



Are you a science teacher in secondary school?
Have you thought about trying to make science learning and a life in science more attractive to your female students?

If so, perhaps you should take a look at this inspiration created by the European ScienceGirls project 😊



CONTENT

Intro: the ScienceGirls way	3
The basic principles	6
The experience must be epic	12
Open schooling and the community	19
The girls should co-create the new science learning	27
Science teacher or science guide	32
Thanks for your interest!	40

All photos from the ScienceGirls project



GOBIERNO
DE ESPAÑA

MINISTERIO
DE CIENCIA, INNOVACIÓN
Y UNIVERSIDADES



FUNDACIÓN ESPAÑOLA
PARA LA CIENCIA
Y LA TECNOLOGÍA

This project has been funded with support from the European Commission.
This publication reflects the view only of the author, and the Commission cannot be held responsible
for any use which may be made of the information contained therein.
The project also received co funding from the Fundación Española para la Ciencia y la Tecnología -
Ministerio de Ciencia, Innovación y Universidades

INTRO

THE SCIENCEGIRLS WAY TO CREATE MORE ATTRACTIVE SCIENCE LEARNING FOR FEMALE STUDENTS



Most schools and teachers in Europe are aware that science education must change - in particular in secondary school.
In general science teaching is rather traditional and is not attractive to young people in the 21st century.

The results are disengagement in school and an increasing number of young people not interested in a career in science.
This clearly contradicts the needs of the European countries in a globalised and very competitive world.

But there are big differences between the reactions of boys and girls to science education.
Boys in general disconnect from science in school, while some of them are still interested in a career in science later in life.
Girls are more able to follow science in school, but do not see themselves working with science later in life.

Importantly, many girls do not find a career in science attractive because they seem to be unable to connect a female identity with a life in science.

Much experimentation is needed to change this scenario.
The European ScienceGirls project focused on *how to make science more attractive to science in a lifelong perspective.*

This presents a double challenge:
- making science education more attractive to girls in school
- allowing girls to create a more attractive image of science compatible to their female identities, thus reducing the resistance towards “a life in science”

Obviously, the first challenge should work to support the second: changed science learning in school should allow the girls to create more realistic, positive and attractive images of “a life in science”.

Gender-directed innovation in science in schools can take on many forms and go in very many directions.
The ScienceGirls project focused on what we believe to be the strongest way to work with the double challenge from above: changed science teaching

methodologies resulting in new ways of science learning in schools as well as such work forms that will allow girls to build new images and scenarios of what a life in science could be for a woman.

The innovation undertaken from the project is extremely focused on the fact that more attractive science learning and careering must link strongly and integrate with the creation of female identities along the teenage years!

The project's innovation builds on the challenge that new ways of science learning should include teenage girls' opportunities to produce sustainable and long-term images of science that integrates well with the creation of their female identities.

The development of such science learning forms that have a serious and lasting impact on the girls' female identity creation is very complex and demanding. This is why ScienceGirls set out to go far beyond what we call "modernisation of science teaching".

"Modernisation of science teaching" is about adding punctual, interesting and entertaining learning activities to traditional science teaching, but without innovating science learning fundamentally.

We believe that such "modernisation" might make it easier for the young students to "swallow" science teaching, but it is not fundamental enough to have the needed impact on the girls' identity creation and developing a new interest in a life in science.

To link strongly to this female identity creation the innovation in science education must go much deeper. It must influence the female personalities created along the teenage years.

The project is convinced that many science teachers are aware of the need to go further than adding small elements of entertainment (visits, dialogues, computer games).

This small inspiration paper is created for those teachers, offering inspiration and orientation to take the first steps to change science learning for the young girls. No doubt the proposed innovation will at the same time help reduce the boys' science resistance considerably.

So, what is the ScienceGirls innovation in science teaching about?

The project found that what is known across Europe as OPEN SCHOOLING seemed to be the most promising and efficient innovation; but also a very demanding one. Important players like the European Commission and recent research strongly recommend the use of OPEN SCHOOLING to bring about fundamental changes in traditional teaching.

Therefore the project, its teachers and female students engaged in open schooling experimentation for a period of almost 2 years, and the lessons learned is precisely what we offer you in this inspiration paper.

How do we present those lessons learned to you in this paper?

We do it through discussing and describing the 5 key elements or dimensions in what we have come to call OPEN SCIENCE SCHOOLING:

→ **THE BASIC PRINCIPLES**

→ **THE EXPERIENCE MUST BE EPIC**

→ **OPEN SCHOOLING AND THE COMMUNITY**

→ **THE GIRLS' SHOULD CO-CREATE THE NEW SCIENCE LEARNING**

→ **SCIENCE TEACHER OR SCIENCE GUIDE**

Besides this paper the project has created a very rich and visual material to further inspire science teachers in secondary school. You can access all this material on the [\[project website\]](#).

ScienceGirls ended in August 2018, but the project and its communities are very open to collaborate with science teachers and schools interested in using the project's innovation in practice. Such collaboration or dialogues can take on very many forms, and you are welcome to contact the project coordinator or the local partners to discuss your possible needs and interests. You will find precise contact information [\[here\]](#).





THE BASIC PRINCIPLES



WHAT ARE THE BASIC PRINCIPLES ABOUT?



The basic principle of open science schooling is that the science engagement must be rooted in the involvement of the girls in substantial real-life science experience or “adventures”.

This is to offer the girls a diversity of strong real-life science experience that allows them to integrate this experience into the development of their personalities in the teenage years.



Open science schooling therefore requires considerable collaboration with science players in the community - science players of all kinds as science is omni-present in our surrounding world.



The girls should work in teams and identify challenging science activities in the community (physical, social as well as virtual), and they should be able to follow those science activities for longer periods and at very close range. The in- school activities in the science education therefore take on the form of “learning when needed and when relevant” instead of “learning when scheduled”.



Such open science schooling will offer the girls rich engagement in a diversity of real-life science and they will interact with a wide range of professionals, including women in science, along their engagement. Open science schooling also ensures that the girls can develop critical voices along the engagement, towards male-dominated science communities as well as to what we call “responsible science”.

KEY POINTS TO BE AWARE OF



The teacher needs strong support from the school, as this kind of open science schooling requires considerable flexibility from the school and from other teachers.



It is of great importance that the engagement of the girls is serious, authentic and takes place along sufficient time periods to allow the girls to build personal experience.



The girls should in teams tell stories to the class and to school peers about their real-life science engagement.



BASIC DIDACTIC PRINCIPLES IN GENDER-SENSITIVE SCIENCE LEARNING

After two years of work in the Project ScienceGirls has been possible to collect the opinion of the 80 girls participating in the project, and her teachers. In this section you can find these opinions in order to use to improve the science learning methodology taking into account gender-sensitive perspective.

Firstly, it is important to know the [opinion of the 80 girls participating in the project] about four crucial issues:



Why don't we like science?

- Lessons are uninteresting
- Teachers are boring
- No experiments
- Very hard to learn
- Dominated by males
- Lacking in confidence
- Distractions in the lessons
- Not understanding the concept of the lesson
- Thinking they can't progress



Why do we like science?

- It is very interesting: lets you explore new things
- It is used in everyday life
- Helps progress in certain jobs: makes human life better
- Helps us learn more about the world we live in
- Experiments are fun

How can we improve our science lessons?

