ALEX catches the echo

Felicitas Fröhlich

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This book is for all children who like to explore their world and express their curiosity. It is meant to show them how open the path ahead of them is, free from gender stereotypes. This story is meant to remind adults how important it is to give children a chance to choose their own paths in their lives!
I am glad that I have always had such people by my side in my lifetime, and I would like to dedicate this book to the "real" Grandma Anni, my mother Marianne, and the "real" Uncle Roli, my partner.
We would also like to thank Martin Hagmüller from the Institute of Signal Processing and Speech Communication, Tinou Ponzer from VIMÖ and Lisa Mittischek from the GenderWerkstätte for their advice. Without them, the book could not have been created in this form.

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Once upon a time,
there was a child named
ALEX.

Alex was very curious and wanted
to know how everything worked.

Especially how sounds and
noises travel through the air.
Alex had a grandmother named Anni.

Grandma Anni's house was in a small
valley surrounded by high mountains.

Whenever someone was behind
the house and shouted something out,
there was a beautiful

ECHO.

Alex was fascinated by the echo.

“How can I hear my own voice,
when I'm standing right here
behind the house?"

(Why is this? You can find out on page 50.)

Alex could also observe something
strange during thunderstorms:

The lightning appeared right away –
but it took longer to hear the

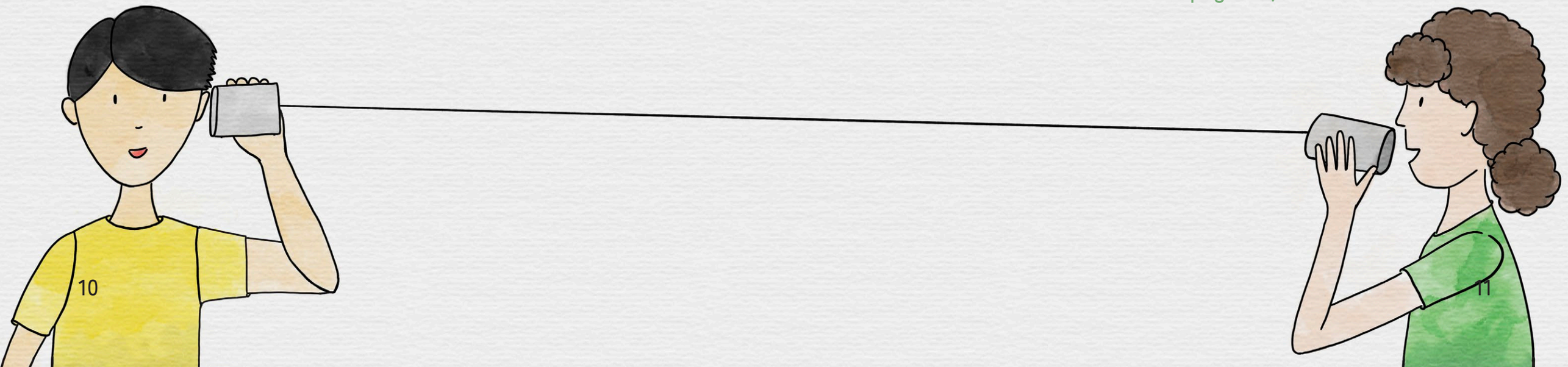
THUNDER.

Together with Ina, Alex did many experiments in the kindergarten.

They also built a

TIN CAN TELEPHONE.

(If you want to build one too, then look on page 49.)



On a kindergarten field trip to a
GROTTO,
Alex was especially excited.

Alex knew that you could hear
a particularly good echo
in grottos and caves.

“Come on, Tim, do you want to hear
the echo again?” asked Alex.

When Alex and Tim ventured a little bit
further into the grotto, they spotted

BATS.

Tim knew a lot about bats.
He even thought that they could
‘see’ in the dark with their ears.

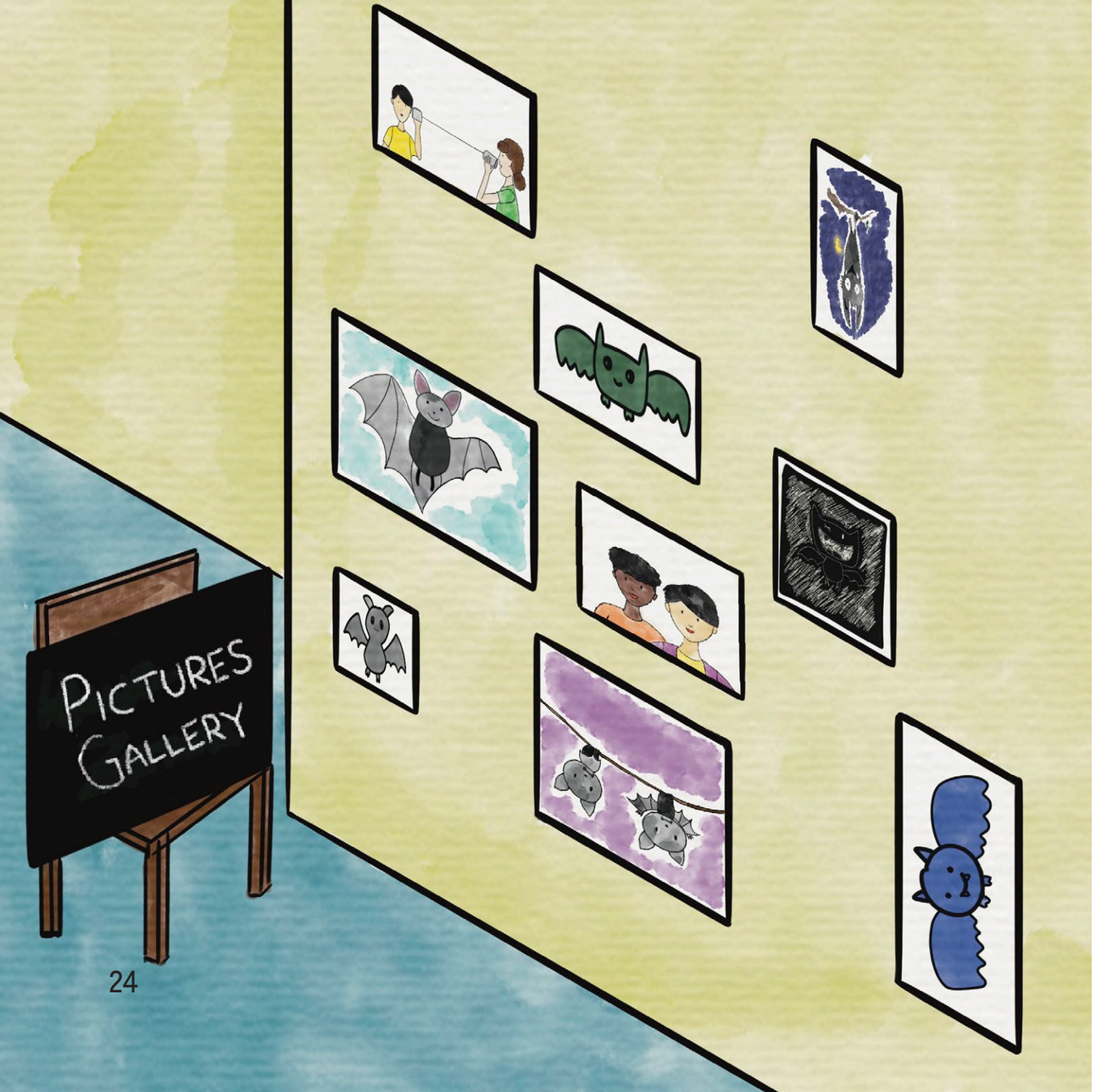
Once the class had returned from the
field trip, Alex immediately asked Harry,
the kindergarten teacher,
“Is it true that bats have
EARS
that can ‘see’?”

