VALÉRIE MAQUIL

CLAIRE LEE

KATALIN KARIKO

GOOD PRACTICES AND TIPS FOR PROMOTING EQUALITY IN STEM EDUCATION

CAMILLA HURST

JOY BUOLAMWINI

EMMANUELLE CHARPENTIER

ELISABETH JOHN

WIDE WOMEN IN DIGITAL EMPOWERMENT

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY | LIST

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digital luxembourg innovative initiatives.

SCRIPT

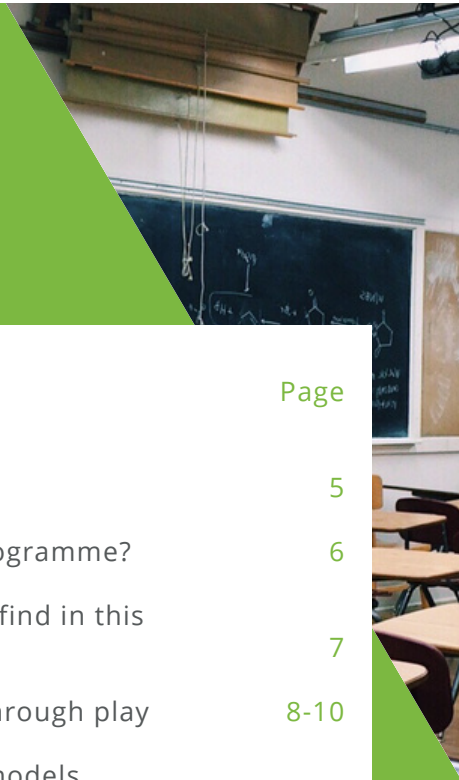
Editorial manager: Marina Andrieu

ACKNOWLEDGEMENTS

WIDE (Women in Digital Empowerment) and **LIST** (Luxembourg Institute of Science and Technology) would like to thank the teachers involved in the training and support programme «Gender4STEM in Action», who developed and implemented projects in their classrooms to raise awareness of equality issues. This guide has been produced thanks to the work of LIST and Dr. Marie Gallais who came up with the practical exercises.

We would also like to thank the **FNR** (Luxembourg National Research Fund with its PSP programme), **Digital Luxembourg** - Service des médias, des communications et du numérique, the **SCRIPT** (Service de Coordination de la Recherche et de l'Innovation Pédagogiques et Technologiques) and the **IFEN** (Institut de Formation de l'Éducation Nationale) for their support in the realisation of this project.

Their contribution made it possible to create this practical guide for teachers. The project was developed with a view to actively involve education professionals and co-construct the proposed tools.



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INTRODUCTION

Gender4STEM came into being thanks to secondary schools and teachers in Luxembourg who raised the burning question: **How can we attract more girls to our classes in technical and computer science subjects?**

The project was therefore developed with the aim of transferring knowledge and expertise on gender issues in technology and providing resources to education staff.

About the project initiator: Women in Digital Initiatives Asbl - also known as WIDE (Women in Digital Empowerment) - has been active for nearly a decade in the promotion of girls and women in the new technologies sector in Luxembourg and Europe. www.wide.lu

ENCOURAGING MORE GIRLS TO PURSUE CAREERS IN STEM THANKS TO THE GENDER4STEM IN ACTION PROGRAMME!

What is the Gender4STEM in Action programme?

STEM (Science, Technology, Engineering and Mathematics) are disciplines that play a key role in our daily lives, not to mention in research and innovation. Girls, however, are still underrepresented in these fields.

We can see that few girls choose STEM fields (just 17% of IT professionals in Europe are women).

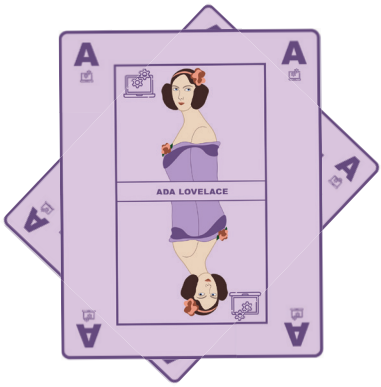
One explanation for this is the persistence of gender stereotypes linked to these fields. Indeed, culture, family, education and job market practices can accentuate these stereotypes.

At the request of numerous schools and teachers, we started our work with the Erasmus+ project «Gender aware education and teaching» (Gender4STEM). Co-funded and led by the LIST (Luxembourg Institute of Science and Technology), (this project brought together six European partners - experts in gender, technology and learning - to increase girls' interest in STEM subjects. One of the goals of the project was to help teachers strengthen their teaching practices on the topic of gender.

