toolkit

Hypatia
PROJECT

INTRO

The toolkit is a ready-to-use digital collection of modules aimed at teenagers to be used by teachers, informal learning organisations, researchers and industry.

The aim is to engage young people and especially girls in STEM and in the discovery of the variety of STEM related careers in a gender inclusive way. The toolkit includes a wide range of hands-on activities: workshops with a scientific content, informal discussions and meetings with STEM professionals.

Each module is composed of three guidelines:

- Explanatory guidelines specific for each activity
- Guidelines dedicated to the theme of gender inclusion
- Guidelines with suggestions for the facilitation

The guidelines give practical support and guidance for the users, recommendations on how to debate gender approaches and differences with young people, support and guidance for facilitators on how to overcome their own stereotypes and suggestions on how to manage the group dynamics by implementing different facilitation strategies.

The toolkit is produced in the context of the Hypatia project by five science centres and museums (NEMO Science Museum, Museo Nazionale della Scienza e della Tecnologia “Leonardo da Vinci”, Bloomfield Science Museum Jerusalem, Experimentarium, Universcience) in collaboration with gender experts, teachers, research industry institutions and teenagers.

The Vision of Hypatia is of a European society that communicates science to youth in a gender inclusive way in order to realise the full potential of girls and boys around Europe to follow STEM related careers.

Below is the complete list of modules that compose the Toolkit, divided into the three contexts.

Schools

- Find Gender Stereotypes in STEM Representations
- Gender Inclusiveness in your Science Teaching
- Inquire: Shape and Action
- Play Decide Game & Debate
- Science Ambassadors and Ambassadresses
- STEM Women Cooperative Card Game
- Test Yourself
- What's your Opinion?

Science Centres & Museums

- Find gender stereotypes in STEM Representations
- Science Café or *Café Scientifique*
- STEM Women Cooperative Card Game
- Test Yourself
- Wearable Technology
- Your Role in Research: Inquiry into Chemical Reactions

Industry & Research Institutions

- Gender optimizing software programming
- Science Ambassadors and Ambassadresses
- Skill Game
- Speed Dating
- Your Role in Research: Inquiry into Chemical Reactions

GUIDELINES ON GENDER BALANCE

WHY IS IT IMPORTANT FOR PEOPLE OF ALL GENDERS TO STUDY AND WORK IN STEM AREAS?

In the coming years, with Europe's knowledge economy developing and new technologies on the rise, skills in science, technology, engineering and mathematics (STEM) are becoming increasingly necessary in order to guarantee an adequate & professional workforce in a broad range of careers. It is therefore imperative to attract and recruit more youth to STEM study programs and ensure the diversity of STEM-trained professionals. The Vision of Hypatia is of a European society that communicates science to youth in a gender inclusive way in order to realize the full potential of girls and boys around Europe to follow STEM related careers.

Institutions and facilitators responsible for implementing science education activities, such as schools, museums and industries have a key role in this. They may influence the ways in which learners construct and negotiate their gender and their attitude towards STEM. This is why it is important to reflect on the gender and science biases we have, to acknowledge the stereotypes and make sure we do not perpetuate them in our interactions with the participants.

FACILITATING GENDER INCLUSION

In facilitating gender inclusive activities it is important to be aware of a few significant concepts.

GENDER AND SEX

Sex refers to biological characteristics and functions which distinguish between males and females: chromosomal sex, gonadal sex, morphological sex.

Gender refers to the social construction of men and women, of masculinity and femininity, which differs across time and space, and across cultures. It is a hierarchical and hierarchizing system of masculine and feminine norms.

GENDER STEREOTYPES AND SKILLS

A gender stereotype is our social perception regarding the attributes of males and females (character, abilities, tendencies, preferences, external appearance, types of behavior, roles, career paths etc.) and our tendency to relate such attributes to individuals of each sex, prior to meeting them (example of stereotype: male are more rational and female more emotional).

When we talk about gender stereotypes and science we refer to roles and abilities that are supposed to be "suitable" for males and for females in science (for example engineering and building are associated more with males than with females).

GENDER AND SCIENCE

STEM are fields of inquiry and knowledge. Like other forms of knowledge, they may include gendered dimensions. When the gender variable is not taken into account by researchers, this can influence the results: for example when medicines are not tested on both male and female. Furthermore, there is a persistent gender gap in the production system of scientific and technological knowledge and in many European countries women are over represented in biology and medical sciences while they are

under-represented in mathematics or informatics. Besides, women are less likely to reach a high level of responsibilities in sciences.

They are depicted as rational, intellectual and independent, and these characteristics are often associated with masculinity. This means that boys or girls who do not identify with such characteristics will think that STEM studies and occupations are "not for them" and avoid STEM completely. This is why it is important to present a complex and diverse image of science.

SUGGESTIONS FOR THE IMPLEMENTATION OF THE ACTIVITY

Defining, recognizing and implementing gender inclusive activities is complex and challenging and requires a constant auto reflexivity of the facilitator about his/her own gender stereotype and bias. Here are some practical indications and reflection questions to assist the facilitator in being inclusive.

INTERACTING WITH THE GROUP

- **Neutrality in assigning tasks and roles**

  How will I assign tasks? What responsibilities will I assign and to whom?

  Avoid assigning stereotypical gendered roles to participants that may contribute to the internalization of 'female' or 'male' identities, for example asking boys to build things and girls to take notes. Ensure that the different roles required by the activity are rotated between participants.

- **Attribution of success and failure, overcoming stereotypical responses**

  Do male students who have failed link their failure to themselves or to external factors?

  Do female students who have succeeded link their success to themselves or to external factors?

  Set a high level of expectations for both sexes. Avoid over indulging with the girls (this leads to dependency rather than independence). Encourage both girls and boys to take risks.

- **Adopt a "Wait Time" to encourage girls to speak in an environment of risk-taking boys who might respond faster than they do**

  How attentive was I to the students' responses? How long did I let them speak for?

  Wait 4–5 second before calling on a student to answer a question. Delaying the answer enables all the students to respond, thus giving everyone the opportunity to come up with it.

- **Interaction with the sexes to overcome the tendency to engage with male students more than with females:**

  Did I direct questions to boys more than to girls?

  Be aware whether the questions are directed more to boys or to girls.

- **Unaware expression of stereotypes**

  Did I pay attention to the students' behaviour in relation to their expression of gender stereotypes?

Teenagers often reproduce gender stereotypes unconsciously or in a subtle way. This might be taken as the chance to underline it and use it as a point of reflection.

DURING A DISCUSSION

- *Are boys more interested in building things and girls in decorating the things produced? Can you switch these roles in the activities?*

  Challenge learners to depart from their preferred interests and widen their engagement in science (many children have gender stereotypic interests that might be challenged).

- *Do you think it could be useful to introduce and discuss the concept of gender or stereotype before or after the activity?*

  Consider if a forgoing explanation of the main concepts about gender and about the terminology/concept connected could enrich the discussion.

- **While facilitating a discussion**

  Acknowledge that different learners have different kinds of prior knowledge that may be relevant in different ways. Discussion can take its point of departure in what learners already know about the subject matter.

MEETING A STEM PROFESSIONAL

Role models are effective in stimulating girls' and boys' interest in STEM. Many activities have STEM professionals as protagonist or give examples of STEM professionals. It is important that these role models do not reinforce gender stereotypes.

- *How many men and how many women appear in the example of STEM professionals I give in the activity? Are they stereotypical?*

  Keep a balance between the number of females and males as speakers or examples. Where possible ask them to talk not just about the scientific content but also about their personal life.

  Ensure that the involved science educators and scientists reflect a broad variety of personalities. Girls and boys are most inspired by role models they feel psychologically similar to themselves (as regards to origin, culture, age, etc.). Otherwise, the standards set by the other person can be seen as contrasting, and girls and boys may react against them.

- *In the activities, do I present the variety of STEM – from computer games to engineering?*

  While choosing STEM professionals and examples involved in the activity, ensure that the diversity of science is represented to the largest extent possible.

FACILITATING AN EXPERIMENTAL SITUATION

While dealing with a specific scientific content participants might not see clearly how this is related with gender balance in STEM. Hypatia activities aim to propose unexpected ways to approach science and scientific content (like chemistry, robotics or making), breaking the stereotypical perception of STEM. This serves to introduce and disseminate a different view of the world of science, unveiling different aspects with which more people – girls and boys – can identify. You can emphasize this aspect while facilitating an activity focused on scientific content rather than on gender.

- For example, an activity framing technology such as the one on wearable technologies could attract more girls than one on transport or missiles.
- Many girls feel more comfortable in a situation based on cooperation, and others even avoid competitive activities. The facilitator could present a challenge with a “story” behind and not just as a competition, or pay attention in balancing competition and cooperation in the same activity.
- Many studies show that girls learn better in an environment that is esthetically pleasing. This is why it is important to create a pleasant and esthetic environment for the activities.

USEFUL LINKS ABOUT GENDER INCLUSION IN THE CLASSROOM

HYPATIA’S THEORETICAL FRAMEWORK

The present document proposes a framework to address gender inclusion in STEM activities. It gives rise to a set of criteria for the analysis of the gender inclusiveness of existing STEM education activities, or for the design of new, gender-inclusive activities.

Theoretical Framework

GENDER EQUALITY IN THE CLASSROOM

We are frequently unaware of the manner in which we relate to boys and girls. School classrooms are no exceptions. Here is a list of points of attention and suggestions aimed at improving the degree of equality in the class in order to encourage girls and boys to pursue the fields of STEM.

Gender Equality in the Classroom

GUIDELINES ON FACILITATION

A BIT OF ADVICE FOR GOOD FACILITATION

A key element for good facilitation is the active involvement of the participants every time a concept or content is presented. Involvement means for example:

- Considering participants' personal experience as a starting point of the engagement.
- Building on their own point of view or prior knowledge.
- Embedding continuously the contributions of the participants in the process.

Facilitation is not easy; it takes practice, time and reflection! In order to transfer these concepts into practical situations – and thus to foster engagement, interaction and discussion – you can find a brief list of suggestions below. They can be helpful in developing good facilitation.

INTERACTING WITH THE GROUP

- Prepare the environment where the activity will take place in advance, organize the space according to the needs of the activity, even changing its usual structure if needed (i.e. you can move tables and chairs around).
- Make sure that all participants can see and hear well.
- Keep eye contact with the participants.
- Address participants as peers rather than as passive spectators or ignorant individuals.
- Listen to people and use their own terms.
- Use questions as much as possible – they can be a useful tool to encourage interaction among the group.
- Stimulate reflections among participants.
- If possible, ask and build on information or elements that can be discovered through direct observation.
- Engage people by linking to their personal experience.
- Encourage participants to express their opinion and elaborate their own considerations.
- During an activity, you might want to organise different group settings – work in smaller groups or in pairs, create plenary moments – to help engagement and better interaction with the experience.
- Before interacting with the participants in plenary, you might want to ask participants to discuss in small groups as a "warm up". This helps involving the shiest people or helps everybody to feel more comfortable about the topic before sharing any consideration in plenary.
- When the discussion is set in small groups, move around the groups checking on work and discussion, and intervene – only in case of difficulties!
- In plenary, try to address everyone as much as possible, encouraging everybody to participate and engage.

FACILITATING AN EXPERIMENTAL SITUATION

- Try to make the activity as participatory as possible: every participant should have the possibility to engage directly with the experiment; avoid demonstrations.
- Do not reveal the results of the experience before the participants' own discoveries and considerations.
- Encourage participants to make initial hypotheses/descriptions/comments about what they think would happen.
- Keep the experiment at the centre of attention and of the discussion.

- Engage learners through an alternation of manual activity, questions and discussion.

DURING A DISCUSSION

- Engage learners through a balance of open-ended questions, closed questions, discussion and exchange of opinions, etc.
- You might want to use provocative dilemmas as tools for debate. Disagreements can be valuable for analysing notions and negotiating views, use them constructively.
- Stimulate and build not only on participants' already-acquired knowledge but also on emotions and imagination.
- Challenge the participants at a suitable level.
- Avoid:
    - A didactic approach and the assessment of participants' knowledge.
    - Monologue.
    - Specialized terms with no reference to real objects.
    - Seeking and dealing only with the correct answers or, even worse, with the correct questions.
    - Not listening.

HOSTING A STEM PROFESSIONAL

- You might suggest to the speaker to alternate between questions and speech allowing participants to take up a more active role and prevent long talks.
- Before introducing a STEM professional, you can ask participants to share their perception about the particular profession, and then discuss it with the speaker.
- Young participants, when they have the possibility to ask free questions, often seem to be interested in the speaker's daily personal lives, in their career path and about what they were like when they were students. You can suggest that speakers use these topics as "hooks" during speeches and conversations.

It helps if speakers bring tools or objects from their daily work with them as examples from their daily practice.

QUESTIONS: A FUNDAMENTAL TOOL FOR LEARNING

Building a relationship with an object is like 'getting to know a new person'. Indeed, this kind of comparison can help understand a possible way of developing questions to be used in learning experiences. In the process of getting to know a person or starting a conversation we move from the basic and concrete to the abstract and more complex. Using questions in a learning situation involves similar steps: starting from basic information (usually elements that could be discovered through observation) working at levels where there is compatibility (i.e. levels where the pupils can become involved and engage through their knowledge, experiences and views), in order to proceed to the discovery of more complex information and concepts. Such an approach invites learners to search within their own repertoire of knowledge and experience for the necessary elements that would help them discover new insights, while at the same time it can operate as the foundation for the development of questions by the learners themselves.

In fact, we are not arguing here for a linear process of 'facilitator-asks – learners-answer'; rather, we argue for a two-way-contribution process, in which both facilitator and

learners are in the position to ask and answer questions. In this sense, questions are the stimulus for initiating dialogue, the tool and *not* the objective. They help new knowledge to be elicited and information to be added within a free flow of ideas, leading to the broadening of understanding.

What are the types of questions that would operate as the method for eliciting information and interpretation, for initiating constructive dialogue, for developing skills and self-confidence in learners – and facilitators themselves?

First of all the basic categories:

- Closed questions – the ones that have only one correct answer.
- Open questions – those that accept more than one correct answer.

Closed questions are usually used when we seek specific information about the phenomenon/topic/exhibit/object etc. and can be further divided to:

- Questions for examination: Answering those questions requires careful examination. The answers offer the first information on the basis of which we construct more detailed knowledge.
- Questions for explanation: The answers offer an explanation – how something works, how it was created, etc. and are closely related to the information derived from the examination questions.
- Questions for comparison: These stimulate comparisons with other situations of the same type, materials, dimensions, etc. and encourage the identification of similarities, differences and connections with the learners' personal knowledge and experience.

On the other hand, open questions encourage the expression of personal views, the employment of pre-existing knowledge of the learners, and the search for personal meanings. Discussion and open-ended questions offer learners the opportunity to pool ideas and share insights in the group followed by opportunities to develop understandings further through deploying and defending insights and opinions.

Open questions can be divided into the following categories:

- Questions for problem-solving: Those demand the use of critical thinking, imaginative thinking, hypothesis and analysis skills and ability for using knowledge for problem solving.
- Questions for prediction: The answers to those questions offer predictions in instances of changes of parameters.
- Judgement questions: Answers to those can be very personal and unique. They demand choices, evaluation of a situation, justification, etc.

You should be seeking a balance between closed and open questions. Asking only closed questions might create a feeling of ignorance among those learners who find it difficult to answer them, since they require relatively minor use of skills and more of specialised knowledge. Closed questions should be used for exploring the object and the new knowledge around it, and, in addition, offer the basis on which to ask the open questions. For any learner, answering open questions implies using their personal context to find the new information. It also enables them to use their own personal experiences, emotion, imagination and skills for meaning-making and personal interpretations.

In the philosophy of an interactive, constructivist approach to learning, the asking-answering of questions means not only the acceptance of more than one correct answer (through open questions), but also ‘allowing learners to get things wrong’, that is, not allowing a learning situation to be limited by seeking only ‘correct’ answers, or by the expectation of pre-determined outcomes. It is important that the facilitator does not jump in too quickly to correct learners, but rather uses the conflicts that arise between their different perspectives helping them to see that there are standards and that their own interpretations are not necessarily the same or as good as those held by other learners. Learning results from reference to, and drawing from, learners’ own understanding of situations, and opportunities for exploration through trial and error.

FIND GENDER STEREOTYPES IN STEM REPRESENTATIONS!

AT A GLANCE

Age Group	13 – 18 years old
Format	Moderated discussion
Duration	90 minutes

OVERVIEW

The workshop focuses on gender-stereotyped representations of science and technologies in advertisements for technological objects (such as computers, smartphones, video games, cars, etc.) and recruitment campaigns for schools, training, or jobs in STEM fields. Through the discovery, comprehension and analysis of stereotypes in these visuals, students will be led to question:

- How these stereotypes influence the way they view the skills/abilities associated with women and men in science and technology.
- How these stereotypes influence their choice of studies and careers.

OBJECTIVES

- Understand what sex and gender stereotypes are and identify them.
- Heighten students' awareness of stereotypes in their daily lives.
- Increase awareness about the negative impact they can have on their own representations of sciences, the world of science and technology, and their study/career choices.
- Learn about careers in STEM and develop an interest in them, regardless of their sex.

SUGGESTED SCENARIO

The activity is designed for a class of students. It could take place during a research center/museum ‘open day’ or for the International Women’s Day. It could also be implemented as a workshop or as an open lesson for secondary schools.

TARGET AUDIENCE

Age	13 – 18
N. participants	20 –30
N. facilitators	1
Type of audience	Students

FORMAT

Moderated discussion.

TOPICS COVERED BY THE ACTIVITY

This activity deals with science and technology in general with a societal approach. In France, this workshop has links with the civic education curricula that promotes gender equality; the mechanisms of sex-differentiated socialization are also studied in high school economic science classes.

DURATION OF THE ACTIVITY

90 minutes.

RESOURCES

MATERIALS

Computer		1
Video projector		1
Flipchart		1
Visual Images	Google search, newspaper	6 (3 different ads + 3 different campaigns)
Pen or pencil & paper		1 per student
Post-its		100
Analysis grids	See “Development of the activity”	6 (1 per group per visual)

NOTE:

To prepare for the activity, facilitators will need to choose the ads that will be shown during the workshop and prepare the analysis grids that will be distributed to students.

USEFUL LINKS, VIDEOS, ARTICLES

- The TWIST project: www.the-twist-project.eu
- Expect Everything campaign: www.expecteverything.eu
- Hypatia Project D2.1 (Criteria for Gender Inclusion) and D2.2 (Good Practices on Gender Inclusion in STEM Communication)
- The most appropriate images, visuals in each country: recent ads for smartphones, computers, video games, recruitment campaigns for researchers or STEM careers in engineering, transportation, energy, nuclear, aeronautics, or information flyers on science and technology programmes at universities and higher education establishments.
- Centre audiovisuel Simone de Beauvoir/Genrimages: www.genrimages.org

SETTING

Closed and modular space so tables can be moved to work in small groups.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

Students will work in plenary sessions and small groups, preferably mixed boys and girls.

INTRODUCTION, 5 MINUTES

Quick introduction explaining to students that they are going to comment on advertisements for daily technological objects and recruitment campaign visuals, followed by an analysis and discussion. The facilitator or teacher will emphasize that they are really interested in what the students think.

DEVELOPMENT OF THE ACTIVITY

Step one, 10 minutes

- The activity begins with a question: *What are the skills, ideas, adjectives, qualifiers that you spontaneously associate with men, boys, girls and women?*
- Give 2 post-its to each student: they will write what they associate with women/girls on one and what they associate with men/boys on the other.

  Note: post-its are anonymous, a very short period of time is given to write down the associations.

- The post-its are then stuck on the flipchart, arranged into 2 columns: one column for words associated with women/girls and one for words associated with men/boys. They will be commented at the end of the workshop.
- The person leading the workshop (the facilitator) then explains the general notion of stereotypes, clichés, preconceived ideas.

Note: definition of sex and gender stereotypes:

- Sex and gender stereotypes are over-generalizations of what girls and boys/men and women are and are not, by nature: "women have no sense of direction", "men are tech-savvy", "women are intuitive", "men are not emotional", etc.
- How do they work? Sex and gender stereotypes legitimize the roles of each sex by "naturalizing" them: they make the different and hierarchical roles of sexes assigned to men and women seem biological and natural.

Step two, 30 minutes

- The facilitator shows the first ad and the group comments on it together to give students an idea of how to analyse an image.
- The students are asked to form three groups, preferably mixed girls and boys.
- The facilitator gives each group a recent ad for a technological object (the ad is printed on a A3 coloured sheet of paper); each group receives a different visual. For example:
  - an ad for a pink phone and for a blue phone
  - a computer marketed for girls, and one marketed for boys
  - an ad for video games showing girls and boys
- Each group is given a blank analysis grid (prepared in advance by the facilitator). Students observe and discuss the visual, and fill in the grid.

Note: the grid indicates the following points to be analysed:

- the link between the object in the ad and the person or people shown in the image
- the target audience of the ad
- the construction of the image

    - the size of the different elements in the image and their connection
    - the colours used (boy/girl gendered colours)
    - description of the people: activity, posture, body part featured, clothing (or nudity), accessories
    - gaze: direction of eyes, intent
    - mouth: position of lips, smile, lipstick, etc.
    - hair: length, colour, done up or loose
    - relationships between men and women: position, expression, size, attitude, etc.
    - text
- Each group chooses a presenter, boy or girl. During the plenary session, each presenter explains the group's findings to the rest of the students.
- A group discussion can follow to give everyone an opportunity to share his or her opinion.
- The facilitator can further comment if necessary and briefly explain what is meant by "gender" and sex and gender stereotypes.

The aim of this step is to highlight associations that advertisers make between technical skill and, in most cases, men; this stereotype often portrays women as incompetent or seductive, and also gives a very narrow and formatted view of masculinity.

Step three, 30 minutes

- The same approach is used for the recruitment campaign visuals. Students are presented with:
    - a very stereotyped visual
    - a less stereotyped visual to foster debate
    - a more neutral visual in terms of sex and gender representation and, if possible, diversity, one that can be used as an example of respecting gender equality and diversity.
- Attention is given to the people represented and the field or place where they are represented: for example, in a recruitment campaign for researchers of all disciplines, a woman is shown in a laboratory in the foreground, another photo shows a medium shot of a man contemplating the stars. This distinction between interior/exterior, infinitely small/infinitely large, is produced in recurring stereotypes.
- Students are asked to identify and discuss the sex and gender stereotypes in the visuals, to fill in the analysis grid, and discuss their observations.
- The teenagers will have a sharper eye after the first step of the activity, but they will still have to consider the presence of stereotypes by themselves in these pictures and the impact they can have when they think about a career in STEM jobs. The previous grid will again help to raise their awareness.
- This step will conclude with a look back at the post-its. Students will compare what was written on the post-its, i.e. women/girl and men/boy word associations:
    - with the stereotypes identified in the ads for technological objects
    - with the stereotypes tied to careers in science and technology

In most cases, there will be many similarities.

- The facilitator asks students for their opinion and launches a discussion on the impact stereotypes have on study/career choices and the representation of careers in STEM.
- The facilitator emphasizes that jobs should be mixed-gender, the need to choose one's studies and career based on skills and likes/dislikes without the influence of preconceived ideas.

CONCLUSION

The activity ends with:

- students' general feedback on the workshop
- a quick presentation of images of "role model" women in various fields such as engineering, astronomy, video games, etc.

The idea is to show students that skill and success have nothing to do with a person's sex.

PARTNER DETAILS

This module was originally developed by Universience, Paris, France.
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universcience

GENDER INCLUSIVENESS IN YOUR SCIENCE TEACHING

AT A GLANCE

Age Group	Adults
Format	Workshop for teachers
Duration	2 times 2 hours

OVERVIEW

This is a teacher professional development workshop focusing on gender awareness in science teaching.

It is about setting the scene of gender where it is important to, for example, introduce the definitions between biological sex and gender and reflect on how and whether girls and boys are approached and perhaps put into boxes in the classroom. To do this requires some preparation and studying the literature, such as the Hypatia theoretical framework.

It is important to organise a training course on gender for teachers, because, more than they think, teachers subconsciously interact with students based on gender stereotypes. And students themselves often have more gender stereotypes than we think. For example, boys can believe that they are better than girls at mathematics or computing. By raising awareness of these situations through training, we can try to counter such stereotypes in education.

OBJECTIVES

The objective is to enhance gender awareness in science teaching and give participants an opportunity to make their teaching practice more inclusive in the future.

SUGGESTED SCENARIO

This workshop has connections to the science curriculum for all science subjects and helps the teacher/educator become aware of gender in their teaching and in the classrooms. During the workshop participants (teachers, teacher trainers, student teachers) reflect on what role gender plays in their own teaching practice.

TARGET AUDIENCE

Age	Adults
N. participants	20 – 30
N. facilitators	2
Type of audience	Teachers, teacher trainers and in-training teachers.

FORMAT

Workshop with group and plenary discussions.