Integrating more hands-on learning:

- Applying a creative twist to traditional course content and engage students on a deeper level
- Skip the theory and get students to dive into the real issues
- Rather than asking students to read class texts at home, teachers should incorporate a group reading session into each class
- More experiments and better equipment in the schools: because it makes lessons more fun and we think we would get more involved. This motivates us and helps us retain the knowledge.
- More outdoor practical: more visits at university, museum, visit labs, factories... related to science
- Bring some of the world's most inspiring leaders of real-life right into the classroom, including some women
- Channelling meaningful discussions can provide students with an arena to express new ideas and voice their opinions
- Less writing and more use of Technology (visual learning) and more demonstrating: We think that if teachers got us more involved, that it would push us further and we would learn more.
- Do more activities in group
- Encourage more colour:
 - › Displaying inspiration posters or creating themed "mood" corners
 - › Allowing students to choose the format: using a format students enjoy the most, making them more naturally inclined to draw on their creativity
- Rewards to motivate students: Rewarding achievement visually in the classroom gives students an incentive to continue doing great work as well as gaining a sense of pride.
- Visualize goals with timelines: Empowering students to set their own goals is an incredible motivator.
- Incorporate humour into the classroom: creating a positive environment in which creativity can flourish.



Why are women not choosing the scientific career?

- Hard to balance with family life. They think that it is difficult and they won't succeed.
- They believe that boys are more intelligent than them, so they don't even try to follow their dreams.
- People think woman are less capable than men are.
- They are not interested in science.
- Because in some scientific workplaces, there are more men than women in that workplace so they might think they won't fit in.
- They don't realize what opportunities are there with science.

- Girls usually prefer to be in contact with people and they think that in jobs related to science it doesn't happen.
- We don't know many examples of girl scientists.
- The role of men in our society is different; boys like to take control and power so the girls go along with this and don't normally like it.



Moreover, it is important to know the opinion of the participating in the project:

As teachers we realized that science history is full of scientist's men names and women scientists are mostly unknown by students in general.

That's why we try to encourage pupils to search about women who had made contributions in fields like maths, astronomy, medicine, chemistry, physics, biology, computer, technology... from some centuries before Christ until nowadays. During their learning period, it is important to show students examples of influential women in Science to girls and boys in order that the boy students also learn about the important role of women in science and research. These examples of women of science should be included in the curriculum. It is very important, working on the recognition of the value of women in research by their male companions and on the recognition of the equivalent value of their companions with respect to them.

I think this fact is essential to change the cultural mental patterns rooted not only in girls, who do not feel adequate to scientific subjects, but especially in boys, who are culturally rooted in the model of scientist-man because they have never known examples of women who have changed the history of science.

However, female models in the scientific field are not the only way to raise the curiosity of girls in the field of science and technology.

Two didactic principles are especially helpful for paying attention to gender and diversity in Science teaching: a **variety of methods** and **engaging students**.

Aside from the standard practice of full-class discussion, it is also worthwhile to consider varying the setting and schedule periods of **small-group work** and **solo work** (which is best kept short during class time).

Gender and diversity conscious teaching is all about improving teaching. It is not about casting aside existing criteria for good teaching or reinventing them altogether; instead it aims to add to and refine existing criteria by raising specific considerations.

It has been checked that a way to work more openly and collaboratively among students with an STEM vision can also enhance skills in girls who encourage them to gain confidence in their possibilities in order to study these subjects at higher levels.

Some examples of methodologies to engage the girls are shown below:

- Career advice and workshops with local STEM leaders to encourage girls to continue with these subjects at a higher level.
- Teamwork: Cooperative learning with girls as team leaders of mixed groups, but they work better in groups of the same gender.
- The girls are more sensitive to achievements than boys and therefore, working in a context where they can stand out it can be a great stimulus.

- After the project they have increased self-confidence: in the mixed class, they participate more than before and are no longer intimidated by their male companions and their possible comments.
- Works aimed at a utility that is not an end in itself but is aimed at cooperation and focused on the concrete problems of Humanity.
- Gratify the successes: the girls are more sensitive than the boys.
- Involve girls more frequently in discussions, is to use more models and illustrative material in order to improve and to train the abstract imagination.
- Doing the exercises on their own. Girls have been active than teachers while doing duties. Teachers were only counsellor to them:
 - › Different approach to teaching making it interesting
 - › Letting student get to results by themselves (more involvement)
 - › Mentoring them into the right direction
 - › More group work
 - › Less homework or using small experiments for homework

We have concluded that the main didactic principles in gender sensitive science learning are engaging the girl students into science by using a variety of methods, recognizing their progress and improving the quality of the learning. The girls are more sensitive and demanding to high quality of teaching.

REFERENCES AND EXAMPLES

INTERVIEW WITH PARTICIPATING TEACHERS IN PAIR CROSS-COUNTRY

In this section, the interview with participating teachers is presented in pair and cross-country.

The teachers talk about several questions raised previously, and they express different interesting point of view that have an especial benefit, because they are of seven countries with different cultures: United Kingdom, Italy, Catalonia, Lithuania, Turkey, Greece and Slovenia.

Pairs cross-country:

Lithuania: Liudmila Gertiene

Slovenia: Aleksandra Frelj

Greece: Ilias Batzogiannis

Catalonia: Maribel Jodar

Italy: Caterina Marcucci

United Kingdom: Catherine Amison

Turkey: Tugba Yaylak



[\[Interview with participating teachers in pair cross-country\]](#)



THE EXPERIENCE MUST BE EPIC



WHAT IS EPIC EXPERIENCE ABOUT?



What we call the “epic” dimension of open science schooling is incredibly important!

The epic dimension is what allows the girls to integrate the science experience in the forming of their identities as girls and women along the teenage years - and this is what offer the girls an opportunity to more freely and with confidence imagine “a life in science”.



Epic means life experience formulated as story-telling: the convergence of the science experience story-telling and the personal story-telling on which the girls’ identities are build: “me, a woman” and “science” linked together through positive stories; stories that work together instead of stories that exclude each other.



We know epics from literature: long life journeys strongly impacting the personalities of the actors involved. But also for example Tour de France is “epic sports”, as this form of sport takes the participants as well as the audience on a long journey.

The girls’ open science schooling adventures should have this epic quality: long periods of deep engagement and with the power to have a positive impact on the girls’ identity creation and how “a life in science” is placed in this identity formation.

KEY POINTS TO BE AWARE OF



The epic dimension cannot be brought about through a number of punctual events, such as visits, dialogues with scientists or engaging in scientific computer games.

Such activity is, of course, valuable in themselves and can form part of an epic experience, but punctual events are not strong enough to fundamentally influence the girls' identity formation and their attitude towards "a life in science".



The epic dimension should be supported by the girls' own story-telling from the science experience, and reflections on "women in science" should be a constant element in the girls' teams' dialogues.



The epic dimension is strongly supported by cross-subject activity in open science schooling: integrating a diversity of other subjects, such as history, social science, politics and similar, will support the positive and lasting impact on the girls' identity creation and their attitude towards "a life in science".

This is a good opportunity to involve other teachers in the open science schooling activities.



Epic dimension is a way to stay in the science community long term. It is also a way of showing girls that a career within Science/STEM is possible and they can achieve their dreams.

The issue is that the influence of the project in the girls doesn't finish after the classes and after the two years of the project. The influence in the girls, of these two years of work, has produced a big impact in their life. In conclusion, the project provides the girls with a before and an after in their day to day, and accompany them long time.

It is important take into account that the opportunities affect the epic dimension. The less opportunities you have, the more impact you will have. The epic dimension has been so huge for the girls. That is not only for one task but also for all the activities.

Adolescence implies a phase of great changes for girls as well as for boys: in particular, girls feel that they are becoming women and begin to live experiences with greater critical spirit; they make their own choices based on how their experiences are able to move their feelings.

