if a family member works in a profession related to your inquiry, invite them in for children to interview them.

OBSERVE YOUR STUDENTS

Observe children closely during the inquiry. Body movements, facial expressions and non-verbal communication will help you to understand what they are thinking and allow you to support their meaning-making.

HAVE CHILDREN DOCUMENT AND SHARE

Ask children to document their explorations by drawing, taking photos, or video recording. Likewise, always make space for them to share their findings and discuss ideas after each inquiry. Gathering data, sharing evidence, and discussing ideas are part of the scientific process and crucial for your little scientists' growth.

While these approaches might feel overwhelming at first, enjoy exploring with your students. Get started, do the best you can with the resources that you have.

Start with a story

Each EarlySTEAM guide uses stories as an entry point for STEAM-based investigations. Reading stories is a shared experience that can provide an engaging way to bring children into the topic. Starting with a story creates a meaningful opportunity for dialogue around the storyline, providing a way to build from children's imagination and open up space to hear their ideas, perspectives and wonderings.

Research findings highlight that children's books can increase the effectiveness of STEAM activities, especially at early ages, as the stories told usually appeal to children's imagination and support decision-making and problem solving. Stories can also provide the opportunity to learn new vocabulary words.

Teaching tips:

I: Consider starting a *word wall* (words that are displayed in large visible letters on a wall) through the lessons, where new words are documented, in the language of instruction or students' spoken languages.

II. Share oral stories or folktales related to each topic from your students' cultural backgrounds, making the storytelling sessions more culturally relevant to them. Inviting family members to share tales is another way of achieving that, while strengthening community connections.

The themes that emerge from the book can serve as prompts for investigations. Guided by what children notice in the story, move into discussing questions children might have layered with brainstorming conversations about science topics.

The SciTeach Center offers an extensive library of resources that includes a great variety of fiction and non-fiction books available for loan. The books are in different languages (Luxembourgish, German, French, English) and represent diverse themes from science to history, geography, sustainability, and more. The available books can be found on eduLibrary. Additionally, consider visiting your local library for more resources and inspiration.

Photo by Nicolas Donnerup

Materials kits

When we provide children with a range of open-ended materials that they can manipulate, experiment with, and modify during their investigations, we set them up to explore creatively, approach problems in unorthodox ways, and come up with innovative solutions or ideas.

The items included in the EarlySTEAM materials kits offer starting points for your explorations and were chosen because they are not typically found in most classrooms.

We encourage you to also make regular classroom articles (e.g., paper clips, painter's tape, etc.) available to students, and gather unconventional materials (natural items, recyclables, household items, etc.) to enrich your resources and students' investigations.

Photo by Nicolas Donnerup

The SciTeach Center offers a set of multimedia inspirations showcasing open-ended, inquiry-based scientific explorations that took place in Luxembourgish primary classrooms, led by our partner teachers. They may serve as inspirations for you to design your own investigations with your students and can be accessed through our website sciteach.uni.lu.

Additionally, the SciTeach Center provides a variety of materials to borrow, including books, science investigation kits, games, taxidermic animals, technical equipment (e.g., microscopes, thermometers, stethoscopes, etc.) and other science teaching resources that can support and enrich your classes.

