SciTeach Center

Université du Luxembourg

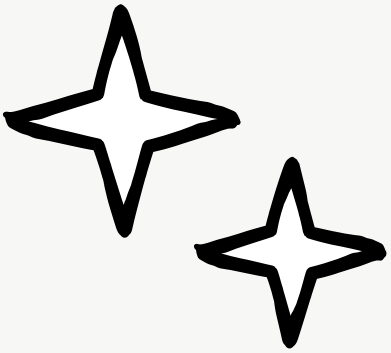
ifen
INSTITUT DE FORMATION DE L'ÉDUCATION NATIONALE

Fondation Veuve Emile METZ-TESCH
ACCOMPAGNER, AIDER, ÉDUQUER

The SciTeach Center

Light & Shadows

Teacher Guide



Authors:
Daniela Bertoli
Sergei Glotov
Christina Siry

The SciTeach Team:
Daniela Bertoli
Thierry Frentz
Sergei Glotov
Kerstin te Heesen
Melanie Jorge Canelas
Patricia Müller
Maria Ounik
Monika Reuland
René Schneider
Christina Siry
Doriana Sportelli
Max Weirig
Sara Wilmes

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Translation to Luxembourgish from English by Marie Lippert.

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Contents

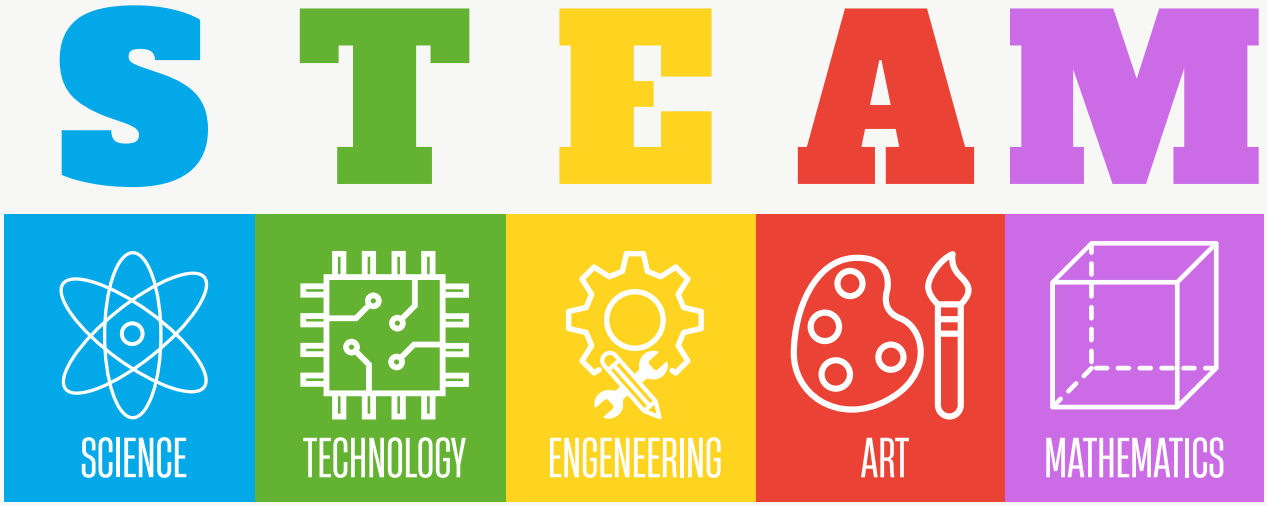
Introduction

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 uni.lu/fhse-en/sciteach-centre.

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.