Rapid brain development in the early teenage years presents both challenges and opportunities to invest in children - in particular for those not interested in science or in any subject- to develop both academic and social-behavioural skills for long-term returns.



Even at school, what they live, as "epic experience" is able to generate real learning. This is truer as the girl in question is generally not interested in the subjects of study. Indeed, in our experience, the participating girls can be divided into three groups:

- Girls who were already interested in science and mathematics, disciplines in which they are very successful; for them the interest has increased, strengthened and they are increasingly convinced of the possibilities offered by scientific careers. This June they are going to do the final exams and then they are going to the secondary grade school (from 14 to 19 Years old). They all choose a scientific school.
- Girls who, despite their success in science, technology and mathematics, were not interested in scientific careers; now they are thinking about this possibility, having met some interesting women/careers and lived an "epic experience" with the project.

→ Girls who do not get good results in these disciplines and are convinced they are not up to it; for them the project has been interesting because they learned to use digital tools, they met successful women that has encouraged them to do their best to realise their dreams. Despite this, they are not convinced to undertake a scientific career because they do not feel up to, in light of the not very good school results.

For all three groups of girls, the project has been “epic” as it has been a great experience. It has been an experience spread over a considerable period of time, in which they felt engaged in science activities at school and outside the school. The point of view of their lives, their schools, their communication, friends, thoughts... have been enlarged in these two years. Therefore, ScienceGirls project has had many chances to “move minds” and to “cross boundaries”.

The impact of science-targeted initiatives in school education as well as initiatives to widen access to real scientific practice, plays an important role for successful social mobility of a teenager in later years. Some examples of different methodologies have been presented in the first part of this Guide: Basic Principles.

In the ScienceGirls project the culminant phase was the Science Visions ENCOUNTER, where the 80 girls work together during a week in Catalonia. This has been for them the topic experience, that undoubtedly touched their emotional sphere. They lived an experience that touched them deeply, as they felt protagonists of a great project. During this week, they work in mixed groups of different countries and they participated in two important events:

→ **Youth Mobile (YoMo) 2018 in Barcelona:** In YoMo they not only visited different spectacular demonstrations and experimentations in Science and Technology, but they also took part in YoMo. They explained to other young visitors of YoMo their project, they showed different experiments to the other visitors of YoMo, and the entire group participated in a performance writing #STEAM with their T-shirts and cups. Below there are some feelings of the girls after their visit to YoMo:



What did you learn from YoMo and has it changed my thoughts about science in real life?

From this experience, we realized that science is part of our daily life and that is also applied in the small things of every day so I changed my idea about science learning.

We learnt that it isn't difficult to innovate nowadays. After the YoMo festival our thoughts have changed a lot towards science in real life, as we have seen all the opportunities it has to offer and how undemanding it has become.

It has changed our thoughts about science because we know science isn't just being in a lab testing things it can be fun and creative.

There is science everywhere and it helps for everything, and we also learned how to bring human into consciousness.

What are your key YoMo messages for the project?

With a little imagination, hard work and science, you are able to do anything you want.

Science can be applied in real life in many different ways. Girls shouldn't be over-run by boys. STEAM is the future and it's very important for the development of our society. Everyone has the same amount of equal rights. Science can be fun and creative and is everywhere.

Science covers a lot more than we first thought and it can be taught in a way that is fun and still be useful in learning.

No matter what, we will all have to face with science and that technology can be very helpful for our future and lives.

- **Visit to Institute of Photonic Sciences (ICFO)** in Castelldefels: this is an international Research Center of Universitat Politècnica de Catalunya. In ICFO the girls could see a lot of different research about light and his applications. All the explanations have been done for young researcher females of different countries.



We can conclude that in order to make science teaching generate "epic dimensions" in teenagers, it is necessary to make them feel part of larger projects, aimed at achieving concrete objectives (dissemination, peer-to-peer challenges, teaching younger girls, etc). In the end, it is possible to achieve this goal from working on a specific plan for a long time. It is also very important in this long period to create especial events, which can influence and impress in the feelings of the girls.



PERSONAL TESTIMONIES FROM SCIENCEGIRLS AND TEACHERS ILLUSTRATING THE EPIC DIMENSION

The girls have written their feelings, thoughts and recommendations:

We keep interested in science because it has amazing opportunities to offer and lots of variety of jobs that we won't get bored in.

ScienceGirls has encouraged me to think about following a career with a STEM background and has given me the confidence to continue with studying science at a higher level.

Science means a lot to me. It has become actually much more important than it was before the valuable educational project activities. I began to pay attention to the things and processes around me. **I have become more curious. I am teaching my parents and sister to pay attention to every detail, for example to the composition of some everyday products or even fragrances.** Actually, I want to study something that features science in my future. If you want, you can learn science in schools, universities, search for different information on internet or in books, but also **you can learn science practically, simply being in nature. You just need to be attentive and observing. I have even started a diary of my observations. I think I will use it in my future, for example while comparing year-to-year observations.**

During these two years of project, we had learned many things and our minds have changed in some aspects. We have noticed that the progress of science is even more important than we thought before. We could also learn more ways to study science and to work in it, and this has helped some of us to finally to decide to study science the next year.

Some teachers explain that mean the project and the epic dimension in their girls:

It has been fascinating to watch how some girls' attitude towards science changed through these two last years. The point of view about science has been clarified. Some of them have even decided to choose a career in science. We have to realise what interests them and make it real inside and outside the class.

While evaluating the events we have done so far, they said that they had become more responsible, ambitious, curious, patience, they had joined the activities willingly, they had learned entertainingly, they had woken up at the weekends to participate in the activities without complaining and lastly, science was something more effective than they thought.

This is an example of a part of the journal, that one teacher has written during the development of the project:

When we learned about the project we felt curious but a little bit reserved because it seemed to us difficult. But we decided to try because if you do not try, you'll never know.

After our team leader's trip to the Kick-off meeting we could also understand the thought of the science of other European girls and we just got to work to change our minds about science, which until then did not like us much.

Thanks to the various visits to the Universities, we have been able to understand the importance of science in everyday life and our interest in it has become much more alive.

The most important phases of the project are approaching, and we are increasingly excited about this, giving us the names of the girls who will leave and we are looking forward to knowing it, after a visit to the universities made in December a small summary of this. That is done cannot be missed, and here we express our words, as science is important, namely: a lot.

Now, our interest in science is very much. We are very happy about the work we have done so far. The thing we like about this project is to be able to swap our opinions with other girls in the fastest time.

The school is ending, but ScienceGirls does not stop, we do it with the heart and won't stop, because this is what we are becoming, happy scientists. We are preparing a dissemination event for families and schoolmates where we will tell what we did during these project months and because we think science is important ... we are excited because we will have to speak to many people, including Mayors and Councillors to the culture of the municipalities of Panicale and Paciano. In addition to the presentation slides, we are preparing a newspaper called #LiveInTheScience, where we talk about our experiences and our ideas. In short, **we have a lot to do!**

We have become so interested in science and its possible facets that we do not stop even with school closed!!! Some of us will participate in the ScienceArt@Umbria summer stage because it seems to us really interesting!

REFERENCES AND EXAMPLES



MOSAIC OF INTERVIEWS WITH PARTICIPATING SCIENCEGIRLS ILLUSTRATING THE EPIC DIMENSION

You can study some interesting material describing the feelings of ScienceGirls from different teams:



[\[Interview Girls Italian team\]](#)



[\[Interview Girls Lithuanian team\]](#)



[\[Interview Girls Greece team\]](#)



[\[Interview Girls Slovenian team\]](#)



[\[Interview Girls Catalan team\]](#)



EXAMPLES OF REAL-LIFE SCENARIOS

The Science Visions Encounter took place in Catalonia. The ScienceGirls teams abroad considered the experience of this Encounter and especially the Visit to Youth Mobile as an impressive action. They highlighted the visit to Youth Mobile (YoMo).