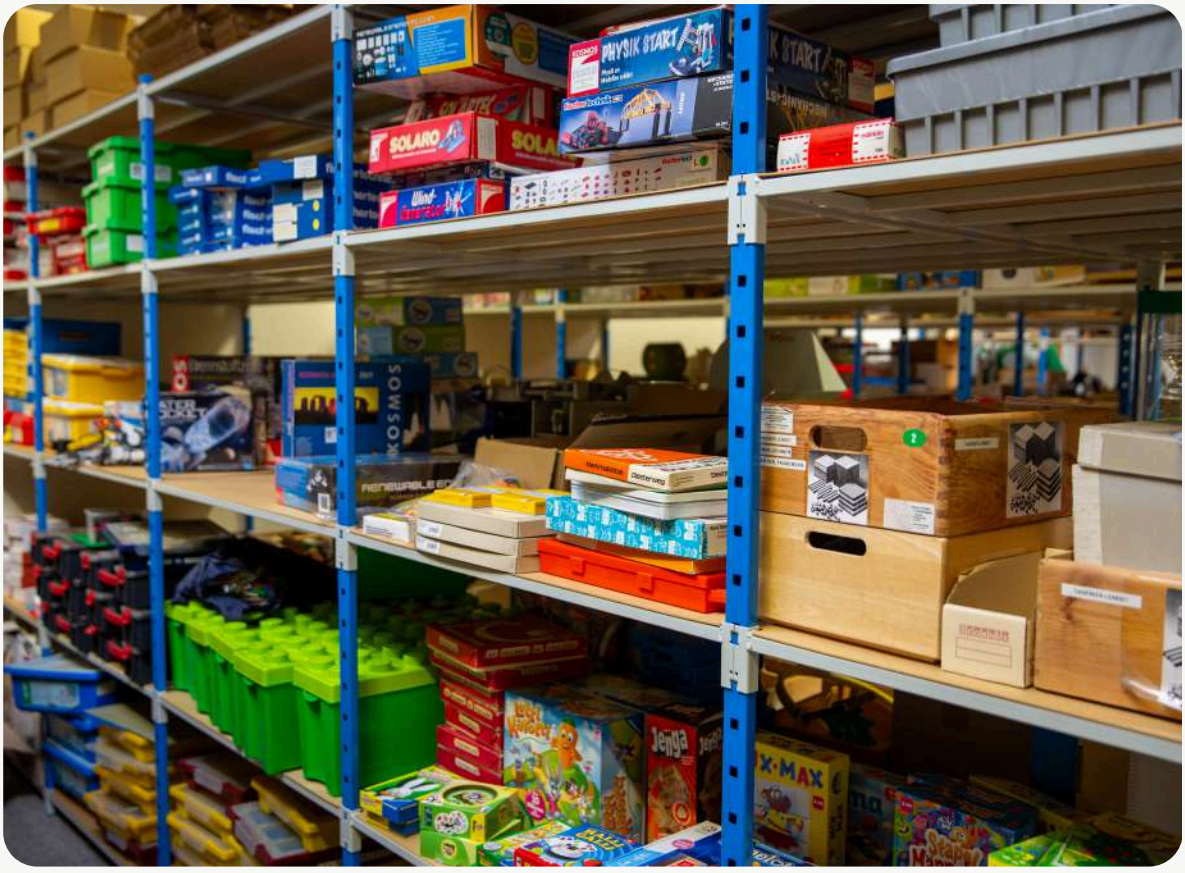
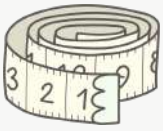


Photo by Nicolas Donnerup

Flying and gliding materials

Included in the “Flying and Gliding” Materials Kit are:

- Two picture books (1 x Muhna Lisa, oder Der Traum vom Fliegen, by Renée Weber; 1 x Die kleine Schnecke lernt fliegen, by Eva Christina Wattler and Franziska Honenhausen)
- One non-fiction book (Papierflugzeuge... die wirklich fliegen, by Nick Robinson)
- One cow hand-puppet
- Three wooden cow toys
- Three wooden snail toys
- One measuring tape
- Laminated images on the topic



Helpful extra materials to explore STEAM activities:

- Natural items: sticks, stones, pinecones, chestnuts, leaves, big seeds, bark, wood chips, shells
- Recyclables: plastic lids and bottles, cardboard boxes, egg cartons, cardboard tubes, bubble wrap
- Man-made materials: buttons, beads, light handkerchiefs, fabric scraps, elastic bands, tin foil, balloons, coffee filters, bolts and nuts, straws
- Stationary: pens, pencils, sticky tape, washi tape, paper, paper clips, scissors, paper (varied sizes, colors, textures)

Get comfortable, dim the lights, and read together!

Unlock children's imagination about flying and gliding by reading the stories of a cow named Muhna Lisa and Little Snail, two characters who dream about flying and seeing the world from above.