Harry brought Alex a **BOOK**
from the reading corner about animals.
It had a large chapter on bats.

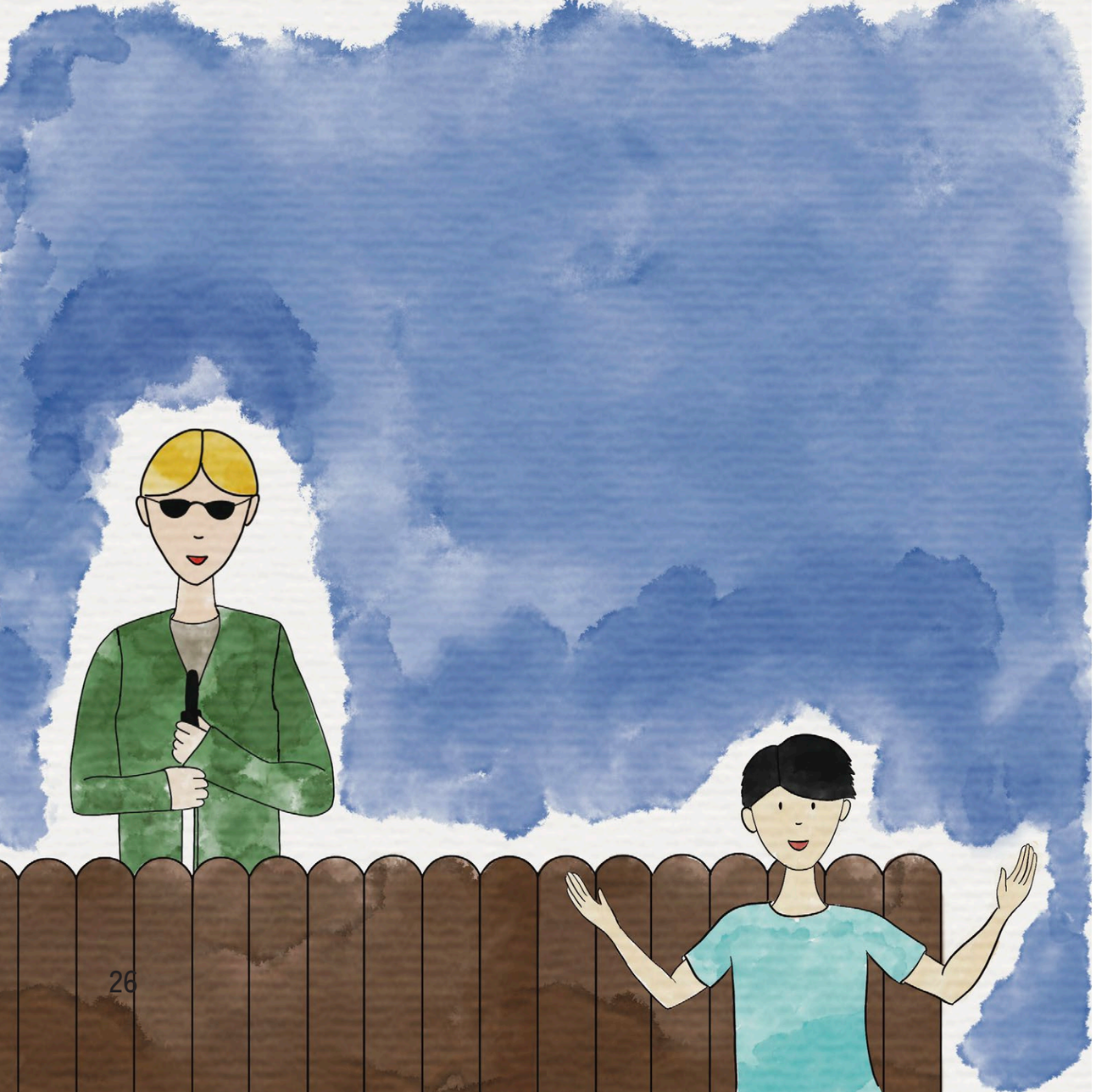
The pictures in the book showed
how bats use their hearing to detect
small animals as well as large objects
like trees that are in their

FLIGHT PATH.

Alex thought that was amazing. In the
DRAWING CORNER,
he immediately started to draw bats.
Ina and Tim joined in.



When pictures where finished,
they were even hung up in the
PICTURE GALLERY
at the kindergarten.



On the way home, Alex met

MR. STEFAN,

a neighbour, and told him
about the exciting field trip.

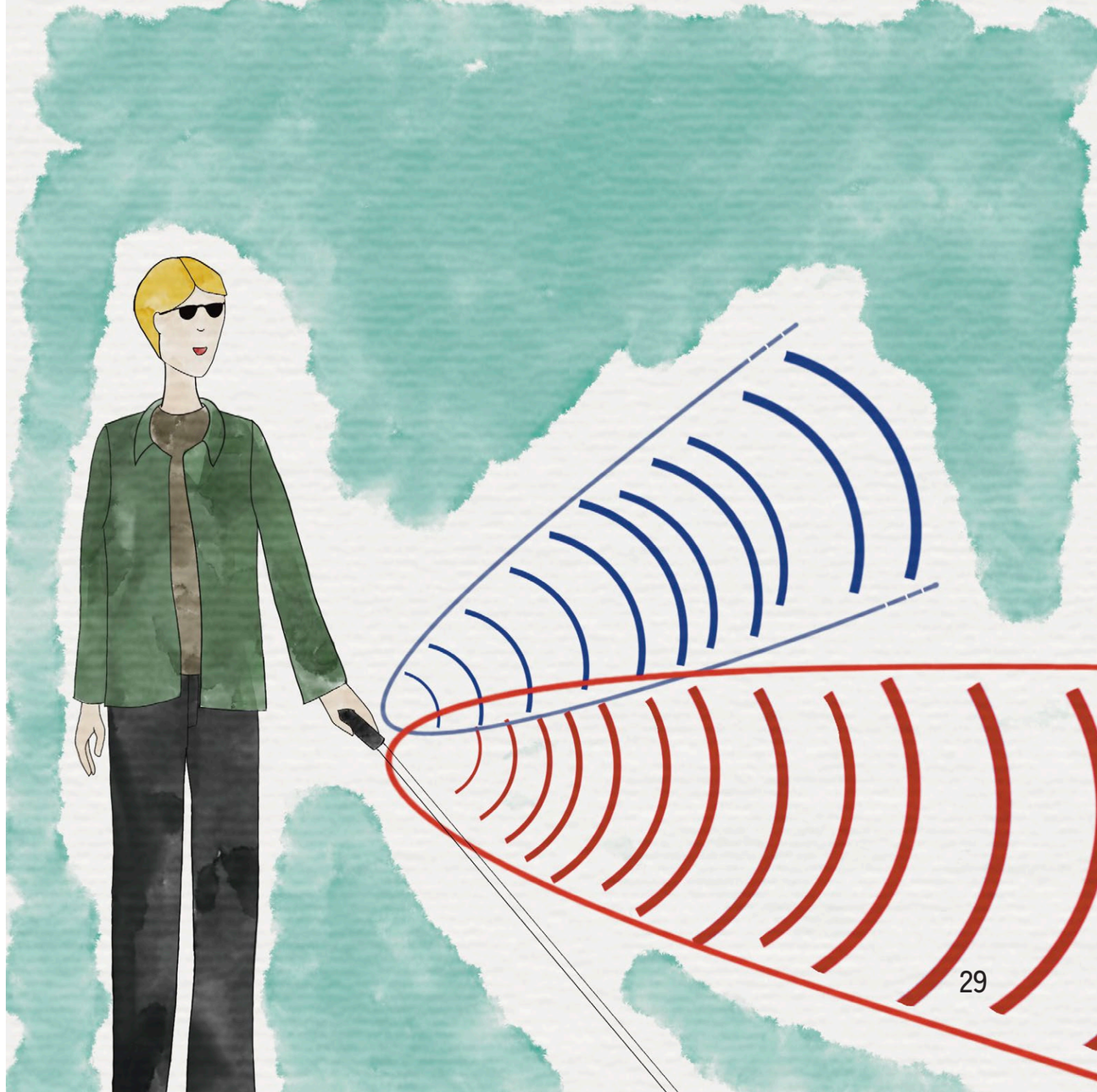
Mr. Stefan then shared some great information. “I also can't see, and that's why I have this cane!

