SciTeach Center

Université du Luxembourg

ifen
INSTITUT DE FORMATION DE L'ÉDUCATION NATIONALE

Fondation Veuve Emile METZ-TESCH
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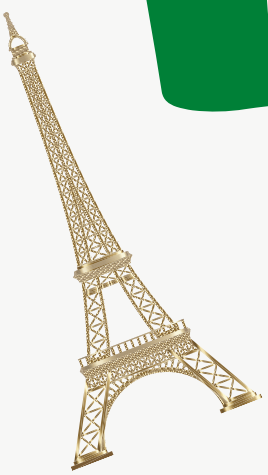
The SciTeach Center

Bridges & Towers

Teacher Guide



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

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Booklet design by Daniela Bertoli and Sergei Glotov in Canva.

Funding by Fondation Veuve Emile Metz-Tesch.

Contents

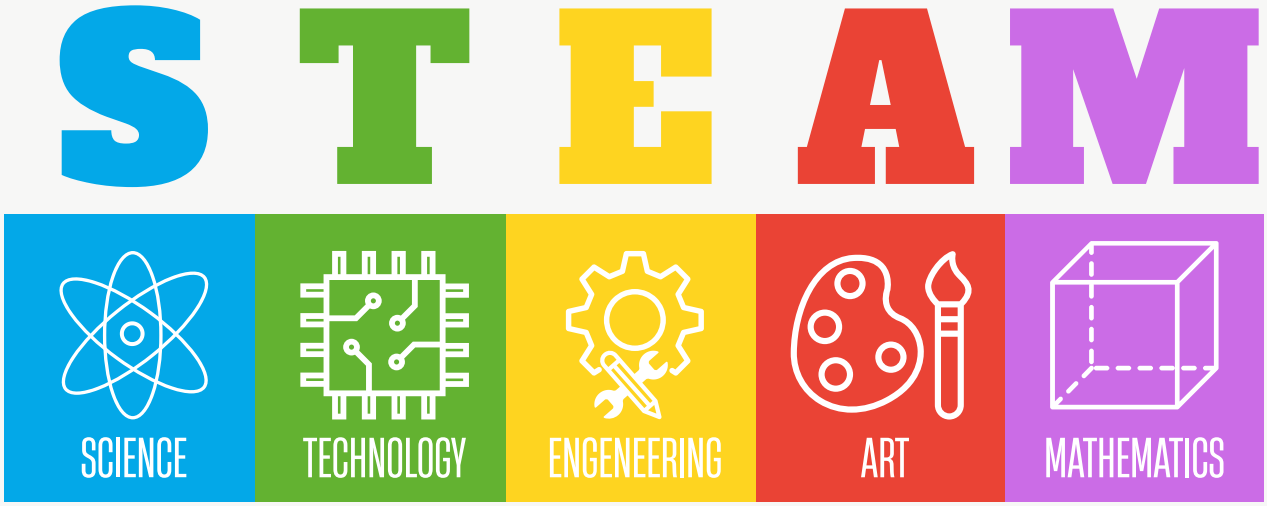
Introduction

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 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.