TOPICS COVERED BY THE ACTIVITY

This workshop focuses on enhancing gender awareness in all science content and background understanding as well as overall in science teaching.

DURATION OF THE ACTIVITY

Suggested duration: 2 times 2 hours would be ideal, but less is also possible. These 2 sessions could also be divided over 2 different days.

RESOURCES

This workshop uses a mix of individual reflection, group and plenum discussions and presentations. The following table with recommended materials will cover any needs for running the workshop:

MATERIALS

Photocopy of student assignments/tasks taken from science compendiums or books in your school context – for each participant		One for each participant
Post-its and pens/pencils		Enough for all participants
Video projector and screen		1
Coffee/tea and cake for break		Enough for all participants
Poster post-its or flipcharts		2 – 4

USEFUL LINKS, VIDEOS, ARTICLES

- *One Size fits all?* is a teacher training development programme developed in the framework of the TWIST project (Towards Women In Science and Technology – EU funded FP7 project).
- The Teacher Training Videos can be found on the TWIST website and on YouTube.

SETTING

The settings of the workshop can be a staff room or classroom or indeed any room where there is a possibility to make a presentation (i.e. use a projector and have a white screen). It could even be in a café kind of setting and/or a homely atmosphere that might give a more inviting atmosphere and thereby engage the participant to take part in reflection and group discussions.

The room needs to enable participants to break up into smaller groups for group discussions and group tasks.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

Workshop participants will work in a mix of groups (from pairs to small groups of 5 – 8 people) as well as a set-up in plenum.

INTRODUCTION

The workshop starts with an introduction to the workshop explaining the objective and introducing gender and gender inclusiveness as the overall theme. Participants will be

encouraged to ask questions, participate in discussions and contribute with insights from the very beginning.

DEVELOPMENT OF THE ACTIVITY

It is important here to mention that each workshop facilitator and presenter will have his or her way of presenting and conducting the different parts of the workshop. The following is an example of what can be included and how the workshop can be facilitated. The different parts included in for example the introduction will also vary from country to country and from institution to institution. This is in itself worthwhile reflecting on.

Introduce gender and why it would be important to reflect on and even challenge gender stereotypes in science teaching. This can be done using a combined PowerPoint-presentation and video statements (see YouTube link to videos below under "Useful links, videos, articles"). In preparation it is important to read and study the literature and find national or even local examples of gender inclusiveness and possibly even gender exclusiveness. These can be statistics or other examples taken from a regional or national context. Furthermore, it can be a good idea to find gender statistics on different educations. Examples of these could be statistics divided between male and female on how many of each are studying to be for example a doctor, engineer, technician or teacher.

Setting up a workshop as this involves studying the literature and finding concrete examples, but at the same time it is worthwhile doing, as these kind of workshops can have a huge impact and even change the way teachers teach.

Suggested program and time schedule:

- **10 minutes welcome and introduction** to workshop and presentation of objective (see above for objective).
- **30 minutes presentation** (PowerPoint or other presentation and/or video) covering the following topics: *What is gender? – How do we understand gender? – Why should we spend time on gender in the classroom and in our teaching? – Why is this important? – Gender in science statistics*. Try and create an open atmosphere where participants feel free to pose questions 'Plenum discussion on for example the following; *If they don't want to study science – they can just study art!* and then the question for discussion could be: *Is it a problem that fewer girls than boys choose to follow a career in science and technology?*
- **60 minutes reflection exercises:** Present and play video statements (there are 4 short videos you can use for this exercise that also are texted in English – see YouTube link to videos below under "Useful links, videos, articles") on different (sometimes provocative) gender issues. These are presented by leading Danish researchers in the field of gender and education. The videos can also be 'live statements' that are presented during the workshop. Invite participants to discuss the statements in small groups following each video and invite them to share their thoughts in plenum. Following all 4 video statements you can take a discussion in plenum and ask *Have these statements, research results and discussions changed some of your thoughts about how you teach?*
- **20 minutes Coffee break.**

- **45 minutes discussion:** A variety of max 4 – 5 science assignments/tasks for school pupils taken from science compendiums or science books in your school context are shared with participants, who then are invited to divide into (mixed gender) groups to discuss if they found them gender inclusive or gender exclusive and why. Participants are asked to discuss what the strengths and weaknesses are of the different assignments and discuss in what ways the assignments could be improved (in relation to making them more 'gender inclusive').
- **Perspective to other 'best practices', 30 – 45 minutes:** If possible, find an example in a commonly used science book for science subjects where you find a science assignment that you find to be especially 'gender inclusive'. Present why you found this assignment or topic successful in being 'gender inclusive and invite participants to share their thoughts on this. Another option is to share out different science assignments and invite participants to discuss how and where they find them to be either gender inclusive or gender exclusive. Their findings can be shared in plenum at the end of the discussions. You can also share the gender guidelines for teaching from the TWIST website and discuss with participants whether or not they could see themselves using such 'recommendations'.

CONCLUSION

To conclude the workshop, you can end with an evaluation and reflective feedback. Participants are asked – again in groups – to reflect on and respond to the following 4 questions:

- *What did you like about the workshop?*
- *What did you miss during the workshop?*
- *What made you reflect most on your own teaching practice? And why?*
- *Do you think the workshop will change your teaching practice? And if so – how?*

At the very end you can invite participants to write a postcard to themselves – that you promise to send between 1 and 3 months after the workshop. Participants write down what specific things they aim to change in their own teaching practice.

GENDER INCLUSION CRITERIA

It is important to organise a training course on gender for teachers, because, more than they think, teachers subconsciously interact with students based on gender stereotypes. And students themselves often have more gender stereotypes than we think. For example, boys often believe that they are better than girls at mathematics or computing. By raising awareness of these situations through training, we can try to counter such stereotypes in education.

The "gender inclusion criteria" developed in the Hypatia project are relevant for raising such an awareness and should be reflected on and discussed with the people who are offering such a class or activity. The following are some examples of how this teacher training workshop can address gender inclusivity on the different criteria levels.

INDIVIDUAL LEVEL

- Should include an alternation of individual reflection followed by group discussions and/or other forms of discussion formats.
- Should alternate between different formats of presentations: i.e. Video presentations, presentations or talks by researchers working on gender or education and other.

INTERACTIONAL LEVEL

- Should include a variation of different interaction forms; group discussion and debate, discussion and presentations in plenum as well as group tasks in pairs or in small groups of up to 5 people.
- Should aim for participants taking different roles, different people presenting in plenum, etc.

INSTITUTIONAL LEVEL

- Should be supported by the physical learning environment and allow participants to split up into groups and come together in plenum. Perhaps the environment can be supportive to the discussions; maybe the area can be set up in a homely manner that invites participants to discuss openly.
- Should invite participants to reflect on and discuss in what way the institutional level can have an influence on their own teaching, and whether this might influence gender inclusiveness or the opposite. (note: the institutional level is important to discuss in relation to any planned teaching activities.)

SOCIETAL/CULTURAL LEVEL

- Will incorporate considering the way gender is implicitly or explicitly conceptualized in society in general and what implications this might have on teaching and in the classroom.
- Will invite participants to reflect on how different stakeholders (ministries, politicians, funding organizations, interest groups etc.) Might also have potential effects on teaching activities in schools in regards to gender.
- Will allow participants to discuss how they might balance some effects of gender exclusiveness that might be seen or noticed in society and discuss how this could be addressed in the classroom and move towards supporting gender inclusiveness.

LEARNING OUTCOMES

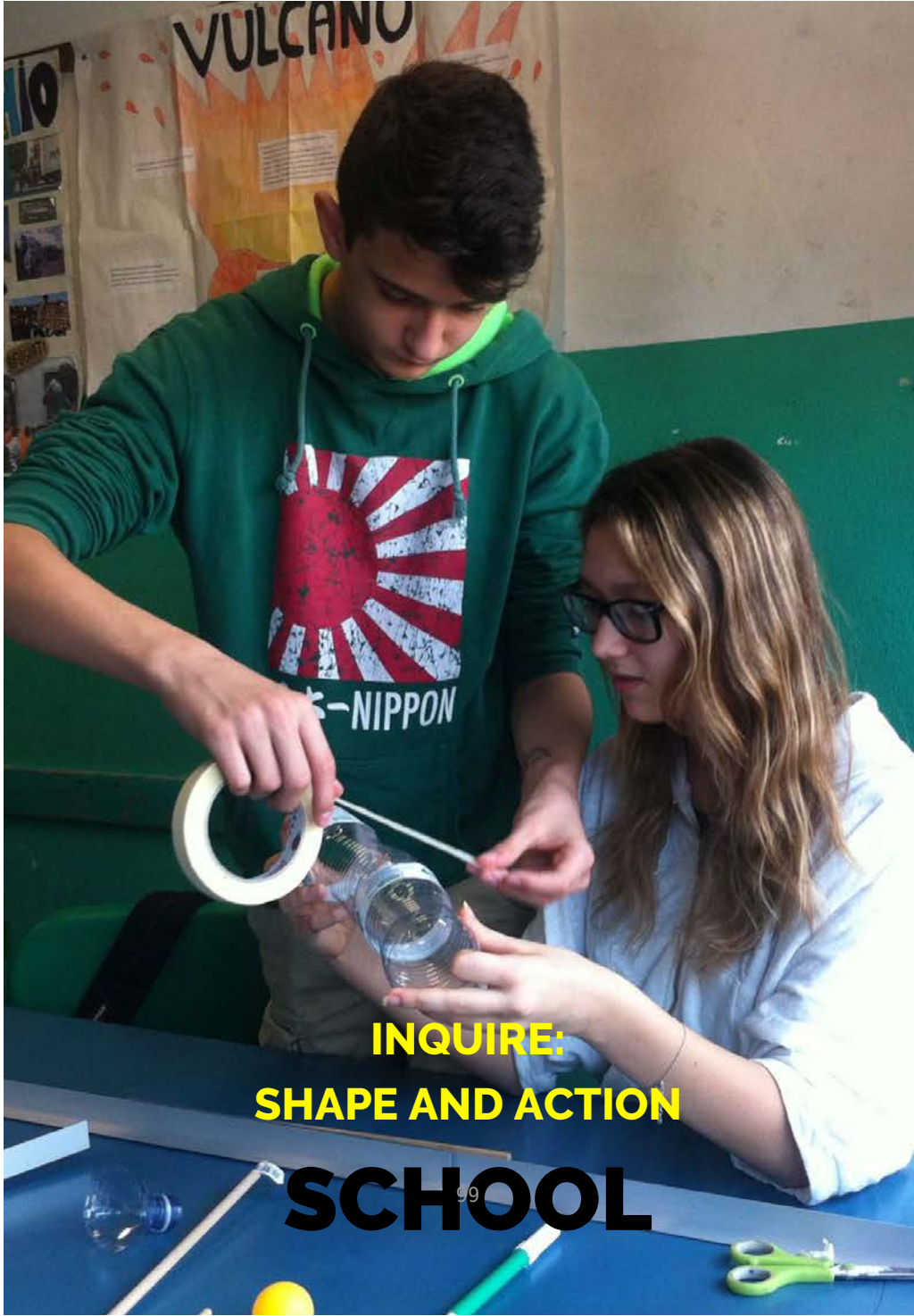
- At the end of the workshop participants should be able to:
  - Reflect on how their own teaching is influenced by their gender understandings
  - Reflect on how their own teaching can be more gender inclusive
- At the end of the workshop participants should have acquired:
  - General knowledge on gender and gender inclusion that will help them to identify challenges related to gender in their own teaching practice.
  - Knowledge and ideas as to how they can engage and motivate a broad group of learners with their teaching.

PARTNER DETAILS

This module was developed by the Danish Science Center Experimentarium, Hellerup, Denmark. Contact: Sheena Laursen, sheenal@experimentarium.dk and Christoffer Muusmann, christofferm@experimentarium.dk

EXPERIMENTARIUM

Cover image: the Danish Science Center Experimentarium, Hellerup, Denmark.



INQUIRE:
SHAPE AND ACTION
SCHOOL

INQUIRE: SHAPE AND ACTION

AT A GLANCE

Age Group	13 – 15 years old
Format	Workshop for students
Duration	2 hours

OVERVIEW

The activity explores some elements of Physics and Engineering in a gender inclusive way and presents different approaches to these topics: play, discussion, representation and construction.

OBJECTIVES

This interactive activity aims at increasing the students' self-confidence in representing scientific concepts in an abstract way and in constructing a structure in order to solve a practical problem.

It deals with an engineering topic, without specifying it until the final discussion, through an activity characterized by play, representation and construction.

The activity aims at presenting Engineering in a gender inclusive way, supporting the participation of all the students and discussing the gender balance in Engineering.

SUGGESTED SCENARIO

The activity can be held in the framework of a science lesson.

TARGET AUDIENCE

Age	13 – 15 years old
N. participants	20 – 25
N. facilitators	1
Type of audience	The audience could be a class of middle-school students.

FORMAT

Workshop for students.

TOPICS COVERED BY THE ACTIVITY

This activity has connections to Physics and Engineering in treating themes as trajectories, speed, force, distance, materials.

DURATION OF THE ACTIVITY

2 hours.

RESOURCES

MATERIALS

Ping pong balls		1 per student
Paper cups		1 per two students
Paper		1 per workstation
Pencils/markers		1 per workstation
Rolls of masking tape		1 per workstation
Cardboard boxes		At least 1 per workstation
Scissors		1 per workstation
Box cutters		1 per workstation
PVC tubes		At least 1 per workstation

USEFUL LINKS, VIDEOS, ARTICLES

- Awesome Pong Trick Shots
- Unbelievable ping pong tricks
- Unbelievable ping pong tricks! trickshots extreme!

SETTING

You need 4/6 working stations for 4/6 persons per station and a table where prepare all the necessary materials.

If the activity is run in a classroom you could for example put together 4 desks in order to create big working stations.

You can ask students to help you to prepare the setting. They felt involved.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

Students work in couples and small groups and are sat around the working stations. The teacher that know the students could form the groups, mixing males and females and avoiding that some group dynamic could reproduce inequality. The activity includes an alternation of pair work, work in small groups, plenary moments, and even an alternation of playing, representation, reflection, construction and discussions moments. That offers to students different group dynamics and help them to find their own favourite way to express themselves.

INTRODUCTION

10 minutes of plenary introduction.

The teacher introduces the pong-shot game: the player throws a ping pong ball in a paper cup. The ball should bounce once before landing in the paper cup.

The teacher can show the game asking a student to try or showing a video as inspiration (for example: Awesome Pong Trick Shots).

The starting questions could be: *Do you know ping pong? How does it work?*

DEVELOPMENT OF THE ACTIVITY

10 minutes in couples

The teacher divides the group in couples and distributes a paper cup and a ball for every couple. The students play the pong-shot game.

10 minutes in groups of 4/6 persons, one group for each working station.

The teacher asks each group to represent what they observed on a sheet of paper.

10 minutes of plenary discussion.

The teacher collects the representations, hangs them in order to show them to the entire classroom. The teacher asks students to find the different and the common elements in their representations.

Quite often the students find a way to represent the trajectory. Therefore the teacher can underline it and ask to the students: *Which are the main elements that can influence the trajectory? What could you do in order to control the ping pong ball trajectory?* The discussion can touch many different aspects: the spot where we make the ball bounce, the direction towards we shoot it, the intensity of the force we use in the movement, the way we throw the ball, the height of the cup, its width, etc.

60 minutes in groups of 4/6 persons, one group for each working station.

The teacher invites the students to create a structure for the pong shot in order to have a controlled trajectory. Therefore the ball should fall from this structure, bounce once and land always in the paper cup. The structure could be a sort of slide or a ramp. The teacher presents the available variety of materials for construction.

During the construction time the teacher is around, asks questions to students about what are they doing and why, she/he can possibly give some tips. Moreover the teacher updates the students about the remaining time to make it easier for them to plan.

CONCLUSION

20 minutes of plenary discussion.

Every group of students presents, shows and tests his structure.

The teacher asks students which were the different variables as speed, starting point, bounces, heights, inclination, materials of the bouncing surface, rotation of the ball, force, distance, and how these factors influenced the trajectory.

The teacher underlines that a scientific activity can have different aspects: observation, exploration, representation, calculation, construction and asks some questions to students that can answer raising their hands: *Which was the favorite part of this activity? Who preferred the introductive play? Who preferred the representation? Who preferred the discussion? Who preferred the construction?*

The teacher can present data asking questions. For example she asks to answer raising the hands to the following question: *Which is the percentage of women engineers employed in US in 2013? 12%, 36% or 48%?* (The right answer is 12%, source: www.aauw.org/research/solving-the-equation/). *Why?*

The teacher concludes discussing about engineering, she can ask: *How many people liked this activity? Why? How many people like the Engineering? What you do not like about engineering? What do you think is the most challenging aspect? Have you ever experimented an activity about engineering?*

The teacher underlines that this activity treats topics related to engineering, such as design, representation, problem solving and construction, without ever mentioning the word "engineering", that often discourage some students. The teacher therefore encourages girls and boys to go beyond bias and prejudices about some professions.

PARTNER DETAILS

MUSEO NAZIONALE SCIENZA E TECNOLOGIA LEONARDO DA VINCI

This module was originally developed by Museo nazionale della Scienza e della Tecnologia "Leonardo da Vinci" in Milan, Italy. Contact: Erica Locatelli locatelli@museoscienza.it & Sara Calcagnini calcagnini@museoscienza.it

Cover image: Photograph: Maur oFermariello. Courtesy Mauro Fermariello and by Museo nazionale della Scienza e della Tecnologia "Leonardo da Vinci" in Milan

PLAY DECIDE GAME & DEBATE

AT A GLANCE

Age Group	14 – 18
Format	Moderated discussion
Duration	90 – 120 minutes

OVERVIEW

An activity very easy to be transferred to many contexts. A discussion session for students, on the **stereotypes for working in STEM in your society.**

To prepare the students for this debate, they play a debate game led by their teacher. During this game, the students will think of a solution for the problems and dilemmas they encounter during the game. After the game, the students make a poster with their solution.

After a short break the debate starts. The debate is led by a moderator (the teacher) and accompanied by an expert panel (some students). The spokespersons for each group of students present their poster with a brief pitch. The expert panel review the solutions and arguments and share their experiences.

Then a number of statements are presented. The students vote for each statement. In response to the result of the vote the students debate with each other and the experts about the propositions.

OBJECTIVES

The object of the game is to explore (together) the topic of stereotypes within working in STEM in your society and knowing what thoughts and beliefs there are on it.

If desired (determined by the group itself), actions can be linked to the topic.

SUGGESTED SCENARIO

At school during a theme week, during class like in the (Dutch) subjects: social science; sociology; economics; human and nature; nature, life & technology; worldview and language, history; technology; philosophy.

TARGET AUDIENCE

Age	14 – 18
N. participants	10 –30
N. facilitators	3–6: 1 facilitator & 1 moderator each 5–10 students & a 3 persons expert panel
Type of audience	secondary science education students

FORMAT

Moderated discussion.

TOPICS COVERED BY THE ACTIVITY

This activity has connections to the science curriculum for job orientation and has gender and STEM as main topic.

DURATION OF THE ACTIVITY

1,5 to 2 hours.

RESOURCES

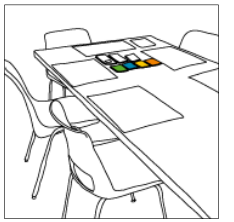
MATERIALS

Placemats	Annex 1	1 for every student
Big A3 placemat	Annex 2	1 per group
Glue (pritt)		2 per group
Pens		1 for every student
Markers (Edding)		3 per group
Highlighting markers		3 per group
Flip-over or standard for the poster		1 per group
Scribble sheets	Annex 3	2 per group
Scotch		1 role per group
PlayDecide Information cards	Annex 4a	1 set per group
PlayDecide Opinion cards	Annex 4b	1 set per group
Common Grid	Annex 5	1 per table
Teacher/facilitator/moderator guideline	Annex 6	1

USEFUL LINKS, VIDEOS, ARTICLES

- www.Playdecide.eu

SETTING



- Each group/table consists of 4 to 10 players (students) and one moderator. Divide the group in girls, boys and/or mixed groups, to your own preference.
- Choose the moderator(s) before the activity and choose with care; students might react better to a charismatic person that has experience in leading conversations with students or some might react better to a young person with whom they can identify better. Either a teacher, parent or student can be the moderator.

- The expert panel should consist of at least three people. These can be either: invited professionals who work in STEM or parents or even some students.
- The activity could be split in two and done on two separate moments.
- When finding facilitators/moderators for a whole class is hard,

- Try to split it up in two sessions with half the group. Maybe in combination with the *Find gender stereotypes in STEM!* module.
- De facilitator can be a moderator as well.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

Tips for the facilitator/teacher:

- Listening is important.
- Try not to do much talking yourself, but guide the conversation.
- Try to understand what they are thinking, to possibly help them to bring things into words, but do not try to persuade them. **You cannot control the outcome!**
- Try to have people to hold onto what they are thinking about something and look for the similarities.
- Try to give turns to everyone and wait until the other person has finished speaking (if it takes too long, ask whether they want to finish as time is limited, so that others can get their turn as well).
- The word "but" can often work inhibitory. For example, use the word 'and', which makes it a bit more open.
- Keep the time: In the session before the defence we have only one hour of time. Make sure you have moments of rest (for example, while reading and wait until everyone has finished reading) before you start. Also ask the students to keep the cards to themselves, since we then are going to tell what cards they have chosen and why. If they do start chatting, ask them to think about why they chose that card and what their arguments are for this choice.

INTRODUCTION

Introduction, 5 – 8 minutes.

The facilitator/teacher starts with a brief plenary explanation of the purpose and the program (see annex 6):

- Explore the topic of *stereotypes for working in STEM in your society* and knowing what thoughts and beliefs there are
- Find arguments to support your opinion
- Recognize the opportunities to break down the existing stereotypes
- Link actions to the topic.

Programme:

- Round 1: Choose information cards
- Round 2: Choose opinion cards
- Round 3: Discussion & find themes
- Round 4: Solutions/actions & poster
- Round 5: Debate
- Round 6: Award (optional).

The facilitator explains the criteria on which the expert panel will evaluate (to be determined by the expert panel). Then every moderator will repeat this in each group and decide who'll be the spokesperson who:

- Is going to do the pitch before an expert panel.
- Takes notes in round 3 and 4 on the scribble sheets. These can be put on the wall.
- Writes down the results (on a large sheet, the moderator takes notes as well on an own paper).

- Ask if any student wants to be that. If there are multiple, pull straws. If nobody wants to do, make a choice.

After that, explain what material is on the table and point out the structure in the next hour:

- The placemats: one per individual and a bigger shared one. You use the placemat the first two rounds, to keep an overview and it states the game proceedings.
- Each student also has its own placemat with the same information on it
- The cards:
    - The green information cards contain information, so you're fed with facts, general views of the population, etc. on STEM and diversity (including a wide example of STEM subjects to interest a wide group of students)
    - The blue opinion cards contain opinions (some complicated or even provocative), open problems, questions, etc.
- The scribble sheets: that they can use in round 3 and 4.
- The poster: is where they should note their slogan and arguments in a neat and tidy way. Best to ask someone with good handwriting to do the writing (on the flip-over next to the table).

Explain the terms of gender, stereotypes, diversity and prejudice (see the gender guideline for definitions).

DEVELOPMENT OF THE ACTIVITY

Round 1: Choose info cards, 5 – 8 minutes.

1. Each player gets four green information cards (shuffle the cards before and hand them out one by one, so not the first four to player 1). These cards state facts & figures on the topic of stereotypes within working in STEM in your society.
2. Each player chooses one (preferred) card, they have a strong opinion about.
3. Go around the group: Everyone reads their own card and explains why they chose that card. (Please note that there is no discussion yet! Ask the students to write down, if they would like to say something, on a specific card.)

Round 2: Choose opinion cards, 5 – 8 minutes.

1. Each player receives four blue opinion cards (shuffle the cards before and hand them out one by one, so not the first four to player 1). These cards state thoughts & beliefs on the topic of stereotypes within working in STEM in your society.
2. Each player chooses one (preferred) card, they have a strong opinion about.
3. Go around the group: Everyone reads their own card and explains why they chose that card. (Please note that there is no discussion yet! Ask the students to write down, if they would like to say something, on a specific card.)

Round 3: Discussion and find themes, 20 – 30 minutes.

1. Start to address the things that students wrote down in rounds 1 and 2 to start the discussion.
2. *Do we want to share something on our, or each other's choice?*
3. Give space when students still have questions to someone else or to share personal experiences or situation, they heard about, that happened because of stereotypes.
4. A discussion can occur from it, and give a head start to the start of clustering themes. (You can help by suggesting e.g.: Education; Cultural/Social; Behavioural Psychology; Political/economic; Biological)
5. If this is not the case then, for example, choose one student and allow him/her to re-read his/her card out loud. Then you can ask, *Does anyone have a card that matches this, according to his/her feelings/opinion?*
6. *Are there any similarities between these cards? Are there contradictions or not? What theme do we, as a group, find interesting?* Try here to elicit a discussion by linking cards together.
7. (You can choose to give the moderator an overview of the texts of all the cards to be able to refer to in the discussion).
8. Together, try to reach a minimum of 2 to 3 themes with cards that contain a similar message or idea referring to stereotypes for working in STEM in your society.