It's not just any cane, though. It has a

SUPER POWER!

Like a bat, it helps me ‘hear’ what's in front of me and can let me know if I’m about to run into something. It has a small device built into the handle that give it this super power.

There aren't many of these canes for blind people yet. I get to try it out. But soon more people with a visual impairment will be able to use it.”



“Really? That's great, so you have a
‘BAT-POWER’ WHITE CANE!”
exclaimed Alex delightedly.
Mr. Stefan had to grin.

The next day, Alex gave Stefan a little homemade bat made of paper that could flap its wings.

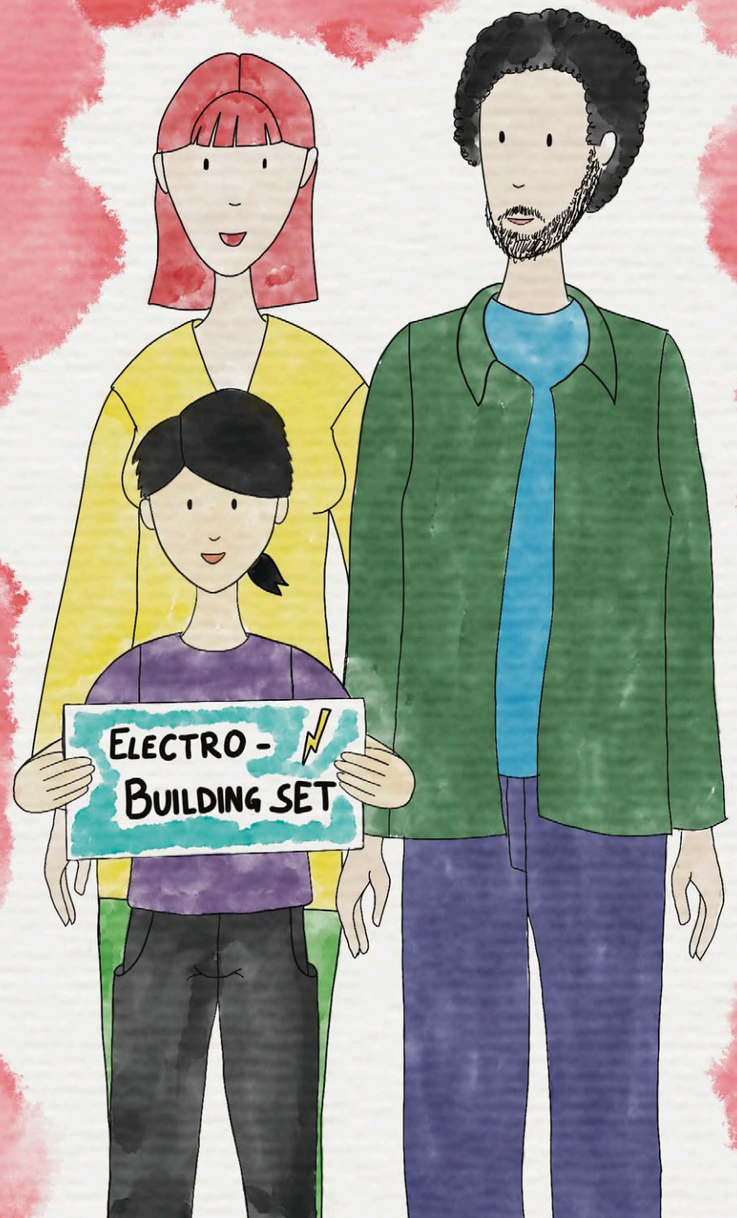
(If you want to know more about the ‘bat’ white cane, check out page 51.)

Even at school, Alex still found sounds
and echoes fascinating.

Once Alex took apart an old **RADIO**,
to see what was hidden inside and
thought to himself,

“Funny, there are a lot of wires and
connections. But how does it all work?”

Alex had become curious.



That's why Alex got a

CIRCUIT CONSTRUCTION KIT

as a present from
Aunt Martina and Uncle Roli.

With the kit, Alex could safely discover how electricity produces sound.

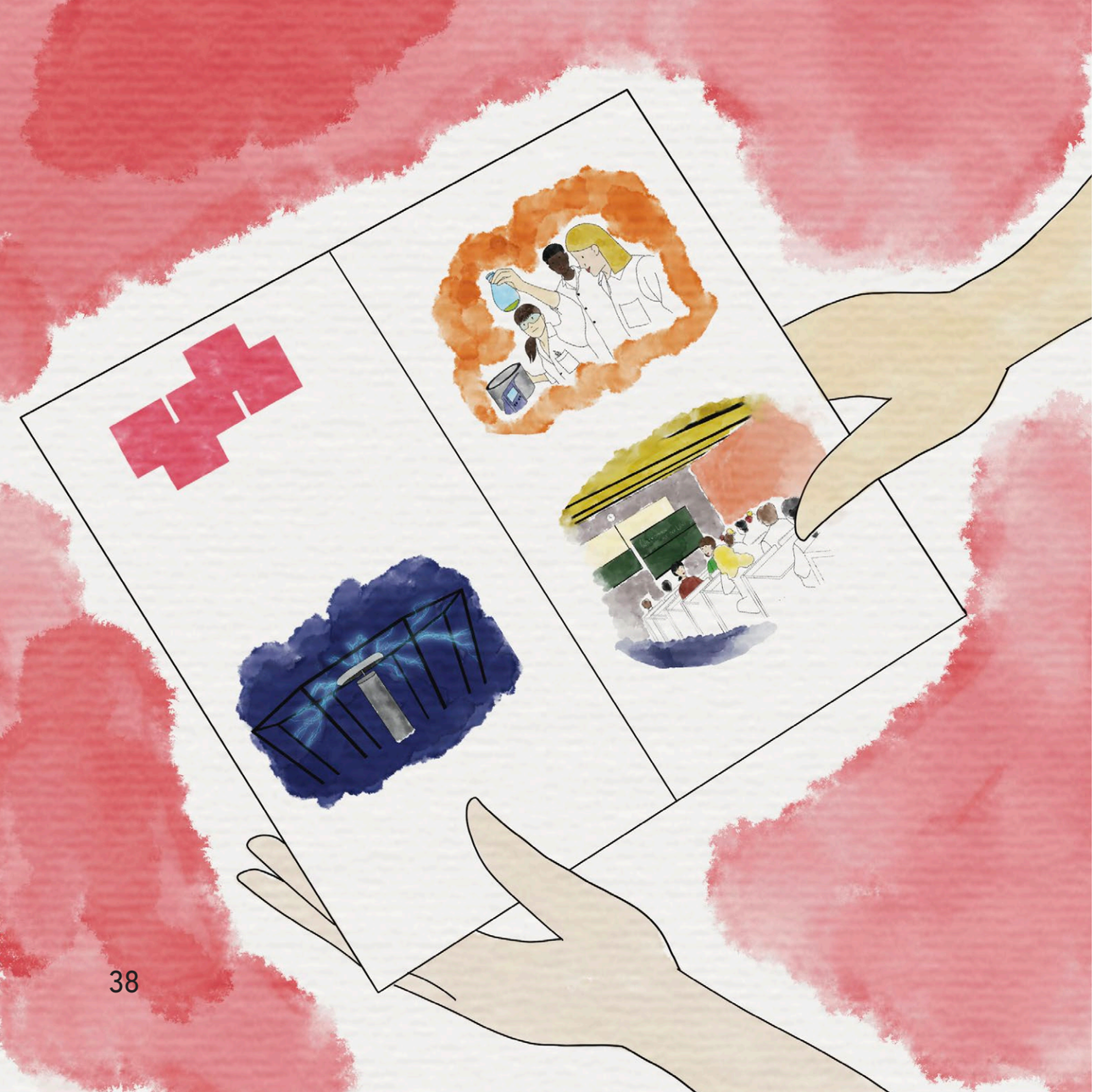
Alex loved to experiment with these things. But would doing experiments like this also be possible later in professional life?