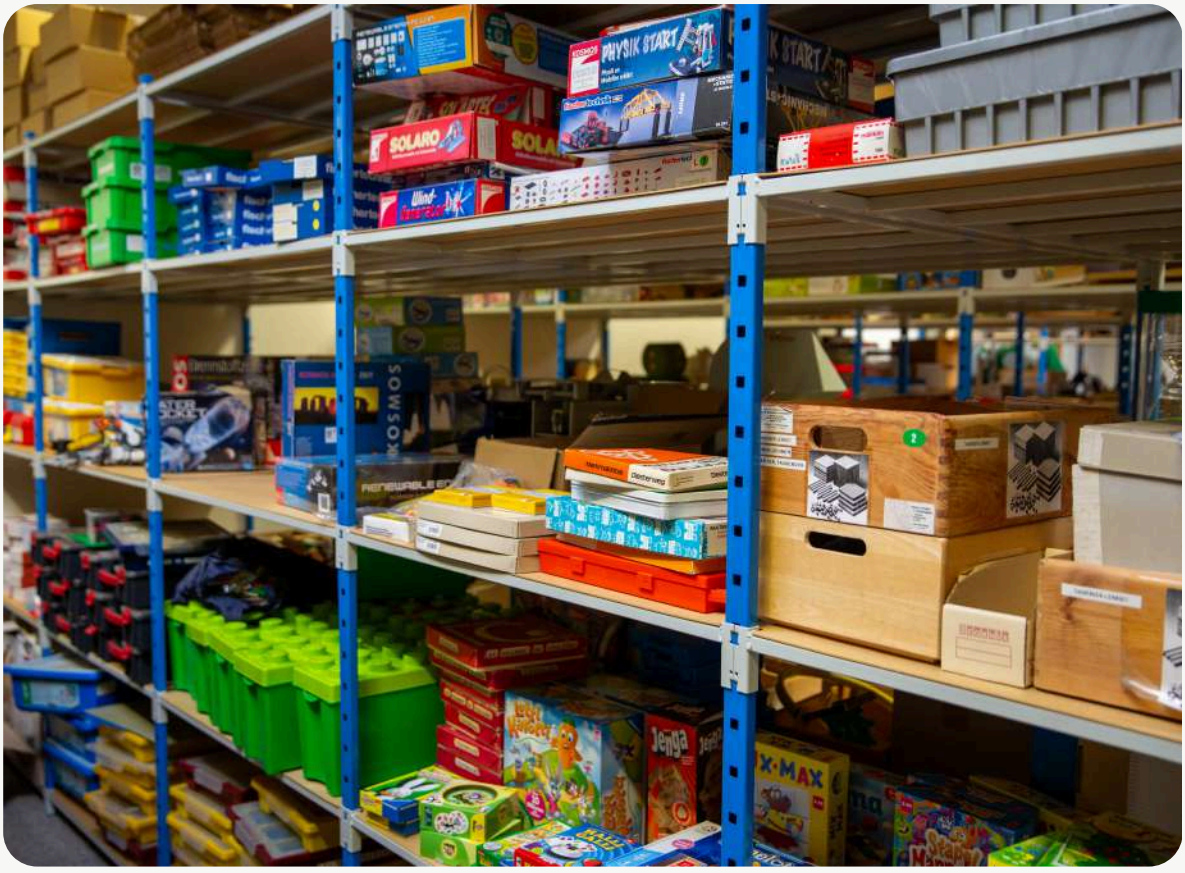
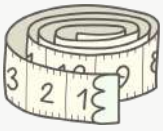


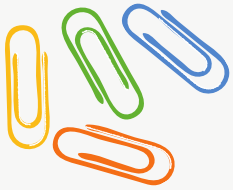
Photo by Nicolas Donnerup

Light and shadows materials

Included in the “Light and Shadows” materials kit are:

- Three picture books (1 x Finestre, by Lola Svetlova; 1 x Jeu d'Ombres, by Hervé Tullet; 1 x Schatten, by Suzy Lee)
- Flashlights
- Different prisms
- Juggling scarves
- Translucent color paddles
- RGB lights





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!

Stimulate children's imagination and curiosity about light and shadows by diving into these playful shadow-themed stories with them.