Round 4: Solutions/actions and poster, 25 – 40 minutes.

1. Consider a number of solutions/actions following the chosen main topic: the existing stereotypes for working in STEM in your society.
2. As moderator you make an inventory of what comes by and you summarize it together on the common grid.
3. The spokesperson of the group writes it on a large sheet, you're on your own paper as support.
1. After that you can give them your own paper, so they can make their slogan and poster.
4. The group makes their slogan & poster. And the spokesperson prepares her/his 30 sec. presentation.

CONCLUSION

Round 5: Debate, 30 – 45 minutes.

1. After a (short) break the debate starts.
2. The debate is led by the facilitator and accompanied by an expert panel. The spokespersons for each group of students present their poster with a brief pitch in no more than 1 minute (aim for 30 seconds).
3. The experts and fellow students can immediately respond. The expert panel review the solutions and arguments and share their experiences.
4. The facilitator writes down the important statements (worthwhile to remember).
5. Then a number of statements are presented. The students vote for each statement. In response to the result of the vote the students debate with each other and the experts about the propositions.

Round 6: Award, 5–10 minutes (optional).

After the debate, there is (optionally) an award for the best poster/presentation.

GENDER INCLUSION CRITERIA

The “gender inclusion criteria” developed in the Hypatia project are relevant for the adaption of Play Decide Game & Debate and should be reflected on and discussed with the people who are offering such a class or activity. Even more they might lay the ground for the success criteria in which to measure the results of the adapted activity. The following are some examples of how this workshop addresses gender inclusivity on the different criteria levels.

INDIVIDUAL LEVEL

- Engages students to prepare themselves for the debate game.
- Involves activities that challenges the students to form opinions.
- Uses activities and approaches that incorporate a clear context so participants understand how, why and where their new knowledge may be put into practice.
- Reflects on which previous knowledge and experience participants have.

INTERACTIONAL LEVEL

- Alternates between; work in alone, in groups and a debate in plenum.
- Notes that all participants feel free to share their arguments during the debate.

INSTITUTIONAL LEVEL

- Could be set up in a differently classroom, where the students aren’t in their normal set-up to invoke thinking out of the box.
- Should include thinking about what kind of an attitude the school itself has – in the debate the teacher can discusses with the group what kind of position they have on gender.

SOCIETAL/CULTURAL LEVEL

- Will put the different opinions about gender into context

LEARNING OUTCOMES

The following learning outcomes are divided accordingly between teachers or facilitators and participants:

- Teachers or facilitators
  After planning and preparing this workshop the facilitator or teacher should have knowledge of and/or be able to:
  - Adapt the activity in relation to targeting a broader group of participants.
  - Gain inspiration from the debate and incorporate this in other teaching activities.
  - Have an awareness and understanding of how to motivate girls and boys to engage in the activity.
  - Have awareness and understanding of the cultural restraints that might be part of a classroom teaching in regards to gender.
  - Realize how to counter target some of the cultural restraints in regards to gender that might be part of a classroom teaching.

- Students/participants:
  At the end of the lesson participants should be able to:
  - Explore the topic of stereotypes for working in STEM in the society and knowing what thoughts and beliefs there are.
  - Recognize the opportunities to break down existing stereotypes.
  - Find arguments to support their opinions.

PARTNER DETAILS

This module was originally developed by NEMO Science Museum in Amsterdam, the Netherlands.
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Cover image: Photograph: Digidaan. Courtesy of Digidaan and NEMO Science Museum, Amsterdam

SCIENCE AMBASSADORS
PEOPLE BEHIND SCIENCE AND TECHNOLOGIES

AT A GLANCE

Age Group	13 – 18 years old
Format	Meet a STEM professional
Duration	50 – 60 minutes

OVERVIEW

The activity consists in inviting one or two STEM professionals to a school. It is important that at least one of the speakers is a woman.

OBJECTIVES

The activity will give students the opportunity to:

- Meet preferably young professionals they can relate to.
- Make connections with a woman/man researcher or engineer, technician.
- Discover their course of study and background: obstacles, doubts, changes in orientation included.
- See how their career has developed and learn more about the world of stem.
- See the connections between their work and the needs of society.
- Gain awareness of the diversity of stem professions.

SUGGESTED SCENARIO

This activity can be implemented either in school or at a workplace (research institute, company, science centre…).

TARGET AUDIENCE

Age	13 – 18
N. participants	15 -30
N. facilitators	1 – 2 (the teacher and a facilitator if needed)
Type of audience	Students

FORMAT

Meet a STEM professional.

TOPICS COVERED BY THE ACTIVITY

The activity has links with job orientation curricula and career guidance.

DURATION OF THE ACTIVITY

50 – 60 minutes.

RESOURCES

MATERIALS

Computer		1
Video projector		1
Seats		15 – 30

USEFUL LINKS, VIDEOS, ARTICLES

- It could be useful to find a short video or interview with a scientist explaining brain plasticity. It can be used at some point during the activity to show that boys and girls have the same skills for studying STEM: with brain plasticity, neural connections are developed all lifelong. So boys are not more “maths oriented” than girls. For example, see this conference of Catherine Vidal on “Does brain has a sex?”.
- A short presentation of gender and/or sex to ‘set the scene’ can also be shown to students. This gives participants a chance to reflect on their understanding of gender and on situations where they have felt ‘left out’ because some activity or class was not targeting them.

SETTING

As it is not a lesson/lecture or a top-down meeting, tables can be arranged so that the speaker(s) and the teacher or the facilitator are sitting with the students to foster interaction (circle for example), if possible in a cosy place that changes from their regular classroom. It is important to create a relaxed atmosphere and working conditions to ensure all participants feel welcome and foster discussion. It is important to ensure that teens are close to and at eye level with the speaker(s).

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

The activity is conducted with one class and in presence of the teacher.

- Young researchers may have reservations about speaking in front of a class they do not know. Some questions might make them feel uncomfortable. It is very important to create trust during the activity so that speakers can speak freely about their true experiences. It is also important that the speaker(s) refrain from reading notes from a paper.
- The speaker(s) will have been briefed on:
    - The importance to understand gender issues and to prepare a clear message on inequalities.
    - The importance of involving girls in the discussion. There is a risk that only boys engage in the discussion.
    - How to react to sexist comments.

    - The need to talk about any obstacles they might have faced (economic, job expectations, disappointments, etc.).
    - What they need to prepare :
        - bring pictures of their work environment to provide a view of the workplace: the lab, office, team, key locations in the institute/center/company, etc.
        - research how many women currently work in the company and in which jobs. It can be interesting to know the percentage of women who hold top positions in the unit/department/company and if there are any salaries discrepancies. It is an easy way to show horizontal and vertical gender segregation.
        - the speaker(s) can be asked about how the number of women and engineers have changed over time, whether there are any specific company policies/charters to promote diversity, and their feeling on diversity in their workplace (*Do they feel like progress has been made?)*
- It is also useful to provide the speaker(s) with frequently asked questions:
    - *What qualifications do I need to apply for university studies?*
    - *Which companies hire the most engineering/sciences graduates?*
    - *What is the percentage of girls studying STEM?*
    - *Do I really need to speak English or other languages?*
    - *How can I start my career with international experience?*
    - *Are the job prospects poor after university? What are the different job opportunities?*
- The teacher is invited to maintain contact with the speaker(s) after the activity (further questions, opportunity to visit the workplace, etc.) and will be able to refer to the activity later on.

Note:

- It is important to select profiles that everyone can relate to so as to avoid exclusion: it is interesting to have young role models, but the diversity of personalities and the different fields they work in (not only successful careers) are equally important. If there are two speakers, it is better to have two people with different jobs and levels (engineer/technician).
- Speaker(s) can be a PhD student, a young researcher, an engineer, or a technician—any science-related job can work. People who work in social sciences can also be considered.
- If possible, choose a woman who does not work in a predominantly female field (biology, medicine). Also try to choose people who have followed non-linear paths to pique student interest and help them understand that there are a variety of paths that lead to STEM careers.

INTRODUCTION, 5 MINUTES

Warm welcome to the teenagers. The facilitator encourages all participants to speak freely and ask any questions they might have at any point in the discussion.

The speakers will explain why they are willing to meet young students (not only because they were asked to) and to exchange with them:

- *Who am I?* (name, age) and *what is my scientific discipline?* (and any other questions about family, hobbies, children, etc.)
- A short video (no more than 3-4min) can be showed to describe, for example, the speaker(s)'s field of science, work environment, relevant personal stories, etc.

Note:

- A good way to kick off the meeting could be to ask students to share what comes to mind when they think of a scientist and/or what jobs they associate with science. It helps encourage students to speak freely and stereotypical representations of scientists are likely to emerge (glasses, man, white coat, laboratory, chemistry, mathematician, medicine, etc.).

DEVELOPMENT OF THE ACTIVITY

First set, 15 min total, (5-minute presentation, 10 minutes for questions from students.)

- The speaker(s) will preferably begin with their studies:
  - *What did I like to study?*
  - *How did I get to the job I have now?*
  - *Why did I choose this course of study?*
  - *What did I like about it?*
  - *What aspects do I use today?*
    This part of the activity is interesting to help students identify with the speakers ("What was he/she doing at my age?") and what they are experiencing right now.
  - If I failed at something, how did I choose another path? Students will be interested in the wide range of individual experiences. It will reassure them there is more than "one way".
  - If PhD student: *What does doctoral student mean? How did I become one?* (studies, professional background, motivations), *Who is paying me now (and how much)?*
- It would be useful to show the students the different paths after high school in your country to emphasize the multitude of bridges to get somewhere (e.g. In France, bridges between engineering schools and PhD degrees; short university degrees and long university degrees)
- It is also interesting to evoke, if that is the case for one of the speakers, some more "chaotic" paths or any doubts they may have had to reach their current professional situation. The ideal model is not very challenging for everyone.

Second set, 25 min total, (10-minute presentation, 15 minutes for questions from students.)

- Example of what the speaker(s) can talk about:
  - *What do I do on a daily basis? What is the purpose?* (Aim of the research, for instance, conduct of the research, who decides on financing, etc.)
  - *Who am I in contact with during the day? Who works with me?* (general organization of the lab)

- *How would I describe a typical day?* (pictures of the work environment, of me working)
- *Do I have a social life?* (to break the stereotype of the antisocial researcher)
- *Who controls/checks what I do? Who is my boss? Do I have one? How is my work evaluated?* (in general: congress, thesis, publications/papers, etc.)
- *What is my research subject, for example? Why is it interesting? Why is it an important question? Why did I choose that subject?*
- *What do I like in this field?*
- *What is more specifically the content of my job? Is it innovative? Why is it interesting?*
- *Also, what is boring about it? What is challenging?*
- *How do I answer scientific questions? What experiments do I do?*
- Describe an experiment (pictures, costs).
- *What are my results? What do they look like, statistics, etc. and what do I do with them?*
- *How much time did it take to get these results?* (length of the research, of an experiment, of the analysis of the results, etc.)
- *What impact does the research have on people?*
- *What is my role in civil society?*
- *Do I have any doubts or concerns about my job and my role? Does my job match my previous expectations?*
- *What are the basic qualities of a researcher?*
- *What is my future?* = job prospects, openings

Note:

- The development of the activity can obviously be flexible and adjusted accordingly to the reactions of students and speaker(s).
- Any material on the real and concrete life of the speakers is welcome. The teacher/facilitator is to prepare this before the meeting, asking speakers to come with short videos, photos, pictures, if possible a little experiment… Make sure they do not plan on bringing the PowerPoint presentation from their last academic conference!

CONCLUSION

To conclude, it is important that students have time to discuss with the speaker(s) on any remarks and comments they have.

- Students can be asked what comes to mind when they think of a scientist now that they met the speaker(s).
- They can also be asked if they have ideas of the job they would like to do later and whether the activity sparked their curiosity about careers in science.
- The students must leave with the feeling that they are able to choose some paths in STEM, that it is a possibility for them too.
- A plenary discussion at the end of the activity, gathering the teacher and students, can help bring more depth to what they heard during the activity.

PARTNER DETAILS

This module was originally developed by Universience in Paris, France.
Contact: Marie-Agnès Bernardis, marie-agnes.bernardis@universcience.fr.

universcience

STEM WOMEN COOPERATIVE CARD GAME

AT A GLANCE

Age Group	13–18 years old students, groups and families
Format	Moderated discussion
Duration	20 minutes to 1 hour

OVERVIEW

By playing a cooperative card game, the public will discover the role of women in STEM knowledge and inventions throughout history.

OBJECTIVES

The activity aims to:

- Offer new role models to teenagers.
- Promote a better representation of women in schools, science centers and museums.
- Show women’s contribution to scientific knowledge.

SUGGESTED SCENARIO

The activity can be conducted in museums as a moderated discussion or at school. It can take place within a broader event or as a standalone activity.

TARGET AUDIENCE

Age	13 – 18
N. participants	2 – 30
N. facilitators	1 or 2 depending on the number of participants
Type of audience	Students, school groups, families, public

FORMAT

Moderated discussion.

TOPICS COVERED BY THE ACTIVITY

Women in STEM throughout history, history of sciences and technologies, and equality.

DURATION OF THE ACTIVITY

20 minutes to one hour depending on the format.

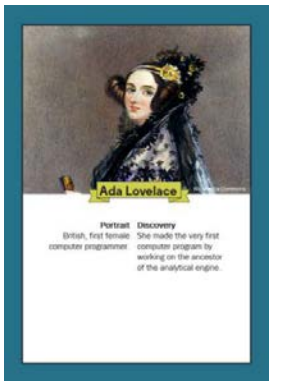
RESOURCES

MATERIALS

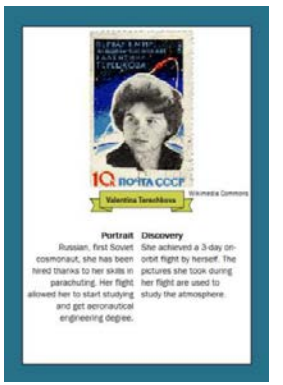
Cards printed on both sides: **FRONT** Photo or painting of a woman scientist + name + a short text presenting her and her biggest/most famous accomplishment or discovery *Note: don't indicate any dates on this side!* **BACK** Photo or painting of a woman scientist + name + year of her biggest/most famous accomplishment or discovery	(See illustration bellow)	30 cards (or more)
Hooks or clothes pegs and rope to hang the cards	 	60 (2 per cards)

Note: How to create a card?

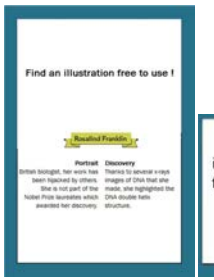
- The content of the cards, including the portrait and the discovery, can be found on online encyclopaedias (Wikipedia for example) or in books.
- Be careful when you choose the illustration/picture: it must be free to use. You can find online database to get license free pictures (Wikimedia commons for example).
- Here are three examples of cards (the front page of the card is on the left, the back side of the card is on the right):

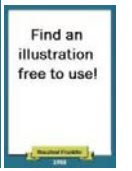


Ada Lovelace



Valentina Terechkova





USEFUL LINKS, VIDEOS, ARTICLES

Wikipedia website, Britannica, books...

SETTING

- If the activity is implemented for a group including more than 10 people: a big wall to hang the cards as the game progresses. You can also choose to place the cards on the floor.
- If there are between 2 to 10 players: several tables and chairs, each with a set of small cards.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

The game can be implemented either for small groups of 2 to 10 and for bigger groups of 10 or more (up to 30).

INTRODUCTION

- For a large group, 5 min to explain the game. The facilitator(s) introduce themselves. They show a portrait card: *We are going to travel back and forth in time, to meet women scientists and learn about their discoveries. This is a cooperative game, so you can discuss as a group to find the correct place for each discovery in the timeline.*
- For small groups: Rules of the game are printed ahead of time and left on the tables with a set of cards. A poster close by lets the public know that they can play without asking. Facilitators can stay nearby to provide any necessary explanations.

Note:

- Choose the women you want to show carefully: you need as much diversity as possible in terms of scientific field, education, age, nationality, sexual orientation (when publicly sated by the woman herself) etc.
- It is best if there are not all “extraordinary” stories: boys and girls need to relate and sometimes highest profiles may do the exact opposite.

DEVELOPMENT OF THE ACTIVITY

For a large group: one of the facilitators hangs a first card with the date showing.

- They pick another card and ask to the group where it should go: before or after the first one.
- The second facilitator (if there is one) can walk among the public to catch some thoughts and encourage the players to share them with the group.
- Facilitators can give some clues, but without providing correct answer.
- The card is hung where the group says it should be.
- The answer is revealed and the card repositioned if needed.
- The facilitators pick a new card (or ask one of the players to take their role).

Note:

- The public can participate on several levels:
    - seek and find answers,
    - engage and encourage others by taking the facilitator’s role,

- handle the cards and hang them,
- suggest new discoveries by women to the game.

- Facilitator(s) must be briefed on the importance of involving girls in the discussion. Especially in groups where there are fewer girls than boys, there is a risk that only boys engage in the discussion. The speaker should also be prepared to hear sexist comments and react accordingly.

CONCLUSION

When the game is completed, or time is up, facilitators invite participants to have a look over the entire timeline: “In a short time, we have seen a lot of discoveries by women throughout history.

- *Do you know other women who are not represented here?*
- *Who is your favourite?*
- *Why?*

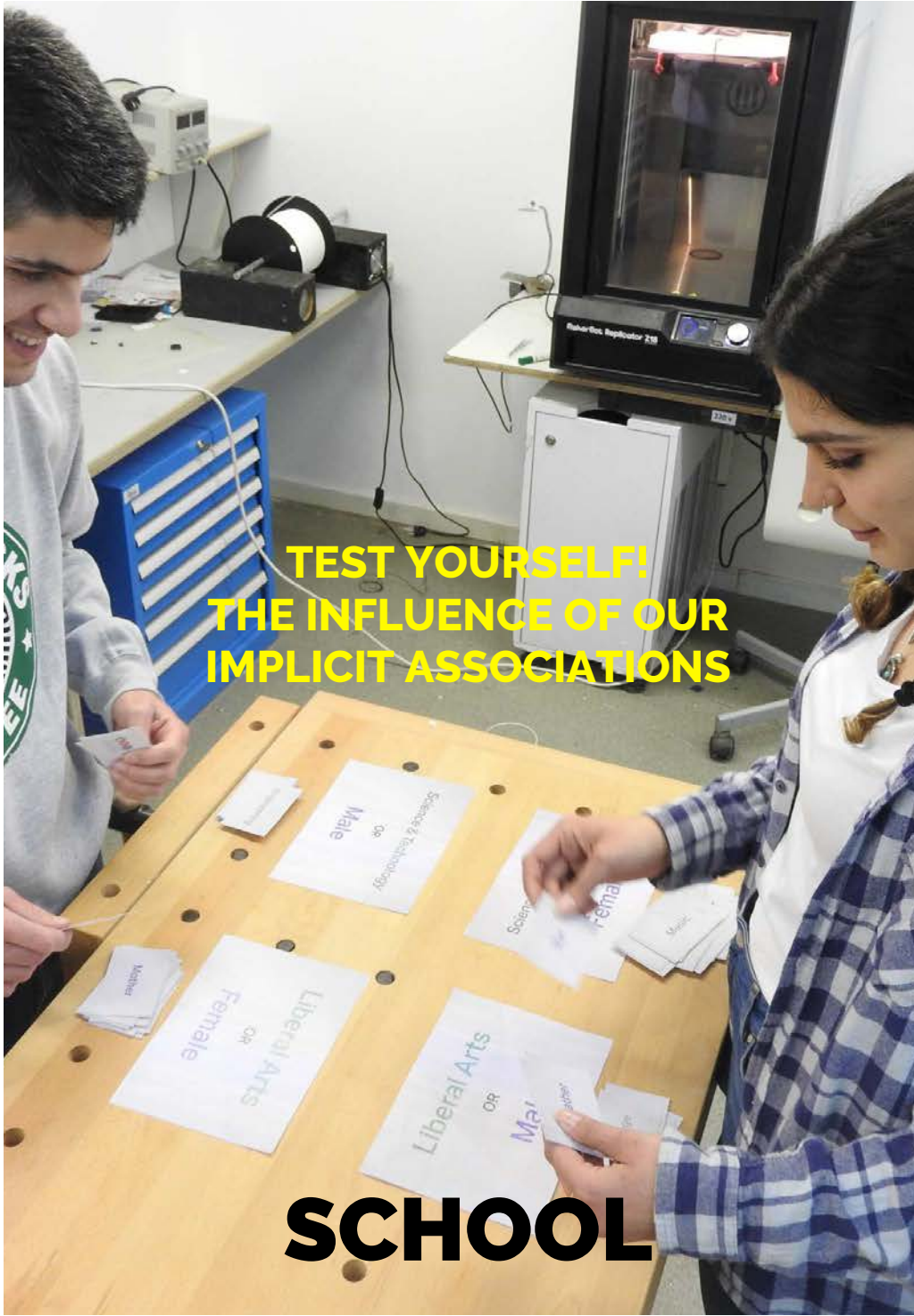
Facilitators explain why women are under-represented: prohibited from teaching, publishing, studying, etc.

A general discussion can then be engaged, if there is time and demand on how to ensure better representation of women in STEM.

PARTNER DETAILS

This module was originally developed by Universience in Paris, France.
Contact: Laurence Battais, laurence.battais@universcience.fr &
Mélissa Richard, melissa.richard@universcience.fr.

universcience



TEST YOURSELF! THE INFLUENCE OF OUR IMPLICIT ASSOCIATIONS

AT A GLANCE

Age Group	Teenagers from 15 years old, adults
Format	Game and Moderated discussion
Duration	About 45 minutes

OVERVIEW

This activity explores the participants' sub-conscious associations regarding the connection between gender and involvement in STEM subjects (sciences, technology, engineering and mathematics) and the liberal arts.
The activity starts with a card game for two players, which explores whether the players tend to relate certain subjects to a particular gender. Through the game, the participants are exposed, in a non-obligatory way, to the gender bias embedded in their sub-conscious, which is likely to influence their behaviour without conscious intent. Thereafter, a group discussion is held, as well as a discussion in the plenum, on the influence of latent associations regarding gender, and their impact on the females' choice to study and to later work in STEM areas.
**The activity is based on the IAT (Implicit Association Test) that measures the implicit opinions and beliefs that people do not want to, or cannot, reveal (in addition to gender, also race, weight, nationality, origin, skin colour and age). The test was developed by Tony Greenwald of the University of Ohio, a little over a decade ago. The test was developed and studied in various states through this site and on the TWIST project site.*

OBJECTIVES

- Exposing to the participants the gender biases implicit in their sub-conscious.
- To be aware of their implicit gender biases in order to reduce their impact on their behaviour and on their decision-making.
- To enable girls and young women to make a more rational decision regarding the choice of STEM area in their studies and future careers.

SUGGESTED SCENARIO

The activity can take place at school in the following frameworks:

- A general social studies lesson with the homeroom teacher.
- An event intended to encourage the choice of scientific and technological tracks by all the pupils and by females in particular.

TARGET AUDIENCE

Age	Teenagers from 15 years old
N. participants	20
N. facilitators	1 facilitator for 20 participants (no need of external experts)
Type of audience	Pupils

FORMAT

Game and Moderated discussion.

TOPICS COVERED BY THE ACTIVITY

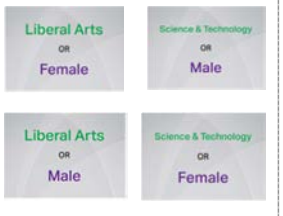
This activity has an unspecified STEM content but it deals with the issue of encouraging teenagers to choose STEM studies.

DURATION OF THE ACTIVITY

About 45 minutes.

RESOURCES

MATERIALS

Playing cards on which are written the words: **woman, girl, aunt, daughter, wife, lady, mother, grandmother, man, boy, father, male, grandfather, husband, son, uncle, philosophy, literature, art, sociology, music, language, history, physics, engineering, chemistry, statistics, neurosciences, biochemistry, astronomy**	You can find a graphic file for producing the signs (size A7) here	30 cards for each participant
Four signs with the captions: Liberal Arts **or** Female Science and Technology **or** Male Liberal Arts **or** Male Science and Technology **or** Female	 You can find a graphic file for producing the signs (size A5) here	4 signs for each pair of participants
Link to the internet or copy the following film to the computer:	royalsociety.org	1 per group
Projector		1 per group
Computer		1 per group
Blackboard or white wall for projection		1 per group

USEFUL LINKS, VIDEOS, ARTICLES

Before holding the activity, we recommend reading background material on the subject that includes statistical data and sources deal with the following topics: Why is it important to encourage equal opportunities? Possible reasons for the given gender inequality and proposals for improving the existing situation.