Towards the end of school,
Alex went with Ina to an

ALL-DAY INFO EVENT

at the university.

Ina loved arithmetic and numbers
and the universe, and really wanted
to study mathematics there.
But Alex wasn't so sure ...



Ina explained:

“Studying is almost like going to school.
But it’s cooler, because you choose a
FAVOURITE SUBJECT
that doesn't exist at school!
You can organise your time freely and
set your own timetable.

You meet many people who
have similar interests.

Plus, you'll **LEARN**
so much that you won't just
have one job, but many!”

Suddenly Ina held a small booklet
under Alex's nose:

“Look what I found! In this field of study,
they build medical devices, like your
neighbour’s white cane! That's what
you've always been interested in!”

(Would you like to know more about this?
Check out page 50).

Alex had become curious and continued
to explore the info event. Then, Alex
learned about another field of
STUDY.

Electrical engineering audio engineering sounded exciting too. People who study this field learn how to make noises sound good in the

RECORDING STUDIO,

no matter how big the room is. Or they learn how to keep the noise from getting so bad in the classroom at school that no one can understand anything.

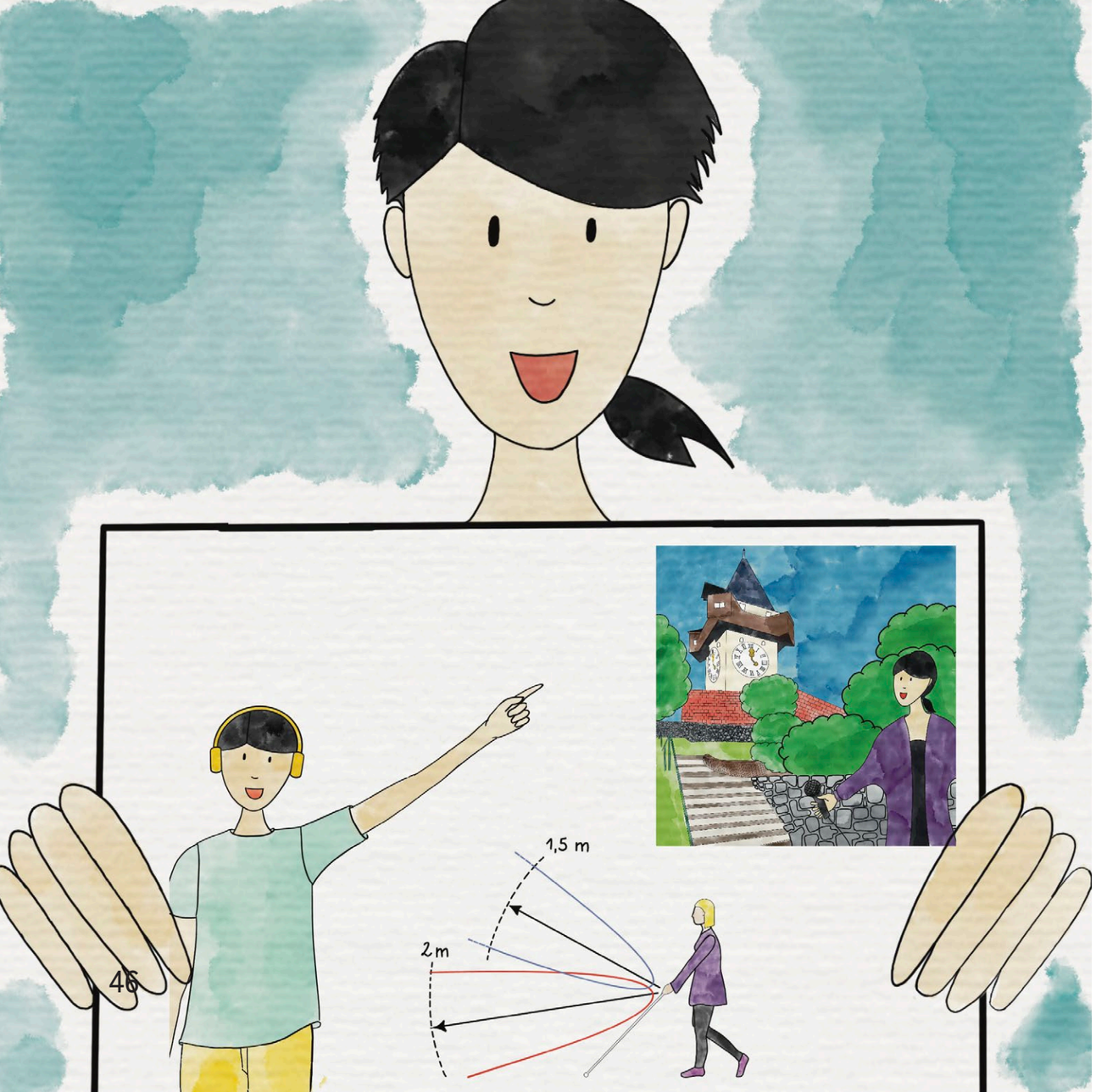
Alex looked more closely at the info booklet. It was interesting that a very good knowledge of music was important for this degree programme.

Alex already played a little

GUITAR.

Maybe Alex should finally ask for a better guitar and meet Tim more often to practice?

(If you want to learn more about the electrical engineering and audio engineering programme, check out page 68.)



Back home, Alex drew all the impressions received on this enlightening day on a large sheet of paper.

There were so many ways to turn a hobby into a

CAREER!

Maybe one day Alex would build ‘bat-power’ white canes? Or maybe control the sound at big concerts. Or maybe something completely different?

There was still time...

Make a Clothespin Bat

What you need:

- A clothespin
- A piece of black paper
- Scissors
- Glue




① Use the clothespin as a template for the bat's body.

② Outline the bat's wings, head and ears on the black paper.
Make the body of the bat wide enough so that you can still fold the bat in half in the center.

③ Cut out the bat, and also cut out a strip of black paper that is as long as the clothespin.

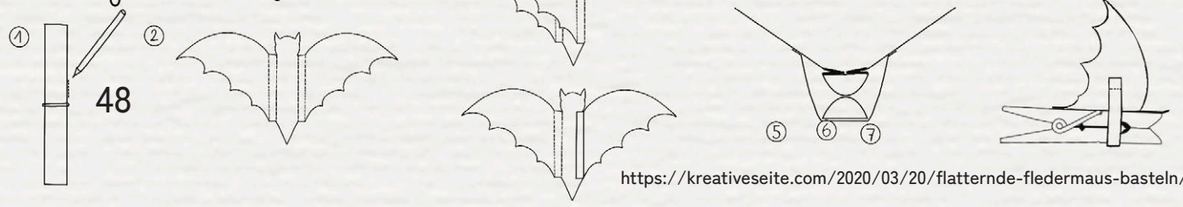
④ Fold the bat in half in the middle of the body
(so that the wings touch each other), then unfold it.

⑤ Glue the bat on the clothespin as shown.

⑥ Fold the ends of the paper strip and glue them on the underside of the wings.