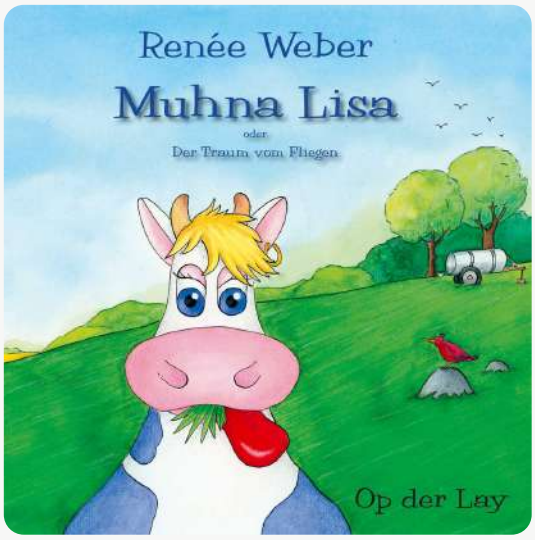


Image credit: Op der Lay

Muhna Lisa, oder Der Traum vom Fliegen, by Renée Weber

Muhna Lisa feels uninspired by her daily routine of chewing grass in the meadows and longs for a more adventurous life. She seizes the opportunity to fulfill her dream of flying when people come to her meadow to launch a balloon.

Die kleine Schnecke lernt fliegen, by Eva Christina Wattler and Franziska Honenhausen

Snail feels mesmerized when its best friend, who has just become a butterfly, tells it stories about its flying adventures and everything it sees from above. Snail dreams about flying and is mocked by the other creatures in the garden for that. However, it perseveres and gets help from her butterfly friend.

Image credit: BoD Buchshop

Brainstorming

What do we know?
What do we want to know?

Start the unit by brainstorming with your students what they already know and what questions they might have. Brainstorming with children provides a key opportunity to hear about their ideas, perspectives, and experiences while engaging them in the topic.

Additionally, listening to children's questions can provide insights into the way they currently understand certain topics/processes, and possible misconceptions they might have, which can help inform your teaching while guiding their explorations.

The approach "*think / pair/ share*" can be a nice way to support your students in thinking about a topic with the goal of discussing their ideas and questions. In considering a question as a class, provide a few minutes for children to think individually, and then encourage them to pair up and exchange on their thoughts.

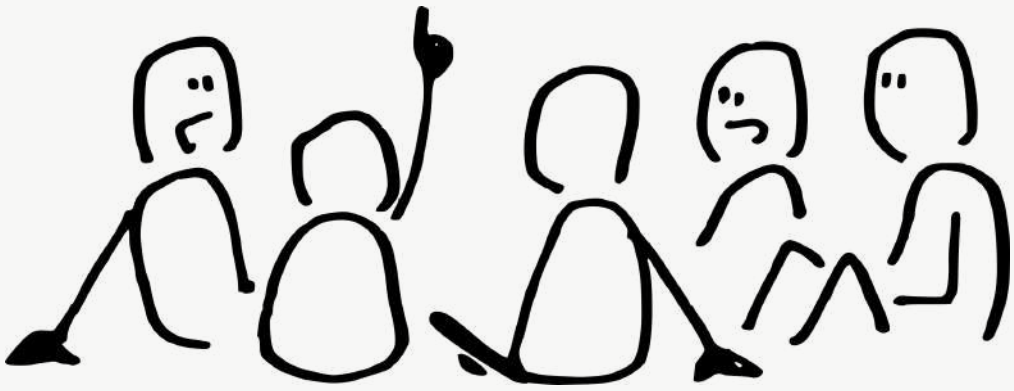
From these pair discussions you can move into a whole-class brainstorming. Consider recording ideas from the discussion on a chart with visual cues as well as words and adding to the list as you move through the different investigations.

We encourage you to value the complexity of children's ideas, even though they might not always be "correct". Throughout the inquiry process, once children have had opportunities to test out different ideas, gather evidence, and learn from each other, these initial thoughts can be revisited and discussed. Furthermore, **making mistakes is part of the scientific process and a powerful way of learning**!

Research findings overall highlight that open-ended structures can create space for children to pursue their wonderings as they creatively engage with play, make observations, test things out, ask questions, exchange ideas and come up with conclusions about scientific phenomena.

Nurturing children's sense of wonder and supporting them to pursue their questions is an important part of science teaching in the early years: it stimulates children's engagement, promotes autonomy, and drives genuine interest in scientific discovery.

Moreover, valuing children's ideas and encouraging them to pursue their own explorations from an early age lays the groundwork for them to keep approaching the world with curiosity and engage critically in science-related conversations as they grow older.



Brainstorming

What do we want to explore?
What can we investigate?
How should we proceed?

Discuss with children their ideas for possible investigations. Some questions that can inspire new understandings as well as new wonderings include:

- What do you know about flying?
- How many things that fly can you think of?
- How does flying relate to your life?
- What do you want to know about flying?