[\[Visit YOMO Italian team\]](#)



[\[Visit YOMO Turkish team\]](#)

Catalan ScienceGirls considered as Epic dimension the relationship established with role-models, the University teachers and researchers, and visiting factories.



[\[Experience epic Catalan team\]](#)



SCIENCE GIRLS OPEN SCHOOLING AND THE COMMUNITY



WHAT IS OPEN SCHOOLING IN THE COMMUNITY ABOUT?



Open science schooling means that the school opens the doors to the realities outside the school: open the doors to the *community*. The community in this context means the totality and diversity of the society. But it can also mean “science community” or “science communities” - the resources the young girls will collaborate with along their new science engagement.



Open schooling does not mean that real-life science in community replaces science learning. It means that the science learning is organised differently:

- Focused on important science challenges in the real world, not on curricula, and using those challenges as the starting point of science learning
- The “school learning” is defined, then, as “science learning when needed, not when abstractly scheduled”
- Organised as interaction between science players in the community and the young students



Open schooling in collaboration with the community therefore means constant and dynamic interaction between the school, the teachers and students - and the science resources in the community.

Who are those “science resources” in the community?

Of course, science is everywhere in life! But not all science activities are important to society, interesting for the girls or appropriate for secondary school learning. The teachers and the girls need to - as a starting point of their science journey - to identify the most attractive, interesting and suitable science resources in the community to collaborate with.

KEY POINTS TO BE AWARE OF



The “community” should be understood in a very broad sense. It could be the town or city of the school, or could be the region or a city close to the town of the school.

It could even be a “virtual community”, as long as this community is well-defined and it is possible to design good open schooling science learning in this community. The basic criterion is that it should be possible for the girls’ teams to collaborate fluently with the science resources identified and for longer periods.



Attractive science engagement might take place in collaboration with a great variety of science resources or science players.

The most powerful collaboration will result from establishing science collaboration with several resources in the community, forming in the best cases small eco-system of science learning along the collaboration.

The school at large and other students might benefit heavily from the existence of such science learning eco-systems.

Examples of possible science players in the community are:

- # Companies engaged in interesting production processes
- # Innovation circles or communities in the city or region
- # Scientific research bodies
- # Public authorities engaged in important responsible science activities
- # NGO’s addressing various forms of societal challenges, such as environmental challenges
- # Any group of citizens or companies addressing important societal challenges with great scientific value



Open science schooling is definitely new to both teachers and students. But it is even more new to people in the community: they are not at all used to work with teenage girls for longer periods and sometimes even through complicated processes.

Therefore teachers and students can expect considerable resistance and hesitation on the side of the community players they wish to interact with.

It will take a lot of good explanation from teachers and students to motivate and mobilise the community’s science players.

The female students must be very good at presenting and winning their case!



Most people, companies and organisations only engage in something when they can see the benefit.

It is therefore important that teachers and students engaging with science resources in the community can explain the benefit of collaborating with young female students for the science and community resources involved, such as:

- # Making the young generation and especially the girls interested in a life in science is a responsibility for society at large, not only for schools
- # Creating small eco-systems of science collaboration in the community can benefit the science resources as well as the community at large
- # The girls’ teams can offer any science activity strong ideas about in what directions the new generations are going
- # It is important to the sustainability of our societies to involve young people, in particular girls and women, in developing critical attitudes towards science and science politics



WHAT COMMUNITY INTERACTION MEANS IN PRACTICE

Firstly, it is important to define what Community means. In the Community, there are different kinds of stakeholders that can be classified as:

- Secondary School / Family
- Universities / School Policy Makers / Business and Companies / NGOs
- Local Authorities
- Local Government

For the project has been fundamental to interact with the community. In the beginning of the project, all the Partners organised an especial event to get to know to the local community the goals and the phases of the project that was starting.

From here on out, each Partner planed his own strategy, and different kinds of stakeholders have more or less participated actively in the project.

Below are presented examples of interaction with the community at different levels practiced for some Partners during the project:



FAMILIES

The interest and participation of families is fundamental.

Teaching has always been a human activity, not just in the sense that it takes humans to do it, but in the fact that it is one of our most intimate relationships outside spousal and familial ones. The ideal learning requires interacting and inspiration.

In the case of Lithuanian team, parents, teachers and community highly appreciate the possibility to take part in the innovative European Erasmus projects. We see it as one of the greatest ways for our students to broaden their mind, meet new people, learn cooperation by working in teams and share their experience. The Project and its ideas were introduced to the parents and community. Parents initiated the event "Putting up nest boxes". Parents, students and teachers, cooperating and helping each other, built the nest boxes during the Woodwork lessons and after school and then all together we put them up on the trees in the school's yard. It was an unforgettable experience! We were all united by the same aim and enjoyed it very much.

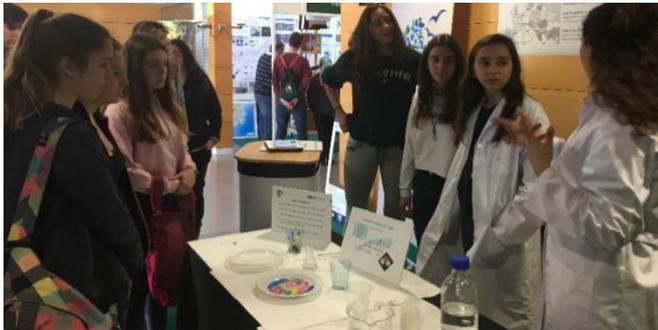


SECONDARY SCHOOL

It is important that the own school knows the project, but also to contact with other schools.

All the Partners presented the project in their own Secondary School, but some partners also interact with other Secondary Schools showing experiments as one opportunity to give information about ScienceGirls Project.

For example Catalonia team had taken part of “Knowledge Fair”. In this event, the girls made a couple of experiments to show science to young students of other Secondary Schools that visited the Fair (about 800 students in two days). It has been a good opportunity to explain ScienceGirls project to the young Community.



UNIVERSITIES

The many Partners visit during the project the University of their County. Some partners have more relationships with the Universities.

For the Italian team Universities, as forges of basic and applied research, represent in our case a great resource, because they invest enough in dissemination. All this should be structural in the path of school studies since primary school (6-10 years) because the routes currently activated concern the students of upper secondary school (14-19 years) and maybe it's too late.

For the Catalan team the relation with University is very strong. The Practice partner collaborates with the UPC that is the Knowledge Partner. This relationship permits many activities organised in collaboration.

A good example is the Workshop Girls in Engineering organized by EXPLORATORI - UPC.

In this journey, the Science Girls Catalonia's team also visited the UPC University in Manresa. It was a guided visit in the University where the Engineering School Headmaster received the girls, and then they could see how several professors, grant holders and PhD students work in the University. At the end of the visit, an act was organised where a study about registered women in the University in the last 10 years was shown. Moreover, four former students explained to them their experiences as women in their engineering work (Mining engineering, Chemical Engineering, Mechanical Engineering, and Electronic Engineering) and finally the Science Girls Catalonia's team talked about their job in the ScienceGirls project.