⑦ Glue the middle of the strip to the bottom of the clothespin.

⑧ Now you can let your bat fly!



https://kreativeseite.com/2020/03/20/flatternde-fledermaus-basteln/

Make a Tin Can Telephone

What you need:

- Two empty, clean tin cans
- A strong string
- Nails and a hammer
- Thick tape




① Cover the sharp inner edges of the cans with the thick tape

② Pound a nail into the bottom of the can to create a small hole (remove the nail).

③ Connect the bottoms of the two cans togeter using the string.

④ Knot both ends of the string, making sure that the knots cannot pass through the holes.

⑤ Stretch the string out and speak into the cans, while another person listens on the other end.

⑥ The sound is not transmitted through the air, but instead through the string!

https://www.wissensforscher.de/download/experimentflyer-zum-thema-akustik-5-4-wir-bauen-ein-dosentelefon/?wpdmdl=2599&refresh=6173e0b9c2f651634984121

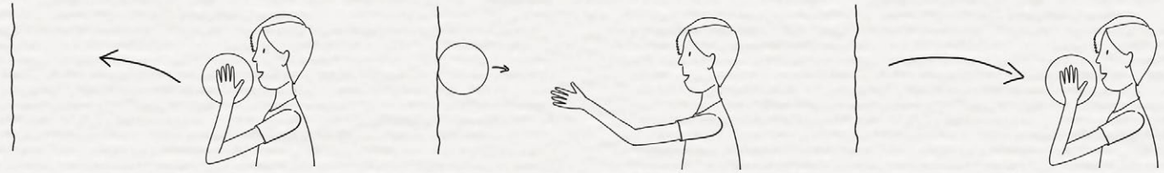
What happens when the string isn't stretched out tightly enough (taut) or when someone touches the string?

When the string is not taut, the sound can't be transmitted.
Also when someone touches the string, the tin can telephone won't work!

How does an echo work?

How could Alex hear such a great echo behind Grandmother Anni's house?
In natural environments, echoes can be heard especially in the mountains. Our shouts bounce back off steep crags and rocky slopes and are reflected.
When sound vibrations are made (these are tiny, invisible waves in the air), these make air molecules move. The air molecules are pushed very close to one another, which makes pressure build up. This pressure then pushes the air molecules in all directions in only a matter of seconds. These sound waves moves exremly quickly - they can travel 340 meters in a single second. When they run into a rocky slope, for example, they can be bounced back toward us - and we hear an echo!

You can visualize what's happening by bouncing a ball against a wall.
The ball bounces back to us.

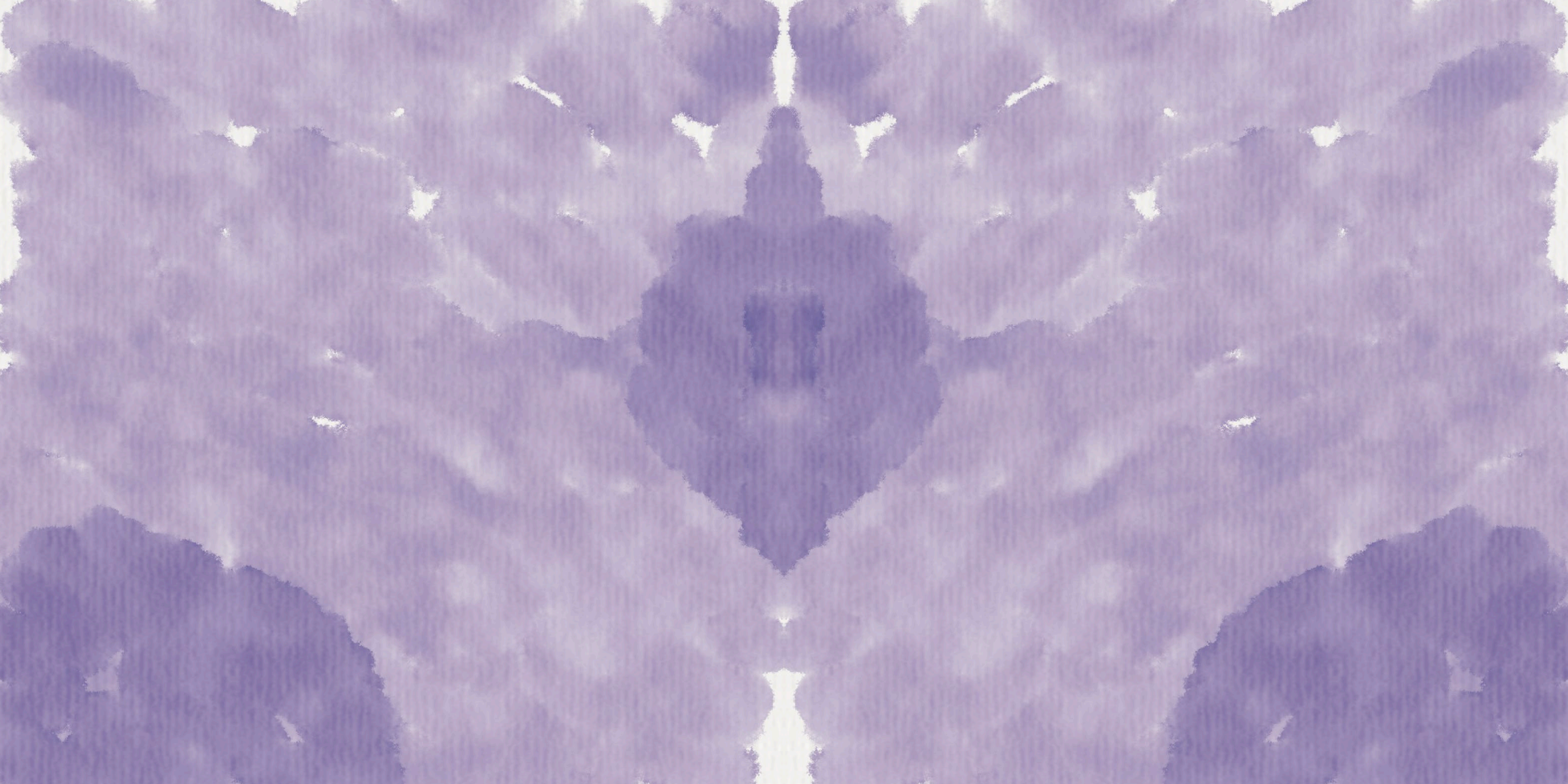


https://kinder.wdr.de/tv/wissen-macht- ah/library/curiosah/science/library-what-is-an-echo-100.html

How does a „Bat-Power" white cane work?

Bats have their very own sonar system. While flying, they emit high-pitched sounds through their mouths. They detect the echoes that bounce back to them and use these to find their way.
A British zoologist studied these natural sonar systems and wanted to use this information to build a white cane. This white cane could detect obstacles at distances of more than a meter. A small device in the handle sends out ultrasound signals (too high-pitched for us to hear).
The cane then detects the echo of these sounds and uses this information to indicate whether the path is free of obstacles. The white cane vibrates to warn the person using it if there is an obstacle in the way.
The closer the obstacle gets, the stronger the vibration gets.
The newly developed white cane can still costs more than 500 euros.

https://www.ultracane.com/



ALEX
catches
the echo

Areas of focus:

Science
Technology
Diversity
Gender Diversity

Accompanying text Gender diversity

Tolerance, sincerity and respect for fellow human beings are values that TU Graz wants to pass on to its employees, students and also to the children in its childcare facility nanoversity. These values are incorporated as a foundation in their children's books.
There is no such thing as a "typical boy/typical girl". Children should be allowed to develop freely, independent of gender classifications that often create barriers. Moreover, more than the two gender identities of male and female exist.[1] The different stories deal with topics related to diversity (gender is just one of many diversity dimensions) but also to science and technology in a child-friendly way, presenting children with a playful approach to these topics.
Unlike Ina and Tim, Alex is deliberately not assigned a specific gender in the story. No personal pronouns are used (I/you/he/she/it/...) and neither are any possessive pronouns (my/your/your/...). This allows the children to deal with how they perceive Alex and to what extent Alex's gender plays a role. The focus is placed on personality, character traits, wishes and needs – because that is what really matters.