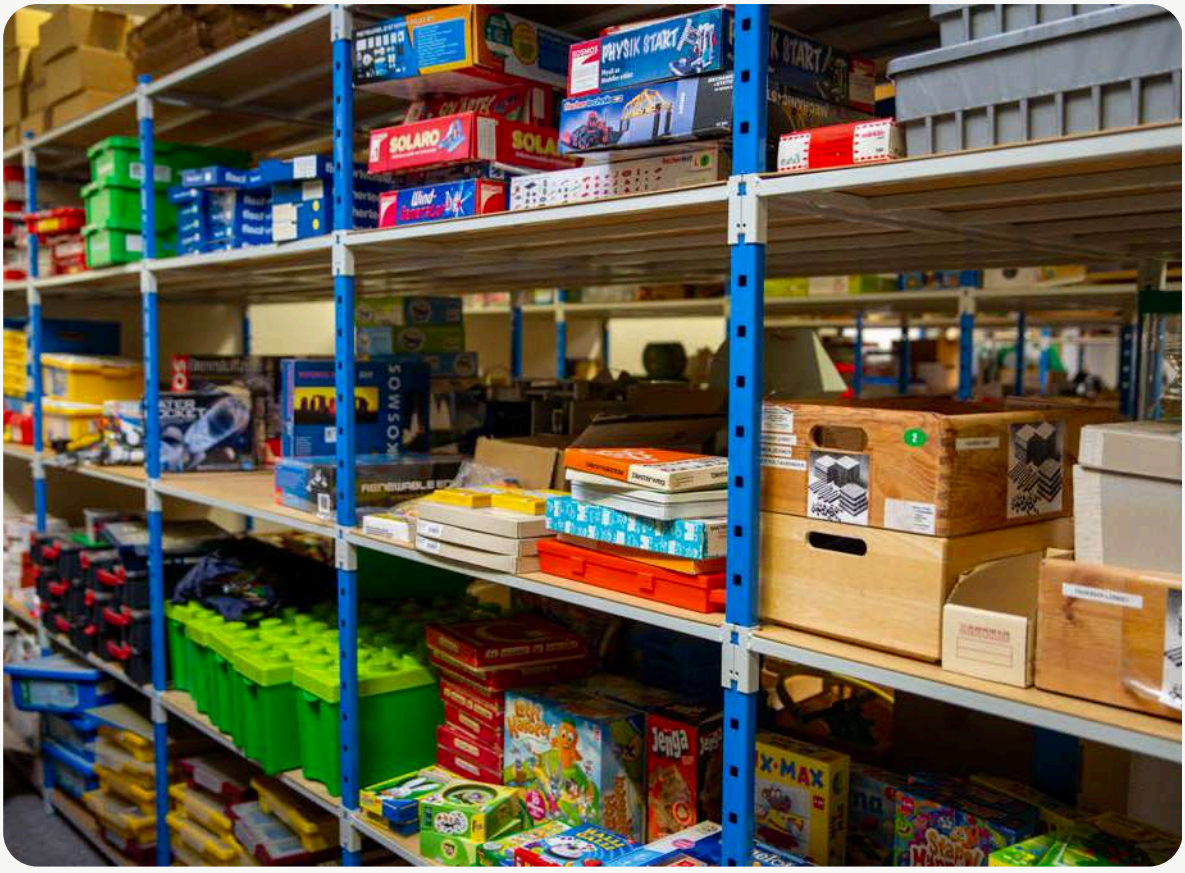


Photo by Nicolas Donnerup

Bridges materials

As Bridges and Towers is a broad topic, we provide two Material Kits: one for Bridges and one for Towers. You are welcome to loan both!

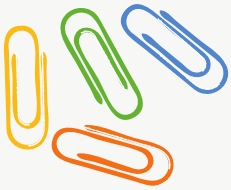
The “Bridges” Materials Kit includes:

- Two picture books (1 x Twenty-one elephants and still standing, by April Jones Prince and François Roca; 1 x Drei Ziegenböcke namens Zack, by Mac Barnett and Jon Klassen)
- One non-fiction book (Brücken Ein Sachbilderbuch für Kinder ab 5 Jahren, by Marc Majewski and Cornelius Hartz)
- Laminated photos of bridges around the world
- Laminated map of a fictional town
- STEAM Explorers Bridge builders set
- Wooden elephants

Towers materials

The “Towers” Materials Kit includes:

- Three picture books (1 x Rapunzel, by Rachel Isadora; 1 x Manpunzel: A Hairy Tale, by John Mashni and Kate Cosgrove; 1 x Rapunzel, by Bethan Woolvin)
- HABA Crooked Towers set
- HABA Wooden blocks
- Laminated photos of towers around the world



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, hi tape, paper, paper clips, scissors, paper (varied sizes, colors, textures)

Stories: Bridges

Get comfortable, dim the lights, and read together!

Unlock children's imagination about bridges and towers by reading the following stories:

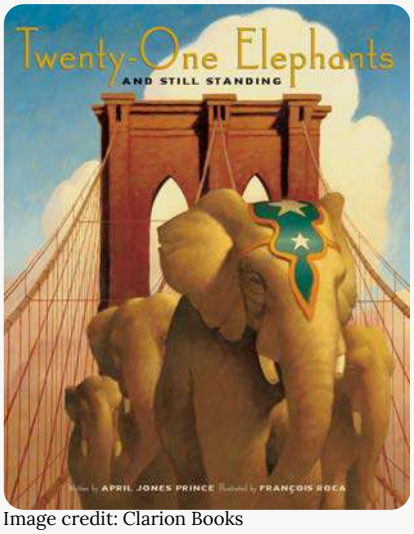


Image credit: Clarion Books

Twenty-one elephants and still standing, by April Jones Prince and François Roca

After 14 years of construction, the Brooklyn bridge was inaugurated in 1819 with much fanfare. However, some people wondered if it was safe and how much weight it could bear. Then, a showman decided to bring in particularly heavy passengers to put it to the test.

