

STEMPOWERED



TEACHING RESOURCES

Student Lesson Plans

www.education.vic.gov.au/techschools

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LESSON 1: PRE-VISIT CLASS

Class Grouping

Whole class, small group, individual

Time

60 minutes

Purpose

The purpose of this lesson is to introduce students to a variety of issues relating to women in STEM. Students will get a sense of the number of girls doing STEM subjects in their own classroom and begin to build an understanding of some of the broader issues affecting women in STEM. They will also be introduced to the women featured in the *STEMpowered* Exhibition and will be asked to formulate their own inquiry question to be answered during their visit to the exhibition.

Activities

1. Class poll and discussion
2. Expert jigsaw
3. Gallery walk

Preparation & Materials

Activity One

- Whiteboard markers

Activity Two

- Stimulus materials (see below). View prior to commencing lesson
- Student access to the internet and to stimulus URL addresses as required
- 1 x printed copies of each written stimulus
- 'Post it' notes for each table group
- Space on classroom wall allocated to communal post-it note board

Activity Three

- Printed *STEMpowered* biographies. The biographies should be placed on the walls around the room
- Gallery Walk & Exhibition Handout

Procedure

Activity One

5 Minutes – Whole Class

Brainstorm

The purpose of this task is to determine the fraction of girls who have considered a career in STEM compared to the fraction of boys. This may give students an indication of the gender bias that exists amongst students pursuing careers in STEM.

Student Activity:

1. What do you think STEM is?
2. Name five careers that students think are STEM related.
3. Ask students 'Who has considered a career in Science, Technology, Engineering or Maths?' Divide the room in half and seek for the students to answer the question above by shifting to the side of the room that best represents their answer to the question.

Teacher note: This will highlight not only how many students understand what STEM is, and have a good understanding of what a STEM career may mean, but will likely highlight the gender imbalance in STEM

4. Briefly discuss student responses. Are they surprised? Concerned? Reassured?

Activity Two

30 Minutes – small groups

Expert Jigsaw

The purpose of this task is for students to work in small teams to inquire into the stimulus provided encouraging them to explore ideas about women in STEM (refer to 'Preparation and Materials'). They will then be asked to share what they have learned with the rest of the class by posting their ideas on a communal note board and participating in an expert jigsaw. It is suggested that you review the stimuli before commencing the lesson.

Student Activity:

1. **(1 minute)**: Divide students into groups of four and provide each group with post-it notes.
2. **(15 minutes)**: Allocate one or two of the stimuli to each group and instruct students to write the title of their stimulus on an individual post-it note. Students should then view/read their stimulus, summarising key points on separate post-it notes. When finished they should stick their notes onto the space that you have allocated for the class's communal post-it board, placing the title of their stimulus at the top. Each group will then be asked to share **three key points** about their stimulus with the rest of the class.
3. **(10 minutes)**: Facilitate a whole class discussion addressing the following questions:
 - What themes do you think are emerging regarding women in STEM? For example, the underrepresentation of women in many STEM careers, gendered stereotypes

preventing girls from undertaking STEM subjects or the unconscious bias of educators and parents influencing the subject choices of girls.

- Are there any issues that stand out to you?
- What do you think could be the cause/s of these issues?
- Why do you think we are looking at these resources today? Guide this discussion by linking it to your upcoming visit to the *STEMpowered* Exhibition, which draws attention to the breadth and diversity of careers for women in STEM. The Exhibition also allows for exploration of the factors that enabled the women who are exhibited to achieve their goals, and the factors that may have made it difficult for them to do so.

Activity Three

25 Minutes – Individual

Gallery Walk

Pre-lesson note to Teachers: Print out the biographies of the STEMpowered Exhibition Women and place these on the wall around the room in preparation for this activity.

Prior to completing this activity, ensure you have printed the Gallery Walk & Exhibition Handout for the students.

The purpose of this task is for students to become familiar with the women who are featured in the *STEMpowered* Exhibition, and to generate an individual Inquiry question that they will be required to answer when visiting the exhibition. Inquiry-based tasks require students to **devise** and then **investigate** an open-ended question by gathering and/or analysing data. Questions should not begin with a simple 'who, where or what' but require deeper thought and reflection.