[1] In Austria there are 6 gender classifications that are entered into the civil registry: male/female/divers/inter/open/no entry – marked as X in the passport. In the case of intersex newborns, one of the alternative gender classifications is entered, which can be changed later if necessary (by receiving the opinion of an expert). Currently, registration for a gender classification that is an alternative to male and female is only possible if medical evidence of a "variant of gender development" is provided. Thus, only intersex people have access to these gender classifications, if they provide evidence of their physical status. However, in its 2018 ruling, the Austrian Constitutional Court ruled that "people only have to accept gender assignments that are regulated by the state that correspond to their gender identity."

More about gender and gender identities in Austria

No gender is ascribed to Alex in the text or the text and pictures do not allow a gender definition. Children and adults can interpret Alex's gender individually when reading this book (as a boy, a girl, both, or neither). Because even if this is not yet so well known: **there are not just two genders, but a variety of genders!** Gender has different classifications, and the classification is not always exclusively female or exclusively male. As we now also know due to the legal recognition of alternative gender classifications, there are biologically and medically more than two genders. Gender identity can also be very diverse and change in the course of life.

Unfortunately, pathologizing still occurs with respect to physical diversity. Variations in sexual characteristics or intersexuality are

listed among the different diagnoses of diseases or disorders in the WHO International Disease Index. Thus, these variations are referred to as diseases, disorders, or deformities. In the field of medicine, we also refer to variation in sexual characteristics (in German: Variationen der Geschlechtsmerkmale (VdG) and in English, differences in sex development (DSD)). For social reasons and due to medical assumptions made about how a child with DSD would develop psychologically and physically, surgeries – including those on the genitals or gonads – and hormonal treatments that are not necessary and not personally chosen still occur in efforts to alter generally healthy bodies and force them to fit the medical and social norms for female and male bodies. Self-advocacy organisations take a critical view of this and campaign for the rights of intersex children, young people and adults and thus their right to choose what happens to their own bodies.

This book enables individuals to identify with many variations of gender identity. Important terms that help to better understand gender identities are explained below.
A person's gender identity and/or body gender does not say anything about a person's sexual orientation or sexuality. Therefore, it is problematic and incorrect to refer to people of a third gender or trans people in german as "intersexuell" or "transsexuell". Whereas in English the terms "transsexual" and "intersexual" are correct.

What does non-binary mean?

When people do not fit into the two-sex, binary categories of "female" or "male," they may use the terms **non-binary, gender-fluid, or genderqueer** to describe themselves.

Source/Further Information (in German)
https://www.nonbinary.ch/was-ist-non-binaer/

Non-binary people can correspond to the currently established female or male norm in terms of sexual characteristics. However, these characteristics do not determine their identity.

Further Information (in German):
https://www.gleichbehandlungsanwaltschaft.gv.at/dam/jcr:8029ba34-d889-4e64-8b15-ab9025c96126/210601_Leitfaden_geschl-Sprache_A5_BF.pdf

What does gender incongruence (in German: trans*) mean?

Persons who identify themselves as gender incongruent feel that the gender identity as experienced and lived does not match the gender classification assigned at birth.
They may use different terms to refer to themselves: **trans, transgender, trans male, trans female,** as having a **trans identity,** or as female or male.

Some non-binary and trans people make the personal choice to change their sexual characteristics, but some do not!

Source/ Further Information:
https://www.gleichbehandlungsanwaltschaft.gv.at/dam/jcr:8029ba34-d889-4e64-8b15-ab9025c96126/210601_Leitfaden_geschl-Sprache_A5_BF.pdf

*Gender sensitivity is an important topic in Austria. Until recently, the generic masculine was mainly used in the Austrian language. A few years ago, gender binomialization was applied to the language (especially in job titles) as a way to increase the visibility of women. To ensure gender-inclusive language, the asterisk *, the underscore _ or the colon : are currently used frequently in Austria. These signs increase the visibility of gender diversity and also make it possible to hear this diversity (by introducing a pause in the speech). The asterisk * can also be used to indicate different endings of words, e.g. trans* stands for transsexual, trans identity, transgender, etc..

What does inter* mean?

Not all people are born with exclusively male or exclusively female sexual characteristics. If one or more sexual characteristics (internal and/or external sex organs, genetic characteristics, hormones) do not enable a traditional assignment and norm, one refers to an intersexual person (or inter* in Austria).

However, there is no "single inter* body", but a broad variety, just as there generally are also among men and women.
Sometimes "variations in sexual characteristics" is used as a synonym for the word inter*.
Some intersexual people also use "inter" as their own gender definition, while others consciously use the binary terms man/woman. Gender identity is unique for each person.

Further Information (in German):
https://vimoe.at/ueber-inter/
https://www.dhz-online.de/archiv/archiv-inhalt-heft/archiv-detail-abo/artikel/eindeutig-uneindeutig/

Trans- and intersexuality have nothing to do with each other, but are not necessarily mutually exclusive. A intersexual person can, for example, refer to themselves as a trans person in the course of their life, if the gender assigned to them after birth does not correspond to their own gender identity. Likewise, trans people sometimes discover in the course of their medical transition that they also have a variety of sexual characteristics.

Further Information:
https://www.gleichbehandlungsanwaltschaft.gv.at/dam/jcr:8029ba34-d889-4e64-8b15-ab9025c96126/210601_Leitfaden_geschl-Sprache_A5_BF.pdf

Gender diversity & children

It is important to empower children with non-binary gender classifications and support their personal perceptions of their gender identity. Not only these children need to be educated about their bodies and other aspects of gender in an age-appropriate and an inclusive way (i.e. not in a pathologizing way), but all children, as well as all adults. Gender should not be a taboo subject, and it is essential for people to learn about the diversity of bodies, sexual characteristics and identities so that they can understand and respect themselves and others. This is a topic of sexual education and helps children to grow up without experiencing a sense of societal pressure, so they can recognise and define their own boundaries and themselves. Gender diversity is often invisible everywhere. Let's pay attention to our language – how often do we assume a binary norm, what do we divide according to gender and why, and what do we convey to children during daily life? Which children and which people do we think of in this way? Are there positive role models for them (in personal interactions, in stories...)?

Further reading tips for children in German:
PS: Es gibt Lieblingseis [PS: There's your favourite ice cream], Luzie Loda
Wer ist die Schnecke Sam [Who is Sam the Snail] by Maria M. Pawtowska & Jakub Szamatek.

All children like to play role-playing games and slip into different roles. This does not indicate anything about their gender identity or sexual identity. Role play is a central element of children's learning, which helps them adapt and integrate to/into society and learn about their identities. In addition, it can promote empathic skills and self-confidence.