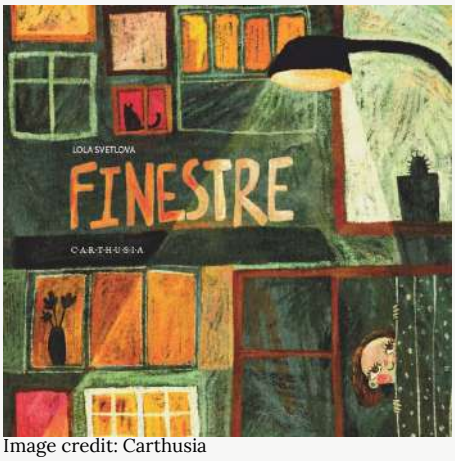


Image credit: Carthusia

Finestre, by Lola Svetlova

In this wordless book, a girl looks at the windows of a building across the street from her house one evening, and is puzzled by the shadows she sees. When what is happening behind the shadows is revealed, we learn that sometimes things are not what they seem.

Jeu d'Ombres, by Hervé Tullet

Grab a flashlight and shine its light on the pages of this book to solve the mystery of where the noises in the garden are coming from.

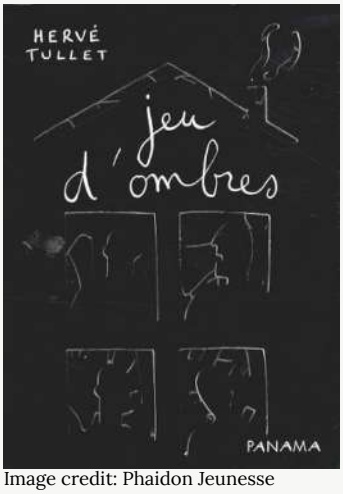


Image credit: Phaidon Jeunesse

Image credit: Bastei Lübbe (Baumhaus)

Schatten, by Suzy Lee

A dark attic full of objects and a light bulb are all that is needed for a little girl to enter a world of imagination through play in this wordless book.

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.

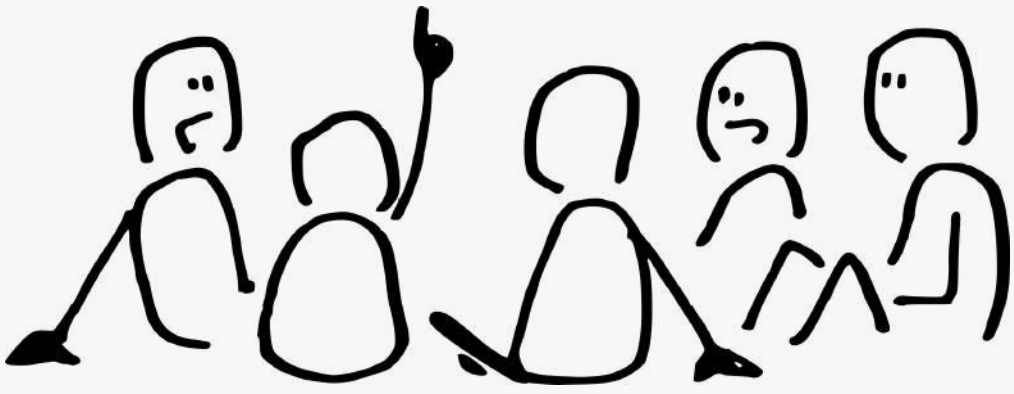
From these pair discussions you can move into a whole-class brainstorming. Consider recording ideas from the discussion on a chart with visual cues as well as words and adding to the list as you move through the different investigations.

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**!

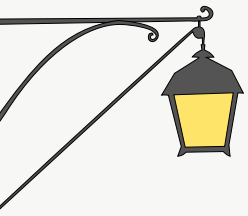
Research findings overall highlight that open-ended structures can create space for children to pursue their wonderings as they creatively engage with play, make observations, test things out, ask questions, exchange ideas and come up with conclusions about scientific phenomena.

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



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

- Explain shadows to someone who does not know what they are.
- Think about your own shadow and shadows of objects, trees and buildings you have seen. What is interesting about them?
- When do we see shadows? How do shadows come to be?
- Can you find any shadows in your current space?

Create a mind map with your ideas.

Brainstorming

How do shadows work?