Create a mind map with your ideas.

Where do we see flying and gliding?

Birds, insects, airplanes, paragliders and balloons: they all fly or glide in different ways! Explore the collection of pictures provided in the Flying and Gliding kit to engage children in conversation around these topics. Where do we see flying and gliding? Are there different kinds of flight? Look at the pictures and discuss.












Photo 1 by Public Domain Pictures on Pixabay; Photo 2 by Alexander Klünsner on Pixabay; Photo 3 by Kyrie Isaac on Unsplash; Photo 4 by Gary Stearman on Pixabay; Photo 5 by Unknown on Pixabay; Photo 6 by Jill Wellington on Pixabay; Photo 7 by Unknown on Pixabay; Photo 8 by zephilwer0 on Pixabay; Photo 9 by Dimitris Vetsikas on Pixabay; Photo 10 by Michael Schwarzenberger on Pixabay; Photo 11 by Ian Lindsay on Pixabay; Photo 12 by WikiImages on Pixabay.

Exploring wind

Wind can make some objects fly! Let's explore the wind!

Ask and prompt your students:

- Find 3 objects that you think can be moved with the air from a hairdryer...
- ...and 3 objects that you think cannot be moved with it.
- Before testing, discuss why you think the objects will or will not move.

Now consider:

- What did you notice?
- Why did/didn't the objects move?
- How do you think the results will change with different positions (angle and distance) of the hairdryer?
- Did anything surprise you?

Investigating with hairdryers

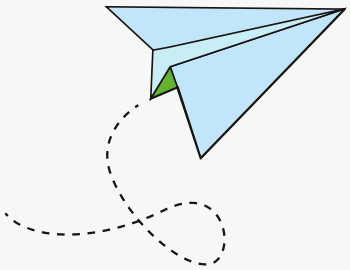
Ask and prompt your students:

- Draw sketches of how the airstream made different objects move.
- Consider how angle, position and the power of the hairdryer would influence the objects moving.

Now consider:

- In a large group, discuss and compare your findings.
- What conclusions can be drawn from your investigations?
- Add the conclusions to your mind map.

Building paper planes



Ask and prompt your students:

- Make a paper airplane or object that flies.
- Make a paper airplane that can go as far as possible.
- Make a paper airplane that can stay in the air as long as possible.

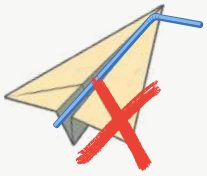
Now consider:

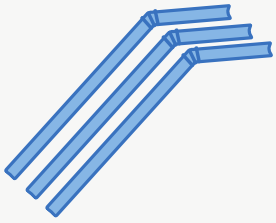
- How did your first design look like, and why did you build it like that?
- How did you design your planes so they would fly far/stay long in the air? Did it work?
- How did you change your models after the first tests, so they could perform better?

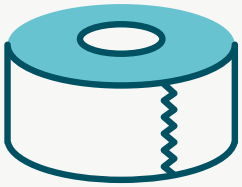
Straw airplanes

Ask and prompt your students:

- Can you make a straw airplane that flies stably?
- For this task, you may only use straws, sticky tape, and paper.
- Please note that straws, not paper, must be the base of your airplane.
- In groups, discuss your designs.







Teaching tip:

As an extension to this activity, introduce a hoop glider to the children, by combining one straw and two 2cm strips of paper. Make 1 small loop and one big loop with each paper strip. Tape each of the loops to one end of the straw, in a parallel position. This can show them one way a flying structure can be made using straws.

Parachutes

Connecting to the story: Muhna Lisa the cow needs a parachute to ensure safety landing after flying. Ask your students, if they can build a parachute for her. When they are finished, have them test its gliding capacity.