For example:

- If more women entered into careers in STEM, what could be the potential benefits for our community?
- What evidence is there to suggest that it has been difficult for women to gain entry into STEM careers?
- How does the work of Dr Tien Huynh help to achieve equality for the underprivileged?
- What can we infer from the statements made by the women about their career pathways?

Student Activity:

1. **(15 minutes)**: Let students know that they will now be participating in a Gallery Walk in their classroom to study the biographies of the women featured in the *STEMpowered* Exhibition. Distribute the Gallery Walk & Exhibition Handout to the students. Ask students to walk around the room in silence, looking at the biographies of the women from the exhibition that has been placed on the walls. Each student should spend roughly **1-2 minutes** studying the information generally and then choose one woman to focus on. Using the Gallery Walk & Exhibition Handout, ask the students to answer the four questions contained in the Handout and also write an additional question they wish to investigate further ensuring students are aware they will need to answer this question when visiting the Exhibition.

2. **(5 minutes)**: Ask students to share their questions with the class. Encourage students to give each other feedback about the questions they have formulated, keeping in mind that feedback should be constructive, specific and helpful. For example: How could you make this question more open-ended?

LESSON 2: EXHIBITION VISIT

Class Grouping

Whole class, small group, individual

Time

60 minutes

Purpose

The purpose of this lesson is to enable students to engage with the *STEMpowered* Exhibition, searching for an answer to their individual inquiry question (generated in Lesson one) and responding to the additional questions provided. Students are encouraged to begin thinking about the issues that may affect women in STEM.

Activities

1. Exploring the exhibition
2. Pair and Share
3. Group Discussion

Preparation & Materials

- 'Gallery Walk & Exhibition' Handout from Lesson 1: Pre-visit class
- Handout: 'Girls and STEM' fact sheet
- Items to record their answer (for example: school based technologies such as iPad or mobile – or clip boards and pens).

Procedure

Activity One

30 Minutes – Individual

Exploring the Exhibition

The purpose of this activity is for students to explore the *STEMpowered* Exhibition, completing their Gallery Walk & Exhibition Handout and reading the Girls and STEM Fact Sheet. They will be required to discuss their findings in pairs and with the class.

Student Activity:

Using the Gallery Walk & Exhibition Handout and the Girls and STEM Fact Sheets, students should explore the exhibition with the intention of answering their own individual inquiry question, as well as the supplementary questions provided to them.

Activity Two

10 Minutes – Paired

Pair & Share

1. After they have explored the exhibition, ask the students to engage in a 'Pair and Share' activity. Each student should find a partner and share the information they have gathered at the exhibition with them. Students should discuss the following questions:
 - Were you able to answer your inquiry question? What was the answer?
 - Did you each have the same responses in the Gallery Walk & Exhibition Handout you were asked to answer?
 - Which person did you find the most interesting or inspiring?
 - STEM subjects are often incorrectly thought of as leading simply to jobs in 'Maths or Science.' Did any of the women in the *STEMpowered* Exhibition have careers in areas that surprised you?

Activity Three

20 Minutes – Group

Group Discussion

1. After the students have paired and shared facilitate a group discussion about their findings, using the same questions students responded to during their Pair and Share activity:
 - Were you able to answer your inquiry question? What was the answer?
 - Did you each have the same responses in the Gallery Walk & Exhibition Handout you were asked to answer?
 - Which person did you find the most interesting or inspiring?
 - STEM subjects are often incorrectly thought of as leading simply to jobs in 'Maths or Science.' Did any of the women in the *STEMpowered* Exhibition have careers in areas that surprised you?

In addition, pose the following questions to students:

- Do we have a culture at **our** school where girls are encouraged to take up STEM subjects?
- If so, what are the factors that encourage girls to take up STEM subjects?
- If not, what are the blockers? How do we address them?

At the conclusion of this discussion, teachers should briefly discuss the 'Post-Visit' task (**Lesson Three: Post-exhibition**) that students will be involved in at the school.

LESSON 3: POST-EXHIBITION

Class Grouping

Individual, small group or whole class

Time

60+ minutes (with scope for extension)

Purpose

The purpose of this final lesson is to encourage students to translate their learning about the lack of women in STEM into action in their own school context. Students are encouraged to gather data from their schools, analyse that data and make practical suggestions about how their school could make a difference to the numbers of girls selecting STEM subjects or considering pursuing a career in STEM.