Here are more suggestions of prompts to discuss and investigate with students:

- How can you make a shadow change?
- Can something have more than one shadow?
- Can shadows have color?
- Can light have a shadow?
- Can shadows get wet?

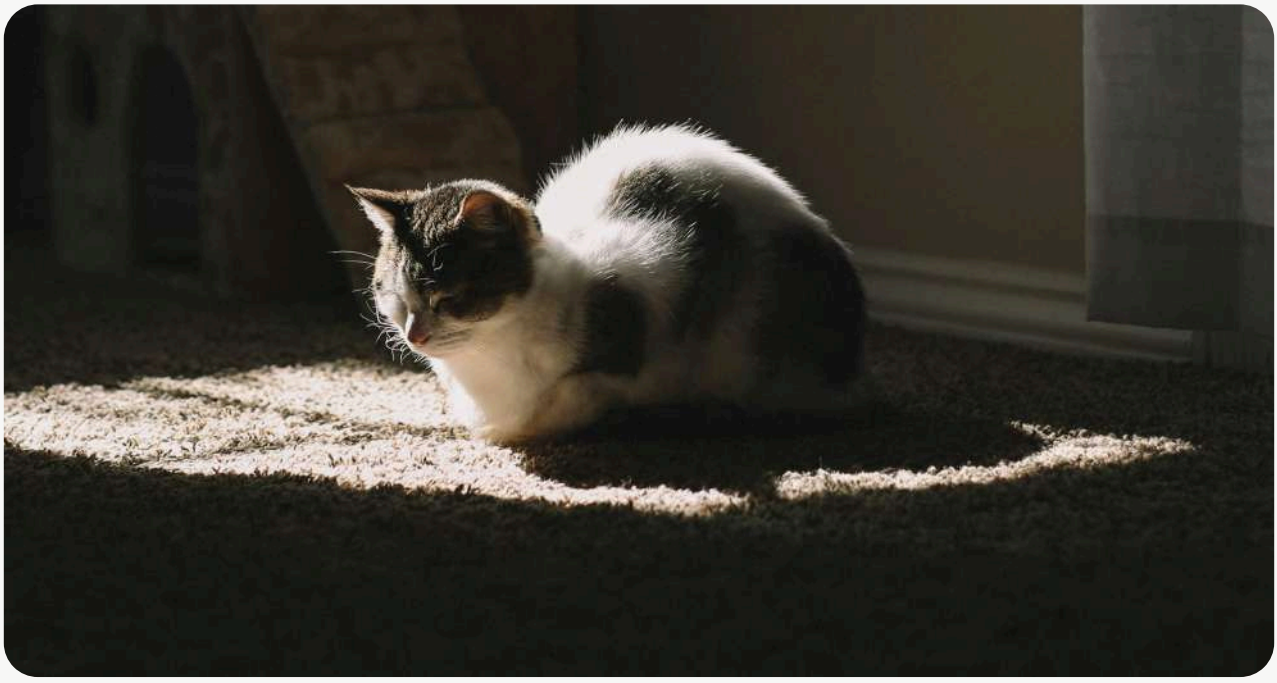


Photo by Justin DoCanto on Unsplash

Playful exploration

Ask and prompt your students:

Set up different light sources and objects for exploring shadows:

- With classroom objects of different shapes
- With shadow puppets
- By combining bodies and objects

Teaching tip:

Challenge students to create really, really long or short shadows. Then provide them with rulers to measure shadows and report their results to others. This way you can connect scientific exploration to mathematics.

Now consider:

- What did you notice during your explorations?
- Did anything surprise you?
- What are you still wondering about?
- Present and discuss your (students') documentation to the other children in your class.

Exploring further:

Bring the exploration outdoors! Go outside and trace shadows at different times of the day. Then discuss what changes, how and why.