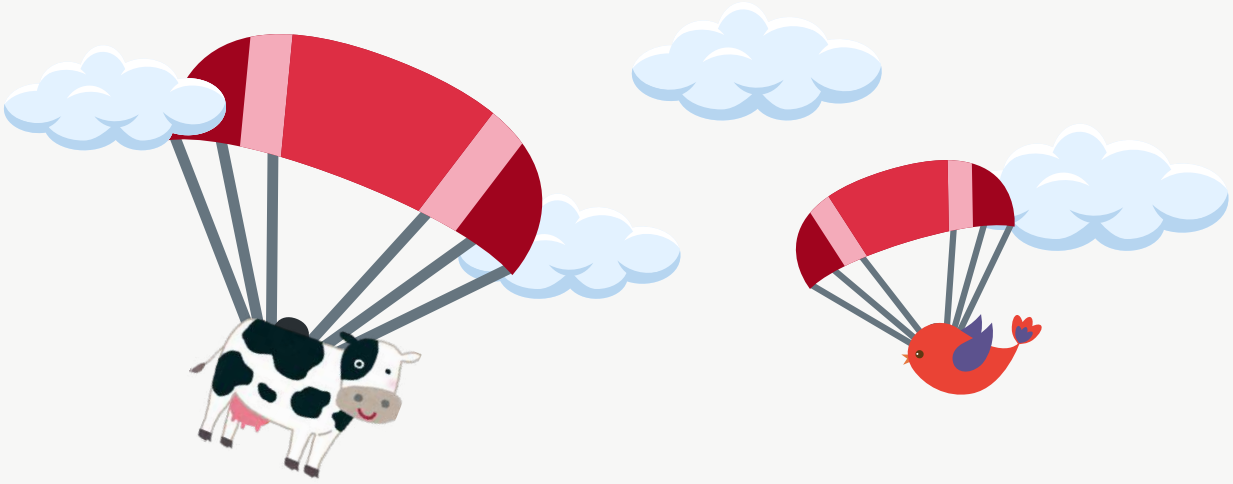
Materials:

- Newspapers
- Aluminum foil
- Tissues
- Paper towels
- Plastic bag
- Kitchen towels
- String
- Paper clips
- Sticky tape
- Wooden cow

Further activity:

Prompt students to adjust their design to make a parachute that 1) stays in the air for as long as possible; 2) can carry both Muhna Lisa and a friend (another wooden cow).

Connecting to the story: Muhna Lisa and Bird like to parachute together, but Muhna Lisa is always much faster. Prompt students to build a parachute that enables Bird to be faster and Muhna Lisa to be slower.



Teaching tip:

Use a feather to represent the bird, and the wooden cow for Muhna Lisa. Demonstrate how, when launching from the same spot and using identical parachutes, the cow always reaches the floor faster.

Helicopters

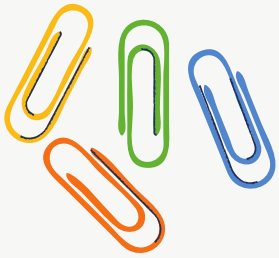
Make a paper helicopter according to the instructions on the next page (also page 34).