Drei Ziegenböcke namens Zack, by Mac Barnett and Jon Klassen

When trying to cross a bridge, three goats need to face the very hungry troll who lives under it. Will they be able to outsmart the troll and avoid being his next meal?

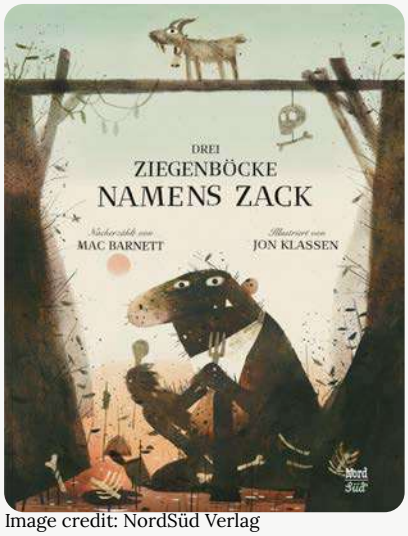


Image credit: NordSüd Verlag

Stories: Towers

Image credit: Peachtree

Rapunzel, by Bethan Woollvin

In this retelling of the classic story, Rapunzel proves to be fearless and quite resourceful to save herself from the evil witch.

Rapunzel, by Rachel Isadora

Rapunzel lived happily with her family until a sorceress took her away and locked her up in a tall tower. Trying to escape, she lets a prince climb her long dreadlocks up to the top one day. However, the sorceress finds out and pushes him off the tower. Now, Rapunzel needs to find a way to break free and reunite with her brothers and the prince.

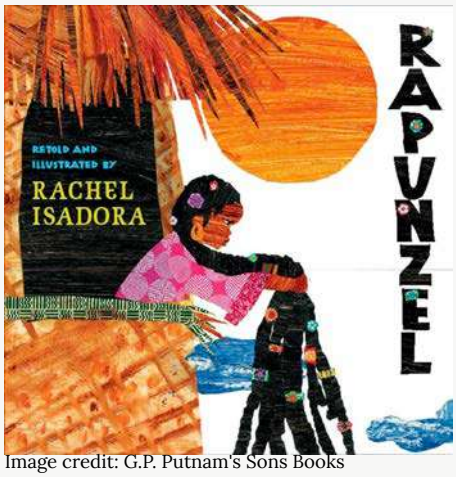


Image credit: G.P. Putnam's Sons Books

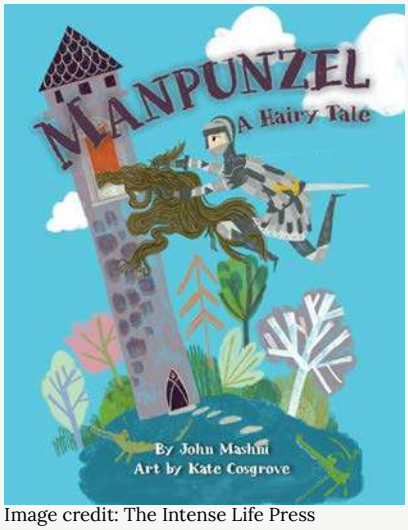


Image credit: The Intense Life Press

Manpunzel: a hairy tale, by John Mashni and Kate Cosgrove

A knight sees a mysterious tower and something similar to a rope hanging from it. When he decides to climb up, little does he know there is a very hairy surprise waiting for him at the top! Prepare for the unexpected in this unique version of the Rapunzel fairytale.

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.

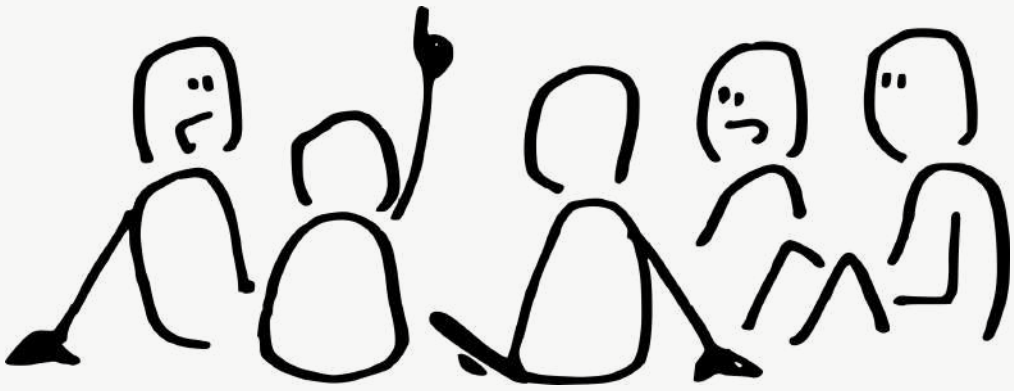


Photo by Chuttersnap on Unsplash

Bridges

Brainstorming

Where do we see bridges?
Why do we need bridges?