As this is a European project, it has been recognised as an example of good practice by Erasmus+ and continues to run in Luxembourg under the name «Gender4STEM in Action».

This programme is coordinated by WIDE, in collaboration with the LIST, and with the support of FNR, SCRIPT and Digital Luxembourg - SMC.

The aim is to expand our activities in this field to connect with local secondary schools and teachers. STEM are fields of the future and girls have their place in them. We want to support new initiatives in secondary schools to encourage girls to go into STEM fields.



Ada Lovelace was a pioneer in computer science. She is best known for making the first real computer program, while working on one of the modern computer's ancestors: Charles Babbage's analytical machine.

Gender4STEM in Action Teaching Assistant

The «Gender4STEM Teaching Assistant» platform is dedicated to teachers and provides concrete tools for more equal teaching practices. It offers about a hundred teaching materials to help not only teachers, but also psychologists and school counselors.

How does this tool work?

It is very simple! The first step is to create your account and log in to the platform. Next, we recommend using the self-assessment tool to identify how gender-equitable your teaching practices are. This will provide you with personalised recommendations for teaching materials to try out in class.

If you want to find out if you have unconscious biases when teaching, you can also participate in two Gender4STEM training sessions. During these sessions you will have the opportunity to share your questions and progress in addressing gender equality in your classes.

What will you find in this guide?

Do you want to implement concrete actions to promote gender equality in class but not sure where to start? This guide can help you!

You will find five worksheets showcasing and illustrating tools to help break gender stereotypes in STEM with your students. You will also find advice from teachers in Luxembourg who have used these tools in their classes.

The «Gender4STEM in Action» team is here to support you. Do not hesitate to contact us if you have any questions or if you are interested in our upcoming training courses.

contact: contact@women-digital.lu

PLAY

DECONSTRUCT GENDER STEREOTYPES THROUGH PLAY

«It made me more aware of gender equality issues in schools»

TOOL: GENDER GAME
Duration of the activity: 1 to 2 hours

MATERIALS AVAILABLE

What is the GG?

The Gender Game (GG) is a board game created by researchers from the Luxembourg Institute of Socio-Economic Research (LISER).

It is for children (aged eight and up), young people and adults, and raises awareness of gender differences in our society. It is available in four languages: Luxembourgish, German, English and French.

To deconstruct gender stereotypes, it is necessary to interact with young people and encourage discussions to make them aware of the existence and effects of these stereotypes in relationships between women and men in society.

The main aim of the game is to encourage participants to question preconceived ideas, construct an argument and become familiar with scientific reasoning.

HOW TO PLAY

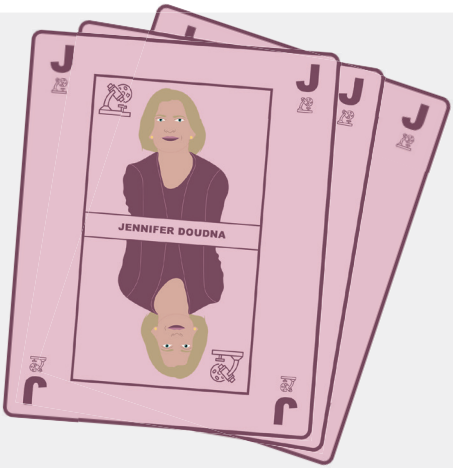
What's included:
A board divided into 20 squares with 4 categories/areas (4 colours) representing gender inequalities: knowledge, work, power and society, 4 counters and 1 dice.

1. The players or teams each choose a counter and place it in a corner of the board.
2. The youngest player starts. They roll the dice and move their counter accordingly. The counters can move in both directions.
3. When the player lands on a square, they draw a card corresponding to that square's category. The number on the card corresponds to a question that will be displayed on the board.
4. The player must answer the question.
   - If the answer is correct, the player gets a point for that category. They pass the dice to the player on the left, who in turn throws the dice.
   - If the answer is incorrect, the player does not get a point for that category. However, they have a second chance to get it when they land on a square of this category again. If they give an incorrect answer again, they will not get the point for this or any other category.
5. The aim of the game is to collect points in the 4 categories as quickly as possible by answering the questions correctly.
6. The game is over when the first player gets 4 points or when the players have used their 2 chances to answer the questions in the 4 categories correctly.
7. The player with the most points wins the game.