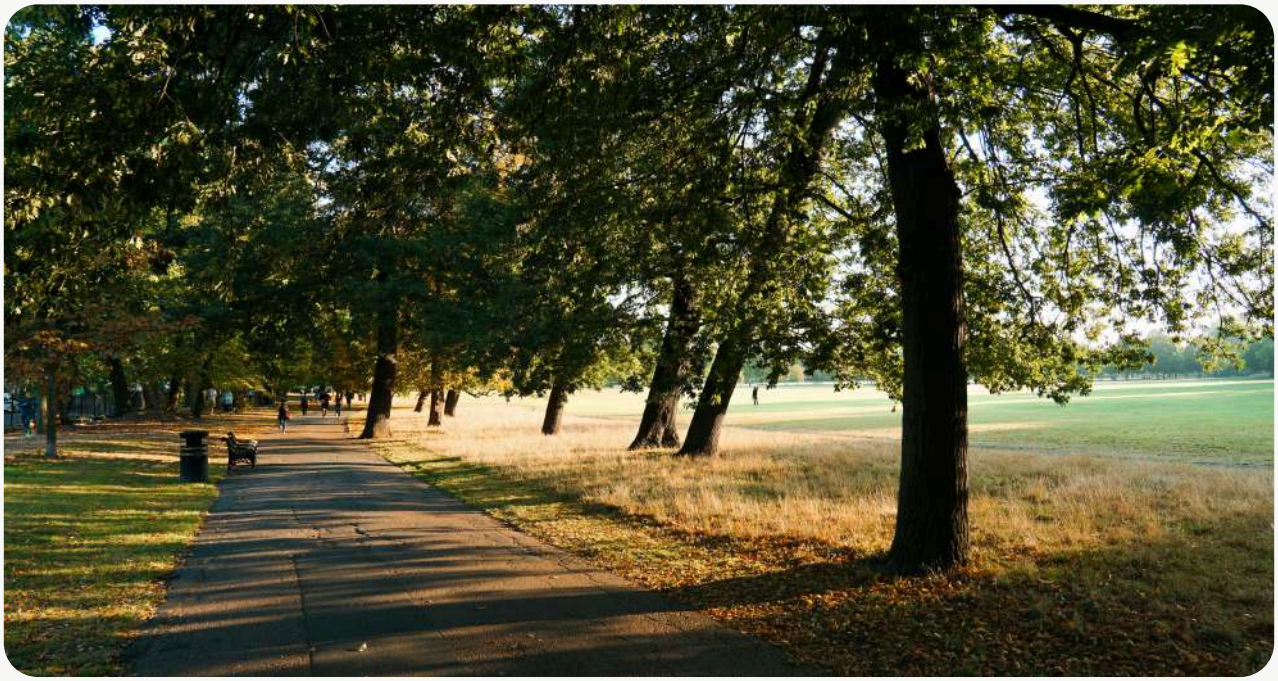


Photo by Jon Foster on Unsplash

Finestre

Read Finestre, by Lola Svetlova, with your class. This story shows us that shadows can be misleading, and silhouettes can hide surprises. Explore this concept with your students by trying the following activities:

Recreate

Ask students to recreate different shadows from the story.

Guess

Have students prepare silhouettes that seem to be one thing but in reality look like another (e.g., a snowman-like outline could actually be a cat) and play a guessing game. For this activity, students can use drawings or create shadows between a white sheet and a light source.

Drawing by Lola Svetlova from Finestre

Shadow theater

Shadow puppetry is an early form of storytelling present in cultures across the world. Become a part of shared history and organize your own shadow theater! Prompt students to:

- Design shadow puppets and tell a story with them.
- Create and present a shadow dance number.
- Investigate examples of shadow play in different cultures across the world.

Photo by Daniela Bertoli

Photo by Daniela Bertoli

Stop-motion animation

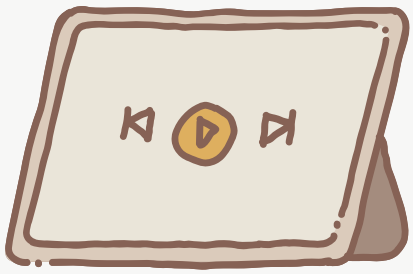
Did you know that the oldest surviving animated feature film was made using shadow puppets? **The Adventures of Prince Achmed** is a German film from 1926, written and directed by pioneering animator Lotte Reiniger.