Activities

1. School Survey
2. Data Analysis
3. Recommendations

Preparation & Materials

- Survey tool of choice (refer to examples provided)
- Access to the internet
- Access to an electronic spreadsheet program with graphing tools. Eg. Microsoft Excel (optional)

Procedure

Activity One

60 Minutes – Individual, small group or whole class

School survey

The purpose of this task is for students (or teachers if time is limited) to survey as many girls in their school as possible about their attitudes towards STEM. Students will then be asked to collate the data and use it to make recommendations about how their school can best support girls to pursue STEM subjects and/or a career in STEM.

Post lesson note to Teachers: The Girls in STEM Fact Sheet provided for Lesson Two provides excellent examples of possible careers in STEM.

If multiple classes from your school are visiting the STEMpowered exhibition, you will need to communicate with your colleagues to ensure that the same cohort of students are not asked

to complete the survey multiple times. Year 10 students could survey Year 8 students; Year 9 students could survey Year 7 students etc. to ensure that there is no overlap.

Student Activity:

1. Students (or teachers) should copy and paste the survey questions below into their chosen data collection tool (see boxed text: A note on Technology). As many girls as possible should be surveyed, and a time limit given with regard to completion of the survey. If using a hard copy, students should physically administer the survey to as many classes as they have been allocated, seeking teacher permission to have students complete the survey on the spot.
2. Once data has been collected, students should collate responses to the questions that have been asked. They may wish to export data into a program like Excel or another electronic spreadsheet program to process their data or to create graphs or tables.
3. Using the data, students should make some practical short, medium and long-term recommendations to their school community about what their school could do to increase the number of girls undertaking STEM subjects. See a detailed list of suggestions below.
4. If conducting this activity in a digital technologies environment, a visualisation activity could be developed using the data, highlighting how to present data in a meaningful and impactful way for different target audiences.

A note on Technology:

Students may use a variety of websites or applications to gather data. Some examples of technology that would support this data collection include Google Forms, Survey Monkey or emailing a survey to students. If technology is not available, students should create a hard copy of the survey.

Extension Activity

If time permits, find out the gender breakdown of students at your school who are currently doing STEM subjects in VCE, and use that data to enrich your findings and inform your suggestions about how your school can make improvements.

SAMPLE SURVEY QUESTIONS HANDOUT

In this survey, you will be asked to answer a number of short questions about girls studying Science, Technology, Engineering and Maths (STEM) subjects. Please answer as honestly as you can.

We will use the results of this survey to come up with recommendations for our school about how to encourage more girls to study STEM.

SURVEY QUESTIONS

1. Have you ever considered taking up a career in STEM or doing STEM subjects in the VCE?
 - a. No
 - b. Yes
 - c. If yes, which subjects have you considered taking in VCE?

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2. List the names of up to three (3) women who are famous for their achievements in STEM.

- a.
- b.
- c.

-
3. In Australia, women are significantly under-represented in many STEM careers. What do you think the blockers are in your school with regards to girls getting involved in STEM subjects?

You may choose more than one answer.

- a. Girls feel uncomfortable about doing STEM subjects because they are considered 'nerdy' or as subjects that are more appropriate for boys.
- b. Girls are not encouraged to do STEM subjects.
- c. There are stereotypes about girls not being good at STEM that affect our confidence. For example: The stereotype that girls are better at English while boys are better at Maths.
- d. Girls don't think they are 'good' at STEM subjects
- e. Other: please specify –

-
4. What could our school do to help you feel more confident to continue to enrol in STEM subjects or to pursue a career in STEM?

Choose your top three answers.

- a. Create girls-only classes for Science, Technology, Engineering and Maths subjects
- b. Support teachers to actively encourage girls to take STEM subjects
- c. Provide education for teachers to help them to challenge 'unconscious bias' or stereotypes, for example: implying that boys are 'naturally' better at STEM subjects by assuming girls get good results by working hard while boys get good results because of their 'natural ability'
- d. Invite women who work in STEM careers to come in and speak to us about their career and about their journey.
- e. Access to career advisors who are knowledgeable about pathways to STEM careers. For example: What do I need to study to become a game designer?