You can find data in English in the report from UNESCO: Women in Science and in the document “Criteria for Gender Inclusion at the individual, interactional, institutional, and societal/cultural levels”.

SETTING

- Arrange the room to enable holding a discussion and watching a short film.
- Tables on which the cards will be placed, so that each two participants will be able to stand on both sides facing each other (the number of tables will be according to the number of participants).

Please note!

- It is important to place the signs in advance in the correct order, so that one can immediately start playing, after receiving the instructions.
- It is important that before the activity, the person directing the game will him/herself play, enjoy the experience, and ask him/herself the questions arising during the discussion.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

The activity includes playing in pairs and discussion in plenum.

INTRODUCTION

Presenting the game, 5 – 10 minutes

The instructor introduces him/herself (name, the scientific/technological area of academic study, his/her stage in studies, etc.). Thereafter, the subject of the workshop is presented in general – "Workshop on Gender and Career in the Sciences and Technology Areas", and the instructions for the game are expounded.

The participants in the game are to classify the cards as fast as possible, according to the two categories appearing on the cards: A category of "female" or "male", and a second category of "Liberal Arts "or "Science and Technology".

Each of the words on the cards is suitable to one of category-pairs: male/female or Liberal Arts/Sciences and Technology. For example, in the category male/female, the word "daughter" pertains to "Female", while the word "son" pertains to "Male". In the category Liberal Arts /Science and Technology, the word "art" pertains to "Liberal Arts" and the word "physics" pertains to "Science and Technology".

Please note!

Some students don't know what liberal arts subjects are and what science and technology subjects are. It is highly recommended to give them some examples and make sure they understand and will be able to sort correctly the cards according the two categories.

DEVELOPMENT OF THE ACTIVITY

Paired card game, 5 minutes

- The participants are divided into pairs.
- Each pair of players participates in two rounds, with a different pair of captions shown them in each round. The pair: Liberal Arts or Female; Science and Technology **or** Male.

- The pair: Liberal Arts **or** Male; Science and Technology or Female.

- At the end of the first round, the players change places and repeat the exercise with the second pair of captions. The cards must be shuffled well after each round.
- At the end of the game the players return to their seats and a discussion is held.

In this link you can find a short video that demonstrates the cards' game:

Discussion in the plenum, 10–15 minutes

Ask the participants:

- *Was the level of difficulty identical in both rounds of the game?*
- *In which pair of categories was the classification easier?*

Listen to the participants' comments.

The game, in fact, examines whether the players tend to relate certain subjects to a particular gender. Through the game, most of the participants are exposed in a non-obligatory manner to the gender bias implicit in their sub-conscious, which is likely to influence their behaviour without any conscious intent.

Studies based on this test show that most people usually take longer to place words associated with the exact sciences when they are connected to the category "Female" rather than to the category "Male", although there is no fundamental connection between the two categories. When there is an associative connection between the categories, people reply very quickly and attribute the word to the correct category, but it will them longer to answer when there is no associative connection between the two categories. But there is also room for optimism: researchers have found that although the stereotypical connection between science and masculinity is common globally (including in countries in which the indices of gender equality

are higher, such as Denmark and Norway), it is lower in countries where there were actually more female scientists! In other words, the more women there are in science, the less will be the gender bias and *vice versa*, the less the gender bias, the greater will be the number of women in science.

Please note!

- The results are likely to be affected by diverse external factors, such as distractions during the game. The game is intended to raise awareness of the subject and not to serve as a diagnostic tool. The results should be approached with a healthy dose of scepticism.
- The claim is that those same biases in our sub-conscious can also affect our behaviour, our attitude towards males and females, and, of course, our decision making.
- For example, a study conducted in Israel (by Victor Lavy, Professor of Economics from Warwick University, England and the Hebrew University, and Dr. Edith Zand, an economist from the Bank of Israel), showed that in external examinations for 6th grade pupils, in which the examiners did not know the examinees' gender, the girls attained better results than the boys. In comparison, in those same examinations that were checked internally by teachers who knew the pupils, the boys obtained significantly better results. This result proves unequivocally that the school teachers discriminated against the girls in mathematical scores, based on a gender. This discrimination affects not only their future success in junior high school and in university, in these subjects, but is one of the factors leading to the absence of females from these professions in the labour market, and even to their lower incomes compared to males.

Questions for discussion:

The claim is that since parents and teachers see more women than men in the liberal arts subjects and more men than women in the science and technology subjects, it may cause them to relate differently to boys and girls in the stage of choosing their course of study at school, and therefore, may influence their decisions making.

- *Have you experienced a different attitude from the teachers towards girls and boys in your class?*
- *How can this affect their success?*
- *Are there differences at home in the way your parents encourage brothers or sisters to study science and technology?*

Listen to the participants' comments.

Showing a short film, 5 minutes

Show a short animated film on the influence of our implicit biases on our decisions, opinions and choices, and on the importance of recognizing them and raising them to awareness. The film is accompanied by subtitles and concludes with the claim that the existence of implicit biases cannot be prevented, but awareness of their existence can reduce their impact. *We can't cure unconscious bias, but with self-awareness we can address it."*

The link for this film is: https://royalsociety.org/topics-policy/publications/2015/unconscious-bias/

We recommend inserting subtitles in the suitable language to the film (approval is given by the Royal Society Organisation to insert translated subtitles in the film).

CONCLUSION

Summary, 5 – 10 minutes

We spoke about the implicit biases we all have that can influence the choice by girls and women of professions in science and technology.

- *Is it/why is it important for both groups to study and work in STEM areas?*

  Hear the pupils' comments and summarise:

Culture is one of the main factors influencing the lesser participation of women in the world of science and technology. One piece of evidence for this is the existence of cultures in which both genders are represented and succeed equally in these professions. In the western world the participation of women in computer sciences is particularly low, while in eastern cultures, in Eastern Europe, in South America and in Africa, women are represented equally in this profession (and sometimes their percentage of participation is even higher than that of their male counterparts).

- *And why is it important for women to work in STEM areas?* (Or you can also ask about the importance of participation of other minorities such as those based on the socio-economic status)

  Hear the students' comments and raise the following claims:

It is important for women to work in STEM areas for several reasons: The value aspect of social equality in an advanced society; for the benefit of society at large, it is important to create a culture that encourages diversity. Diversity enables the expression of diverse opinions and approaches necessary to solving complex problems, and facilitates the full realization of the potential embedded in a particular society. If the potential of 50% of the population is not fully realized the entire society loses out.

GENDER INCLUSION CRITERIA

INDIVIDUAL LEVEL

- The activity enables all the participants to have an emotional experience in a simple card game on which the activity is based.
- The activity includes diverse formats of activity that enable different learners to be engaged: playing a card game, watching a short film and participating in a group discussion.

INTERACTIONAL LEVEL

- The activity includes playing and a group discussion, during which the participants discover that they all have the same experience of implicit bias regarding gender, and discover that none of them is free of stereotypical thought.

INSTITUTIONAL LEVEL

- During the discussion the participants broach situations that occur in their immediate environment, in school and at home, where implicit biases regarding gender are manifested. Bringing those implicit biases to the awareness in the context of gender and of STEM can

influence the attitude of pupils/teachers to males and females regarding their choice of scientific and technological subjects.

SOCIETAL/CULTURAL LEVEL

- The activity exposes the participants to the impact of culture and society on the females' choice of STEM subjects in school and in their future careers.
- The activity exposes the participants to the opinion of policy makers (Ministry of Education, Ministry of Science and Industry) regarding the importance of adequate representation of girls and women in STEM subjects in school, in academia and in industry.

LEARNING OUTCOMES

At the end of the lesson:

- The participants should be aware:
  - That their implicit biases can influence their decisions, opinions and choices and that there is a big importance to recognize them and be aware of them.
  - That females can develop a career in STEM to the same extent as can males. The main reason that their representation is not compatible in some of these professions is the social attitude (of males and females) regarding the status of females in society.
- The pupils will be able to make a more rational decision when choosing an area of study in high school and later in the academia.

PARTNER DETAILS

This module was first developed by Bloomfield Science Museum Jerusalem, Israel. Contact: Eti Oron, etio@mada.org.il

Cover image: Courtesy of Bloomfield Museum Jerusalem.

WHAT'S YOUR OPINION? ABOUT THE CONNECTION BETWEEN GENDER AND SCIENCE

AT A GLANCE

Age Group	15 – 18 year old pupils, adults
Format	Moderated discussion
Duration	70 – 80 minutes

OVERVIEW

The activity offers an interactive way to confront participants with their own prejudices and stereotypes. In an individual, secret ballot, each participant expresses an opinion regarding stereotypical claims as to whether females are capable of, and suitable to scientific and technological professions. Thereafter, discussions are held in small groups and in the plenum on the reasons for the under-representation of women in some fields of STEM (Science, Technology, Engineering and Mathematics), on the value, social and economic importance of equal opportunities, and on proposals for activities that could improve the existing situation.

OBJECTIVES

- To expose the participants to, and to have them confront themselves with, the prejudices and stereotypes regarding gender and science.
- To enable the females to make a more rational regarding their choice of STEM areas in their studies and careers.

SUGGESTED SCENARIO

The activity can be held at school in the framework of a social activities class, in a science class, in the context of encouraging choosing scientific technological tracks, or in the framework of an event for choosing high school graduation study tracks. For teachers and pre-service teachers the activity can be held in the framework of teachers' training.

TARGET AUDIENCE

Age	15 – 18 year old pupils, adults
N. participants	15 – 40 participants
N. facilitators	1 (there is no need for external experts)
Type of audience	School groups, groups of teachers or groups of pre-service teachers

FORMAT

Moderated discussion.

TOPICS COVERED BY THE ACTIVITY

This activity has an unspecified STEM content but it deals with the issue of encouraging teenagers in general and women in particular to choose STEM studies.

DURATION OF THE ACTIVITY

70 – 80 minutes.

RESOURCES

MATERIALS

Beads (2 colours)		3 beads per pupil (different colour for each gender)
Velcro		A strip of 10 – 15 cm
Stickers (a text or an icon representing "Agree", "Don't know", "Disagree")		Stickers for each statement)
A4 sheet with the text of the statement		3
Scissors		1
masking tape		1
Cutting knife		1

3 possible options to create a ballot box		
Shoe box		3 or 6 see in the linked picture above option 1 or 3
Cardboard box		3 see in the linked picture above option 2
Transparent plastic cups		3
Opaque paper cups (much bigger than the transparent plastic cups)		9 see in the linked picture above option 1

USEFUL LINKS, VIDEOS, ARTICLES

Before holding the activity, we recommend reading background material on the subject that includes:

Statistical data regarding:

- The scores of males and females in the STEM subjects that indicate the abilities of both sectors.
- The updated number of students from both genders in academia in diverse STEM subjects (mathematics, physics, computer sciences and biology).
- The updated number of employees from both genders in industrial R&D departments.

Sources deal with the following topics:

- Why is it important to encourage equal opportunities? Possible reasons for the given gender inequality and proposals for improving the existing situation.
- You can find data in English in the report from UNESCO: Women in Science and in the document "Criteria for Gender Inclusion at the individual, interactional, institutional, and societal/cultural levels".

SETTING

ORGANIZATION OF THE CLASSROOM OR ACTIVITY AREA:

- A table for placing the ballot box, positioned in a way that will enable a secret voting as far as possible: In one corner of the room, beside the entrance door, behind the door etc.
- The tables in the classroom are arranged in a way to facilitate working in groups of 4–5 pupils.
- A blackboard on which one can write.

BALLOT STATION

- Prepare beads of different colours for the males and the females (three for each participant).
- Prepare a ballot box. One can prepare a large box with nine holes (in groups of three), into which the beads are

to be dropped. Next to each hole is a mark meaning "agree", "disagree", or "no opinion". Each group of three holes relates to a separate statement. Inspiration for constructing the ballot box from three other boxes (shoe boxes or cardboard boxes) can be obtained from three construction proposals shown in the picture in the section on "materials" (note – each proposal pertains to one statement; a box should be prepared for each statement).

- A transparent container (transparent plastic cup or soft drink bottle) should be placed under each hole. The containers are covered during the voting, and it is not possible to see how the others voted (see picture in the section on "materials").

PRINT OR WRITE ON A SHEET OF A4 PAPER THE THREE FOLLOWING STATEMENTS:

1. Some believe that men are better than women in science and technology.
2. Some believe that women are less rational than men and therefore less suitable to work in STEM.
3. Some believe that women may be good students but lack scientific talent.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

Pupils work individually, in small groups and in plenary session.

INTRODUCTION

Voting at the ballot station, 10 – 15 minutes

We recommend starting the activity with individual secret voting at the ballot station and only thereafter presenting the subject of the lesson.

Please note!

- Maintaining secrecy is important in order for the voting to manifest the personal opinion of each voter, rather than that expected of him/her.
- It is important for the voters not to see how others voted, so that their vote will not be biased.
- It should be emphasized to the pupils that there is no correct or incorrect answer. Voting is according to what they feel.

DEVELOPMENT OF THE ACTIVITY

Presenting the subject and counting votes, 15 minutes

After the voting, the pupils should gather in their places, the subject of the lesson should be presented, the balloting station opened, and the results noted on a chart on the blackboard.

<u>Presenting the lesson topic</u>

- *What do you think; is there a difference in the number of men and women engaged in the STEM subjects? Do you know more female engineers or male engineers?*

  Listen to the pupils and say that the lesson will deal with the subject of gender equality in the context of science and technology.

- *What is the significance of the word "gender"? Is the word gender parallel to the word sex (biology)?*

  It is worth listening to the pupils opinions and only thereafter explaining the difference.

  The concept of gender refers to social aspects of biological sex, i.e. the social and cultural significances of the biological aspects. Thus gender attributes do not necessarily emanate directly and exclusively from the biological differences between the genders, but manifest the cultural perception that translates biological difference to values that determine the social status of the two genders in society. When we talk about gender and science we refer, in fact, to the gender role that manifests the social customs and habits customary in that society, in other words, which roles and abilities are "suitable" for males and which for females.

- Therefore, *what is the significance of a gender stereotype or prejudice regarding gender?*

  It is worth first hearing the pupils' comments and then to summarize and explain.

A stereotype is the social perception of attributes that are distinctive of groups of people and social categories, and their attribution to people who belong to these groups. Stereotype causes us to analyse social situations incorrectly. A gender stereotype is our social perception regarding the attributes of males and females (character, abilities, tendencies, preferences, external appearance, types of behaviour etc.), and our tendency to relate male attributes to males and female attributes to females, still prior to meeting them.

Opening the ballot box, counting the votes and their notation on the chart on the blackboard

We recommend dramatically opening the ballot box and allowing the pupils to be impressed by the results. Clear differences can be seen according to the number of beads and their colour in each of the transparent containers.

Thereafter, two volunteers will count the beads and note the results on the blackboard according to the following table:

Some believe that men are better than women in science and technology.				Some believe that women are less rational than men and therefore less suitable to work in STEM				Some believe that women may be good students but lack scientific talent.			
	Agree	No opinion	Disagree		Agree	No opinion	Disagree		Agree	No opinion	Disagree
♀				♀				♀			
♂				♂				♂			
SUM				SUM				SUM			

Brief discussion of the results of the ballot and presenting data from the field, 10 minutes

The teacher will summarize the results for the pupils. *Are the results surprising? Do you think the results represent the*

opinions prevalent in the public (other areas, other ages, etc.)? *Do the questions annoy you? Do you resent them? Do you think the results reflect the reality in the field?*

Listen to the pupils and provide some national data from the field regarding the situation of males and females in science and technology – in school, in academia and in industry.

Please note!

The data shown below relates to Israel. Please enter the data according to the country where the activity takes place.
The data can be presented in brief or through questions and answers as follows:

Ask the pupils the following questions and ask them to raise their hand when they hear the answer compatible with their opinion.

- *Who received higher scores in the 8th grade national examinations in science and mathematics – the males or the females?*
  Whoever thinks that the females received higher scores – please raise your hand; whoever thinks the males received higher scores – please raise your hand; whoever thinks that the males and the females received equal scores – please raise your hand.

  Answer: Almost equal scores, small disparity in favour of the females.

- *What is the ratio between the number of females and the number of males studying for a (first and second) university degree in mathematics, statistics and computer sciences?* (Raise your hand according to the ratio each thinks exists.)

  Half of the students are males and half females; about ⅓ of the students are female and about ⅔ are male, some ⅔ are female and about ⅓ are male.

  Answer: Less than ⅓ of the students are female. The situation is worse regarding doctorate studies, where only 20% of the students are female.

- *What is the ratio between the average number of female and male Hi-Tech employees in all areas of science and technology?* (Raise your hand according to the ratio each participant believes exists.)

  An equal number of males and females, about ⅓ females and ⅔ males, about ⅔ females and about ⅓ males

  Answer: About 65% males and about 35% females.

In conclusion, we have seen that the girls' scholastic abilities are similar to those of males, but fewer of them address certain academic scientific and technological studies (In school, too, there are fewer females who choose to study physics and computer sciences), and the number of females in R&D departments in industry is very small relative to the number of males in those departments.

Discussion in small groups, 10 – 15 minutes

Division into groups of 4–5 pupils

The groups will discuss three subjects, will note the main points of the discussion on a piece of paper, and thereafter will present the result of the discussion in the plenum.

1. *What do you think are the reasons for the existing situation of inadequate representation of females in some areas of science and technology and in R&D departments in industry*? List at least two reasons.
2. National policy makers (government ministries, senior stakeholders, etc.) are convinced of the importance of an equal number of females studying and involved in all areas of science and technology. *What do you think?* Note at least two reasons.
3. *What do you think can be done to improve the existing situation in school and/or in academia and/or in industry?* Note at least two suggestions.

Presenting the results of the group discussion in the plenum, 10 – 15 minutes

Each group will present the results of the discussion for 2–3 minutes.

During the presentation one can ask *whether the decisions were unanimous? Did anyone make a suggestion that was rejected? Was there a difference between the females' opinions and the males'? Did anyone of the participants raise a point that you did not think of previously? Did questions or considerations arise for which you do not have answers?*

If indeed questions were raised for which the pupils did not know the answer, we recommend trying to explore the topic and/or asking them to seek information on the subject, and afterwards to involve the other pupils.

Please note!

Try not to be judgmental during the discussion regarding the opinions expressed by the pupils. Raising diverse claims can be based on facts (such as statistical data) over which there are (usually) no argument and on the participants' different perceptions of the world, which is based on the influence of family, friends, and personal factors for which no judgmental opinion can be voiced.

CONCLUSION

Summary, 5 – 10 minutes

Should a matter of principle not be mentioned in the pupils' presentation the teacher will add the information. It is important to conclude the discussion with a clear position that the current situation is that females are not adequately represented in science and technology, and that the main reason for it does not lie in the lack of compatibility or their ability, but in social, cultural influence. The decision whether or not to choose to study and work in science and technology should be taken not in accordance with "what is accepted" and what is expected of one, but according to ability and personal interest. It is important to emphasize that there are differences between males and females, but these differences are smaller than those existing amongst all males and all females. Different people with different abilities are suitable for working in science and technology. Furthermore, researchs have proven that the more varied the work teams and the greater variety of communities they represent, the more points of view they offer and the more creative solutions they reach.

Additional option for teachers and pre-service teachers for humoristic conclusion of the workshop:

Does something seem strange to you in the following sentences? (Or alternately, one can ask in which year do you think the following sentences were published?)

- **Fact!** Women have a career and men go to work.
- **Today's question:** *Is it time we took men's contribution to academia seriously?*
- **Today's question:** *Can men really be both good dads and have good careers at the same time*?
- **Congratulations** to all men in STEM for juggling housework, a job, and developing a career. Some even have kids too! *How do they do it?*

Do you think that in a hundred years they will also sound strange?

* These sentences were published on twitter @manwhohasitall

GENDER INCLUSION CRITERIA

INDIVIDUAL LEVEL

The activity includes diverse ways to express the personal opinions of all the participants and their involvement in activities:

- Secret, individual balloting by all the participants.
- Discussion in small groups enables the involvement of participants who find it hard to express their opinions in the plenum.
- Presentation in the plenum enables some participants to express themselves as best possible.
- The need to express opinions regarding social issues causes emotional involvement in the activity.

INTERACTIONAL LEVEL

- The activity includes diverse formats of activity that facilitate diverse interactions amongst the participants: discussions in small groups, discussions in the plenum, and presentations of group representatives in the plenum.

INSTITUTIONAL LEVEL

- During the activity the participants are asked to make suggestions for activities that the school can do in order to encourage more females to choose STEM subjects.

SOCIETAL/CULTURAL LEVEL

- During the activity, the pupils are aware of the policy makers' (government ministries, senior stakeholders, etc.) agenda regarding the importance of integrating more females in academia and in industry, and of the need to encourage females to choose STEM subjects in school.
- Presents the subject of gender in the context of STEM subjects in a manner that obligates the involvement of pupils and expressing their opinions on associated issues.
- Presenting statistical data regarding gender and STEM in a manner that surprises and arouses thought.

LEARNING OUTCOMES

At the end of the lesson pupils should be aware:

- That females can develop a career in STEM to the same extent as can males. The main reason that their representation is not compatible in some of these professions is the social attitude (of males and females) regarding the status of females in society.
- Of the social reality of the incompatible representation of females in STEM, of the possible reasons that led to this, and of the possible ways the situation can be improved.

PARTNER DETAILS

This module was first developed by Bloomfield Science Museum Jerusalem, Israel. Contact: Eti Oron, etio@mada.org.il

Cover image: Courtesy Bloomfield Science Museum Jerusalem.

FIND GENDER STEREOTYPES IN STEM REPRESENTATIONS!

AT A GLANCE

Age Group	13 – 18 years old
Format	Moderated discussion
Duration	90 minutes

OVERVIEW

The workshop focuses on gender-stereotyped representations of science and technologies in advertisements for technological objects (such as computers, smartphones, video games, cars, etc.) and recruitment campaigns for schools, training, or jobs in STEM fields. Through the discovery, comprehension and analysis of stereotypes in these visuals, students will be led to question:

- How these stereotypes influence the way they view the skills/abilities associated with women and men in science and technology.
- How these stereotypes influence their choice of studies and careers.

OBJECTIVES

- Understand what sex and gender stereotypes are and identify them.
- Heighten students' awareness of stereotypes in their daily lives.
- Increase awareness about the negative impact they can have on their own representations of sciences, the world of science and technology, and their study/career choices.
- Learn about careers in STEM and develop an interest in them, regardless of their sex.

SUGGESTED SCENARIO

The activity is designed for a class of students. It could take place during a research center/museum ‘open day’ or for the International Women’s Day. It could also be implemented as a workshop or as an open lesson for secondary schools.

TARGET AUDIENCE

Age	13 – 18
N. participants	20 -30
N. facilitators	1
Type of audience	Students

FORMAT

Moderated discussion.

TOPICS COVERED BY THE ACTIVITY

This activity deals with science and technology in general with a societal approach. In France, this workshop has links with the civic education curricula that promotes gender equality; the mechanisms of sex-differentiated socialization are also studied in high school economic science classes.

DURATION OF THE ACTIVITY

90 minutes.

RESOURCES

MATERIALS

Computer		1
Video projector		1
Flipchart		1
Visual Images	Google search, newspaper	6 (3 different ads + 3 different campaigns)
Pen or pencil & paper		1 per student
Post-its		100
Analysis grids	See “Development of the activity”	6 (1 per group per visual)

NOTE:

To prepare for the activity, facilitators will need to choose the ads that will be shown during the workshop and prepare the analysis grids that will be distributed to students.

USEFUL LINKS, VIDEOS, ARTICLES

- The TWIST project: www.the-twist-project.eu
- Expect Everything campaign: www.expecteverything.eu
- Hypatia Project D2.1 (Criteria for Gender Inclusion) and D2.2 (Good Practices on Gender Inclusion in STEM Communication)
- The most appropriate images, visuals in each country: recent ads for smartphones, computers, video games, recruitment campaigns for researchers or STEM careers in engineering, transportation, energy, nuclear, aeronautics, or information flyers on science and technology programmes at universities and higher education establishments.
- Centre audiovisuel Simone de Beauvoir/Genrimages: www.genrimages.org

SETTING

Closed and modular space so tables can be moved to work in small groups.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

Students will work in plenary sessions and small groups, preferably mixed boys and girls.

INTRODUCTION, 5 MINUTES

Quick introduction explaining to students that they are going to comment on advertisements for daily technological objects and recruitment campaign visuals, followed by an analysis and discussion. The facilitator or teacher will emphasize that they are really interested in what the students think.

DEVELOPMENT OF THE ACTIVITY

Step one, 10 minutes

- The activity begins with a question: *What are the skills, ideas, adjectives, qualifiers that you spontaneously associate with men, boys, girls and women?*
- Give 2 post-its to each student: they will write what they associate with women/girls on one and what they associate with men/boys on the other.

  Note: post-its are anonymous, a very short period of time is given to write down the associations.