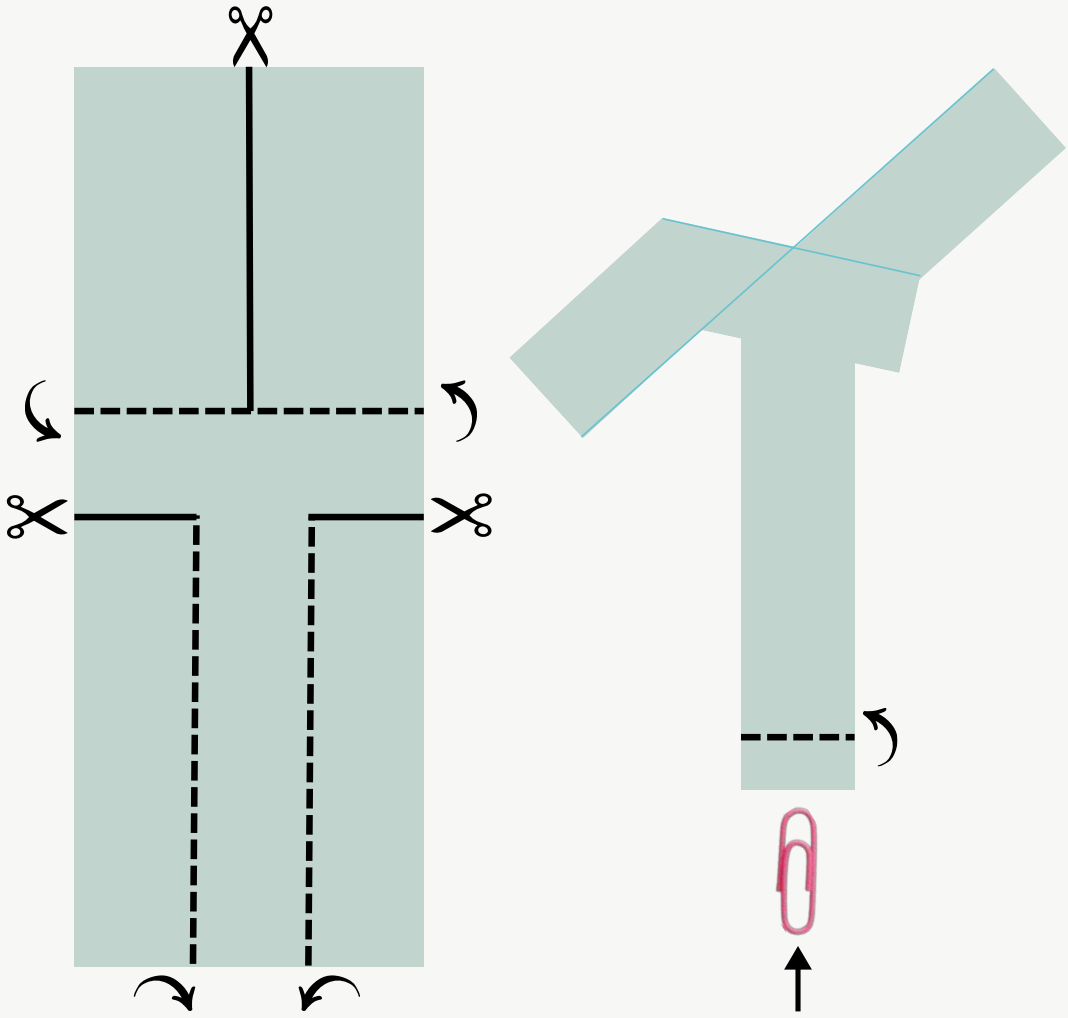
Ask your students:

How can you make your paper helicopter fly?

Prompt your students to investigate what happens when they:

1. Launch it from different heights.
2. Launch helicopters of varied sizes.
3. Launch helicopters made with paper of different weights.
4. Launch helicopters with more paper clips attached to them.
5. Launch helicopters indoors versus outdoors.





Now consider:

- Which helicopter hits the floor the fastest?
- Does anything change when you test your helicopters outdoors versus indoors?
- Which helicopter stays in the air the longest?
- What was the highest number of paper clips your helicopter could carry and still fly?
- Did changing the size or the weight of paper affect your helicopter's performance?

Vinegar rockets

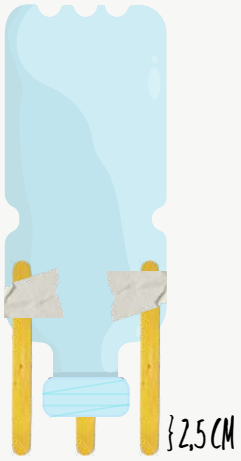
Materials:

- 1/5 Cup vinegar
- 1 Tbsp baking soda
- 3 Sticks/straws
- 1 Cork
- 1 Plastic bottle
- Sticky tape
- Funnel

Let's make a rocket!

Step One:

Tape the sticks around the bottle to make a launching pad.



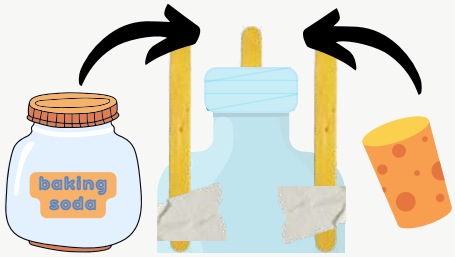
Step Two:

Pour the vinegar into the bottle.
Now take your experiment outdoors.

For the steps three and four, make sure to be outside.

Step Three:

Pour the baking soda in. **Quickly**, put on the cork, place the bottle on the ground in launching position, and walk away.

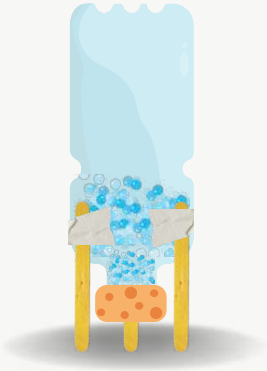


Safety tip:

Because of the pressure built inside, the rocket will launch potently. A grown-up should perform step three while little scientists observe from afar.