SCHOOL POLICY MAKERS

It is very important the dissemination of the Project to the stakeholders as School Policy makers. In the case of Knowledge Partner of Universitat Politècnica de Catalunya it has been a very good relation with the Educational Department of Generalitat de Catalunya. This relationship has finished with common organization of STEAM Journey (5th July 2018). In this journey STEAM method will be promoted in all the educational centres of Catalonia, including Primary and Secondary levels.

The EXPLORATORI of natural resources of UPC, that is the leader of the ScienceGirls Project, will have an especial stall in the Workshop in order to explain his Projects. In fact, the most important issue is that de Catalan ScienceGirls will participate in the Inaugural Session of the Workshop, and they will explain their project, as an example of good practices to engage the Girls in Science. It has been the Educational Department, which proposed to the EXPLORATORI to collaborate in this Workshop with the ScienceGirls.



JORNADA PER EXPLORAR LES STEAM AL TERRITORI

BUSINESS AND COMPANIES

There are two kinds of interaction with the Companies:

- Sponsoring the projects
- Visiting the factories and receiving conferences and assessment of their professionals

UK team in their community interact with different companies and establishments by linking up with them and sponsoring us (for example BAE Systems). In ScienceGirls we came up with ideas of what activities we wanted to do. Our BAE ambassadors generally helped to prepare and advise on these topics but we worked in teams to complete these tasks.

Catalan team has established relations with GSMA in order to give funds to organize the Science Visions Encounter in Catalonia.

All the partners realised school trips to nearby factories and facilities. The different companies collaborate to open their institutions to the ScienceGirls.

For the Italian team this project has taught that to motivate girls' interest in scientific - technological disciplines, interaction with the local scientific community is fundamental. Girls are very practical, it is not enough for the teacher to tell them that a theory or a scientific discovery is important; they want to see it in practice. For this, it is necessary that the school organize meetings with experts from its territory and accompany the girls in the research places, to see what really happens and why it happens, and what it is used for what the researchers are doing. To do this, all the community should cooperate. The institutions must make this process of "openness to the outside" possible through conventions and funds for school transport. In practice, projects could be

implemented involving stakeholders and guaranteeing bonuses for companies participating in them.

In the same way, all the partners tried to reach out to the community and find female scientists in their region. The girls had some interviews with female scientists and if possible, women conduct the visits to the factories.



LOCAL AUTHORITIES

The relationship with the local authorities is fundamental for the good development of the project. For that reason, it is very important to explain the project to the Mayors of the cities and their educational collaborators. In addition, it is necessary to disseminate the project to other local institutions, for example County Council.

The Major of the city has received Lithuanian team. This meeting was purposefully organised to promote Science Girls project, its ideas and activities also to listen to the opinion of the expert concerning the project topic in Pasvalys area and in general.

The Mayor of Pasvalys is a person of broad mind and rich experience. Due to his political and social activities he has travelled a lot and met many different people. He is aware of the situation of women involvement in Science in Pasvalys and can compare it with other regions. It was interesting to listen to his opinion. We also talked about the ways of women employment in Pasvalys, about young girls' free time spending and their engagement into social life of Pasvalys community. Our students asked questions about the involvement of Municipality, Labour Office and other political and social institutions into the activities promoting education and employment in our area.

In the case of the Catalan team, the Mayor of Berga is a young woman, which has been a very good role-model for the girls. The Mayor and the educational collaborators together with President of County Council and his educational collaborators have participated in all the events organised in the city. They even have organised press conferences together, in order to inform the local press about the project and the events planned.



NATIONAL GOVERNMENT

For the Knowledge partner of Catalan team UPC the relationship with the educational representatives of the Catalan Government has been crucial. The team explained the Project ScienceGirls to the representative staff of Educational Department the Catalan Government. Since the beginning of the project, the interest of the Government on the project has been very high. In the most important events of the project the educational representatives of the Catalan Government has been participated.

The most significant example is that it was the first time that the team of Catalan ScienceGirls to visit YoMo (2017). The UPC team organised a Photo-call, in order to disseminate the project to the visitors of YoMo. The President of the Government of Generalitat de Catalunya, Carles Puigdemont participated in the Photo-call. The President uploaded his own photo to his Instagram, and the photo received 3.000 likes in one hour.

Moreover, the Knowledge partner of the Catalan team (UPC) has participated in the Federación Española de Ciencia y Tecnología Call for grants 2017, and has granted a fund in order to organize the Encounter and the Multiplier event of ScienceGirls.

In conclusion, for the girls Community interactions, in a practical way, means to learn all the skills that they had learned by the theory, and see how it is in the real world by their own and had their own experience of that. They also said that it is very enriching for them and it helped them a lot.



REFERENCES AND EXAMPLES

MOSAIC OF INTERVIEWS WITH PARTICIPATING COMMUNITY PLAYERS

You can access interviews of different role-models in the world of Science and Technology:



[\[Interview Role-model Chemical Engineering\]](#)



[\[Interview Role-models Engineering\]](#)



[\[Interview Role-model Material Science\]](#)



Have you ever thought of working a science-based job?

[\[Interview Role-model Food production\]](#)



[\[Interview Role-model Meteorologist\]](#)

EXAMPLES OF REAL-LIFE SCENARIOS

In this section, you can find different examples of women in Science and Technology, that some groups of girls visit practicing Open Science Schooling methodology:

The ScienceArt@Umbria campus offered participants the opportunity to challenge the experimental method through workshops for monitoring environmental conditions of some local artworks. The girls of Italian team participated in this summer campus.



[\[Participation in The ScienceArt@Umbria campus PDF\]](#)

[\[Participation in The ScienceArt@Umbria campus Video\]](#)

The Noesis -Thessaloniki Science Centre and Technology Museum is a cultural and educational non-profit organization. It offers the public an environment conducive to the familiarisation with and the understanding of Natural Sciences and Technology, and is actively involved with subjects concerned with the technological culture.



[\[Visit at Noesis, Thessaloniki science centre technology museum\]](#)

Answers of ScienceGirls Lithuanian team to the questions:

1. What does “Science” in real life mean for you in your school, local area, region and your country?
2. What are the opportunities and barriers that exist to continue science learning into real environments?



[\[ScienceGirls Feelings and Findings about Science in real life\]](#)



[\[Photo-call with President of Catalonia with girls of Catalan team at YoMo 2017\]](#)



[\[Visit to Sugar Factory Elazi Seker of Turkish team\]](#)



[\[Presentation of the project ScienceGirls of the Lithuanian team in a meet with the Mayor of Pasvalys GINTAUTAS GEGUŽINSKAS\]](#)



SCIENCE
GIRLS

THE GIRLS' SHOULD CO-CREATE THE NEW SCIENCE LEARNING



WHAT IS CO-CREATION ABOUT?



The term “co-creation” is increasingly used in Europe and beyond to characterize a very important dimension in various forms of innovation. In short, it designates that innovation should happen WITH and not FOR people. Innovation FOR means top-down innovation not reflecting the needs and interest of those affected by the innovation, while innovation WITH indicates that the people affected by the innovation should be involved in the full innovation circle: from the beginning to the end.



Innovation in science education is a good example. Young students should be involved in creating the new ways of science learning in school and should ensure that the new ways are attractive, relevant and useful to 21st century students and their lifestyles and learning styles. This means that the young students should not only participate in open science schooling activities, but should be involved in the in the schools' and teachers' design and planning of those open science schooling activities. In other words: the young students should be involved in the negotiation of new science learning methods with teachers and with the schools - and with the community resources.