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- f. Include women in our STEM subjects, not just men.
For example: Acknowledging women who have been responsible for important scientific breakthroughs.
 - g. Help to educate our parents and provide them with information about career possibilities for girls in STEM.
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WHAT SORTS OF STRATEGIES COULD WE USE IN OUR SCHOOL?

In the 'Girls' Future – Our Future' study undertaken in Australia by the Invergowrie Foundation¹, the following interventions and initiatives were shown to have potential to improve girls' participation in STEM:

- Addressing unconscious biases in teacher. Eg. Teachers not being aware that they are assuming only boys will want to pursue STEM subjects or that they are making comments that discourage girls from believing they are good at Maths or Science.

For example 'this is a really great test result, but girls are much better at English so perhaps that's where you should focus your attention.'

How do you think your school could educate teachers about unconscious bias?

- Educating teachers, parents and carers to help them to understand the stereotyping of girls' interests and abilities in relation to STEM subjects.

What are the stereotypes?

How could you address them?

Check out the [#InspireHerMind](#) project².

- Working with teachers and schools to encourage all learners, and girls in particular, to engage with STEM. Think about how this might work in practice at your school.

What sorts of things would your school need to do?

- Schools partnering with industries and local communities, to provide girls with real life STEM opportunities, including mentoring and industry placement, and engagement with role models who are "everyday" STEM professionals.
- Quality career advice for girls on the diversity of STEM-based career possibilities.
- Changing curriculum content to better reflect women's contributions to STEM.
- Holding special events such as information and career evenings, with guest appearances, or provide special learning experiences (like the one you've just had)!
- Find people in your local community who are prepared to mentor girls in their area of interest. Check out the '[Million Women Mentors](#)'³ project for inspiration.

¹Hobbs, L., Jakab, C., Millar, V., Prain, V., Redman, C., Speldewinde., Tytler, R., & van Driel, J. (2017). *Girls' Future - Our Future. The Invergowrie Foundation STEM Report*. Melbourne: Invergowrie Foundation.

²[Inspire her Mind video](#)

³[Million women mentors website](#)

GALLERY WALK AND EXHIBITION HANDOUT

MY INQUIRY QUESTION FOR THE *STEMPOWERED* EXHIBITION IS:

ANSWER

WHO IS THE MOST INSPIRING WOMAN WHO YOU LEARNED ABOUT TODAY? WHY?

WHO CAN YOU RELATE TO THE MOST? WHY?

WHAT WERE YOU SURPRISED BY?

WHAT WAS ONE THING YOU FOUND PARTICULARLY INTERESTING?

ADDITIONAL NOTES:

GIRLS AND STEM FACT SHEET

Did you know¹?

- Overall, girls perform **equally well** as boys in Maths and Science.
- The higher numbers of boys doing Science and Maths subjects is **not** a result of biological factors. Boys are not 'naturally' better at STEM subjects than girls.
- Test scores in science in both primary and secondary school show **girls having equal or greater success rates when compared with boys.**
- Despite this, girls still express **feelings of being less capable** than boys at STEM subjects and tend to participate less in science lessons.
- Across Australia only **5.9%** of girls take Physics, only **6.2%** of girls take Advanced Maths, only **16.5%** take Chemistry and only **20.6%** of girls take Intermediate Maths in VCE (or its equivalent).
- These statistics are significantly worse for Indigenous girls, girls from rural or remote schools and girls from lower socioeconomic backgrounds.
- It has been estimated that **75% of the fastest growing occupations**, including those in the creative industries and humanities, will require Science, Technology, Engineering and Maths-related skills and knowledge.
- At the same time, the number of **girls** undertaking STEM subjects at school has been dropping at an alarming rate, which means there is a **serious lack of women in STEM professions.**
- Across Australia, the percentage of girls undertaking VCE (or its equivalent) in the following subjects is:
 - Only **5.9%** of girls take Physics;
 - Only **6.2%** of girls take Advanced Maths;
 - Only **16.5** of girls take Chemistry; and
 - Only **20.6%** of girls take Intermediate Maths.
- The low numbers of girls in Physics and (Advanced) Mathematics are particularly troubling because these subjects are considered the STEM subjects that provide access to university level Science and Engineering Courses, and to job opportunities after graduating from such courses.¹Hobbs, L., Jakab, C., Millar, V., Prain, V., Redman, C., Speldewinde., Tytler, R., & van Driel, J. (2017). *Girls' Future - Our Future. The Invergowrie Foundation STEM Report.* Melbourne: Invergowrie Foundation.