- The post-its are then stuck on the flipchart, arranged into 2 columns: one column for words associated with women/girls and one for words associated with men/boys. They will be commented at the end of the workshop.
- The person leading the workshop (the facilitator) then explains the general notion of stereotypes, clichés, preconceived ideas.

Note: definition of sex and gender stereotypes:

- Sex and gender stereotypes are over-generalizations of what girls and boys/men and women are and are not, by nature: "women have no sense of direction", "men are tech-savvy", "women are intuitive", "men are not emotional", etc.
- *How do they work?* Sex and gender stereotypes legitimize the roles of each sex by "naturalizing" them: they make the different and hierarchical roles of sexes assigned to men and women seem biological and natural.

Step two, 30 minutes

- The facilitator shows the first ad and the group comments on it together to give students an idea of how to analyse an image.
- The students are asked to form three groups, preferably mixed girls and boys.
- The facilitator gives each group a recent ad for a technological object (the ad is printed on a A3 coloured sheet of paper); each group receives a different visual. For example:
  - an ad for a pink phone and for a blue phone
  - a computer marketed for girls, and one marketed for boys
  - an ad for video games showing girls and boys
- Each group is given a blank analysis grid (prepared in advance by the facilitator). Students observe and discuss the visual, and fill in the grid.

Note: the grid indicates the following points to be analysed:

- the link between the object in the ad and the person or people shown in the image
- the target audience of the ad
- the construction of the image

    - the size of the different elements in the image and their connection
    - the colours used (boy/girl gendered colours)
    - description of the people: activity, posture, body part featured, clothing (or nudity), accessories
    - gaze: direction of eyes, intent
    - mouth: position of lips, smile, lipstick, etc.
    - hair: length, colour, done up or loose
    - relationships between men and women: position, expression, size, attitude, etc.
    - text
- Each group chooses a presenter, boy or girl. During the plenary session, each presenter explains the group's findings to the rest of the students.
- A group discussion can follow to give everyone an opportunity to share his or her opinion.
- The facilitator can further comment if necessary and briefly explain what is meant by "gender" and sex and gender stereotypes.

The aim of this step is to highlight associations that advertisers make between technical skill and, in most cases, men; this stereotype often portrays women as incompetent or seductive, and also gives a very narrow and formatted view of masculinity.

Step three, 30 minutes

- The same approach is used for the recruitment campaign visuals. Students are presented with:
    - a very stereotyped visual
    - a less stereotyped visual to foster debate
    - a more neutral visual in terms of sex and gender representation and, if possible, diversity, one that can be used as an example of respecting gender equality and diversity.
- Attention is given to the people represented and the field or place where they are represented: for example, in a recruitment campaign for researchers of all disciplines, a woman is shown in a laboratory in the foreground, another photo shows a medium shot of a man contemplating the stars. This distinction between interior/exterior, infinitely small/infinitely large, is produced in recurring stereotypes.
- Students are asked to identify and discuss the sex and gender stereotypes in the visuals, to fill in the analysis grid, and discuss their observations.
- The teenagers will have a sharper eye after the first step of the activity, but they will still have to consider the presence of stereotypes by themselves in these pictures and the impact they can have when they think about a career in STEM jobs. The previous grid will again help to raise their awareness.
- This step will conclude with a look back at the post-its. Students will compare what was written on the post-its, i.e. women/girl and men/boy word associations:
    - with the stereotypes identified in the ads for technological objects
    - with the stereotypes tied to careers in science and technology

In most cases, there will be many similarities.

- The facilitator asks students for their opinion and launches a discussion on the impact stereotypes have on study/career choices and the representation of careers in STEM.
- The facilitator emphasizes that jobs should be mixed-gender, the need to choose one's studies and career based on skills and likes/dislikes without the influence of preconceived ideas.

CONCLUSION

The activity ends with:

- Students' general feedback on the workshop.
- A quick presentation of images of "role model" women in various fields such as engineering, astronomy, video games, etc.

The idea is to show students that skill and success have nothing to do with a person's sex.

PARTNER DETAILS

This module was originally developed by Universience in Paris, France.
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universcience

SCIENCE CAFÉ OR CAFÉ SCIENTIFIQUE

AT A GLANCE

Age Group	13 – 15 or 15 – 18
Format	Meet a STEM professional
Duration	2 hours

OVERVIEW

The Science Café focuses on broadening the scope when it comes to choosing a future career. Many girls find it difficult to see themselves within the field of science and technology and specifically within the field of technology. Some of this is due to boundaries often associated with gender.

This activity is a facilitated discussion following the principles of *Café Scientifique*. Facilitators educated in these principles will create a dialogue meeting between a couple of female scientists from various fields and a group of teenagers. The topics to be discussed will be chosen by the researchers, and facilitators will create the discourse for the meeting. Researchers should be asked to also focus on their career and touch on the challenges they have met and how they managed to overcome them.

Following the opportunity to meet with real life scientists, participants are given the chance to reflect on what role gender plays when choosing a future education and career, and in what way gender has affected the professional lives of the female scientists.

OBJECTIVES

The objective is to enhance awareness about the possibilities in the world of science and break down possible (un)conscious biases people might have about scientists with a specific focus on female scientists. Many teenagers lack a variety of real life role-models they can relate to, and the Science Café gives them the opportunity to meet up with researchers that can tell about their personal motivations and choices – and the challenges and opportunities they have met along the way. The participants may even be inspired to choose a career within STEM.

SUGGESTED SCENARIO

The scenario is well-placed in an informal science learning setting such as a science center or museum. It can also be placed in other settings, where a group can be gathered in a relaxed, egalitarian and informal way. It is important that the setting creates an atmosphere, where you are not expected to take notes, rather the participants should be inspired to enjoy themselves and engage in discussions. It is a place where anyone can come to explore the latest ideas in science and technology and can also take place in cafes, bars, restaurants and even theatres, but always outside a traditional academic context.

TARGET AUDIENCE

Age	13 – 15 or 15 – 18
N. participants	20 – 50
N. facilitators	2
Type of audience	Teenagers and their teachers

FORMAT

Presentations by role models in science and moderated plenary discussions.

TOPICS COVERED BY THE ACTIVITY

This activity aims towards giving career guidance targeted to teenagers in regards to the education and career paths they might choose or aspire to choose and specifically focusing on STEM careers.

DURATION OF THE ACTIVITY

Suggested duration: 2 hours.

RESOURCES

This moderated discussion uses a mix of presentations and Q&A-sessions.

The following table with recommended materials will cover any needs for running the workshop.

MATERIALS

Video projector and screen		1
Coffee/tea and cake or biscuits		Enough for all participants
Poster post-it or flipchart		1

USEFUL LINKS, VIDEOS, ARTICLES

- cafescientifique.org
- sciencecafes.org
- the-twist-project.eu
- Hypatia project

SETTING

The venue needs to strike a balance between being large enough to accommodate the audience and small enough to allow them to hear each other and interact successfully. We recommend that the size is 20-40 persons. Above this number it can be hard to have a lively discussion, where everyone feels addressed.

Set time aside to let the teenagers engage in activities or exhibits after or during the Science Café if it is held in an institution that has such activities. These can range from engaging in a science exhibition on water to engaging in an activity that focuses on health for example. This will also give an opportunity to further inspire and engage.

Sometimes teenagers see science as difficult, boring and ‘a closed world of its own’. By putting science back into culture and everyday life – and doing it in a setting, where everyone is feeling comfortable – it hopefully becomes relevant and intriguing.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

Science Café will usually be held in plenum, yet it is optional for the researchers to suggest small group discussions during the café in order to engage all of the participants.

INTRODUCTION

The Café Scientific starts with an introduction to the researchers and the aim of the day – to broaden and inspire towards the scope of possible education and career paths for the participants. Facilitators will encourage participants to ask questions, participate in discussions and otherwise contribute from the very beginning.

DEVELOPMENT OF THE ACTIVITY

It is important here to mention that the following is merely meant as examples and can be seen as inspiration to the organisers and researchers. The different parts included in the examples will also vary from country to country and from institution to institution.

The number of speakers is one of the first things to consider. Is a single speaker enough if combined with a well-facilitated discussion? It can be. Yet, often two scientists will cover a broader spectrum of science and give different perspectives on STEM and also on gender-related issues. Three or more is also an option, but it requires that the facilitators can balance the different parts of the café in order to make room enough for each scientist, yet keeping an eye on the overall timeframe. This risk if you have a 'panel' of speakers is that the audience becomes viewers of, rather than participants, in a debate. It is crucial that the visiting scientists are good at addressing and relating to the participants.

It can also be a good option to mix different kinds of speakers, so that different perspectives are given and discussed. Scientists are one kind of group (that can easily be divided into several subgroups), yet also people from other parts of society can be inspiring, when it comes to discussing STEM and gender, e.g. philosophers and sociologists – maybe even politicians.

In order to get the right persons as speakers, take contact to different groups and organisations. It can be outreach departments of your nearest university, scientists that are used to work with education and teenagers, the local council, NGO's. It all depends on what works in your local circumstances.

At the beginning of the café suggest introducing gender and why it is important to reflect on and even challenge gender stereotypes when considering a future career path.

Suggested program and time schedule:

- **12 minutes welcome and introduction** to Science Café, the topic is briefly introduced, welcome to participants and researchers and welcome to the 'set-up' – which is briefly explained.
- **2 x 20 minutes talks.** Each scientist (or other speaker) presents themselves, their fields, personal choices and considerations and challenges they have met along the way. Q&A sessions after each presentation.
- **15 minutes break** after either the first or second presentation. (Remember there may only be one presenter).
- **40 minutes discussion.** It might be a good idea to prepare the overall discussion question with participating teenagers before the Science Café. This would also add to a sense of ownership. It might even be a possibility that one of the participating teenagers presents the discussion question in the beginning and why they have chosen it. The following question is simply an example of

what a question might look like: “Is it a problem that fewer girls than boys choose to follow a career in science and technology?”. The discussion is facilitated by the organisers.

- **Conclusion, 10 – 20 minutes.** What do we take home from the café?

CONCLUSION

To conclude the Science Café we end with an evaluation and reflective feedback. Participants are asked to discuss in small groups (or two and two) if this has made them reconsider the options they have in regards to choosing a future career path and study. Equally important is whether their view upon gender and the career stereotypes often associated with these has either changed or been challenged.

After the groups or pair discussions there will be a short plenum discussion. The organisers thank the researchers and teenagers (and teachers) for showing up and taking part in the café.

GENDER INCLUSION CRITERIA

The “gender inclusion criteria” developed in the Hypatia project are relevant for the adaption of software programming classes and should be reflected on and discussed with the people who are offering such a class or activity. Even more they might lay the ground for the success criteria in which to measure the results of the adapted activity. The following are some examples of how this workshop addresses gender inclusivity on the different criteria levels.

INDIVIDUAL LEVEL

- Includes presentations or talks by scientists, who are asked beforehand to reflect on their own experiences as women (or men) in science. They bring their experiences to the participants, who are about to choose their own careers.
- Introduces participants to the concept of gender and the role it plays when choosing what to study.

INTERACTIONAL LEVEL

- Will alternate between different types of discussion formats such as group discussions, plenum debates and for example short discussions in small groups.

INSTITUTIONAL LEVEL

- Can take place in a physical learning environment where participants can come together in plenum. It might be supportive if the setting is informal and could be followed by a chance to try out hands-on activities or other exhibits related to science – in other words perhaps in a science center or museum.
- Might bring up how an institution might influence the teenagers’ feeling of being included and discuss and reflect on what gender representations are found and used in their school or workplace.

SOCIETAL/CULTURAL LEVEL

- Will touch on the way gender is implicitly or explicitly conceptualized in society in general and how this concept is created and maintained through media, politicians and other powerful groups. Depending on the time participants can reflect and discuss more on this.

LEARNING OUTCOMES:

- At the end of the Science Café the participants should be able to:
    - Reflect on different career options in STEM and how gender biases may influence their own. understandings of possible study and career paths.
- At the end of the workshop participants should have acquired some of the following:
    - Knowledge of certain career possibilities within STEM.
    - A clearer understanding of what being a scientist might encompass.
    - Understanding of everyday life and/or careers of scientists.
    - Some knowledge on gender issues in science
    - Knowledge and ideas that can inspire them when choosing a future career path.

PARTNER DETAILS

This module was developed by the Danish Science Center Experimentarium, Hellerup, Denmark. Contact: Sheena Laursen, sheenal@experimentarium.dk and Christoffer Muusmann, christofferm@experimentarium.dk

EXPERIMENTARIUM

Cover image: the Danish Science Center Experimentarium, Hellerup, Denmark.

STEM WOMEN COOPERATIVE CARD GAME

AT A GLANCE

Age Group	13–18 years old students, groups and families
Format	Moderated discussion
Duration	20 minutes to 1 hour

OVERVIEW

By playing a cooperative card game, the public will discover the role of women in STEM knowledge and inventions throughout history.

OBJECTIVES

The activity aims to:

- Offer new role models to teenagers.
- Promote a better representation of women in schools, science centers and museums.
- Show women’s contribution to scientific knowledge.

SUGGESTED SCENARIO

The activity can be conducted in museums as a moderated discussion or at school. It can take place within a broader event or as a standalone activity.

TARGET AUDIENCE

Age	13 – 18
N. participants	2 – 30
N. facilitators	1 or 2 depending on the number of participants
Type of audience	Students, school groups, families, public

FORMAT

Moderated discussion.

TOPICS COVERED BY THE ACTIVITY

Women in STEM throughout history, history of sciences and technologies, and equality.

DURATION OF THE ACTIVITY

20 minutes to one hour depending on the format.

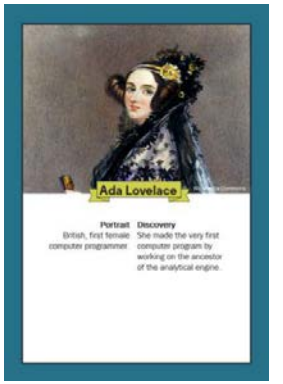
RESOURCES

MATERIALS

Cards printed on both sides: **FRONT** Photo or painting of a woman scientist + name + a short text presenting her and her biggest/most famous accomplishment or discovery *Note: don't indicate any dates on this side!* **BACK** Photo or painting of a woman scientist + name + year of her biggest/most famous accomplishment or discovery	(See illustration bellow)	30 cards (or more)
Hooks or clothes pegs and rope to hang the cards	 	60 (2 per cards)

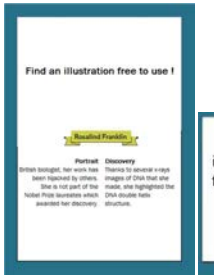
Note: How to create a card?

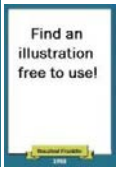
- The content of the cards, including the portrait and the discovery, can be found on online encyclopaedias (Wikipedia for example) or in books.
- Be careful when you choose the illustration/picture: it must be free to use. You can find online database to get license free pictures (Wikimedia commons for example).
- Here are three examples of cards (the front page of the card is on the left, the back side of the card is on the right):



Ada Lovelace

Valentina Terechkova





USEFUL LINKS, VIDEOS, ARTICLES

Wikipedia website, Britannica, books...

SETTING

- If the activity is implemented for a group including more than 10 people: a big wall to hang the cards as the game progresses. You can also choose to place the cards on the floor.
- If there are between 2 to 10 players: several tables and chairs, each with a set of small cards.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

The game can be implemented either for small groups of 2 to 10 and for bigger groups of 10 or more (up to 30).

INTRODUCTION

- For a large group, 5 min to explain the game. The facilitator(s) introduce themselves. They show a portrait card: “We are going to travel back and forth in time, to meet women scientists and learn about their discoveries. This is a cooperative game, so you can discuss as a group to find the correct place for each discovery in the timeline.”
- For small groups: Rules of the game are printed ahead of time and left on the tables with a set of cards. A poster close by lets the public know that they can play without asking. Facilitators can stay nearby to provide any necessary explanations.

Note:

- Choose the women you want to show carefully: you need as much diversity as possible in terms of scientific field, education, age, nationality, sexual orientation (when publicly sated by the woman herself) etc.
- It is best if there are not all “extraordinary” stories: boys and girls need to relate and sometimes highest profiles may do the exact opposite.

DEVELOPMENT OF THE ACTIVITY

For a large group: one of the facilitators hangs a first card with the date showing.

- They pick another card and ask to the group where it should go: before or after the first one.
- The second facilitator (if there is one) can walk among the public to catch some thoughts and encourage the players to share them with the group.
- Facilitators can give some clues, but without providing correct answer.
- The card is hung where the group says it should be.
- The answer is revealed and the card repositioned if needed.
- The facilitators pick a new card (or ask one of the players to take their role).

Note:

- The public can participate on several levels:
    - seek and find answers,
    - engage and encourage others by taking the facilitator’s role,

- handle the cards and hang them,
- suggest new discoveries by women to the game.

- Facilitator(s) must be briefed on the importance of involving girls in the discussion. Especially in groups where there are fewer girls than boys, there is a risk that only boys engage in the discussion. The speaker should also be prepared to hear sexist comments and react accordingly.

CONCLUSION

When the game is completed, or time is up, facilitators invite participants to have a look over the entire timeline: “In a short time, we have seen a lot of discoveries by women throughout history.

- *Do you know other women who are not represented here?*
- *Who is your favourite?*
- *Why?*

Facilitators explain why women are under-represented: prohibited from teaching, publishing, studying, etc.

A general discussion can then be engaged, if there is time and demand on how to ensure better representation of women in STEM.

PARTNER DETAILS

This module was originally developed by Universience in Paris, France.
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universcience

TEST YOURSELF!
THE INFLUENCE OF OUR IMPLICIT ASSOCIATIONS

AT A GLANCE

Age Group	Teenagers from 15 years old, adults
Format	Game and Moderated discussion
Duration	About 45 minutes

OVERVIEW

This activity explores the participants' sub-conscious associations regarding the connection between gender and involvement in STEM subjects (sciences, technology, engineering and mathematics) and the liberal arts.

The activity starts with a card game for two players, which explores whether the players tend to relate certain subjects to a particular gender. Through the game, the participants are exposed, in a non-obligatory way, to the gender bias embedded in their sub-conscious, which is likely to influence their behaviour without conscious intent. Thereafter, a group discussion is held, as well as a discussion in the plenum, on the influence of latent associations regarding gender, and their impact on the females' choice to study and to later work in STEM areas.

* *The activity is based on the IAT (Implicit Association Test) that measures the implicit opinions and beliefs that people do not want to, or cannot, reveal (in addition to gender, also race, weight, nationality, origin, skin colour and age). The test was developed by Tony Greenwald of the University of Ohio, a little over a decade ago. The test was developed and studied in various states through this site and on the TWIST project site.*

OBJECTIVES

- Exposing to the participants the gender biases implicit in their sub-conscious.
- To be aware of their implicit gender biases in order to reduce their impact on their behaviour and on their decision-making.
- To enable participants to make a more rational decision regarding the choice of STEM area in their studies and future careers.

SUGGESTED SCENARIO

At the museum in the following frameworks:

- A meeting for students on a scientific topic of choice, that includes a module about gender and science;
- An event for students, to encourage the choice of STEM subjects.

TARGET AUDIENCE

Age	Teenagers from 15 years old, adults
N. participants	20
N. facilitators	1 facilitator for 20 participants (no need of external experts)
Type of audience	School groups, groups of teachers or groups of pre-service teachers

FORMAT

Game and Moderated discussion.

TOPICS COVERED BY THE ACTIVITY

This activity has an unspecified STEM content but it deals with the issue of encouraging teenagers to choose STEM studies.

DURATION OF THE ACTIVITY

About 45 minutes.

RESOURCES

MATERIALS

Playing cards on which are written the words: **woman, girl, aunt, daughter, wife, lady, mother, grandmother, man, boy, father, male, grandfather, husband, son, uncle, philosophy, literature, art, sociology, music, language, history, physics, engineering, chemistry, statistics, neurosciences, biochemistry, astronomy**	You can find a graphic file for producing the signs (size A7) here	30 cards for each participant
Four signs with the captions: Liberal Arts **or** Female Science and Technology **or** Male Liberal Arts **or** Male Science and Technology **or** Female	 You can find a graphic file for producing the signs (size A5) here	4 signs for each pair of participants
Link to the internet or copy the following film to the computer:	royalsociety.org	1 per group
Projector		1 per group
Computer		1 per group
Blackboard or white wall for projection		1 per group

USEFUL LINKS, VIDEOS, ARTICLES

Before holding the activity, we recommend reading background material on the subject that includes statistical data and sources deal with the following topics: Why is it important to encourage equal opportunities? Possible reasons for the given gender inequality and proposals for improving the existing situation

You can find data in English in the report from UNESCO: Women in Science and in the document “Criteria for Gender Inclusion at the individual, interactional, institutional, and societal/cultural levels”.

SETTING

- Arrange the room to enable holding a discussion and watching a short film.
- Tables on which the cards will be placed, so that each two participants will be able to stand on both sides facing each other (the number of tables will be according to the number of participants).

Please note!

- It is important to place the signs in advance in the correct order, so that one can immediately start playing, after receiving the instructions.
- It is important that before the activity, the person directing the game will him/herself play, enjoy the experience, and ask him/herself the questions arising during the discussion.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

The activity includes playing in pairs and discussion in plenum.

INTRODUCTION

Presenting the game, 5 – 10 minutes

The instructor introduces him/herself (name, the scientific/technological area of academic study, his/her stage in studies, etc.). Thereafter, the subject of the workshop is presented in general – "Workshop on Gender and Career in the Sciences and Technology Areas", and the instructions for the game are expounded.

The participants in the game are to classify the cards as fast as possible, according to the two categories appearing on the cards: A category of "female" or "male", and a second category of "Liberal Arts "or "Science and Technology".

Each of the words on the cards is suitable to one of category-pairs: male/female or Liberal Arts/Sciences and Technology. For example, in the category male/female, the word "daughter" pertains to "Female", while the word "son" pertains to "Male". In the category Liberal Arts /Science and Technology, the word "art" pertains to "Liberal Arts" and the word "physics" pertains to "Science and Technology".

Please note!

Some students don’t know what liberal arts subjects are and what science and technology subjects are. It is highly recommended to give them some examples and make sure they understand and will be able to sort correctly the cards according the two categories.

DEVELOPMENT OF THE ACTIVITY

Paired card game, 5 minutes

- The participants are divided into pairs.
- Each pair of players participates in two rounds, with a different pair of captions shown them in each round.
- The pair: Liberal Arts or Female; Science and Technology or Male.

- The pair: Liberal Arts or Male; Science and Technology or Female.

- At the end of the first round, the players change places and repeat the exercise with the second pair of captions. The cards must be shuffled well after each round.
- At the end of the game the players return to their seats and a discussion is held.

In the following link you can find a short video that demonstrates the cards' game:
https://www.youtube.com/watch?v=SqAZfXBkeG4&feature=youtu.be

Discussion in the plenum, 10 – 15 minutes

Ask the participants:

- Was the level of difficulty identical in both rounds of the game?
- In which pair of categories was the classification easier?

Listen to the participants' comments.

The game, in fact, examines whether the players tend to relate certain subjects to a particular gender. Through the game, most of the participants are exposed in a non-obligatory manner to the gender bias implicit in their sub-conscious, which is likely to influence their behaviour without any conscious intent.

Studies based on this test show that most people usually take longer to place words associated with the exact sciences when they are connected to the category "Female" rather than to the category "Male", although there is no fundamental connection between the two categories. When there is an associative connection between the categories, people reply very quickly and attribute the word to the correct category, but it will them longer to answer when there is no associative connection between the two categories. But there is also room for optimism: researchers have found that although the stereotypical connection between science and masculinity is common globally (including in countries in which the indices of gender equality are higher, such as Denmark and Norway), it is lower in countries where there were actually more female scientists! In other words, the more women there are in science, the less will be the gender bias and *vice versa*, the less the gender bias, the greater will be the number of women in science.

Please note!

The results are likely to be affected by diverse external factors, such as distractions during the game. The game is intended to raise awareness of the subject and not to serve as a diagnostic tool. The results should be approached with a healthy dose of scepticism.
The claim is that those same biases in our sub-conscious can also affect our behaviour, our attitude towards males and females, and, of course, our decision making.

For example, a study conducted in Israel (by Victor Lavy, Professor of Economics from Warwick University, England and the Hebrew University, and Dr. Edith Zand, an economist from the Bank of Israel), showed that in external examinations for 6th grade pupils, in which the examiners did not know the examinees' gender, the girls attained better results than the boys. In comparison, in those same examinations that were checked internally by teachers who knew the pupils, the boys obtained significantly better results. This result proves unequivocally that the school teachers discriminated against the girls in mathematical scores, based on a gender. This discrimination affects not only their future success in junior high school and in university, in these subjects, but is one of the factors leading to the absence of females from these professions in the labour market, and even to their lower incomes compared to males.

Questions for discussion:

The claim is that since parents and teachers see more women than men in the liberal arts subjects and more men than women in the science and technology subjects, it may cause them to relate differently to boys and girls in the stage of choosing their course of study at school, and therefore, may influence their decisions making.