Bridges are around us, and their sight is so familiar. Ask students which bridges they know in their communities, and make a list. Then, explore the questions above with your students.

Photo by Marc Blue on Unsplash

Teaching tip:

Before asking any questions, ask children to draw a bridge. You can use their drawings as a starting point for the discussion.

Let's compare!

Use these photos (provided in the Materials Kit) of different bridges and ask students to categorize them. Allow students to come up with categories on their own. Afterwards, discuss their reasoning behind the groupings.









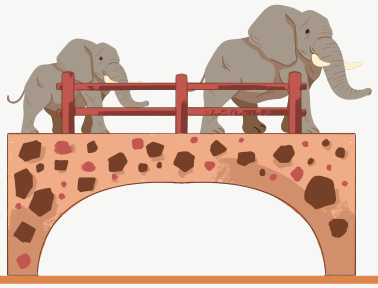



Photo 1 by Joshua Kettle on Unsplash; Photo 2 by Aveedibya Dey on Unsplash; Photo 3 by Ali Nuredini on Unsplash; Photo 4 by Nguyen Minh on Unsplash; Photo 5 by Yehor Litsov on Unsplash; Photo 6 by Moritz Kindler on Unsplash; Photo 7 by Lin Mei on Unsplash; Photo 8 by James Forbes on Unsplash; Photo 9 by Lee Robinson on Unsplash; Photo 10 by Elina Radionova Girsa on Unsplash; Photo 11 by Connor Mollison on Unsplash; Photo 12 by Laurynas Žižys on Unsplash

Stable bridges

How does the shape of a bridge affect its strength and stability?

In the "Twenty-One Elephants" story, some people wondered if the bridge was strong enough. Now, ask children to pretend that they are engineers, and build a stable bridge with only two pillars (e.g., books or wooden blocks) and one sheet of thick paper. Can they make a wooden elephant to stand on top of the bridge? Encourage exploration through trial-and-error.



Now consider:

- What makes a bridge strong?
- Which shapes are better and why?

The solution here is to fold the paper accordion-style. The folds act as beams where the weight is more evenly distributed, so the bridge doesn't collapse when you place the elephant on top.

Plan a bridge

On the next page, you find a map of a fictional town - Keinebrücken, located somewhere between Saarbrücken and Zweibrücken. This small town has been expanding, and now the townsfolk have decided to build a bridge across the river to connect its two sides. However, they only have resources for one bridge.

Ask students to examine the map (included in Materials Kit). Can they help the townsfolk decide where to build the bridge? Have students explain the reasoning behind their choice of location.


Offices


Mall


Houses


Hospital


City Park


School


Cafe


Stadium


Church

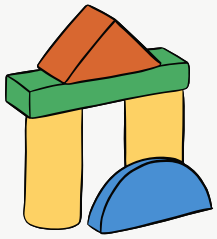

Farm


Playground

Shop

Building a bridge

Thanks to your students, the town is about to have a bridge. Now that the location is decided, encourage students to build a prototype using everyday materials.



Suggested materials

- Wooden blocks
- Cups
- Bottles
- Egg containers
- Corks
- Clothespins
- Toilet paper rolls
- Boxes
- Cardboard
- Straws
- Sticks
- Modelling clay
- Tape
- Kapla

Teaching tips:

Instead of open-ended constructions, you can also challenge students to:

- Build a bridge with only one material
- Build a bridge with only one pillar
- Build a curvy bridge
- Build the tallest possible bridge
- Build a two-layered bridge

Now consider:

- What story can students tell about their bridge?
- What was important for students during the construction?
- How did they decide on the overall look of their bridge?

Further activities:

- Bring the exploration outdoors! Go outside and explore the bridges in your commune, both big and small. What kind of bridges are they? Ask students to draw these bridges and discuss their characteristics, functions, lengths, and materials.

- One of the most iconic bridges in Luxembourg is the Red Bridge/ Grand Duchess Charlotte Bridge. Ask students to interview people in their community to find out about the history of the bridge and the changes it underwent through time.