Step Four:

STEER CLEAR! Wait for your rocket to launch, and record it in slow motion to watch later.

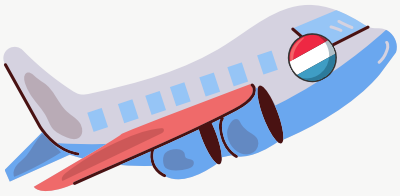


Launching position

STEER CLEAR!

Explore further

Here are other things you can try:



1. Make an airplane out of cardboard boxes for the dramatic play area.

2. Create a story: you are an astronaut who mistakenly landed on an unknown planet. What is it like there?

3. Build a rocket out of clay, play dough, or other materials.

4. Visit the airport to observe real airplanes.

5. Where do airplanes taking off from Luxembourg go? Draw the flight routes on a map.

Photo by Unknown on Luxair

6. Use chalk to draw an actual-size outline of an airplane on the ground. How many children-long is it? How else can you measure it?

7. Visit the Luxembourg Aviation Museum in Mondorf-les-Bains.

Photo by Unknown on Mondorf

8. Check out ESERO's resources to bring space into the classroom: esero.lu.

9. Investigate how your body can represent different flight movements, and create a flight dance number.

References

Doris, E. (1991). *Doing what scientists do: Children learn to investigate their world*. Portsmouth.

Erol, A., Erol, M., & Başaran, M. (2022). The effect of STEAM education with tales on problem solving and creativity skills. *European Early Childhood Education Research Journal*, 31(2), 243–258. https://doi.org/10.1080/1350293X.2022.2081347

Hunter-Doniger, T. (2021). Early childhood STEAM education: The joy of creativity, autonomy, and play. *Art Education*, 74(4), 22–27. https://doi.org/10.1080/00043125.2021.1905419

Tippett, C. D., & Milford, T. M. (2017). Findings from a pre-kindergarten classroom: Making the case for STEM in early childhood education. *International Journal of Science and Mathematics Education*, 15(Suppl 1), 67-86. https://doi.org/10.1007/s10763-017-9812-8

Vartiainen, J. (2021). Play Is a Pathway to Science: STEAM education in early childhood. *Childhood Education*, 97(5), 56–59. https://doi.org/10.1080/00094056.2021.1982295