Inspired by the **One Thousand and One Nights** stories, Lotte and her team created a film with cardboard cutouts, creating movement frame-by-frame. This technique is called stop-motion, when objects are physically manipulated in tiny movement between individually photographed frames.

Still from The Adventures of Prince Achmed (1926, dir. Lotte Reiniger) on Milestonefilms

In small groups create your own stop-motion animation with shadow puppets!

1. Brainstorm an idea for the story. Who would be the main character(s)? What would they say or do? Where would it be set?
2. Prepare the setting (it can be a simple white background, a drawing or some cutouts made by children).
3. Have children make shadow puppets using paper or carton.
4. Assign the roles with children (puppeteers, camera operator, set manager) and practice the story, without filming it.
5. With a camera in a fixed position in front of the frame, have children take a photo each time after slightly shifting the position of items within the frame.
6. Ask students to record a voiceover, provide sound effects, or play music to use for the film.
7. Assemble the photos in succession either using apps (search online for stop-motion animation apps) or in editing software (e.g., iMovie or Microsoft Movie Maker). Remember to add the sound.



Exploring light

Light is necessary to create shadows, so let's explore light and how it works! Here are some suggestions of activities to engage children in investigating light. Remember to dim the lights before you start.

Prisms and mirrors

Make different prisms, mirrors and reflecting objects available for children to investigate with different light sources.

Transparency, translucency & opaqueness

Provide transparent (all light passes through), translucent (some light passes through), opaque (no light passes through) objects for children to investigate with light.

Water droplets

Ask children to spray water from a spray bottle directly into a light beam. Document this using slow-motion video for later discussion.

Colorful light

Have children attach pieces of colorful cellophane paper to flashlights using elastic bands. Prompt them to test how the light changes.

RGB color mixing

Following up on the previous activity, ask children to place three flashlights with beams of different colors (red, blue, and green) next to each other, projecting their lights onto a wall.

Have them walk, dance and play in front of the lights, while observing what happens with their shadows on the wall.

Then, guide children to experiment with modifying the angles of the flashlights and the spacing between them to see what changes. Playing music during this exploration adds a sensorial layer to it.

Photo by Sergei Glotov

Explore further

Here are other inspirations:

Shadows and Animation

Learn more about Lotte Reiniger, her art and legacy. Search for *The animation genius you've (probably) never heard of* at bbc.com, or follow this link.

Shadows and Dance

Check out Shadowland, a dance spectacle by Pilobolus, at pilobolus.org/shadowland.

Shadows and Diversity

Read My Shadow is Pink (available for loan at the SciTeach Center) with your class, a book about a boy who wanted to wear a dress.

Image credit: BBC

Image credit: Pilobolus

Image credit: Larrikin House US

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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

Notes

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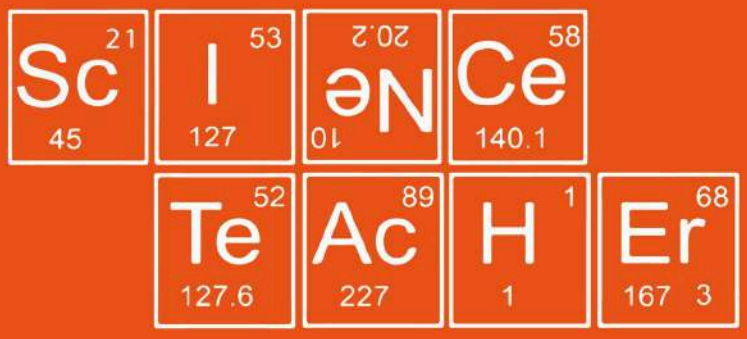
EarlySTEAM Guide



SciTeach Center

UNIVERSITY OF LUXEMBOURG
MAISON DU SAVOIR, ATELIER 4.550
2, PLACE DE L'UNIVERSITÉ
L-4365 ESCH-SUR-ALZETTE
T +352 466644 9339

FOR MORE INFORMATION
UNI.LU/FHSE-EN/SCITEACH-CENTRE

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