Feedback:

The game was played at the Lycée Technique de Lallange: 21 pupils (between 13 and 14 years old) as part of a maths course.

«The game highlighted stereotypes and raised collective awareness of inequalities. They played the game in Luxembourgish, which facilitated the discussions. Pupils learned historical facts. The question that struck me the most was the one about the emergence of women's rights to vote in different countries. For me, the GG really complements the students' education on gender equality.»



Jennifer Anne DOUDNA is an American biochemist, researcher and professor of biochemistry, biophysics and molecular biology at the University of California, Berkeley. Together with Emmanuelle Charpentier, she was awarded the Nobel Prize in Chemistry in 2020 for their discovery and development of gene editing technologies.

Practical advice:

- Make sure the room is spacious enough to set up the game (3mx3m) with chairs for the teams.
- Set up a video projector and give a microphone to the students speaking.
- Do not underestimate the time needed for this activity as it might take longer than expected.
- Wherever possible, hold face-to-face sessions.
- Moderating the reactions by separating moments of reflection from moments of discussion.

INSPIRE

DISCOVER FEMALE SCIENTIST ROLE MODELS PAST AND PRESENT

«I realized that people have stereotypes even if they ignore it»

TOOL: TOP TRUMPS CARDS

Duration: 2h30, (two and a half sessions)

MATERIALS AVAILABLE

Description

This workshop aims to highlight and discuss the stereotypes that students think of when women in STEM disciplines are mentioned. Afterwards, they should research female role models, create biography cards and create a timeline.

By learning about historical and contemporary female role models in STEM, this activity will inspire girls (and boys) to take an interest in these disciplines and stimulate their skills in researching and synthesising information as well as in working together.

How to do this exercise?

Session 1 (1hour):

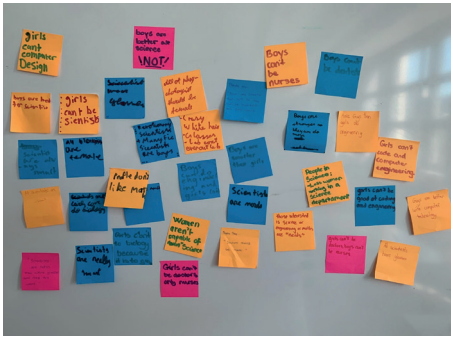
- Identify and discuss the stereotypes that come to students' minds when they think about girls and women in STEM.
- Ask students to write them down on post-its, stick them up on the board and talk about them.
- Q&A session on the subject.

Session 2 (1hour):

- Creation of «TOP TRUMPS» cards on historical or contemporary women scientists.
- Ask students to choose a female STEM role model and

find out about her discoveries, her role in science,...*
- Next, ask them to create a «TOP TRUMPS» card for the chosen scientist, adding their own topics and giving their own notes.

Session 3 (30 minutes):
- Create a timeline with all the cards and display it in the school corridor.
- Feedback from the students.



Feedback:

This was done in biology class with 20 pupils aged 12 (50% girls and 50% boys) at the International School of Luxembourg (ISL).

The questions asked before and after the experiment showed a better understanding of the role of women in science, and the pupils themselves felt these roles were more accessible to them.

Teacher's comments: «As a biology teacher, I now take more time to reflect on and highlight the role that women have played in getting to where we are now in terms of scientific progress.»

Students' comments: «People have stereotypes», «Scientists are smart», «Why do people think women can't do the same things as men?»

Practical advice:

This activity can be organised as part of an equality-focused curriculum.

Thanks
to feedback from the teachers who tried this out, we believe that this quick and easy activity is worth doing to reinforce understanding and break down barriers. This way, it can really be integrated into the school curriculum.

*Sources : https://500womenscientists.org/press.

ENGAGE

INVOLVE YOUR STUDENTS IN PEER RESEARCH AND INVITE THEM TO TALK ABOUT STEREOTYPES IN SCHOOLS

«The programme enabled me to confirm concepts and approaches that I was already applying, at least partially.»

TOOLS: RESEARCH WORK

Duration of the activity: 1h, every 2 weeks

MATERIALS AVAILABLE

Description

The teacher asks groups of 2 to 3 students to conduct research and prepare a presentation on one of the following societal themes:

- Girls and science in secondary schools (combatting stereotypes)
- Sustainable development (Large scale, which allows you to target a specific theme)

Instructions for students:

- Structure your presentation clearly.
- You can include images, short videos, interviews, your personal opinions, statistics, etc.
- Make sure your work is well presented.
- Do not forget to include a bibliography.
- Do not copy and paste; all sources should be indicated at the end of the presentation.
- Your work should be unique and should not resemble the presentation of another group, otherwise you will be penalised. So, it is best to avoid inter-group communication!