Source: https://www.backwinkel.de/blog/rollenspiele-kindergarten/

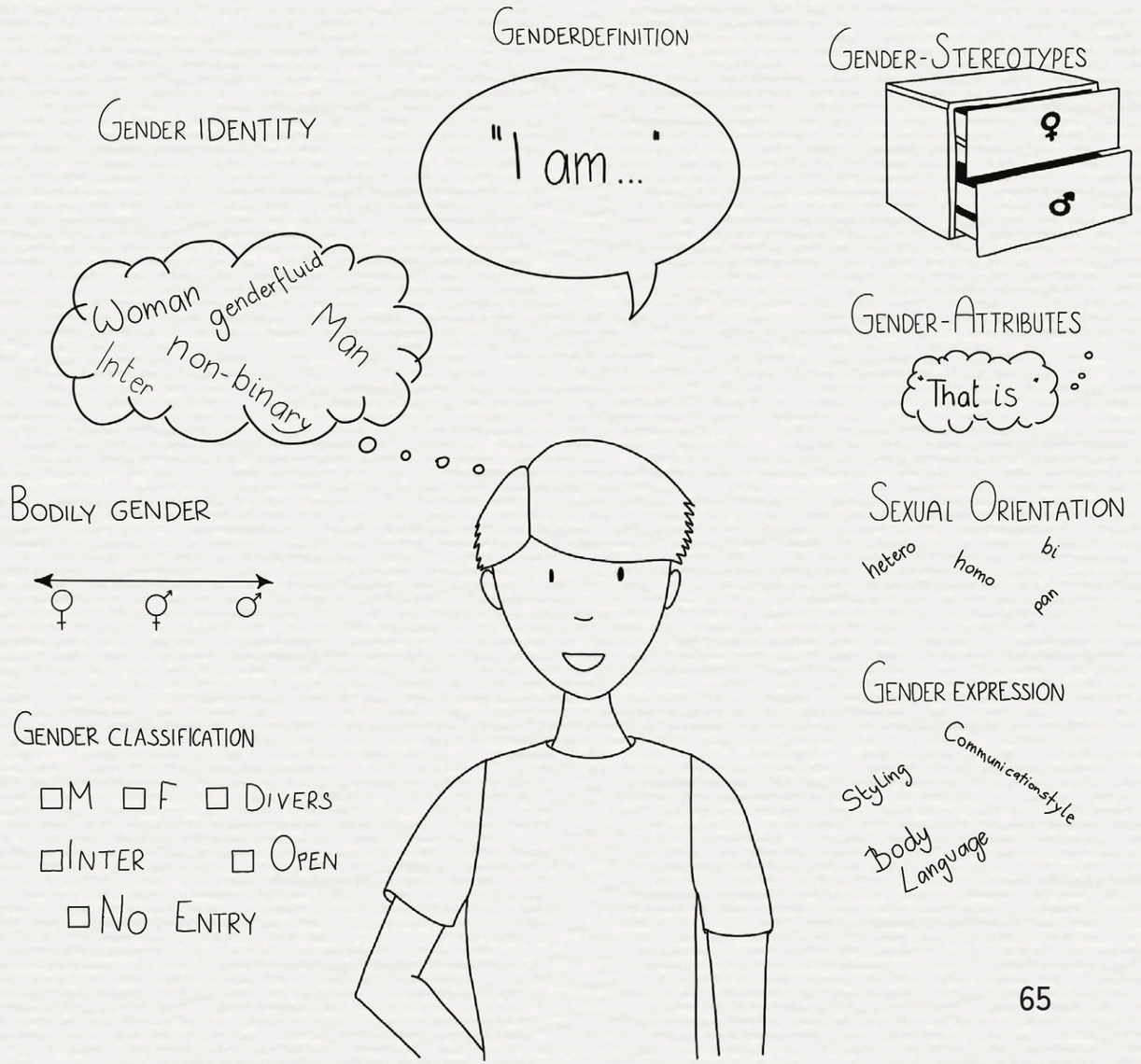
Addressing gender in daily life

Unless people have knowledge and develop awareness of gender diversity, people cannot be properly "interpreted", properly named, or properly addressed with respect to their gender identity in our society.

It is important not to take the idea for granted that all people have a binary gender identity and to always offer to use alternative personal pronouns to the binary pronouns he/she.
In some situations, it can be helpful to ask which pronoun a person would like to be addressed by.
However, it is important not to force anyone to talk about their gender identity.

Further Information (in German):
https://www.nonbinary.ch/non-binaeres-geschlecht/

Here is a simple model with Alex to illustrate the different levels of gender:



Why the topic of gender diversity is also important for applied technology

To what extent does gender play a role in technological infrastructure? The recognition of gender diversity, both socially and legally, naturally affects the technological infrastructure.

Here is an example: It is particularly relevant for developers and programmers to determine which forms, databases, etc. they design for members of our society. Often little thought is given to the design of these forms or databases with regard to gender, and default options are adopted.
In teaching, gender is usually still presented as a simple, binary variable.
This makes it all the more important for us to raise awareness of these issues among those who create these designs.

A good indication of this is the fact that a doctoral title can also be selected in official forms. However, there are fewer people with such a title (about 1%) than there are intersex people (about 1.7%).

https://www.gleichbehandlungsanwaltschaft.gv.at/dam/jcr:8029ba34-d889-4e64-8b15-ab9025c96126/210601_Leitfaden_geschl-Sprache_A5_BF.pdf

Further information:

Ombud for Equal Treatment
Taubstummengasse 11, 1040 Vienna
0800 206 119
www.gleichbehandlungsanwaltschaft.gv.at | gaw@bka.gv.at

VIMÖ - Association of Intersex People Austria
vimoe.at | info@vimoe.at

VARGES - Counselling Centre for Variations in Sexual Characteristics
varges.at | beratung@varges.at bildung@varges.at

Venib - Non-binary Association
venib.at | venib@riseup.net

Platform Intersex Austria
www.plattform-intersex.at | info@plattform-intersex.at

TransX - Association for Transgender Persons
www.transx.at | transx@transgender.at

What is Electrical Engineering – Audio Engineering?
(explained in a way suitable for children)

This study brings two worlds together: The world of sounds and the world of technology. Technology is a Greek word that translates as "craft". Today, the word is generally used to describe machines and devices that are made by people and make our lives easier.

For the study Electrical Engineering - Audio Engineering, you need on the one hand a good hearing and passion for music. On the other hand, you should enjoy technology and and be interested in electronic devices. Electronic devices are powered by electricity. Often small computers are built into these devices.
When you have finished your studies, you can develop devices and equip rooms to record, mix and play music. You can build systems that can be used to listen to music. But you will also have a lot of knowledge about sounds and noises of other kinds. You can help to combat noise, for example, in school classes, in offices, or on the motorway. You know how tones and noises spread and how they can be slowed down and "swallowed". You can also build hearing aids or devices that produce artificial speech, if someone cannot produce speech sounds themselves because of a disease.

Back to the study. You get important knowledge in many subjects:

- **Mathematics:** Nearly 3,500 years old, this is one of the oldest sciences: It involves calculating with numbers and geometric shapes. With mathematics, we can logically explain many processes in the world. It is an important basis for many other sciences.

Now you probably want to know what science is? In science, we increase our knowledge by learning, developing and researching certain things. New knowledge must first be considered before it can be spread. Mathematics and other sciences are taught at universities.

- **Physics:** This belongs to the field of natural sciences. In this study, you can learn about the forces in nature and how they work. These forces and their effects are described with mathematical formulas and checked in experiments to see if they are correct. For example, we know that water cannot be sucked up more than 10 meters. Trees need water, but are often much taller. How do trees get the water up to the top?
- **Electrical engineering:** This science deals with how electrical energy (electricity) can be generated, distributed and measured. You will also learn how electronic devices such as mobile phones, computers, headphones work.
- **Computer science:** This is the science of information and how it is processed automatically. An example is the weather report. Many stations around the world measure the temperature, the humidity of the air, the air pressure, the wind and other things. The measuring devices send the data to a central computer. This is designed in such a way that it can independently produce a weather forecast.
- **Acoustics:** Acoustics is the study of sound and its propagation. Sound is everything that we can hear with our ears and process in our brain. Sound can, therefore, be anything: the noise of a machine, the sound of a musical instrument, the bang of an explosion and, of course, sounds as we produce them by speaking. So sound always has a source and spreads through space

by vibrating in waves. There is sound that is useful, like speech and music, and there is sound that is disturbing, like traffic noise or construction site noise. Humans hear sound only within a certain range. Animals, such as bats, can also hear other in other ranges.