This co-creation principle is even more important in the case of creating open science schooling for teenage girls to counter the production of disengagement and disconnection from a life in science. *Why is that?* Because science learning innovation developed by educational authorities, schools, teachers and community collaborators are likely to be based on the strongly male-dominated science world and science discourse. The teenage girls and the young women are the only ones to adequately represent the perspectives and interests of “women in science”

KEY POINTS TO BE AWARE OF



The (gender-sensitive) co-creation also means that schools and teachers should not simply take over and replicate ready-made open science schooling models - such as the ScienceGirls models.

(This is why we call our guidance “inspiration” and not “model”).

It is important that your open science schooling initiatives are created from scratch, so to speak.

Obviously you will use our material as inspiration, but the design, planning and organisation of your open science schooling should indeed

→ Reflect your specific situation and interests

→ Reflect your access to relevant science resources

→ Involve the girls actively in designing the science activities, including negotiating the open schooling collaboration with science resources in your community



A very important dimension in open science schooling for teenage girls is precisely to encourage and ensure a critical attitude towards science in society, towards gender-biased science - and towards the dominating science discourse at large.

You should therefore be prepared to constantly create open space for such critical dialogues, such as “if young women decide to go for a life in science, will they need to act, behave and work like men?”

And if not, then what? What can we learn from women in science?

In fact such critical questions lead to an overall and fundamental question:

“Should girls come to science or should science also come to girls?”

This question involves many political, social and ethical challenges, and working through these challenges - along their open science schooling journeys - will precisely allow the girls to create new images of science that might integrate well in the formation of their female identities.

The ultimate objective of open science schooling for teenage girls is not to persuade all girls to go for a life in science, but to offer them a much more open and less resistance-based choice.



WHAT YOUNG STUDENTS' CO-CREATION MEANS IN PRACTICE

Co-creation is a learning journey. Two or more parties that are involved in co-creation have to adopt new practices and processes. To implement co-creation while doing some given tasks, it is necessary to tag on to collaborative culture. Creation of collaborative culture requires creative thinking in solving problems, leadership, knowledge management, cooperative learning, experiential learning, communication, quality management, and continuous improvement. In that way, some partners of the ScienceGirls Project have been using cooperative learning in order to involve more the girls and to achieve the goal of co-creation with them.

Some teams in the the whole ScienceGirls project used the methodology of learning and cooperative work. In all the activities carried out, the girls worked in small groups led by the teachers where the division of tasks and mutual help facilitated the achievement of the objectives set and none of the girls felt excluded. This method of work is very much appreciated by the girls who have declared they prefer it to individual work and have considerable advantages:

- Involvement of all girls because in the group, each member has its own role.
- Reduction of anxiety from failure, because in the group we help each other to achieve the final goal - this facilitates the participation of even the weakest people who maybe alone do not feel able to reach the goal.
- Creation of significant bonds and reinforcement of pre-existing ones: this aspect should not be underestimated, because significant learning is generated first of all in a peaceful learning environment.

In these times, teamwork is one of the most used methods even in the workplaces. In fact, "knowing how to collaborate" is one of the key competences of citizenship present in the European recommendations (RECOMMENDATION OF THE EUROPEAN PARLIAMENT AND OF THE EUROPEAN COUNCIL of 18 December 2006) that the students should possess at the end of the cycles of education.

This is involving the students in the process of generating new ideas concerning the Project matter and even decision making so that to gain more insight in the needs of the students or to find out the ideas that are easy to implement but might be quite effective in reaching the Project goals and mission. Moreover, co-creation improved the relationship between teachers and students.

In practice students' co-creation means that the students have their own ideas on experiments and projects. Students have the opportunity to speak freely about curricula and what is more interesting for them to learn about.

The world has changed. Humans have developed a lot since Middle Age. However, not even the greatest minds in the world have been able to change the way humans live on their own. They did it by cooperating. For us, co-creating means working together, leaving our differences aside to mix all of our talents to reach a common goal, even in the learning processes.



WHAT “FEELING SCIENCE” MEANS TO TEENAGE GIRLS

This section aims explaining what “feeling science” means to teenage girls, in order to illustrate the important subjective aspects of science engagement. The “feeling science” is presented in two different points of view: the own girls and their teachers.

After two years of project, these are the opinions of the girls:

“Science is very important, because it is the study of human beings and all that surrounds them, therefore also the study of us, we human beings, all the same. For this reason, no distinctions must be made of any kind”.

“I discovered that science is important in everyday real life”

“I like to meet the role models because I saw directly how fascinating their work is”.

“I would like to be a researcher in the field of medicine and find the solutions for important diseases such as cancer”.

“The ICFO centre visited in Catalonia Science Visions ENCOUNTER is a dream research centre; it would be great to work there”.

“I learned to control my anxiety thanks to all the activities we do such as: speaking in front of many people, communicating with people of other countries, speaking in English...I have been forced to test my skills!”.

“In science we all like “hands on” lesson and doing the practical elements. We liked working in groups so we could consult and compare our answers with each other. However, sometimes it was good to work alone to make sure you know what the lesson was trying to achieve”.



The point of view of teachers is presented below:

According to what observed, for our girls, to feel science means that the activities to be carried out are undertaken with a spirit of initiative and making significant contributions because the topic on which one works or the task to be completed is felt as one's own is felt as important, something worth working hard for. To achieve this, which is a long-term goal, it is first necessary to realise significant scientific experiences, such as the role model interview, the visit to the University departments, listening to and reading in-depth information on the subject. At the end of the project we have girls who, on their own initiative, make presentations on the solar system

and the universe for classmates, or who ask to take a math lesson to primary school children.

At the first, because of the type of the girls' school, they used to have not much interest in science. But from the beginning of the project, their interests have been rising. That is thanks for real-life, cooperative, effective, creative activities. Now we strongly believe that they have a big interest in science and experiences that has changed their opinions about their future.

Science is more than test tubes, complicated apparatuses, and physical and chemical reactions. Science is all around us and girls/students can pick up science concepts from their everyday activities. We have to satisfy our students' curiosity by engaging them in easy and exciting activities and watch them learn new concepts faster and better. **Science activities and experiments** for teenagers can be simple, fun but very handy and promising.

We had some discussions with the girls in order to understand what "science feels like" for them at the end of the project. We came to these:

- Science helps everything work
- Science makes us healthy
- Science helps us have a better living
- Doing science is difficult but doable if you try it
- Science is everywhere around us
- Being an author of a project or a co-creator

Feeling science, for us, means that you enjoy doing it and you are anxious to discover and find out new things about science. Teenagers usually want to study science for many different reasons, for example to have a good job. In our opinion, science is the way to build a better world.

REFERENCES AND EXAMPLES

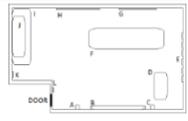
Girls telling their story: the newspaper #LiveInScience - pictures of girls working: the editorial staff of the newspaper.



[\[The newspaper #LiveInScience of Italian team\]](#)



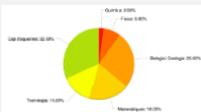
[\[Creating some recycling projects of Turkish team\]](#)



[\[Creating an Escape Room Greek team PDF\]](#)
[\[Creating an Escape Room Greek team Video\]](#)



[\[Learning electronics making the LED mask\]](#)



[\[Questionnaires to Secondary students of the School - Catalan team\]](#)



[\[British Science week - UK team\]](#)



SCIENCE TEACHER / SCIENCE GUIDE



WHAT IS SCIENCE GUIDE ABOUT?



For most schools and science teachers open science schooling conflicts with the traditional curriculum-based school. This does not seem to change much in the near future.

Schools and teachers will therefore have to take on a considerable challenge:

Making Mission Impossible possible...