- *Have you experienced a different attitude from the teachers towards girls and boys in your class?*
- *How can this affect their success?*
- *Are there differences at home in the way your parents encourage brothers or sisters to study science and technology?*

  Listen to the participants' comments.

Showing a short film, 5 minutes

Show a short animated film on the influence of our implicit biases on our decisions, opinions and choices, and on the importance of recognizing them and raising them to awareness. The film is accompanied by subtitles and concludes with the claim that the existence of implicit biases cannot be prevented, but awareness of their existence can reduce their impact. *We can't cure unconscious bias, but with self-awareness we can address it.*"

The link for this film is: https://royalsociety.org/topics-policy/publications/2015/unconscious-bias/

We recommend inserting subtitles in the suitable language to the film (approval is given by the Royal Society Organisation to insert translated subtitles in the film).

CONCLUSION

Summary, 5 – 10 minutes

We spoke about the implicit biases we all have that can influence the choice by girls and women of professions in science and technology.

- *Is it/why is it important for both groups to study and work in STEM areas?*

  Hear the pupils' comments and summarise:

Culture is one of the main factors influencing the lesser participation of women in the world of science and technology. One piece of evidence for this is the existence of cultures in which both genders are represented and succeed equally in these professions. In the western world the participation of women in computer sciences is particularly low, while in eastern cultures, in Eastern Europe, in South America and in Africa, women are represented equally in this profession (and sometimes their percentage of participation is even higher than that of their male counterparts).

- *And why is it important for women to work in STEM areas?* (Or you can also ask about the importance of participation of other minorities such as those based on the socio-economic status)

  Hear the students' comments and raise the following claims:

It is important for women to work in STEM areas for several reasons: The value aspect of social equality in an advanced society; for the benefit of society at large, it is important to create a culture that encourages diversity. Diversity enables the expression of diverse opinions and approaches necessary to solving complex problems, and facilitates the full realization of the potential embedded in a particular society. If the potential of 50% of the population is not fully realized the entire society loses out.

GENDER INCLUSION CRITERIA

INDIVIDUAL LEVEL

- The activity enables all the participants to have an emotional experience in a simple card game on which the activity is based.
- The activity includes diverse formats of activity that enable different learners to be engaged: playing a card game, watching a short film and participating in a group discussion.

INTERACTIONAL LEVEL

- The activity includes playing and a group discussion, during which the participants discover that they all have the same experience of implicit bias regarding gender, and discover that none of them is free of stereotypical thought.

INSTITUTIONAL LEVEL

- During the discussion the participants broach situations that occur in their immediate environment, in school and at home, where implicit biases regarding gender are manifested. Bringing those implicit biases to the awareness in the context of gender and of STEM can

influence the attitude of pupils/teachers to males and females regarding their choice of scientific and technological subjects.

SOCIETAL/CULTURAL LEVEL

- The activity exposes the participants to the impact of culture and society on the females' choice of STEM subjects in school and in their future careers.
- The activity exposes the participants to the opinion of policy makers (Ministry of Education, Ministry of Science and Industry) regarding the importance of adequate representation of girls and women in STEM subjects in school, in academia and in industry.

LEARNING OUTCOMES

At the end of the lesson:

- The participants should be aware:
  - That their implicit biases can influence their decisions, opinions and choices and that there is a big importance to recognize them and be aware of them.
  - That females can develop a career in STEM to the same extent as can males. The main reason that their representation is not compatible in some of these professions is the social attitude (of males and females) regarding the status of females in society.
- The pupils will be able to make a more rational decision when choosing an area of study in high school and later in the academia.

PARTNER DETAILS

This module was first developed by Bloomfield Science Museum Jerusalem, Israel. Contact: Eti Oron, etio@mada.org.il

Cover image: Courtesy Bloomfield Science Museum Jerusalem, Israel.

WEARABLE TECHNOLOGY

AT A GLANCE

Age Group	13 – 18 years old
Format	Workshop
Duration	2 hours (for workshop) 45 minutes, minimum (for drop-in)

OVERVIEW

The activity involves the participants in:

- The exploration of technological tools (sewing machines, laser cutters, digital cutter…) and materials (textile oddments, leds…) for the creation of wearable products.
- The approach to the process of selection and organization of elements and materials through which people create objects.
- The reflection about the gender balance among the makers.

OBJECTIVES

The activity aims to:

- Create a connection between the interest of youngsters and the work of a technologist.
- Involve participants in designing and creating new technological objects using technological tools (with a gender connotation).
- Create a gender inclusive environment.

SUGGESTED SCENARIO

MUSEUMS

- Workshops with school groups.
- Drop in for weekend visitors.
- Maker space and fablab.

TARGET AUDIENCE

Age	13 – 18 years old
N. participants	25 (dimension of the workshop group or maximum number of participants in the drop-in setting)
N. facilitators	2 (if the participants use technological tools that require a specific know-how – sewing machines, laser cutters…– extra explainers are essential)
Type of audience	Families, youngsters, adults.

FORMAT

Workshop.

TOPICS COVERED BY THE ACTIVITY

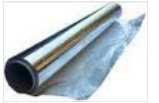
Electricity, circuits, work of designers and problem solving.

DURATION OF THE ACTIVITY

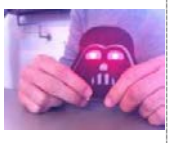
2 hours for workshop or 45 minutes, minimum for drop-in.

RESOURCES

MATERIALS

Scissors		20 – one per participant
Post-it		4 reels
Posters with STEM professional profiles (drafts in annex 1)		1 box
LEDs		100 (approximately 8 for each project)
Copper wire		100 m
conductive wire		1 reel
Aluminium Foil (for food packaging)		1 roll
button batteries (3 v)		20

Felt (2mm thick)		25 sheets (approximately 10x10 cm)
Automatic bottons		30
Hairclips		15
Shoestrings		10
Mini Motor		5
Oddments		3-4 small pieces (10*10 cm)
Elastic Band Roll (about 1 cm wide)		3 m (this can be used both as a wearable material and to attach the batteries to a surface)
Safety Pins (different dimensions)		60

Examples of Wearable Technology (objects if possible, otherwise images)	  

USEFUL LINKS, VIDEOS, ARTICLES

- www.instructables.com
- www.plugandwear.com
- www.opitec.com

SETTING

- 8 working stations for 2/4 participants per station.
- A big table with all the materials. The materials should be easily accessible for the participants during the entire activity.
- The materials on the table are divided by type: conductive materials, fabrics, decorative materials...
- One or more tables where to put working tools (the position of the technological tools should encourage participants to use them).
- 3 or 4 examples of wearable technology with circuits.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

In pairs, in small groups.

With school groups the pairs should possibly avoid a mix of males and females in order to encourage the engagement with all the different aspects of the object production (avoiding, for example, that females deal with the sewing part while males deal with the technological part).

INTRODUCTION

- Show different examples of already made wearable technologies (keep in mind that examples influence largely the visitors' work. It is important to present examples relating to all the available tools).
- Let people explore the materials and the tools on the tables.
- If you use special tools like sewing machines or laser cutters show how to use such tools.
- The participants also get to test an existing circuit to understand how circuits work.
- The explainers support the exploration of the participants if there are any questions.

DEVELOPMENT OF THE ACTIVITY

- The participants are requested to create their own wearable technology inspired by the materials and relying on their own creativity.
- They start making hypothesis (also by drawing their ideas on paper), choosing materials and building strategies.
- Explainers should become involved if the participants require it or when someone gets stuck for lack of creativity or confidence with the materials and tools.

CONCLUSION

Once objects are completed, each group describes how they work. The group can take pictures or videos and share them on social media with the museum tag. At the end of the day there can be a parade and a photo shoot or mini video with all the objects created that day.

As a conclusion of the activity, participants are invited to reflect about the connection between what they have done and gender balance in STEM.

In the case of a workshop, explainers should facilitate a plenary discussion about how much the participation in the activity is gendered and if the actions required by the activities are gendered in daily life (for example sewing or building a circuit). The facilitator can ask: *Who personally used needle and thread today? Who used LED Circuits?* And so on for the different tools*. Was it the first time for you? Did you do anything in this activity that you did not before? Did you have the chance to do anything you do not usually do? Is there something that you would like to try and you do not had the opportunity to use? Why? What was most usable? And what most challenging?*

The facilitator can even present some gender data from statistical analysis, in order to underline the gender gap in the public opinion, (i.e. from www.aauw.org)

In the case of a drop-in activity, the discussion can be difficult to propose to every single group, so you can use the linked evaluation sheet. One can leave for every participant the printed evaluation-file in order to encourage a personal reflection.

PARTNER DETAILS

MUSEO NAZIONALE SCIENZA E TECNOLOGIA LEONARDO DA VINCI

This module was originally developed by Museo nazionale della Scienza e della Tecnologia "Leonardo da Vinci" in Milan, Italy. Contact: Erica Locatelli, locatelli@museoscienza.it & Sara Calcagnini, calcagnini@museoscienza.it

Cover image: Photograph: Lorenza Daverio. Courtesy Lorenza Daverio and Museo Nazionale della Scienza e della Tecnologia “Leonardo da Vinci”, Milan.

YOUR ROLE IN RESEARCH
INQUIRY INTO CHEMICAL REACTIONS

AT A GLANCE

Age Group	13 – 16 years old
Format	Workshop
Duration	60 minutes

OVERVIEW

An authentic way to interact with materials, chemical substances and specimens. Boys and girls perform an experiment to test the characteristics of common substances. The students are directly involved in an inquiry process and will be able to see the link to the larger picture of the societal context wherein this activity fits. They use this experience in a discussion on the profession and roles within laboratories and will be able to see the link to the larger picture of the societal context wherein this activity fits.

OBJECTIVES

- Provide a way to practically engage with STEM content and material.
- Create the condition for participants to alternate between the specific details of a task, and its more overarching implications.
- Enthuse a diverse group of young people for scientific research/topics.
- Introduce working with an inquiry process.
- Introduce a look into the working life of a scientist.
- Get acquainted with the different roles within laboratories.
- Introduce the societal context of research.
- The experiments proposed in the activity stimulate wonder and surprise with the students.

SUGGESTED SCENARIO

Open days for families, orienteering days for secondary schools, workshop for school groups. As a workshop in the laboratory of a science museum. A workshop for school classes, for families (e.g. special holiday workshop), for teenagers (career orientation events or open nights).

TARGET AUDIENCE

Age	13 – 16
N. participants	25 – 30
N. facilitators	2
Type of audience	Students, visiting families or teenagers

FORMAT

Workshop.

TOPICS COVERED BY THE ACTIVITY

This activity will relate to the science curriculum for chemical reactions of BTB (bromothymol blue) diluted in distilled H2O, CaCl2 and NaHCO3. The essence of the test is an acid/base reaction, with BTB as an indicator.

It gives an image on the work a scientist/researcher can do and helps the students to see science as a serious career choice.

During a discussion the link is being made to the context of the laboratory and examples where the students can relate to.

DURATION OF THE ACTIVITY

1 hour.

RESOURCES

MATERIALS

Short guideline for the facilitator	Annex 1	1
Short guideline for the students	Annex 2	1 per working station
Re-sealable zipper bags, 1 Liter, max. 1 ½ Liter		3 per working station
20ml bottles of BTB (bromothymol, acidity indicator) diluted in distilled H_2O, with pipette	 or 	1 per working station
Black pots with $CaCl_2$ (calcium chloride)		1 per working station
White pots with $NaHCO_3$ (sodium bicarbonate/baking soda)		1 per working station
Measuring cups small	 or 	3 per working station
Measuring spoon		1 per working station
Pen or pencil & paper		2 per working station
Mortar (if needed)		1 per working station
Lab coats		1 per student
Lab glasses		1 per student
Paper towels		1 per working station

USEFUL LINKS, VIDEOS, ARTICLES

- Zip lock bag reactions on chymist.com
- Reaction in a Bag on ucsb.edu
- Reaction bag on YouTube

SETTING

Prepare the experiment in part 1: a scientific experiment which includes the opportunity for the participants to make choices about the variables, and not only follow the instructions of a procedure.

Choose the facilitators with care.

- Students might react better to a charismatic person that has experience in leading conversations with students or some might react better to a young person with whom they can identify better.
- Ensure that the involved science educators and scientists reflect a variety of personalities/characteristics and roles within the organisation! Make sure the level of ranking is not divided high = male, low = female.

Make sure the space where you receive the students has the possibility to do the experiment and have a group discussion. 1 Working station/table per 3/4 participants is needed.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

The students will be working in groups of 3/4 all the time with clear instructions. In general the facilitator encourages participation by all students, make sure that students don't get stuck, encourages questions and discussion, makes the transitions of what this experiment shows and what that tells us in the larger view of the socio-scientific role of the specific institution, makes an active link to diversity where possible

INTRODUCTION

Introductions, 5 minutes

The facilitator shows the materials, explains the safety rules and introduces his/herself:

- *What is your role and how did you get there (education and/or prior jobs)?*
- *What do you do on a regular day of work? You work together with who?*
- *How that relates to being a scientist?*
- Briefly tells what the students can expect, explain that they are going to do the work a scientist does, doing their own inquiry with experiment they'll chose themselves

Start with a general question that will be answered in this experiment and put it in a context. The facilitator asks the students this question and valorises the answers. The students let their ideas go freely.

- *Have you ever been in a chemistry lab?*
- *What, do you think, does a chemist do?*
- *How do you become a scientist?*
- *What, do you think, is a reaction?*

DEVELOPMENT OF THE ACTIVITY

The facilitator explains that the following experiment they will do provokes a chemical reaction determining whether a substance is alkali or acidic.

A type of experiment we would do to, for example, test cleaning products: acid products react with calcium (bathroom) and alkali/base products react with fat (oven), but also to your skin.

Guided experiment, 15 minutes

Scientists sometimes need to follow very specific guidelines/ already established procedures to conduct an experiment to discover and understand the specific characteristics of specific substances. For example when they want to perform the same test on different products.

First we are going to do an experiment in a zipper bag with guided action:

Each group (4-5 students) has a kit with:

- 3 zipper bags
- a bottle 50ml BTB (bromothymol, acidity indicator) diluted in distilled H_2O
- a black pot with $CaCl_2$
- a white pot with $NaHCO_3$
- 3 measuring cups
- 1 measuring spoon
- a mortar (if needed)
- a paper and pen
- paper towels

The facilitator does this experiment together with the students to guide them through the guideline:

- (If needed) grind the chunks of $CaCl_2$ with the mortar.
- Take 1 zipper bag.
- Put three teaspoons of $NaHCO_3$ and one teaspoon of $CaCl_2$ in the zipper bag.
- Fill the measuring cup with 10 ml. BTB in H_2O and place it upright on the bottom of the bag.
- Close the bag and try to squeeze out the air, while the measuring cup stays upright.
- Shake the bag and see what happens.
- Write down all your observations.

The students collect observations.

The facilitator moves between groups and focuses on the comments about changes in colour, change in temperature, foam/volume changes, but does not comment on them.

When mixing CaCl2, $NaHCO_3$ and BTB in a zipper bag, we can see and feel different phenomena (from the outside of the bag):

- Heating and subsequent cooling of the bag.
- The change of the colour.
- Foam formation resulting in the inflation of the bag.

We continue without discussing the observations

Open experiment, 15 minutes.

Scientists sometimes conduct a more open experiment/procedure if the scientific question is more open on the substances. For example when they want to know what different reactions are with different proportions. So we will try this out as well. Freely experiment with zipper bag:

The facilitator explains that, to find out what is happening, we are going to repeat the experiment by changing the variables. For example, we may choose to use only two substances at a time.

Each group of students has 2 extra zipper bags and 2 extra measuring cups and are free to choose variables to experiment with to find out what happens in the zipper bags and understand it.

The students collect observations. The facilitator moves between groups.

CONCLUSION

Discussion of the results & findings of each group, 25 minutes

- *What have we discovered in this specific experiment?*
  - A solution of $CaCl_2$ is slightly acidic and BTB gives it a yellow colour. Explain the terms acid-base
  - A solution of $NaHCO_3$ is alkalic and BTB gives it a blue colour.
  - If these solutions are added together, an acid-base reaction occurs, releasing CO_2 gas. At first it generates bubbles and the air blows up the bag (CO_2 – carbon dioxide– generated by the reaction of $CaCl_2$ and $NaHCO_3$ with H_2O).
  - At first it is warm to the touch (because heat is released during the reaction between H_2O and $CaCl_2$), this is an exothermic reaction.
  - Then we feel cold (because the formation of CO_2 –from $CaCl_2$ and $NaHCO_3$– absorbs the heat), this is an endothermic reaction.
  - The essence of the trial is an acid-base reaction with BTB as indicator substance.

- *What did each of you just do? What different roles did you have/what role does a scientist have in these kinds of experiments?*
  - selecting variables
  - conducting observations
  - making deduction
  - documentation.

  The facilitator might add needed skills as well, speaking from her/his own experience: persistence, diligence, patience, to be able to work alone and on the other hand to work in a team, to be prepared for satisfaction besides moments of frustration.

- *What other roles can a scientist have/what kind of job can a chemistry graduated do?*

  The facilitator can point out the following examples when the students don't think of them, to give a good idea of the societal impact a scientist can have:

  - Teacher, like your own teacher present.
  - Explainer, like a facilitator in a science museum.
  - Interviewer, like science journalists.
  - Writer, every experiments should be shared in science magazines.
  - Briefing of (inter)national colleagues, so the outcome can be used by others.
  - Creative, to think of what is important in the research by writing research plans.
  - Influencing policy, so governments act on discoveries made.
  - …etc.

During this discussion the facilitator or another present researcher discusses with the students her/his daily work.

- *What does a(n average) day look like?*
- *Who does (s)he work with?*
- *What are the different activities that are typical to her function?*
- While going into this, (s)he explains what is being done in laboratories:
  - Substances that do not exist in nature are being produced.
  - Substances that do exist in nature can be purified
  - Producing chemicals (legally or illegally).

- Research into materials (like research into radioactive materials and yet undiscovered elements).
- There are also a range of laboratories that do all kinds of analyses (for example analyses of soil samples or household cleaners).

- *What do you think we do in this kind of laboratories?*

Explain that laboratories can be part of a hospital or a university, but also be part of a small or large company, or a government agency. Next to laboratories for scientific research there are also laboratories for practical uses:

Quality Laboratory

Many companies have a quality laboratory, where they test the purity and properties of raw materials, auxiliary materials, semi-finished and finished products. In the pharmaceutical and food industry is a microbiology laboratory is essential to avoid the risk of food poisoning and contamination of the final product.

Hospital Laboratory

Hospitals have a general clinical chemical/haematological, medical microbiological, pharmaceutical toxicological and pathological laboratory. To examine all bodily fluids, but especially blood, urine, faeces, sputum and tissue. Mainly the general clinical chemical/haematological laboratories perform a 24/7 role and are continuously available for urgent analysis. The other laboratories listed are not constantly being used, only when needed. At the head of a hospital laboratory is a laboratory specialist. In the case of the clinical chemical laboratory, this is the clinical chemist. In the case of the microbiological laboratory, this is the clinical microbiologist. At the pathology lab, this is the pathologist. And the hospital pharmacist manages the pharmaceutical toxicological laboratory.

Forensic laboratory

A forensic laboratory investigates traces to determine the facts of crimes and identify the perpetrators. The investigation into traces of DNA has boomed in recent years, so even older crimes can be solved, where researchers previously searched for a solution unsuccessfully.

Construction Physical Laboratory

Some examples of research are:

- Wind nuisance and wind loads on and around buildings in the wind tunnel.
- Sun and shade on and around buildings
- Air- and waterproofness of facade elements
- Sound insulation of walls, doors and facade elements.
- Fire resistance of structural parts.

- *What aspects of this work do you think is most socially relevant and why? How can we impact the society most?*
  The facilitator notes and points out his/her observations in this: different type of people, gender etc.
- *Who sees him/herself becoming a scientist (like me☺)?*

GENDER INCLUSION CRITERIA

The “gender inclusion criteria” developed in the Hypatia project are relevant for the adaption of Your Role in Research and should be reflected on and discussed with the people who are offering such a class or activity. Even more they might lay the ground for the success criteria in which to measure the results

of the adapted activity. The following are some examples of how this workshop addresses gender inclusivity on the different criteria levels.

INDIVIDUAL LEVEL

- Encompasses a variety of different ways of engaging students by doing an activity, using discussing both in a groups as well as in small groups and showing different contexts where research can take place (different kind of labs, different roles).
- Involves activities that include a variety of problem solving and research methods such as selecting variables, conducting observations, making deductions and documentation.
- Uses activities that incorporate a clear context so participants understand what their role in research could be.
- Reflects on which previous knowledge and experience participants have.

INTERACTIONAL LEVEL

- Alternates between instructions in plenum; work in groups and discussions in plenum.

INSTITUTIONAL LEVEL

- Support the planned activities within the organization, the lab that already exists
- Include thinking about what kind of an impact the institution itself has – in the discussion the workshop leader discusses with the group what different roles scientist can have in society.

SOCIETAL/CULTURAL LEVEL

- Puts the different carriers you can have in science into context.
- Showcases and/or discuss areas where science is used to benefit the society.
- Broadens the views students have on science and scientists.
- Discuss the ‘whys’ and ‘where’s’ of society’s use of science.

LEARNING OUTCOMES

The following learning outcomes are divided accordingly between teachers or facilitators and participants:

- **Teachers or facilitators:**

  After planning and preparing this workshop the facilitator or teacher should have knowledge of and/or be able to:

  - Adapt the activity in relation to targeting a broader group of participants.
  - Gain inspiration from science.
  - Have an awareness and understanding of how to motivate girls and boys to engage in the activity.
  - Have awareness and understanding of the cultural restraints that might be part of a classroom teaching in regards to gender.
  - Realize how to counter target some of the cultural restraints in regards to gender that might be part of a classroom teaching.

- **Students/participants:**

At the end of the lesson participants should be able to:

  - Deduce which factors influence different phenomena in a chemical reaction.
  - Have an idea how to work with an inquiry process
  - Know what kind of skills you need to have to be a scientist.
  - Know the different kind of roles you can have within research
  - Be aware of some examples of what science can be used for in society.

PARTNER DETAILS

This module was originally developed by NEMO Science Museum in Amsterdam, the Netherlands. Contact: Meie van Laar, *vanlaar@e-nemo.nl*

Cover image: NEMO Science Museum, Amsterdam.

GENDER OPTIMIZING SOFTWARE PROGRAMMING FOR CHILDREN/TEENAGERS

AT A GLANCE

Age Group	Adult trainers/teachers and educators
Format	Workshop
Duration	Between 2 and 6 hours

OVERVIEW

This activity aims to gender optimise and improve already existing workshops on software programming for children/teenagers. Most schools must teach software programming to middle school groups and quite a few industrial companies choose to offer workshops on programming for schools. This activity aims to reach out to developers, teachers and facilitators to gender optimise these workshops and ultimately target a broader group of girls and boys. In other words this workshop is about redesigning an activity in order to take gender into account.

This activity will in turn help prepare teachers and student teachers to work with and teach their students software programming. The activity will focus on a science and technology approach as well as a didactic approach in regards to teaching software programming to school students.

OBJECTIVES

The main objective is to create gender optimised activities that lead to a larger interest in STEM. The objective is to raise the interest in technology with regards to software programming. The focus is specifically on engaging more young people to take an education within STEM (here specifically within technology). The engagement is reinforced through the tools and suggestions on gender inclusiveness.

SUGGESTED SCENARIO

The activity will relate mainly to mathematics and ‘science and technology’ and will focus on already developed workshops that could benefit from an adaption to motivate and reach a broader group of school students (girls and boys).

The following are the main topics and connections within software programming to the school curricula in relation to mathematics:

- Students can see the common language between everyday language and expressions with mathematical symbols (to get something (perhaps a robot) to do ‘this and this’ – we need to use a programming language).
- Students can use expressions with variables – here under with digital tools.

The following are the main topics and connections within software programming to the school curricula in relation to “Science and Technology” (which is a school subject in Denmark):

- Students can describe a process from a first resource to a final product.
- Students can develop and use steering and simple sensors in their programming and use these to handle robots.

TARGET AUDIENCE

Age	Adult trainers/teachers and educators who develop and host programming workshops for 12 – 15 years old.
N. participants	15 – 25
N. facilitators	2
Type of audience	Facilitators of software programming workshops – who might be school teachers, teacher trainers or in-training teachers as well as other kinds of educators or trainers.

TOPICS COVERED BY THE ACTIVITY

The scientific contents of such an activity are software programming as well as an understanding of how to translate everyday language into a programming language.

This activity will promote an understanding of a technology that isn't always visible and noted but used on a daily basis.

DURATION OF THE ACTIVITY

Suggested duration: 2 – 6 hours.

RESOURCES

Note that the following resources are suggestions that might be used in a software programming class and these can vary and will depend on the activity and available resources.