- **Music:** In this study, the hearing is trained and an instrument is learned. The computer can also be a musical instrument. Recorded sounds and tones can be changed and reassembled on the computer. For this, theoretical knowledge about music is also important. Music theory is a world of its own, consisting of notes, scales and much more. In this study, you can learn to understand how music and pieces of music can be created, how they can be replayed or how new pieces of music can be made - even for a whole orchestra.

Since more people are interested in such a study than there are places for them at the universities, there is an entrance examination, at least at TU Graz. For the first part of your studies (with a bachelor's degree), you need at least 3 years (6 semesters), and then you can work or continue your studies..

Riddle: How can it be that you hear equally well from almost every seat in the theatre, regardless of whether you are sitting in the front row, in the middle or at the very back?
Answer: It is because of the way the theatre is built. The room or hall is often built like a funnel, like a big megaphone. In addition, loudspeakers in very specific places ensure that the sound waves reach everyone. Take a close look next time you're in the theatre and try it out!

Sources:
https://klexikon.zum.de/wiki/
https://www.tugraz.at/studium/studienangebot/bachelorstudien/elektrotechnik-toningenieur/

What is Biomedical Engineering?
(explained in a way suitable for children)

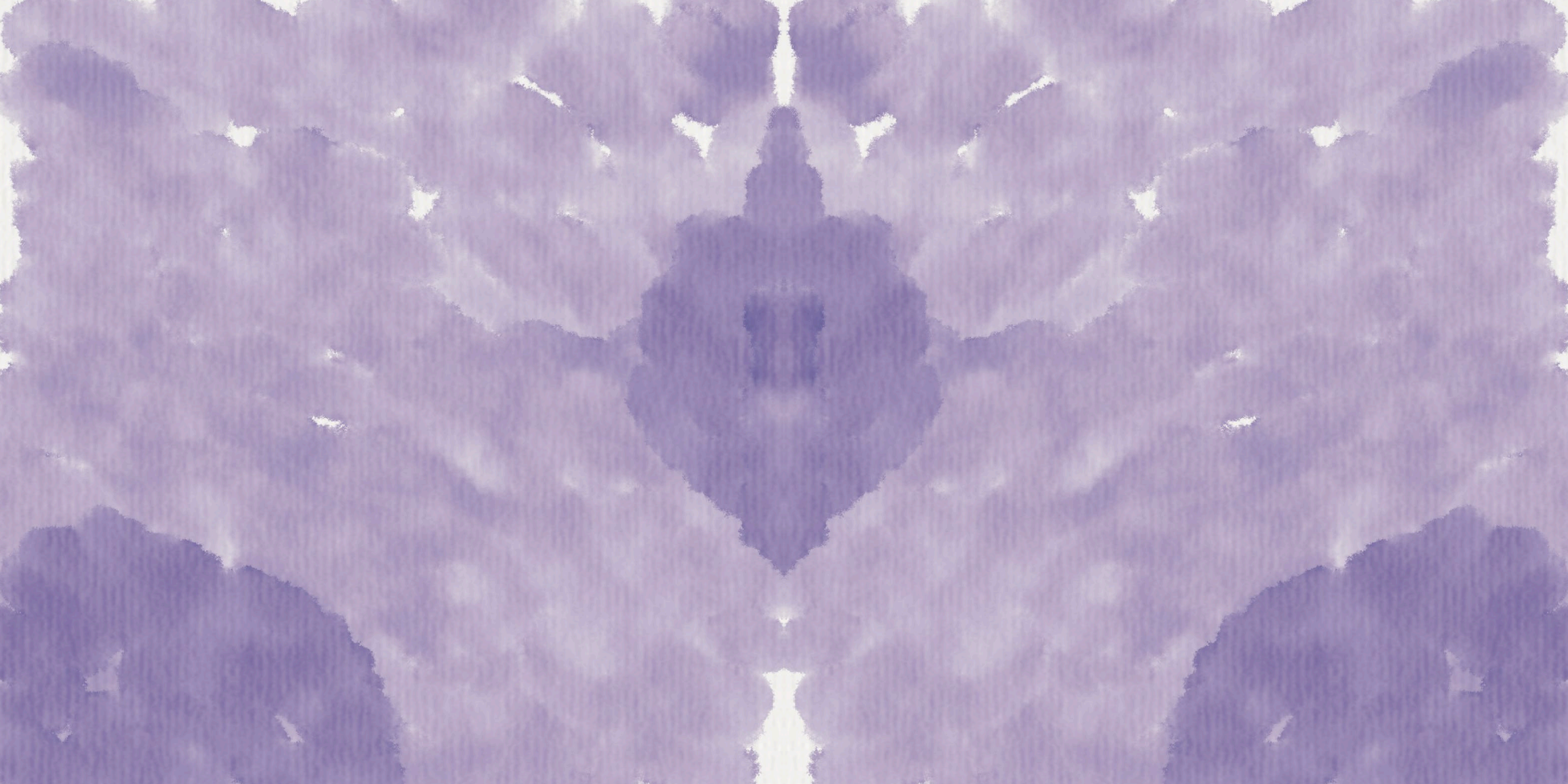
This study is very colourful! Colourful not in the sense of colours but colourful in that it is composed of many different subjects. You get so much basic knowledge in each subject that you can then speak, communicate and transfer information in all subjects. This is quite important for finding technical solutions to medical questions. Such questions can be: How is it possible to control artificial joints, such as those in a hand, arm, or foot, with mere thought? How can diabetics avoid the inconvenience of having to take blood samples? Or how can a person with a visual impairment move through space like a bat? Of course you already know – bat-powered white cane, of course.
Back to the study. In Biomedical Engineering, you get basic knowledge in many different subjects. Many of these subjects, such as mathematics, physics, electrical engineering and computer science, are already explained in the study for electrical engineering audio engineering (see page 42). In addition, the following important subjects are covered:

- **Medicine:** This is the science of diseases or in other words the art of healing.
- **Biology:** This is the science of living things, i.e. plants, animals and the mammalian human being.

For the first part of your studies (in the bachelor's degree programme), you need at least 3 years (6 semesters) at TU Graz. There is no entrance examination. You can then work or continue your studies.

Sources:
https://klexikon.zum.de/wiki/
https://www.tugraz.at/studium/studienangebot/bachelorstudien/biomedical-engineering/

Do you want to find out more about science now? Here is a link to experiments in German language that you can easily do at home. Most of the time, you have everything you need at home or you can collect it in nature. Isabella and Konstantin show you the experiments in their LABORATORY AT HOME: https://www.youtube.com/channel/UCp7AnHXbkcQGWbWhoXVGmXQ



ALEX catches the echo

Alex is a curious child. Alex has been fascinated from a young age about many things, whether it's about the echo that comes seemingly out of nowhere, the thunder that occurs in a night-time thunderstorm, or how sounds can travel through the air. One day, when Alex learns that bats can fly safely through the night relying on sound alone, a passion is born. Can we humans also use sound to move around? Mr. Stefan lives on Alex's street, and he can! He uses a white cane that is equipped with a special device. This device, called a sonar device, helps Mr. Stefan move safely around town. Just before graduation, Alex accompanies Ina, an old kindergarten friend, to an all-day info house at a technical university. Students can receive training to enter many different professions there. Will Alex also find something there?

You will find a short accompanying text in the appendix that provides those reading aloud, and especially parents and educators, with background information and further suggestions.

This book is one of a series of 6 children's books published by the Verlag der Technischen Universität Graz. The series focuses in particular on those values that form the foundation of the educational care of children at Graz University of Technology: tolerance, openness and appreciation of fellow human beings, animals, diversity, nature as well as technology and natural sciences.

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