Open science schooling does not only conflict with the rather rigid organisation of education in classes, subjects and detailed time schedules, it also fundamentally challenges the traditional teacher roles.

Teachers will experience that they partly lose “control” over the learning activities; they will fear that these activities will be hard to evaluate and test - and that the activities will interfere with and take time away from the teaching of other subjects.



Science teachers therefore need strong support from the school management and an open collaborate attitude from other teachers.

Science teachers should not be “lonesome pioneers and martyrs”.

There are at least 4 major challenges:

- Creating time and open space for the open science schooling activities
- Negotiating the collaboration and understanding of other teachers
- Organise “science learning when needed” along the open science schooling activities (also taking into consideration the curriculum)
- Ensure that the girls’ teams document their activity in such a way that evaluation and assessment is possible



Once the teachers acquire some experience most of them will start enjoying the new science guide roles. Thanks to this new role the teachers will be able to learn alongside their female students, including appreciating the wide range of community collaboration.

KEY POINTS TO BE AWARE OF



Science teachers engaging in open science schooling and make an effort to offer the teenage girls new images of science and a life in science are indeed frontrunners!

They must be prepared to overcome very many obstacles and roadblocks and to tackle many new situations.

However, such teachers - and their schools - should consider this struggle a very important investment in the quality and relevance of future science education - and a very important investment in the girls' professional and personal future.

It is of great importance to undertake such challenges as a team of teachers - not as individual teachers.



Remember that also the female students are used to traditional teacher-based education!

Therefore it is natural to expect some confusion, frustration and resistance along the open science schooling journeys.

Experience shows, however, that most girls strongly benefit from open science schooling and that most of them want to continue learning this way.



Young students are not used to document their activity.

They need from the very first day to learn how to document and story-tell important steps in the science journeys - and to learn to do this in creative ways and using a variety of digital media.

Such quality documentation and story-telling serves many important purposes:

→ Half of the girls' learning is documenting the activities, as it includes reflections on form and content

→ Solid documentation helps the teacher to evaluate and assess the girls' science learning

→ Good story-telling creates a communication platform for the various community collaborators, allowing them to follow and enjoy their participation

→ Good story-telling helps building lessons learned and new knowledge about how to organise open science schooling efficiently



Consequently the new teacher role as science guide is also about helping the girls produce creative story-telling.

This includes a variety of digital media. The teacher should work alongside the girls to build still stronger competence in the field of digital story-telling:

→ Creative design of documents

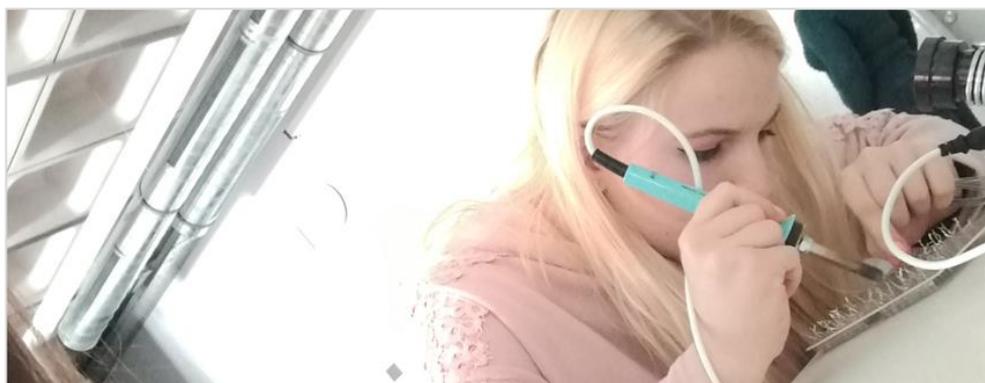
→ Photo and video documentation and editing

→ Animation creation if needed

→ Online presentation of the story-telling

→ Efficient use of social media

Creative story-telling offers teachers new and exciting experience that can be exploited in many other educational situations - and creative story-telling helps motivate and mobilise community collaborators!



THE NEW SCIENCE TEACHERS ROLES IN PRACTICE

Until now, the following actions can be considered as standard tasks of a science teacher:

- Secure high quality teaching and learning and leading by own example in the classroom.
- Take action to raise standards of learning for all students.
- Make effective use of resources.
- Preparing and developing ability- and age-appropriate curricula.
- Demonstrating hands-on activities prior to assignment.
- Evaluating student performance on tests, reports and lab activities.
- Collaborating with other teachers, staff, students and parents to support student progress.
- Staying current on the latest technology and scientific discoveries.

Knowledge is not any more something that teachers have and transfer to the students. So teacher is the person that guides the student through his/her interest. Teacher's role is more someone that has to provide a good learning environment, good materials and guide students to solve their questions.

In the new science teachers roles it should go further:

- A science teacher not only helps answer questions, they inspire their students to seek out the answers for themselves.
- Through lab experiments, field trips, mixed media materials and computer research, you'll have the opportunity to encourage students to explore the natural world around them and learn new and evolving scientific theories in real life. In a way that they learn more from doing and not only listening.
- Students' homework would be to make experiments on their own and not only to see them in a book.
- Making his students feel comfortable, not fear.
- Motivating his students by finding more attractive ways of teaching **for them**.
- Making them understand the connection of what they learn with the real life.
- Few ideas of new methodologies:
 - › "Did You Know?" this method may be used to introduce new science facts to the students.
 - › "Give me a reason" this technique may be used to make the students think and answer scientifically.
 - › "Science in Media" method may be used to show the use of scientific principles in Films, Comics, etc.

Science teacher must try to develop in their pupil commitment to the performance of specific type of role within the structure of society. It goes without saying that he is responsible for the transmission to his pupils the skills enabling them to fulfil their future admit role in work and other aspect of learning.

Society and especially politicians should understand that teachers have the greatest part to play in society. Science teachers are the mirrors of society and a

society which does not respect its teachers is bound to go in failure. Science teachers are considered to be a backbone for the development of a nation. To be gender-sensitive, the teaching must also favour group work and emphasize the social aspect of the scientific topic dealt with. In addition, it has to introduce examples of role models in the curriculum.



PERSONAL TESTIMONIES FROM PARTICIPATING SCIENCE TEACHERS ILLUSTRATING THE NEW ROLES



Annalise Sales, Science Teacher

- Chemistry is a fundamental subject that underpins everything in existence. Day to day life depends on chemical reactions and our environment as we know it is constantly changing as a result. Chemistry allows students to develop an understanding and appreciation of how our world works at a molecular level. The essential skills, such as inquiry and analysis, provided by Chemistry lessons are also transferrable to many subjects, careers and further education.

Students become confident in using a wide range of specialist equipment, they implement critical thinking, learn to work independently and collaboratively, and apply their scientific knowledge to explain new concepts and phenomena. All of these skills and attributes are essential not just for success in school, but are crucial for a diverse range of professions. I want students to be enthused by Chemistry and to produce the next generation of scientists, improving their aspirations and building their self-confidence and drive to succeed.



Hayley Lappin, Science Teacher and ScienceGirls lead

- My strengths, as a teacher, are my ability to quickly and efficiently build strong relationships with my pupils. I utilise this relationship to adapt my teaching style for each individual class and where possible each student.

I know now this is the basis for planning and teaching outstanding lessons, which allow students to make visible progress; but at the same time allowing them to have fun. Science as a subject lends itself to fun, creative, and engaging lessons and I believe it should be taught with as much of a hands-on approach as the topic and environment allows.