As this activity aims to gender optimize already existing classes/activities on software programming (such as MicroBot Technology, Lego MindStorm, etc) the resources mentioned below are not necessary to make the activity, rather it is suggestions for needed materials in a class setting, where the students would work within this workshop area.

MATERIALS

Lego Mindstorm sets (or MicroBot Technology or other programming sets)		1 set per 2 participants
Lego Mindstorm table for test		1 per 10 participants if possible – otherwise the floor can also be used for testing
Lego Mindstorm program		1

USEFUL LINKS, VIDEOS, ARTICLES

- Lego Mindstorms
- www.firstlegoleague.org
- Search on YouTube for Lego Mindstorm films – also in your own language.
- Gender guidelines for adapting activities:
  - *One size fits all?* is teacher training development programme developed in the framework of the TWIST project (Towards Women In Science and Technology – EU funded FP7 project).
  - Check out The Twist Project website for other suggestions.

SETTING

After identifying and contacting industrial partners or research institutions or others that develop and offer software programming workshops for school groups it will be necessary to see if the contacted partner is interested in adapting their workshop. Once this is established the next step will be to find a date and setting to meet up. Here it is important to discuss how the workshop targets a broad group of children taking different learning styles and preferences into account and discuss how the workshop could be improved taking these considerations into account.

The setting for the workshop will depend on the contacted partner and could be at the industrial partner that develops the workshops or at the school where the workshops take place. Following this initial meeting the workshop should be jointly adapted.

DESCRIPTION AND TIME SCALE

Here is an example of how a software programming class might be set up in a gender inclusive manner. You could even call this task ‘Redesigning’ an activity in order to take gender into account.

GROUP MANAGEMENT

A workshop will usually start with an introduction in plenum where after participants are divided into pairs for the remaining of the workshop.

INTRODUCTION

The teacher/facilitator briefly presents the workshop introducing the objective.

The teacher goes on to introducing the teaching/learning cycle to put the workshop into a relevant didactic context for the class. The workshop can also be put into science context by explaining which skills are developed in relation to science literacy, technological literacy and mathematics literacy. This is important to target a broad group of girls and boys and to put the science into context where more participants will realise the relevance of the workshop.

Mention that this activity aims to redesign a programming activity where gender is taken into account. The following are considerations that might be relevant to reflect on:

- Less competition and more structure.
- Greater focus on achieving a meaningful and creative outcome.
- Maintain time constraint but with no single correct response.
- Alleviate stress levels by promoting a more supportive, non-confrontational approach.
- Emphasise the mathematical and problem solving element by creating an algorithm as a sequence of instructions.

- Ensure the experience is more multidisciplinary in character.
- Promote a balance of study and application.
- Foster perceptual and symbolic learning and foster gross motor skills.
- Retain kinaesthetic and experiential activities.

DEVELOPMENT OF THE ACTIVITY

The pupils are then introduced to the element of programming via for example the “Learn to program” on the Lego Mindstorm site or via other software programming programs.

They work like this for ca. 30 minutes.

Once the pupils are introduced to the software programming they could receive an engineering challenge that they then solve with the Lego Mindstorm robot.

CONCLUSION AND FOLLOW-UP

The adapting of the workshop will involve a discussion with either the industrial partner or the teachers who develop this programme. The focus here will be of a didactic manner and focus on a teaching situation with a specific focus on how to involve a broad group of students – hereunder girls (who often are not involved in software programming). Focus should be on putting the learning into context – where is this used in life? (for example for optimising robots in elder care – or in the medicinal industry – or in regards to sustainable development and energy efficiency).

This workshop example has looked at the concept of First Lego League, which focuses on reaching all the way around with a concept that is put into context and aims to solve a societal problem – often in collaboration with a company/industry.

There should always be a follow-up and evaluation of each workshop and this should in part focus on whether the workshop managed to involve a broad group of participants (girls and boys) and whether or not they alternated in the different roles – such as experimenting, testing, planning, etc. It is highly recommended that some success criteria are set up covering these areas. Read more below under “Gender inclusion criteria” on this.

GENDER INCLUSION CRITERIA

The “gender inclusion criteria” developed in the Hypatia project are relevant for the adaption of software programming classes and should be reflected on and discussed with the people who are offering such a class or activity. Even more they might lay the ground for the success criteria in which to measure the results of the adapted activity. The following are some examples of how this workshop addresses gender inclusivity on the different criteria levels.

INDIVIDUAL LEVEL

- Will encompass a variety of different ways of engaging students.
- Will involve activities that include a variety of problem solving and engineering methods such as planning, developing, building, testing and improving.
- Will use activities and approaches that incorporate a clear context so participants understand how, why and where their new knowledge may be put into practice.
- Will reflect on which previous knowledge and experience participants have.

INTERACTIONAL LEVEL

- Will alternate between presentations in plenum; work in pairs and discussions in plenum.
- Focus on changing roles/work areas (such as taking turns in planning, making notes, programming and building).
- Will note that all participants experience success in regards to solving the challenges.

INSTITUTIONAL LEVEL

- Should support the planned activities and this could include the physical learning environment and for example creating space in order to build and test the robot in an inspiring setting.
- Could be set up differently in the room – re-think where you plan – and why – re-think where you are creative – and why.
- Should include thinking of what kind of an impact the institution itself has – how do teachers present or speak of science or technology?

SOCIETAL/CULTURAL LEVEL

- Will put programming into context.
- Showcase and/or discuss some societal areas where programming offers solutions to societal challenges.
- Will invite participants to bring forward situations where they have seen results of programming.
- Will discuss the ‘whys’ and ‘wheres’ of society’s use of programming.

LEARNING OUTCOMES:

The following learning outcomes are divided accordingly between teachers or facilitators and participants:

- Teachers or facilitators:
  After planning and preparing this workshop the facilitator or teacher developing the software programming activities should have knowledge of and/or be able to:
  - Adapt the activity in relation to targeting a broader group of participants
  - Reflect on how programming can be used in classroom teaching.
  - Gain inspiration from technology and specifically ICT (Information and Communication Technologies).
  - Have an awareness and understanding of how to motivate girls and boys to engage in the activity.

- Have an awareness and understanding of the cultural restraints that might be part of a classroom teaching in regards to gender.
- Realise how to counter target some of the cultural restraints in regards to gender that might be part of a classroom teaching.

• Students/participants:

At the end of the lesson participants should be able to:

- Program a (Lego Mindstorm) robot or other.
- Solve a challenge in relation to programming.
- Be aware of some example of what programming can be used for in society.
- If discussed – realize that gender stereotypes might influence our choices.

PARTNER DETAILS

This module was developed by the Danish Science Center Experimentarium, Hellerup, Denmark. Contact: Sheena Laursen, sheenal@experimentarium.dk and Christoffer Muusmann, christofferm@experimentarium.dk

Cover image: the Danish Science Center Experimentarium, Hellerup, Denmark.

SCIENCE AMBASSADORS

PEOPLE BEHIND SCIENCE AND TECHNOLOGIES

AT A GLANCE

Age Group	13 – 18 years old
Format	Meet a STEM professional
Duration	One hour or more

OVERVIEW

- The person in charge of outreach activities in a private/public company or a research institute invites one or two speakers, including at least one woman, to meet a class or a group of teens.
- The activity can be followed by a visit of the key locations in the company or research institute: labs, machines, computer control centre, etc.

OBJECTIVES

The activity will give teens the opportunity to:

- Meet professionals they can relate to.
- Make connections with a woman/man working in a stem-related job.
- See the workplace and people in their work environment
- Discover their course of study and background: obstacles (economics, gender, etc.), doubts, changes in orientation include.
- See the connection between their work and the needs of society.
- Demystify the image of the scientist seen as a white old man in a lab coat with strange glasses and get an idea of gender imbalance in the stem workforce.
- Make them see how representations can influence their career choices.

SUGGESTED SCENARIO

This activity can address a group of teens or a class invited with a teacher. In any case, it is important to maintain a reasonable number of participants, as small groups are more likely to foster interaction.

TARGET AUDIENCE

Age	13 – 18
N. participants	15 –30
N. facilitators	1
Type of audience	Students

FORMAT

Meet a STEM professional.

TOPICS COVERED BY THE ACTIVITY

The activity has links with job orientation curricula.

DURATION OF THE ACTIVITY

One hour or more.

RESOURCES

MATERIALS

Computer		1
Video projector		1
Seats		15 – 30
Goodies or a souvenir of the activity (ex: USB sticks, pen, key rings….)		15 – 30

USEFUL LINKS, VIDEOS, ARTICLES

The company’s website and the link on human resources.

SETTING

As it is not a top-down meeting, any arrangement can be used so that the researcher/engineer/technician and the teacher are sitting with the teens (and their families) to foster interaction. It is important to ensure that teens are close to and at eye level with the speaker(s).

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

- It is important for the outreach activity responsible to create a positive atmosphere and working conditions so that all participants feel welcome.
- The person in charge of outreach activities will preferably be there for the meeting and will have briefed the speakers beforehand:
    - If it is not possible to visit any other site of the workplace, speakers should bring pictures of their work environment to provide a view of the workplace: lab, office, team, key locations in the institute/center/company, etc. The speaker(s) should also be invited to show any artefacts/materials that might interest the participants.
    - Ask the speaker(s) to check how many women work in their company/research institute and in which jobs; and who, man or woman, is the head of the unit/department/company. It is an easy way to show horizontal and vertical gender segregation.

- It is also be useful to provide the speaker with some frequently asked questions and examples of answers:
  - *What qualifications do I need to apply to your company?*
  - *How many graduates does the company hire per year (What levels of qualification, kinds of degrees, for which departments?)*
  - *Is speaking English or other languages a hiring requirement?*
  - *How do beginners get their start in the company or research institute?* (internships, volunteering for International Experience programs, etc.)

Note:

- It is important to select profiles that everyone can relate to so as to avoid feelings of exclusion. Although it is interesting to have young role models because students can easily identify with them, priority should be given to the diversity of personalities and the fields they work in. For example, speaker(s) may not necessarily have bright and successful careers, they can be: an intern, a young researcher, an engineer or a technician employed in the company with a STEM-related job.
- Speaker(s) must be briefed on the importance of involving girls in the discussion. Especially in groups where there are fewer girls than boys, there is a risk that only boys engage in the discussion. The speaker should also be prepared to hear sexist comments and react accordingly.

INTRODUCTION, 5 MINUTES

Warm welcome to the teenagers. The speakers will explain why they are willing to meet young people (not only because they were asked to) and to exchange with them: W*ho am I?* (name, age) and *What is my scientific discipline?* (and if the speaker wishes: questions about private life: hobbies, partners, family, etc.)

Note:

A good way to kick off the meeting could be to ask students to share what comes to mind when they think of a scientist and/or what jobs they associate with science. It helps encourage students to speak freely and stereotypical representations of scientist are likely to emerge (glasses, man, white coat, laboratory, chemistry, mathematician, medicine, etc.)

DEVELOPMENT OF THE ACTIVITY

First set, 15 min total, (5-minute presentation, 10 minutes questions from students.)

- The speaker(s) will preferably begin with a focus on their personal experience: what they did during their studies when they were the age of the participants. It is an important step so that teens can easily identify with them:
  - *What did I like to study?*
  - *How did I get the job I have now?*
  - *What was I passionate about when I was younger?*
  - *How did I end up in this specific career path among (probably) several others?*
  - *Who influenced me? Who did I listen to?*

    - *Did I encounter any orientation issues/challenges?*
    - *If I failed at something, how did I choose another path?*

Students will be interested in the wide range of individual experiences. It will reassure them to know there is more than "one way".

- It would be useful to show the teens the different paths after high school to emphasize the multitude of bridges to get somewhere.
- It is also interesting to evoke, if that is the case for one of the speakers, some more "chaotic" path or any doubts they may have had to reach their current professional situation. The ideal model is not very challenging for everyone.

Second set, 25 min total, (10-minute presentation, 15 minutes questions from students.)

- The speaker(s) can talk about:
    - *What do I do on a daily basis? What is the purpose?*
    - *Who am I in contact with during the day? Who works with me?* (organization of the unit/lab)
    - *How would I describe a typical day?*
    - *Who controls/checks what I do? Who is my boss? Do I have one? How is my work evaluated?*
    - *What is more specifically the content of my job? Is it innovative and why? Why is it interesting?*
    - *Also, what is boring about it? What is challenging?*
    - *What do I like about this field?*
    - *What about salaries?*
    - *What are the impacts of my job in daily life or for future uses if there are any?* Otherwise speak about the specific nature of the scientific activity that has no links with everyday life, e.g.: research in astronomy.
    - *Do I have doubts or concerns about my job and my role?*
    - *Does my job match my previous expectations?*
    - *What are the basics qualities of my job?*
    - *What is my future (job prospects, openings)?*

Note:

- The development of the activity can obviously be flexible and adjusted accordingly to the reactions of students and speaker(s).
- Any material on the real and concrete life of the speakers is welcome (or videos, little experiments, pictures of working tools).

Tips:

- To prevent only boys from asking questions:
    - Split teenagers up into small groups (2-3) to prepare their questions for the speaker(s), give them a few minutes to come up with questions.
    - Teens should be given the option of sending emails to the scientist if they are too shy to ask in front of everyone.

- If students seem unconcerned about gender diversity issues:
    - The facilitator can stress the fact that boys and girls have the same possibilities, and both are part of gender equity.
    - It can be mentioned that promoting gender equity, especially in STEM, is on the agenda of the ministries of education in most European countries and major companies.
    - Promoting a gender-balanced workforce is also a key issue in European and national politics.

CONCLUSION

Time for discussion, other questions or remarks and feedback. Teens must leave with the feeling that they are able to choose some paths in STEM, that this is a possibility for them too.

PARTNER DETAILS

This module was originally developed by Universience in Paris, France.
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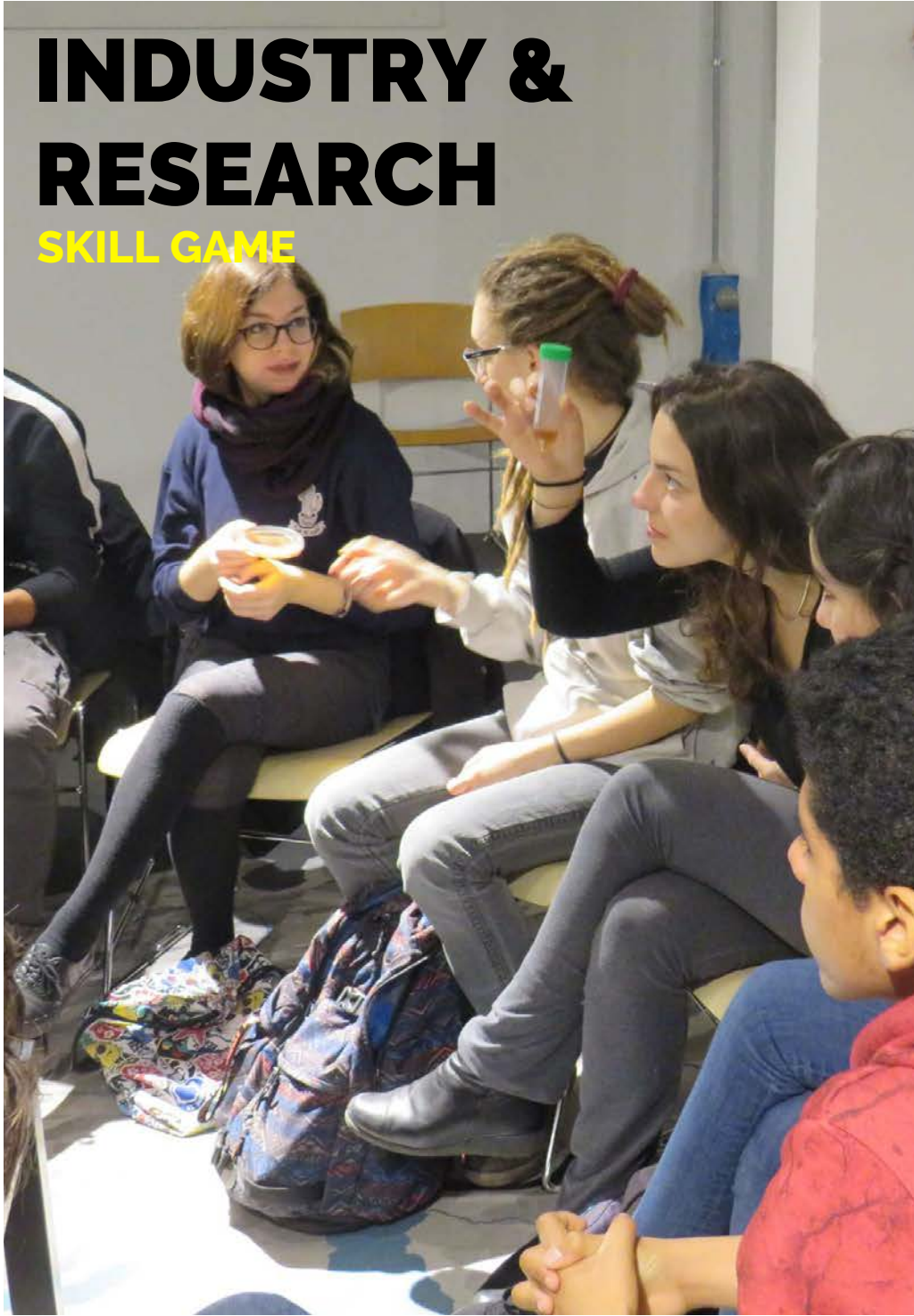
universcience



SKILL GAME

AT A GLANCE

Age Group	13 – 18 years old
Format	Meet a STEM professional
Duration	1,5 hour

OVERVIEW

The activity asks participants to reflect on their own skills. Different STEM professions are represented through a game and the participants discuss the associated skills with STEM professionals.

OBJECTIVES

This activity aims to discover the variety of skills that can be developed in a STEM career, emphasizing the unexpected ones, and to face some bias concerning STEM professions.

SUGGESTED SCENARIO

The activity works with a group of participants who know each other. It could take place during a research center/industry ‘open day’ or workshop for secondary schools.

TOPICS COVERED BY THE ACTIVITY

This activity deals the orientation after secondary school and helps to develop awareness towards STEM carriers.

TARGET AUDIENCE

Age	13 – 18 years old
N. participants	25 – 30
N. facilitators	1 facilitator and at least 3 STEM professionals. We suggest to represent a variety of STEM professions and of gender.
Type of audience	Secondary school students

DURATION OF THE ACTIVITY

1 hour and 30 minutes.

RESOURCES

MATERIALS

Pencils		30
Post-it		100
Posters with STEM professional profiles	drafts in linked doc	

USEFUL LINKS, VIDEOS, ARTICLES

- Video “Unsung heroes of science”
- Holland Codes career tests
- Gardner multiple intelligences

- "Talent Viewer" activity in Dutch
- Professions atlas in Italian

SETTING

Create a circle with all the chairs (one for every participant). Hang to the wall or to a poster support the posters with STEM professional profiles.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

There is an alternation of individual work, work in couples and plenary moments following this schedule:

Activity parts	Time	Group management
Welcome & introduction	10 min	Plenary
Individual skills on post-it	5 min	Individual
Skill circles	15 min	Couples
Comments on personal skills	5 min	Plenary
Posters	10 min	Individual
Meet the STEM professionals	40 min	Plenary
Conclusion	5 min	Plenary

INTRODUCTION

10 minutes of plenary introduction.

Present yourself and all the STEM professionals without specifying the profession of everyone (the participants have to guess it later).

Everyone has skills and we want to help the participants to discover what their main talents are or could be developed in every environment. Sometimes is hard to define a quality for the participants. In order to help them to focus their own predispositions, give some examples asking questions to be answered raising the hands. You can ask: *Who likes to chat with other people? Who likes playing role games? Who finds easy to remember quotes, poems or song lyrics? Who sings under the shower? Who finds easy to remember telephone numbers?*

DEVELOPMENT OF THE ACTIVITY

Individual skills on post-it, 5 minutes of individual work.

Distribute post-its and pencils and ask students to write down their own skills, using one post-it for each.

Skill circles, 15 minutes of work in couples.

The group of students should know each other. We ask participants to divide in two groups. The first group forms a circle facing outwards. The second group forms a second circle, around the first one, facing inwards. In this way, each person would be in front of someone. In 3 minutes every one has to state which is the best quality of the person in front of her/him and listen his best quality stated by the other. After 3 minutes, the external circle will turn clockwise in order to have new couples. They will start again to state qualities. The rotation is repeated a third time.

The facilitators and the professionals go around, listen the participants and possibly help who finds difficulties.

Comments on personal skills, 5 minutes in plenary.

The facilitator collects spontaneous comments about this first part of the activity. She/he can ask: *Who found a correspondence*

between what was written on the post-it and what was stated by the schoolmates? Who had correspondence among different schoolmates statements? Who received unexpected statements of qualities? Which ones? Why? Who feels rewarded after this comparison?

Posters, 10 minutes of individual work

The posters present different professions, the related daily tasks and work contexts. An empty space is left for the related skills.

The facilitator delivers post-its and pencils asking each student to look at the posters, to write down one or more associated skills and to stick the post-its in the reserved space.

Meet the STEM professionals, 40 minutes in plenary

Ask participants to guess and associate every STEM professional to one STEM profession represented in the posters. Each professional comments then his/her related poster valorising every students contribution and referring to their own personal experience. It would be interesting if the professionals

CONCLUSION

5 minutes of plenary conclusion

The facilitator thanks the STEM professionals and all the participants and underlines how much variety there is among STEM professions and how much a variety of people with different skills are necessary in STEM careers.

PARTNER DETAILS

MUSEO NAZIONALE SCIENZA E TECNOLOGIA LEONARDO DA VINCI

This module was originally developed by Museo nazionale della Scienza e della Tecnologia "Leonardo da Vinci" in Milan, Italy. Contact: Erica Locatelli, locatelli@museoscienza.it & Sara Calcagnini, calcagnini@museoscienza.it

Cover image: Photograph: Lorenza Daverio. Courtesy Lorenza Daverio and Museo Nazionale della Scienza e della Tecnologia “Leonardo da Vinci”, Milan.

SPEED DATING
ENCOUNTERS BETWEEN PUPILS AND SCIENTISTS & ENGINEERS

AT A GLANCE

Age Group	Teenagers from 15 years old
Format	Meet a scientist and moderated discussion
Duration	About 1 hour

OVERVIEW

Young scientists and engineers who work in diverse STEM fields (Science, Technology, Engineering and Mathematics) in the academia and the industry, meet small groups of pupils for one time informal encounters. The participants are exposed to diverse STEM fields by female scientists from under represented fields such as computer sciences and physics, and male scientists who represent fields where male representation is inadequate or equal to female representation such as biology or chemistry. The activity will emphasize representation of various careers in STEM disciplines, including less familiar ones such as patent registration and consultancy. The activity ends with a short interactive game (Kahoot – see the explanation below), intended to expose the participants to a stereotypical approach and generate curiosity over statistics regarding STEM and gender.

OBJECTIVES

- To expose the participants to the diverse STEM subjects, especially those in which women are poorly represented.
- To expose the participants to the diverse careers in STEM subjects.
- To present female engineers and researchers as role models for the school girls (on the assumption that the public is more familiar with male engineer and researcher role models).

SUGGESTED SCENARIO

- For the industry: In the framework of open days for pupils that include visits at authentic work place of the engineer/researcher (laboratories, clean room etc.).
- For schools: In the framework of an event to encourage the choice of STEM subjects followed by presentation of the STEM subjects taught in school by the teachers.
- For museums: In the framework of an event to encourage the choice of STEM subjects at schools and STEM careers in the future.

TARGET AUDIENCE

Age	Teenagers from 15 years old
N. participants	40 pupils
N. facilitators	1 facilitator and 5-6 researchers & engineers
Type of audience	Pupils 9th-10th grade (before selection their course of study in high school)

FORMAT

Meet a scientist and Moderated discussion.

TOPICS COVERED BY THE ACTIVITY

This activity has an unspecified STEM content but it deals with the issue of encouraging teenagers to choose STEM studies.

DURATION OF THE ACTIVITY

About 1 hour.

RESOURCES

MATERIALS

Gong		1
Stopper		1
An easel or something else to hang a sign with information about the researcher / engineer		1 for each researcher/engineer
Computer + internet connection		1
Projection screen or white wall		1
Smart phone		1 for each pupil

USEFUL LINKS, VIDEOS, ARTICLES

Before holding the activity, we recommend reading background material on the subject that includes statistical data and sources deal with the following topics: Why is it important to encourage equal opportunities? Possible reasons for the given gender inequality and proposals for improving the existing situation.

You can find data in English in the report from UNESCO: Women in Science and in the document "Criteria for Gender Inclusion at the individual, interactional, institutional, and societal/cultural levels".