Outcome:

- Pupils have 15 minutes to present their thoughts on the chosen topic to their class. At the end, they are asked questions.
- Both content and form are evaluated: the PowerPoint/ Canva presentation, as well as way their presentation skills.
- The best presentations will be selected for presentation to another class.

Goals:

- Raise awareness of a societal issue.
- Combine teaching, learning by doing and sharing with peers.
- Develop the following skills: conducting research, preparing a presentation, giving an oral presentation, engaging in discussions, sharing opinions, etc.

Practical advice:

Organise exchanges between classes of different levels, give students time to work on the project, leave them free to choose a topic that addresses gender stereotypes in schools by treating the topic with open source tools and adapting the presentation for younger pupils.

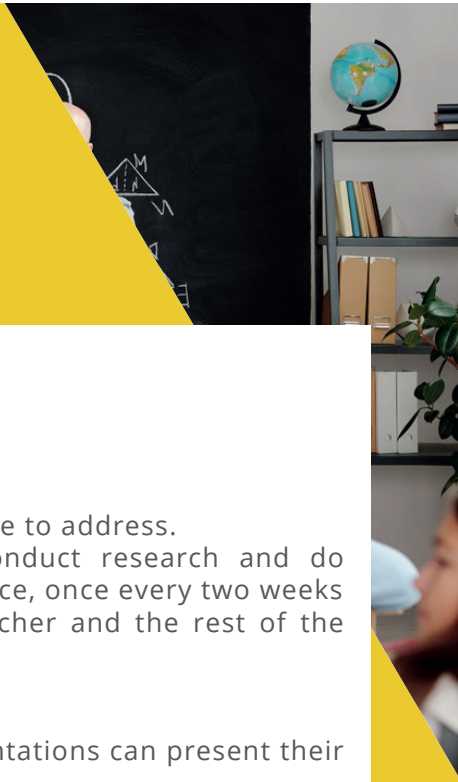
Feedback and advice:

Implemented at the Lycée Technique du Centre as part of the biology course. The 4th grade, International Baccalaureate class, did research and presentations in groups. Of the 15 students in the class, 10 (4 groups) chose the theme: «Girls and science in secondary school: fighting against stereotypes».

Two groups from this class were then selected to present their study process to a class of 7th graders. The exchanges were successful and provided an opportunity to share experiences of stereotypes and inequalities, and to discuss future school orientations.

Teacher's comments:
«I can imagine doing this project again next year - maybe even making it a cross-curricular project. The second stage involving presentation to another class can be more detailed and thorough: round table with discussions, evaluation of the project by the pupils, etc. We could even film the different stages and make a small documentary.»

Pupils' comments:
«It made me realise that anyone can work wherever they want!», «I was able to talk about things I hadn't dared to talk about before», «Girls are not less talented in mathematics and physics».



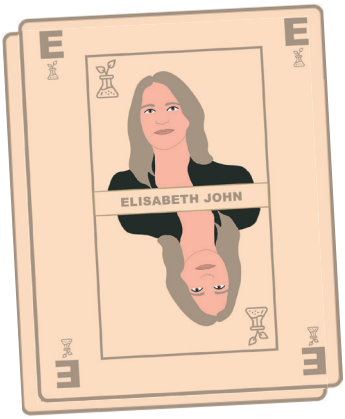
How to do this activity?

First step:

- The students choose a societal theme to address.
- In groups of 2 to 3, students conduct research and do presentation work, mostly face-to-face, once every two weeks
- They present their work to the teacher and the rest of the class.

Second step:

- The groups that give the best presentations can present their work to another class.
- They exchange with other students



Elisabeth John is a doctor of genetic biology. She is the coordinator of the Scienteens Lab, a research laboratory at the University of Luxembourg dedicated to teenagers. In 2015, Elisabeth received an FNR award for her work in promoting science to the public.

CHALLENGE

TEST YOUR STUDENTS' KNOWLEDGE OF WOMEN SCIENTISTS

«I learnt historical facts, became aware of socio-economic truths and identify gender stereotypes.»

TOOL: DISCUSSION WORKSHOP
Duration of the activity: approx. 1h

MATERIALS AVAILABLE

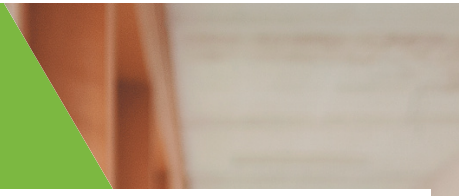
Who do you recognize?