Photo by Procrastineur49 on Wikipedia

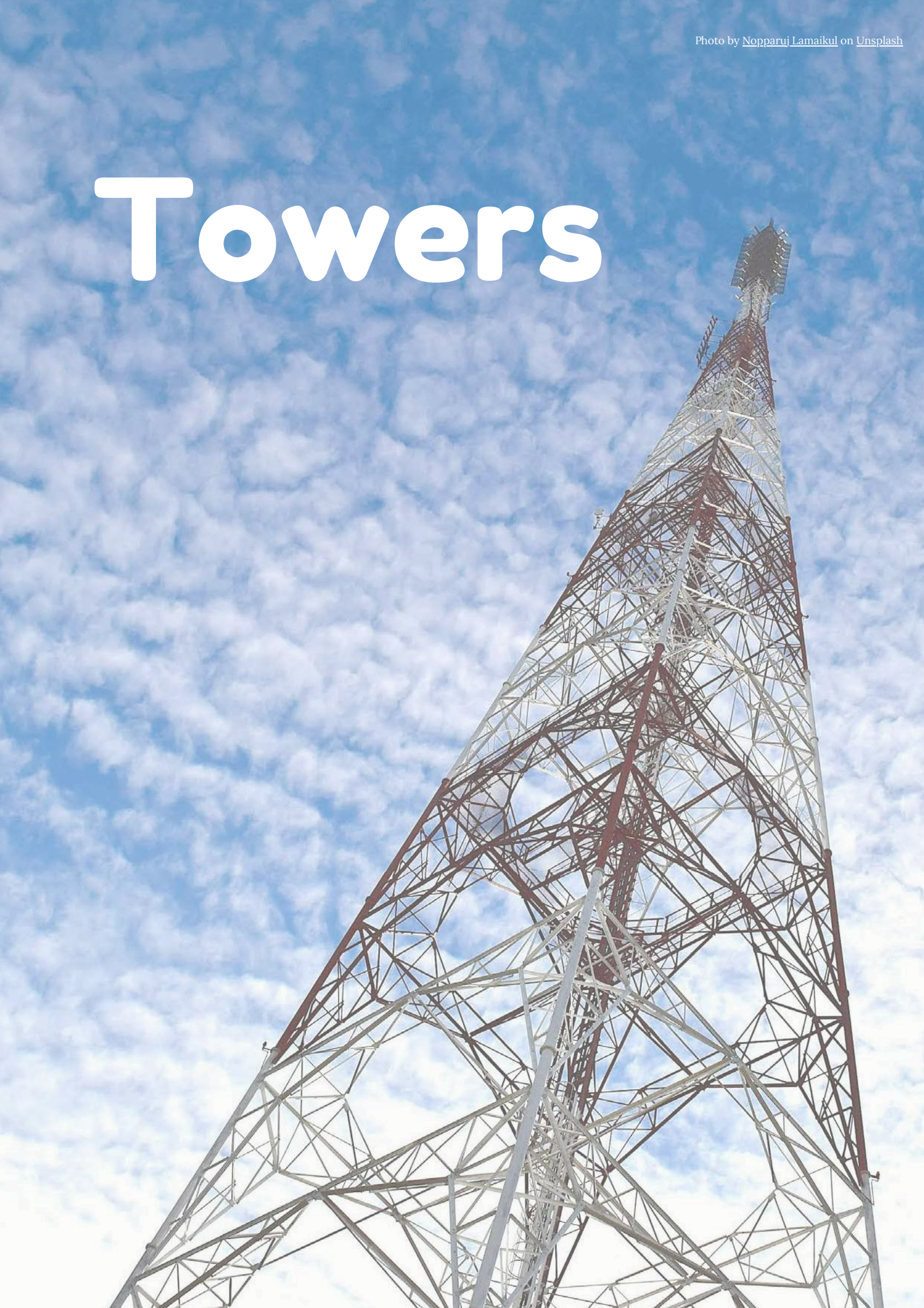


Photo by Nopparuj Lamaikul on Unsplash

Brainstorming

What is a tower?
What towers do you know?
What types of towers exist?

On the surface, the answer to the "What is a tower?" question seems obvious. However, for example, what distinguishes a tall building from a tower?

In English, the word “Lighthouse” has a house in it, since a person operating it used to live there, hence “house”. However, in German, the same word is “Leuchtturm”, meaning “glow/shine” (leuchten) and “tower” (turm). So is it a house or a tower?