Emma Coulter, Head of Science Department

- My passion to teach science comes from my enthusiasm for science and my ambition to promote and inspire current and future generations of students to develop scientific skills and aspirations to become scientists. Science is important in education because it is relevant to everyday experiences, providing explanations for how things work and enables students to understand new concepts, pursue interests and make knowledgeable decisions. I also believe that science education is essential for acquiring skills including critical thinking, interpreting information and communication skills. In my lessons an effective method to keep students interested and engaged is planning and executing student-led lessons that enables students to learn scientifically through self-discovery, which concurs with the current 'how science works' aspect of the curriculum.



Francesco Macchioni

- In a new dimension of science teaching, aimed at involving girls more, and probably even boys, the teacher must completely dismiss the clothes of the "absolute master of knowledge", demonstrating him first that science is made up of attempts and failures, and that they must not live in the belief that to be really girls they must always be perfect because nobody is perfect, and of course they must not be afraid of the judgment of others. The history of humanity is full of failures from which new ideas were born that led to progress. The teacher becomes more than anything else a facilitator; the one who, having the appropriate knowledge and skills, involves the girls in the topics to be dealt with through activities that stimulate their curiosity; it helps them to explore the phenomenon, to ask questions, to plan investigations and to generate new ideas; focuses their attention on the fundamental aspects of the experiences and explains the scientific concepts that underlie these phenomena. Finally, it helps them to extend what they have learned in other contexts, generating competence.



Caterina Marcucci

- In my opinion, to be gender-sensitive, science teacher must encourage more the girls to try (when for examples doing experiments or trying to explain a phenomenon), even if they are afraid of making mistakes, because science (and of course even life!) can grow only if failure is seen as a new beginning. The teacher must introduce examples of great women of science so that both boys and girls recognize the role of women in science and thus break the misconception that men are more inclined to scientific disciplines than women. The methodology should encourage teamwork and provide concrete examples of how the study of scientific phenomena and their application can improve the quality of life and help humanity. The teacher should gratify the results obtained by the girls, who are generally more sensitive than male classmates. To this end, it is important that families and local institutions are involved in the change.



Clementina Bruni

- Learning by discovery is an excellent strategy that allows the students to establish a certain empathy with the teacher and which makes science, a notoriously

difficult discipline, a "palatable meal"; obviously the lessons must be supported by internal and external laboratory activities and ICT. Stimulated by curiosity, the lessons become participatory, the immersive environment where students take responsibility for their own learning and the teacher has the role of guide alongside the pupils. The classroom is a place where the best students are encouraged to help those less good. I think that this methodology, despite being more difficult to undertake for a teacher, it is more likely to succeed with both girls and boys. To be more gender sensitive, science teaching has to be focused on topics that deal more with the social benefits of science. The ultimate goal is precisely to train a competent person who knows the "knowing how to act".



Laura Saccucci

- I live my role as a professor of scientific and mathematical subjects, and I've probably always lived it, as a guide for the new generations in a world that is continuously evolving from the technological point of view. My desire, and therefore my goal, would be to give them the tools to be protagonists of all this and not mere users or passive observers, so that they can "feel on" what these innovations really mean for the human race, with the hope that this drives them to take part in it one day. In this context, therefore, I often dedicate space to a discussion that concerns the history of some discoveries or laws or formulas considered obvious or always existed, so that one can understand that the scientist or the mathematician is a job, made of effort, dedication, habit to failure and especially those who achieve their goals is the one who has not given up, which perhaps had a "dream" of realization that goes beyond mere money or other kind of satisfaction.



Tuğba YAYLAK

- After I started the project, I deeply realized that the importance of the science for the girls. Thanks for the meetings and some activities that we have done before the meeting. Both the girls and I got impressed a lot. Teachers are the learners who learn from the learners. So in the process, I have observed the girls and see their improvement about science and also how to explain themselves on their own and as a group. There was a purpose at the project that is to raise the interest about science of the girls. But, during the process, while we were trying to achieve this, we had lots of sub-purpose too. These are communication skills, language skills, self-confident, peer to peer interaction, inspirational people (they impressed not only girls but also me) cultures. I was counselor of the girls in the last year and I didn't say that they need to know the answer themselves, or that they need to provide the answer even if you don't know it! It's much more meaningful if you can help them to find the answer for themselves. I think we achieved this thanks for the Science Girls project. As Jacques Ranciere said in his book "The Ignorant Schoolmaster": "To explain something to someone is first of all to show him he cannot understand it by himself." "Whoever teaches without emancipating stultifies.



Roma, a teacher of Biology

- One of the major things that have to be present in a Science Class is Curiosity. Curiosity develops knowledge. Learning is fueled by Curiosity, Logical Thinking and Imagination. Some small extraordinary tasks/ experiments should be used to break the monotonous classroom routines and give students the possibility to enjoy Science.



Ligita, a teacher of Physics

- Involving Experiments will be my priority. Experiments are one of the primary techniques in teaching subjects especially science and they are a fun and interesting way to teach Science to the students. Simple experiments may be conducted in classrooms for demonstrating major concepts like Gravity, Force, etc. I try to organize various Science Exhibitions in which the students demonstrate their experimental skills and creativity.



Lina Rauckiene, the school's headmistress

- Learning is slowed down by fear. The teacher should make sure that students do not fear to interact with him/her. He/she should encourage interaction in the classroom by avoiding being too loud and harsh.



Rasa, a teacher of-Science

- Science learning may become boring if the student is not shown the connection between theory and practice. Discussing about real world applications of a theory or law makes the student understand it better and decreases the chances of forgetting. It also enhances the student's logical and investigative skills. "Inventions or Discoveries are the result of connecting theory with reality".



Maribel Jódar

- In our school we work with a digital book that divides each science lesson into 5 stages: engage, explore, explain, elaborate and evaluate. The way to work is to face up the students with some games or real problems in life that have to be solved. Students can go further step by step respecting individual learning time. That way of work means to change the role. Teacher is much more a "busy bee", helping and collecting ideas from the pupils, encouraging them to be challenge. Students have to produce and elaborate final materials, working in pairs, in group or in collaborative way.



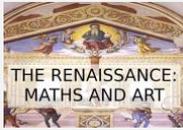
Sandra Bessa

- Science teacher has to be someone who loves science and can transfer his/her passion and motivation to pupils. Someone who are opened to teach in real scenarios and also make girls/boys to be critical.



REFERENCES AND EXAMPLES

EXAMPLES OF REAL-LIFE SCENARIOS



[\[Math lesson: the golden section of Italian team\]](#)



[\[Aurea figures of Italian team\]](#)



The almost 100 science girls participating in the project are now leaving the scene. But, surely, they will take other science learning and a life in science scenes in the future..!

AND NOW: **PRAGMATICS!**

Dear science teacher!

We hope you have enjoyed reading the open science schooling for girls inspiration resulting from the 2 years ScienceGirls project - and we hope the inspiration will be useful to you.

During the reading you will no doubt be thinking: Yes, this is nice, I like these ideas very much; but it is impossible to do this in my school. We need to agree with you: it is very difficult to create full scale open science schooling for your teenage girls. At least it will take several steps, patience and persistence.

However, you should not step back just because you and your colleagues do not feel able to do all this in one move.

There are many ways in which you can implement open science schooling for your secondary school girls *partly*.

In the first steps you might decide that you are able to practice some of the elements in open science schooling - and then slowly expand this practice in the years to come.

It's much better to accept some pragmatism and start working with some of the ideas - and then pursue further perspectives step by step.

Thanks for your interest; we wish you good luck with your new science girls initiatives!

Remember that you can establish dialogues and get support from the project and from project partners.

<http://science-girls.com/contact-us/>

And remember that you can find much more ScienceGirls material on our [website](#).