Description

When you think of a scientist, what image comes to mind? Which of these women/Luxembourg women do you recognise? With 10 questions, the teacher challenges students' knowledge of women scientists and engages them in a discussion about the underrepresentation of women in STEM.

Practical advice:

- Talk to students before and after the workshop
- Ensure enough time to organise this workshop
- Conclude it by discussing the important concepts presented with students.



How to do this activity?

This activity has 4 stages:

"Warm-up" (15 minutes)

- Introduction to the session: plan and objective of the workshop.

Quiz (20 minutes)

- The first simple, general question is called the «warm-up» question.
- Questions to challenge students' perception and knowledge of women (and men) in science. For example, you could show a mix of photos of women celebrities and scientists and ask them who they recognise.

Discussion (15 minutes)

- Questions to raise with students could include: Why are women/girls in STEM less well-known? What are the gender stereotypes in STEM? What is your own experience? Are you considering studying or pursuing a career in STEM?

Débriefing (10 minutes)

Feedback:

Activity done at the Lycée des Garçons d'Esch-sur-Alzette as part of the Physics course with a class of 22 pupils in 3ème.

The workshop lasted about an hour and took place remotely via Microsoft Teams. The students answered questions in the chat room.

To the question: *«What is the closest image of a scientist for you?»*, the majority of students chose a picture of their teacher and a female scientist. They easily recognised pictures of celebrities, followed by Ada Lovelace, a pioneer in computer programming. Joy Buolamwini (computer scientist at the MIT Lab), Katalin Karikó (Hungarian biochemist), and Emmanuelle Charpentier and Jennifer Joudna (two 2020 Nobel Prize winners in Chemistry) are rarely recognised.

EXPLORE

ENCOURAGE GIRLS' CREATIVITY AROUND THEIR OWN STEM PROJECTS

«I enjoyed the exchanges with my fellow teachers and being able to take part in a concrete project for gender equality in my classroom.»

TOOL: ACTIVITIES IN A MARKERSPACE

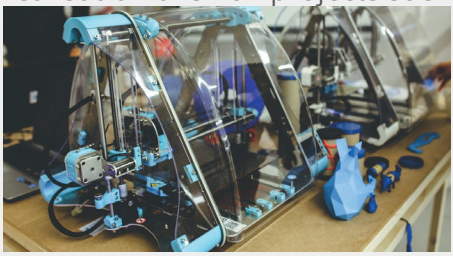
Duration of the activity: 2h every 2 weeks

MATERIALS AVAILABLE

Description

The «makers» community enjoys taking part in engineering-oriented projects and creating objects. A MakerSpace allows interested students to carry out projects of their choice.

Activities available: introduction to microcontrollers and their graphic area, programming in C, Python or Scratch, introduction to video games, planning and realisation of small projects such as creating a mobile robot or a weather station.



The aim of this activity is to educate students in STEM using a more dynamic approach to enable them to develop their creative and interpretative skills.

What are the key steps in this activity?

Teacher's proposal: make a project from A to Z (object, programme...).

Complete liberty on the subject (in groups or individually)

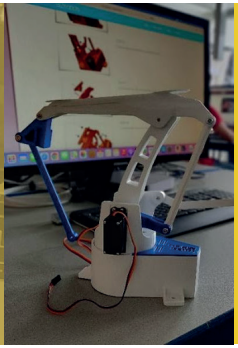
Global planning (research, design and 3D printing, assembly, electronics,...)

Feedback:

Experience in the 3rd B class (mathematics) with 7 students (4 girls and 3 boys), in the Makerspace at the Lycée Aline Mayrisch, supervised by a science teacher. The Makerspace is indeed an option in the 3ème B curriculum. The students attended this activity once every fortnight, on Mondays for 2 hours. A room in the school was designated as a Makerspace where there were3D printers, laser cutting machines, PCs, soldering irons, etc.

Students' comments:

«I want to become an engineer. That's why I chose this option», «I don't know what I want to do later but I'm glad to have the chance to use this course's tools to build my project. I like the fact that I can design my project pretty freely», «I have already done programming and I wanted to continue but not necessarily in a formal setting. We liked the idea of designing a game together.»



Practical advice:

As a teacher, it is important to be open-minded; «Say "yes" rather than "no" to students' ideas and projects!