Photo by Fabian Navarro on Unsplash

Brainstorming

Ask and prompt your students:

- Look closely at the photos of different towers.
- What are the similarities and differences between them?

Now consider:

- What happens/used to happen inside these towers?
- What materials were the towers built with?
- What are the reasons for building these towers?
- How does the purpose of a tower affect the choice of materials it is built with?







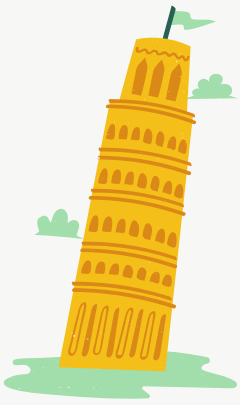





Photos 1, 2, 4, 5, 6, 7, 8, 9, 10 by Sergei Glotov. Photo 3 by Mr Xerty on Unsplash; Photo 11 by Sini Tiainen on Unsplash; Photo 12 by Niccolo Candelise on Unsplash

Building a tower

Read one of the provided versions of the Rapunzel story. When discussing the tale, ask the children: If they were to live in a tower, how would they want it to look like? Inspired by the book, ask students to build any tower of their choice.



Suggested materials

- Wooden blocks
- Cups
- Bottles
- Egg cartons
- Corks
- Clothespins
- Toilet paper rolls
- Boxes
- Cardboard
- Straws
- Sticks
- Modelling clay
- Tape
- Kapla

Teaching tip:

Instead of open-ended constructions, you can also challenge students to:

- Build a tower with only one unconventional material
- Build the tallest tower possible
- Build a tower that is hollow inside, so it can house a small toy
- Build a tower that only has one building block as a base
- Build a leaning tower (similar to the one in Pisa)

Ask and prompt your students:

- Create and tell the story of your tower.
- Consider where they would place their tower and why.

Now consider:

- What did the students notice during the construction process?
- What was planned and what was eventually built?
- What were the factors that influenced change, in case it happened?

Explore further

Here are other things you can try:

1. Have children build towers and knock them down with balls. This movement activity will support gross motor skills & hand-eye coordination.

2. How would Rapunzel see the world from the top of her tower? Explore perspective and ask children to draw something in their surrounding from above, by taking them to the top of stairs or upstairs windows.

3. In her book, Rachel Isadora uses collages with different colors and textures to tell the story. Inspired by her art, have students create a collage of their tower, or their favorite part of the Rapunzel stories you read.

4. Ask children to bring family photos of towers they've visited. What's the story behind the photo? Where and why was it taken? Have students bring a picture, share their stories and describe the towers in it.

5. Set up a Rapunzel dramatic play corner in your classroom. Build a tower using milk cartons or large cardboard boxes. Add pieces of fabric and a long braid made of yarn, so children can dress up.

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SciTeach Center

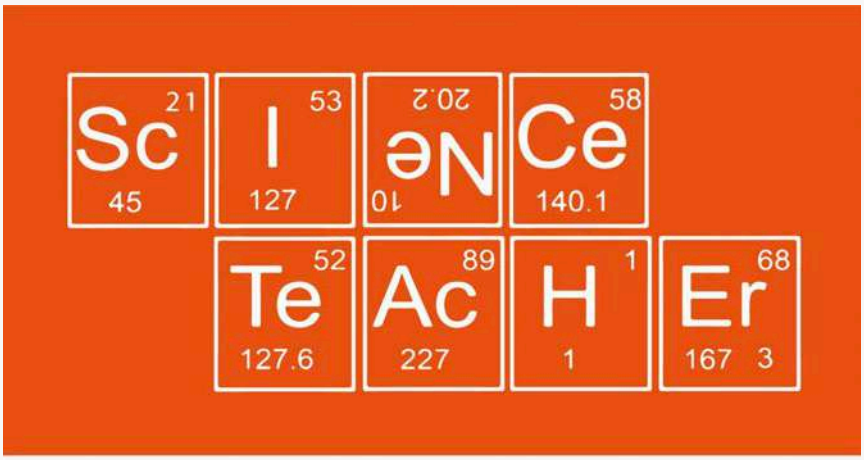
The SciTeach Center was opened in 2016 via a partnership between the University of Luxembourg, the Ministry of Education, the Ministry of Higher Education and Research, and the National Research Fund. Since then, the SciTeach Center continues to develop initiatives that are diverse in location (at the 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.

Bridges and Towers
EarlySTEAM Guide



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ISBN 978-99987-641-0-1