SETTING

Preparation for the activity includes recruiting several researchers and engineers. While recruiting it is important to consider the following topics:

- The researchers and the engineers will represent a broad variety of STEM subjects. Female will represent STEM areas with low female representation and male will represent STEM areas with low/equal male representation.
- The researchers and the engineers will represent a broad variety of careers that can be developed in the STEM subjects.
- We recommend choosing researchers and engineers as far as possible, with good communications abilities with people in general and with pupils in particular.
- The number of researchers and engineers is in accordance with the number of participants – an engineer/researcher for each six-seven pupils. We recommend conducting the activity with a minimum of five researchers and engineers, so that each participant will be able to meet five researchers and engineers.
- When the activity is held in school, we recommend recruiting the engineers/researchers from amongst the parents. It is important to maintain the balance between the number of men and women.

Please note!

We recommend holding two rounds of the session, i.e., for a double number of pupils. Much time is invested in the recruitment of the researchers/engineers, and it is a pity not to expose them to many school students.

- It is important to talk to or to meet the engineers and the researchers before the session with the pupils:
  - To explain to them the format in which the sessions with the pupils will be held (small groups for seven minutes).
  - To tell them what is expected of them when talking to the pupils:
    The personal aspect – why and how they chose their occupation, was there anyone who influenced their direction of choice? Were there difficulties on the way? What were they? Etc.
    The professional aspect – talk about their work, about the larger picture of the subject in which they work, rather than only about the small details: how does their research/work contribute to society at large and to them personally?
  - To emphasize the importance of a conversation at the level suitable to the pupils, so that they can

understand and gain an impression regarding the work. It is important to use scientific terms with which the pupils are familiar, and if necessary to explain their meaning. There is no need to go into small details. One should think of ways to simplify the subject so that it will be popular and give a feeling of understanding, even if not in depth. (It cannot be expected that a talk of a few minutes will cause them to understand the occupation/research in depth.)

- To prepare them to questions the pupils might ask at a personal level, so that they are not surprised… pupils often ask very practical questions such as *What subjects did you study in school?*, *Were you an outstanding student?, Are the university studies difficult?*
- To send them the "Gender Equality in the Classroom" brochure, with the tips for egalitarian teaching and the guidelines on facilitation and on gender issue (see below).

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

The pupils work in small groups at the speed dating stage and work together in the plenum at the conclusion.

INTRODUCTION

The moderator tells the participants that in the next 45 minutes they will meet females and males scientists who work in diverse STEM fields in the academia and the industry. They will have a short conversation with each scientist/engineer in small groups and will have the opportunity to ask them about their professional careers and some personal aspects such as: challenges, obstacles, successes, disappointments etc.

DEVELOPMENT OF THE ACTIVITY

Speed Dating activity, 40 minutes

- The participants are divided into groups of seven male and female pupils (we recommend maintaining a numerical balance between the genders).
- Each female researcher or engineer sits on a chair with seven chairs around her. Next to her is a sign with her name, her field of work, and the name of the company or university in which she works.
- Each group sits on the chairs opposite a different engineer/researcher.
- The progression of the game is explained: From the moment the gong is heard, each researcher/engineer talks for exactly seven minutes with the group next to her. After six minutes the gong is struck reminding the participants that one minute remains. After seven minutes, the gong is again struck and each group moves to the adjacent station, (moving clockwise or counter clockwise).

Please note!

- Each group of pupils talks at four or five stations, according to the time allocated and the pupils' interest.
- The operator strikes the gong and the conversation starts.
- After six minutes the operator strikes the gong and reminds the participants that one minute remains.

- After seven minutes, the operator strikes the gong to conclude the discussion.
- Each group rises and moves to the adjacent station (decide in advance if movement is clockwise or counter clockwise).

Summary, 5 minutes

The pupils are gathered and asked:

- *Did you discover something new or surprising in the activity?*
- *Did you encounter an area of science/technology you did not know previously?*
- *Did you hear something today that caused you to think differently about STEM professions and gender?*

CONCLUSION

An interactive game with smartphones (the Kahoot application), 15–20 minutes

Please note!

For this part of the activity, each participant needs a smartphone and there is need for internet connection.

The closure of the event summons a trigger to expose the participants to the stereotypical perception and to generate curiosity over statistics regarding the professions of STEM and gender.

This part will be conducted by a representative from the world of industry, or the teacher, or the instructor (hereinafter the operator) dependent on the place where the activity takes place.

The pupils will be told that in this activity they will have to use their smartphones and the Kahoot application to answer a few questions about the professions of STEM and gender.

Please note!

A detailed explanation of the Kahoot application can be found on the link: getkahoot.com

- Follow this link. The game will be projected on the screen.
- The pupils are asked to connect to the "Kahoot" application (write the word Kahoot in Google and connect to the application (kahoot.it), and type in the number (pin code) appearing on the screen.
- One can see the names/nicknames of the pupils who are connected to the game on the screen.

Please note!

The first part of the game is a survey in which it is important for the voting to be anonymous and secret. It is important to tell the participants that the response is personal, and it is important for each to answer according to his/her personal feeling.

- The moment the screen shows that all the pupils are connected to the game, the START key should be pressed.
- The pupils will answer ("agree", "disagree", or "no opinion") three survey questions:
  1. Some believe that men are better than women in science and technology.
  2. Some believe that women are less rational than men and therefore less suitable to work in STEM.

3. Some believe that women may be good students but lack scientific talent.

- The results of the participants' voting can be seen after each question.
- After responding to the survey, the operator will say that now, after expressing their opinion, we will see some data from the field.

Please note!

In the next game the pupils will have to answer seven questions regarding the extent of success of females compared to males in tests in STEM, the ratio between the number of females and males studying STEM subjects in school and in the academia, the number of male workers compared to the number of female workers in R&D in STEM occupations, and so on.

This time, in contrast to the previous game, it is a competitive game. The pupils' names who answered the most questions correctly will be displayed on the screen.

- The operator will press the following link. The game will be projected on the screen.
- The pupils will connect to the game code that will appear on the screen.
- The operator will press the START key and the game will begin.
- The questions that will appear on the screen (one after the other) are:
    1. The ratio between the males' and the females' averages in national tests scores in Science and Technology is:

       A small gap in favour of females; A small gap in favour of males; No difference between the scores; A big gap in favour the females.

    2. What is the ratio between the number of female and male pupils in computer sciences in high school?

       50% females 50% males; 68% males 32% females; 82% males 18% females; 40% males 60% females

    3. The ratio between the number of female and male pupils in the academia for a PhD in engineering is:

       60% males 40% females; 23% males 77% females; 50% males 50% females; 77% males 23% females

    4. The proportion of women in the senior academic faculty in 2011 was:

       2.7%; 35.1%; 77%; 11.2%

    5. The ratio between the number of male and female workers in Hi-Tech industries in the R&D departments is:

       65% males 35% females; 90% males 10% females; 50% males 50% females; 40% males 60% females

    6. What is the ratio between female and male engineers in computer sciences in Africa and South America?

       A small gap in favour of males; A big gap in favour of females; A small gap in favour of males; The same number of males and females

7. Marie Curie won the Nobel Prize in: Physics; Biology; Chemistry; Physics and Chemistry

- At the end of the game it will be possible to see who won, i.e., who knew (guessed…) the data from the field on gender and science.

Please note!

The questions should be adapted to the data suitable to the country. Should the event be held in school, data can be added that relate to the school. Should it be held an industrial framework, data pertaining to the gender situation in that society can be added.

Subjects for discussion:

- *Did the answers to the questions, i.e. the data from the field, surprise you? Why?*

  Listen to the pupils' comments.

  We have seen from the data from the field that females do as well in tests as males, i.e., the assumption is that the ability of females is similar to that of males.
- *If this is the case, why do you think there is a difference in the ratio between the number of females and the number of males studying/working in STEM?*

  Listen to the pupils' comments.

  Say that the current situation is that women are not represented adequately in some areas of STEM, and that the main reason for this does not lie in their lack of compatibility or their ability, but in the social cultural impact. There is a different expectation of men compared to women regarding areas of study and career. One piece of evidence for this is the existence of cultures in which the two genders are represented and succeed equally. In the western world, for example, the participation of women in computer sciences is particularly low, while in eastern cultures, Eastern Europe, South America and Africa, they are represented equally in this discipline (and sometimes the percentage of their participation is even higher than that of their male colleagues).
- *So how can one alter the situation?*

  Listen to the pupils' comments.

Summarize and say that it is primarily important that both the boys and the girls know the data – both regarding the females' ability and the statistical data that show that although females can do as well as males, fewer of them study and work in STEM areas. Furthermore, it is important to arrange for the boys and girls to meet women who work in these areas as role models, to refute common stereotypical thought regarding women and STEM.

It is important for women to work in STEM areas for several reasons:

- The value aspect of social equality in an advanced society.
- The importance of creating a society that encourages diversity. In solving complex problems in every sphere, including in Science and Technology, it is important to hear a broad variety of opinions and approaches from women, men, diverse sectors etc.
- The potential embodied in a particular society cannot be realized if 50% of it is not fully realized

GENDER INCLUSION CRITERIA

INDIVIDUAL LEVEL

- The activity presents a broad range of subjects from STEM areas and a variety of careers in which one can work after studying these fields.
- All the pupils have the opportunity to express their opinion in the Kahoot game by using their own cell phone.
- Most pupils feel comfortable participating in an informal conversation with a small number of participants.
- The instructions to researchers and engineers emphasize the contribution of their research or work to society and not only the details of the research itself. Presentation of these different aspects allows a wide range of learners to be involved in the conversation.

INTERACTIONAL LEVEL

- The activity includes diverse formats of activity that facilitate diverse interactions amongst the participants: a discussion in the plenum and participation in an informal conversation in a small group.
- The activity includes a presentation of young female researchers and engineers, who serve as a role model for the female pupils. Male researchers and engineers are more familiar to the pupils, and therefore it is necessary to mainly present women. In any case, male researchers and engineers can be integrated in the activity, as long as a numerical balance between men and women is maintained.

INSTITUTIONAL LEVEL

- At the end of the activity statistical data are presented that describe the gender situation in STEM in school, in the academia and in industry. The pupils are asked to express their opinion on ways to alter the existing reality.
- During the discussion the engineers or the researchers can relate the fact whether their company/university has a gender policy or not.
- The area in which the activity is conducted is adapted to holding a large number of conversations in small groups. It is important to assure a large, spacious space that can contain several conversations simultaneously in an informal atmosphere.

SOCIETAL/CULTURAL LEVEL:

- The activity includes exposing the participants to female researchers and engineers from areas and careers in which women are inadequately represented. This exposure in fact introduces to the participants a less known aspect of STEM areas.
- During the conclusion of the activity the pupils are exposed to the importance industry allocates to increasing the number of pupils in STEM areas, who will be part of the reserve from which the employees will be recruited in the future.
- Presenting statistical data regarding gender and STEM in a manner that surprises and arouses thought.

- Presents the different representation of females in the STEM subjects – there are subjects (in school, in academia and in industry) where there is greater representation of females, such as biology and chemistry, compared to professions where this is particularly low, such as in computer sciences and physics.

LEARNING OUTCOMES

At the end of the lesson:

- Pupils should be able to choose an area of study based on broader familiarity with a variety of subjects and new types of career.
- The pupils will be able to make a more rational decision when choosing an area of study in high school and later in the academia.

PARTNER DETAILS

This module was first developed by Bloomfield Science Museum Jerusalem, Israel. Contact: Eti Oron, etio@mada.org.il

Cover image: Courtesy Bloomfield Science Museum Jerusalem, Israel.

YOUR ROLE IN RESEARCH

INQUIRY INTO CHEMICAL REACTIONS

AT A GLANCE

Age Group	13 – 16 years old
Format	Meet a STEM professional
Duration	60 – 90 minutes

OVERVIEW

An authentic way to interact with materials, chemical substances and specimens. Boys and girls perform an experiment, typical for the industry/research institution they are visiting and in line with the institutions stated aim. They test the characteristics of common substances, they are directly involved in an inquiry process. They use this experience in a discussion on the profession and roles within the industry/research institution and will be able to see the link to the larger picture of the societal context wherein this activity fits.

OBJECTIVES

- Provide a way to practically engage with STEM content and material.
- Create the condition for participants to alternate between the specific details of a task, and its more overarching implications.
- Enthuse a diverse group of young people for scientific research/topics.
- Introduce working with an inquiry process.
- Give a look into the working life of a scientist.
- Get acquainted with the different roles within the visited industry/research institution.
- Introduce the societal context of research.
- The experiments proposed in the activity stimulate wonder and surprise with the students.

SUGGESTED SCENARIO

Open days for families, orienteering days for secondary schools, workshop for school groups.

TARGET AUDIENCE

Age	13 – 16
N. participants	25 – 30
N. facilitators	3 – 4
Type of audience	Students

FORMAT

Meet a STEM professional.

TOPICS COVERED BY THE ACTIVITY

This activity relates to the science curriculum for chemical reactions of BTB (bromothymol blue) diluted in distilled H_2O, $CaCl_2$ and $NaHCO_3$. The essence of the test is an acid/base reaction, with BTB as an indicator.

It gives an image on the work a scientist/researcher can do and helps the students to see science as a serious career choice.

During a discussion, with the performance of an experiment, the link is being made to the context and an example where the students can relate to.

DURATION OF THE ACTIVITY

60 – 90 minutes.

RESOURCES

MATERIALS

Short guideline for the facilitator	Annex 1	1
Short guideline for the students	Annex 2	1 per working station
Re-sealable zipper bags, 1 Liter, max. 1 ½ Liter		3 per working station
20ml bottles of BTB (bromothymol, acidity indicator) diluted in distilled H_2O, with pipette	 or 	1 per working station
Black pots with $CaCl_2$ (calcium chloride)		1 per working station
White pots with $NaHCO_3$ (sodium bicarbonate/baking soda)		1 per working station
Measuring cups small	 or 	3 per working station
Measuring spoon		1 per working station
Pen or pencil & paper		2 per working station
Mortar (if needed)		1 per working station
Lab coats		1 per student
Lab glasses		1 per student
Paper towels		1 per working station

USEFUL LINKS, VIDEOS, ARTICLES

- Zip lock bag reactions on chymist.com
- Reaction in a Bag on ucsb.edu
- Reaction bag on YouTube

SETTING

We need 1 working station/table per 3/4 participants.

Choose the facilitator and scientists with care.

- Students might react better to a charismatic person that has experience in leading conversations with students or some might react better to a young person with whom they can identify better.
- Ensure that the involved science educators and scientists reflect a variety of personalities/characteristics and roles within the organisation! Make sure the level of ranking is not divided high = male, low = female.

Brief the students teacher to prepare the students before they come and visit:

- A short talk about the industry and the scientist and his/her field can be enough.

Make sure the space where you receive the students has the possibility to do the experiment and have a group discussion.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

In general the facilitator encourages participation by all students, make sure that students don't get stuck, encourages questions and discussion, makes the transitions of what this experiment shows and what that tells us in the larger view of the socio-scientific role of the specific institution, makes an active link to diversity where possible

The students will be working in groups of 3/4 all the time with clear instructions.

Part 1 of the activity in this guideline is an example and should be an activity that the industry/research institution chooses themselves (see setting).

Part 2 of the activity is what brings a sur-value to the industry/research institution.

INTRODUCTION

Introductions, 5 minutes

The facilitator shows the materials, explains the safety rules and introduces his/herself:

- *What is your role and how did you get there (education and/or prior jobs)?*
- *What do you do on a regular day of work? You work together with who?*
- and *How that relates to being a scientist?*
- Briefly tells what the students can expect, explain that they are going to do the work a scientist does, doing their own inquiry with experiment they'll chose themselves

Start with a general question that will be answered in this experiment and put it in a context. The facilitator asks the students this question and valorises the answers. The students let their ideas go freely.

- *Have you ever been in a chemistry lab?*
- *What, do you think, does a chemist do?*
- *How do you become a scientist?*
- *What, do you think, is a reaction?*

DEVELOPMENT OF THE ACTIVITY

Part 1: The experiment

The facilitator explains that the following experiment they will do provokes a chemical reaction determining whether a substance is alkali or acidic.

A type of experiment we would do to, for example, test cleaning products: acid products react with calcium (bathroom) and alkali/base products react with fat (oven), but also to your skin.

Guided experiment, 15 minutes

Scientists sometimes need to follow very specific guidelines/already established procedures to conduct an experiment to discover and understand the specific characteristics of specific substances. For example when they want to perform the same test on different products. This is what we are going to try out first:

First we are going to do an experiment in a zipper bag with guided action:

Each group (4–5 students) has a kit with:

- 3 zipper bags
- a bottle 50ml BTB diluted in distilled H_2O
- a black pot with $CaCl_2$
- a white pot with $NaHCO_3$
- 3 measuring cups
- 1 measuring spoon
- a mortar (if needed)
- a paper and pen
- paper towels.

The facilitator does this experiment together with the students to guide them through the guideline:

- (If needed) grind the chunks of $CaCl_2$ with the mortar.
- Take 1 zipper bag.
- Put three teaspoons of $NaHCO_3$ and one teaspoon of $CaCl_2$ in the zipper bag.
- Fill the measuring cup with 10 ml. BTB in H_2O and place it upright on the bottom of the bag.
- Close the bag and try to squeeze out the air, while the measuring cup stays upright.
- Shake the bag and see what happens.
- Write down all your observations.

The students collect observations.

The facilitator moves between groups and focuses on the comments about changes in colour, change in temperature, foam/volume changes, but does not comment on them.

When mixing $CaCl_2$, $NaHCO_3$ and BTB in zipper bags, we can see and feel different phenomena (from the outside of the bag):

- Heating and subsequent cooling of the bag.
- The change of the colour.
- Foam formation resulting in the inflation of the bag.

We continue without discussing the observations.

Open experiment, 15 minutes

Scientists sometimes will conduct a more open experiment/procedure if the scientific question is more open on the substances. For example when they want to know what different reactions are with different proportions. So we will try this out as well. Freely experiment with zipper bag:

The facilitator explains that, to find out what is happening, we are going to repeat the experiment by changing the variables. For example, we may choose to use only two substances at a time.

Each group of students has 2 extra zipper bags and 2 extra measuring cups and are free to choose variables to experiment with to find out what happens in the zipper bags and understand it.

The students collect observations. The facilitator moves between groups.

CONCLUSION

Part 2: The discussion, 20 minutes

Discussion of the results & findings of each group.

- *What have we discovered in this specific experiment?*
    - A solution of $CaCl_2$ is slightly acidic and BTB gives it a yellow colour. Explain the terms acid-base.
    - A solution of $NaHCO_3$ is alkalic and BTB gives it a blue colour.
    - If these solutions are added together, an acid-base reaction occurs, releasing CO_2 gas. At first it generates bubbles and the air blows up the bag (CO_2 – carbon dioxide– generated by the reaction of $CaCl_2$ and $NaHCO_3$ with H_2O)
    - At first it is warm to the touch (because heat is released during the reaction between H_2O and $CaCl_2$), this is an exothermic reaction.
    - Then we feel cold (because the formation of CO_2 –from $CaCl_2$ and $NaHCO_3$– absorbs the heat), this is an endothermic reaction.
    - The essence of the trial is an acid-base reaction with BTB as indicator substance.
- *What did each of you just do? What different roles did you have/what role does a scientist have in these kinds of experiments?*
    - selecting variables
    - conducting observations
    - making deduction
    - documentation

The facilitator might add needed skills as well, speaking from her/his own experience: persistence, diligence, patience, to be able to work alone and on the other hand to work in a team, to be prepared for satisfaction besides moments of frustration.

- *What other roles can a scientist have/ what kind of job can a chemistry graduated do?*

  The facilitator can point out the following examples when the students don't think of them, to give a good idea of the societal impact a scientist can have:

    - Teacher, like your own teacher present.
    - Explainer, like a facilitator in a science museum
    - Interviewer, like science journalists.
    - Writer, every experiments should be shared in science magazines.
    - Briefing of (inter)national colleagues, so the outcome can be used by others.
    - Creative, to think of what is important in the research by writing research plans.
    - Influencing policy, so governments act on discoveries made.
    - …etc.

During this discussion the facilitator or another present researcher discusses with the students her/his daily work.

- *What does a(n average) day look like?*
- *Who does (s)he work with?*
- *What are the different activities that are typical to her function?*
- While going into this, (s)he explains what is being done in laboratories:
    - substances that do not exist in nature are being produced
    - substances that do exist in nature can be purified
    - producing chemicals (legally or illegally)
    - research into materials (like research into radioactive materials and yet undiscovered elements)
    - there are also a range of laboratories that do all kinds of analyses (for example analyses of soil samples or household cleaners).
- *What do you think we do in this kind of laboratories?*

  Explain that laboratories can be part of a hospital or a university, but also be part of a small or large company, or a government agency. Next to laboratories for scientific research there are also laboratories for practical uses:

Quality Laboratory

Many companies have a quality laboratory, where they test the purity and properties of raw materials, auxiliary materials, semi-finished and finished products. In the pharmaceutical and food industry is a microbiology laboratory is essential to avoid the risk of food poisoning and contamination of the final product.

Hospital Laboratory

Hospitals have a general clinical chemical/haematological, medical microbiological, pharmaceutical toxicological and pathological laboratory. To examine all bodily fluids, but especially blood, urine, faeces, sputum and tissue. Mainly the general clinical chemical/haematological laboratories perform a 24/7 role and are continuously available for urgent analysis. The other laboratories listed are not constantly being used, only when needed. At the head of a hospital laboratory is a laboratory specialist. In the case of the clinical chemical laboratory, this is the clinical chemist. In the case of the microbiological laboratory, this is the clinical microbiologist. At the pathology lab, this is the pathologist. And the hospital pharmacist manages the pharmaceutical toxicological laboratory.

Forensic laboratory

A forensic laboratory investigates traces to determine the facts of crimes and identify the perpetrators. The investigation into traces of DNA has boomed in recent years, so even older crimes can be solved, where researchers previously searched for a solution unsuccessfully.

Construction Physical Laboratory;

Some examples of research are:

- wind nuisance and wind loads on and around buildings in the wind tunnel
- sun and shade on and around buildings
- air- and waterproofness of facade elements
- sound insulation of walls, doors and facade elements
- fire resistance of structural parts.

- *What aspects of this work do you think is most socially relevant and why? How can we impact the society most?*
  The facilitator notes and points out his/her observations in this: different type of people, gender etc.
- *Who sees him/herself becoming a scientist (like me☺)?*

GENDER INCLUSION CRITERIA

The “gender inclusion criteria” developed in the Hypatia project are relevant for the adaption of Your Role in Research and should be reflected on and discussed with the people who are offering such a class or activity. Even more they might lay the ground for the success criteria in which to measure the results of the adapted activity. The following are some examples of how this workshop addresses gender inclusivity on the different criteria levels.

INDIVIDUAL LEVEL

- Encompasses a variety of different ways of engaging students by doing an activity, using discussing both in a groups as well as in small groups and showing different contexts where research can take place (different kind of labs, different roles).
- Involves activities that include a variety of problem solving and research methods such as selecting variables, conducting observations, making deductions and documentation.
- Uses activities that incorporate a clear context so participants understand what their role in research could be.
- Reflects on which previous knowledge and experience participants have.

INTERACTIONAL LEVEL

- Alternates between instructions in plenum; work in groups and discussions in plenum.

INSTITUTIONAL LEVEL

- Explains the subject of research of.
- Includes thinking about what kind of an impact the organization itself has – in the discussion the workshop leader discusses with the group what different roles scientist can have in society.

SOCIETAL/CULTURAL LEVEL

- Puts the different carriers you can have in science into context
- Showcases and/or discuss areas where science is used to benefit the society
- Broadens the views students have on science and scientists
- Discuss the ‘whys’ and ‘where’s’ of society’s use of science

LEARNING OUTCOMES

The following learning outcomes are divided accordingly between teachers or facilitators and participants:

- **Teachers or facilitators**

  After planning and preparing this workshop the facilitator or teacher should have knowledge of and/or be able to:

  - Adapt the activity in relation to targeting a broader group of participants
  - Gain inspiration from science
  - Have an awareness and understanding of how to motivate girls and boys to engage in the activity
  - Have an awareness and understanding of the cultural restraints that might be part of a classroom teaching in regards to gender
  - Realize how to counter target some of the cultural restraints in regards to gender that might be part of a classroom teaching

- **Students/participants**

  At the end of the lesson participants should be able to:

  - Deduce which factors influence different phenomena in a chemical reaction.
  - Have an idea how to work with an inquiry process.
  - Know the different kind of jobs in the organization.
  - Know what kind of skills you need to have to be a scientist.
  - Know the different kind of roles you can have within research.
  - Be aware of some examples of what science can be used for in society.

PARTNER DETAILS

This module was originally developed by NEMO Science Museum in Amsterdam, the Netherlands.
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Cover image: NEMO Science Museum, Amsterdam.

Hypatia PROJECT

Hypatia is an EU Horizon 2020 funded project that addresses the challenge of gathering different societal actors around bringing more teenagers, especially girls, into STEM careers both in school and as a choice of learning and career in the future. It aims at changing the ways sciences are communicated to young people in and out of school to make them more gender inclusive.

This project has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation (H2020-GERI-2014-1) under the grant agreement No. 665566.