Do not underestimate the time needed for an activity, as you may need longer than originally planned.

NON-EXHAUSTIVE LIST OF WOMEN IN STEM

(see more examples on our website www.wide.lu)

Marie-Sophie Germain was a French mathematician, physicist and philosopher. She is known for the arithmetic theorem that carries her name and for her work on the elasticity theory. In order to devote herself to mathematics(which, at that time, was reserved for men), she used a false name from 1794 to 1807: Antoine Auguste Le Blanc.

Rosalind Elsie Franklin, a molecular biologist, is undoubtedly one of the most famous scientists of the 20th century. In 1935, she decided to study physics - an ambitious and courageous project for a British woman at that time. She gained her doctorate in chemical physics at Cambridge University in 1945 before leaving for Paris to study new techniques in X-ray diffraction.

Alice Augusta Ball was an African-American chemist who developed the «Ball Method» - the most effective treatment for leprosy at the time. This infectious disease causes severe and disfiguring skin lesions as well as nerve damage in certain parts of the body.

Radia Perlman is a software designer and network engineer sometimes called the «Mother of the Internet». She is most famous for her invention of the spanning-tree protocol (STP) which is fundamental to the operation of network bridges. She has also made important contributions to many other areas of network design and standardisation, such as link-state routing protocols.

Katalian Karikó is a Hungarian-born biochemist, specialist and inventor of the mRNA technology. Her research has been instrumental in the development of vaccines against Covid-19. She is currently Senior Vice President at BioNTech.

Dr Swati Mohan is an Indian-American aerospace engineer responsible for guidance and control operations on NASA's Mars 2020 mission. She has also worked on several missions such as Cassini (mission to Saturn) and GRAIL (two spacecraft in training to the Moon).

CONCLUSION

It is important to remember that gender and equality issues are part of a wider context than school and the field of science. Socialisation norms are still strongly gendered!

There are many more questions than there are answers or ready-to-use solutions. Asking questions is the first step. Action can take many forms and can be integrated easily into your daily practice.

Based on our discussions with teachers, our experience in the field and our exchanges with organisations active in promoting girls in STEM in Europe, here are **12 tips for a more egalitarian science education.**

1. The issue of **equality between girls and boys starts at home and as soon as they arrive at daycare!** Just look at the types of toys offered to young children: trucks for boys and dolls for girls. And this is something that happens in all social circles. Observing the marketing segmentation of girls and boys in the shops makes us aware of the impact this can have a few years later in the classroom.

2. Providing **STEM activities in school** (e.g. coding and robotics) is important. **Girls are just as interested in science as boys**, as can be seen by observing groups of children.

3. Be **careful what you say** when you find yourself talking about what is «for girls» and «for boys» - especially in terms of behaviour, skills or jobs. You can correct yourself quite easily if you pay attention.

4. It is important to remember that **gender stereotypes really do influence students' decisions about their future careers.** It is important to pass on messages to deconstruct these prejudices which are still very present in society. Young people are particularly sensitive to this at the age when they have to make important choices.

5. You should **ban all jokes** (even nice ones!) about gender stereotypes. Do not tolerate sexist remarks and jokes from students (or adults)

6. Take the time to **openly discuss specific situations and the gender stereotypes students may face**. They have little opportunity to express themselves on this subject, but it is often crucial in their perception of professions.

7. Do not hesitate to **refer to famous or less well-known women in science or technology**, whether relevant to the course or not. Encourage students to do the research themselves to see their reactions and to raise awareness.

8. Try to **leverage on current events**. The topic of women in science is very present in the media. Take advantage, for example, of Nobel prize announcements to assess the situation. It is necessary to show that all women can feature in the future of STEM.

9. Check in the school curriculum **when these topics could be discussed with all pupils**. In Luxembourg, one possibility would be to set up STEM equality activities with the pupils in «Life and Society» or «Digital Sciences» courses.

10. It would be relevant to include training sessions to raise teachers' awareness of fairness in teaching in STEM in their initial and in-service training. To our knowledge, this is not (yet) the case in most European countries.

11. Share initiatives aimed at girls to boost and encourage even more STEM vocations! Rails Girls, girlsindigital.lu and other programmes and events are aimed specifically at girls.

12. Remember that these topic don't just concern girls, so don't hesitate to involve boys in equality issues!

Do you want to take stock of your teaching practices?
Are they gender equal?

Take the Gender4STEM questionnaire and get recommendations for teaching materials to try out in your classroom.

www.wide.lu