Notes

SciTeach Center

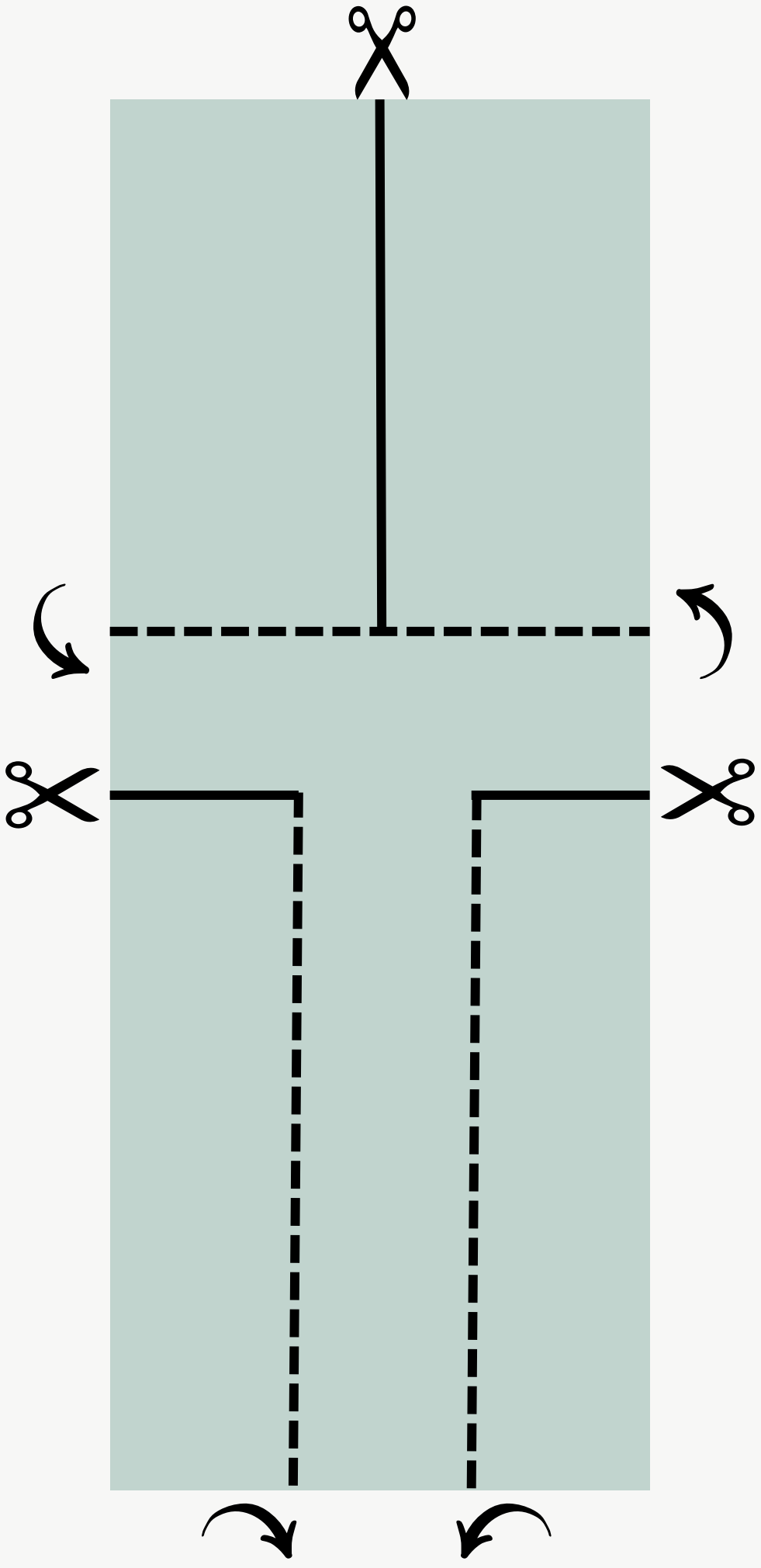
The SciTeach Center was opened in 2016 via a partnership between the University of Luxembourg, the Ministry of Education, the Ministry of Higher Education and Research, and the National Research Fund. Since then, the SciTeach Center continues to develop initiatives that are diverse in location (at the SciTeach Center, outdoors, online, at partner schools) and audience (people within one school or across a range of schools). The SciTeach Center's mission is to support science education at the primary school level through professional development workshops, extensive resources library, and a variety of teaching guides.

The SciTeach Center's work is research-based and embedded in classroom practices, as we work collaboratively with in-service primary school teachers in Luxembourg, who actively co-plan and co-teach with the SciTeach Center's researchers. Since its opening, the SciTeach Center has developed projects that support inquiry-based education, STEAM pedagogy and education for sustainable development. The team has also developed different downloadable teaching guides including the *Lët'z Teach Science!* and *Science Outside* series.

The SciTeach Center continuously provides IFEN accredited professional development workshops which are co-designed by teachers and researchers and respond to the specific needs of local teachers. You can browse the SciTeach Center's offerings through the IFEN catalogue, using keyword "SciTeach".

For more information and resources visit us online via sciteach.uni.lu or in-person at the Maison du Savoir, 4th floor, Atelier 4.550, located at the Belval Campus of the University of Luxembourg.

Photo by Nicolas Donnerup



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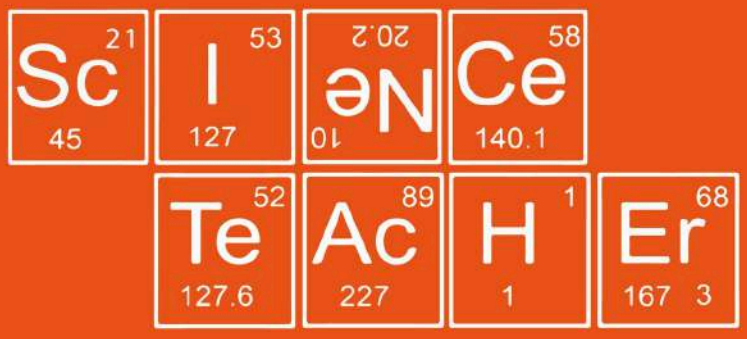
EarlySTEAM Guide



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ISBN 978-99987-641-8-7