What about the role of gender stereotypes?

An **enormous amount of research**¹ both in Australia and internationally shows that there are very powerful gender **biases** within STEM education. These biases are sometimes obvious and sometimes subtle. E.g. teachers specifically encouraging boys to take STEM subjects in VCE, or male scientists always being used as examples in class.

The lower numbers of girls and women pursuing STEM-related careers appear to be influenced by **lifelong gender stereotyping, not ability**.

E.g. girls being told that they are 'not good' at science, that boys are 'better at maths', or that STEM subjects and careers are not 'feminine'.

The stereotypical view that STEM subjects are somehow 'masculine' or 'something that boys are better at' helps to create a belief in girls that science is not something that they are good at or can pursue.

Research also shows that girls with **high scores** in **high-level** mathematics are less likely than boys with **lower scores** to be encouraged to take highest-level maths classes as a result of gender stereotyping.

Children **as young as two** have been shown to develop an awareness of gender stereotypes. For STEM, this has **important consequences** because research over a long period of time has shown that many of the STEM fields where women remain under-represented are viewed as '**masculine**'. Children as young as six have been shown to associate science with males.

¹Hobbs, L., Jakab, C., Millar, V., Prain, V., Redman, C., Speldewinde., Tytler, R., & van Driel, J. (2017). *Girls' Future - Our Future. The Invergowrie Foundation STEM Report*. Melbourne: Invergowrie Foundation.

What sorts of subjects fall under the STEM umbrella? Where can STEM lead me?

The products of STEM knowledge are all around you. Whenever you turn on your phone, eat food, text your friends, or measure your heart rate, you are using products of STEM knowledge.

Examples of traditional school STEM subjects include:

- Biology
- Chemistry
- Physics
- Design & Technology
- Maths
- Information and Communications Technology (IT or ICT)
- Computer Science
- Economics
- Geography

And the career possibilities are mind blowing!

In the *STEMpowered* Exhibition alone, there are women working in genetics, technology and gaming, environmental science, health, nanotechnology, engineering, health research, technology and health, technology and art, immunology, and environmental sustainability.

In addition, you could choose to study something like, but not limited to:

- Aerospace Engineering
- Biology
- Civil Engineering
- Food and Technology
- Psychology
- Zoology
- Design
- Astronomy
- Chemical Engineering
- Computer Science
- Mechanical Engineering
- Statistics
- Nutrition
- Music Engineering
- Biochemistry
- Chemistry
- Electrical Engineering
- Physics
- Mobile App Development
- Medic Textiles and Polymers

But what sorts of jobs do these degrees lead to?

In terms of career paths, some of these subjects offer a quite straightforward progression to particular careers. Aerospace engineering, for example, could lead into a graduate job working for one of the world's major aircraft designers, such as Rolls Royce.

But not every STEM-related graduate job is this obvious. For example, a STEM degree could lead to a career working on special effects in Hollywood, helping to design new sportswear, or revolutionising the farming industry. This is in addition to roles in areas such as finance and accountancy, construction, telecoms, and the energy sector.

Check out these websites for more information:

[STEM Australia careers webpage](#)

[About STEM education in Victoria webpage](#)

[What is STEM? Top Universities webpage](#)

[STEM degree list website](#)

VISUAL STIMULUS FOR LESSON ONE – ACTIVITY 2

Expert Jigsaw

It is suggested that you review these stimuli before commencing Lesson One. This will allow you to choose the most appropriate texts for your class, and to allocate them to students accordingly. There are more stimuli listed below than you will need, so you may wish to allocate two short videos to one group and one longer video to another, or one written article to a group and a longer video to another group etc.

- [Girls in Stem at Girls' Schools: written article](#)
- [Let's banish the myth that there aren't many female role models in STEM: written article](#)
- [Introducing a Girl to Engineering Video](#) (06:22)
- [Black Girl's Code Video](#) (03:09)
- [GoldieBlox & Rube Goldberg "Princess Machine" Video](#) (02:07)
- [Where my Ladies at? Video](#) (06:00)
- [Unconscious STEM bias: video](#) (3:00).
- [Inspire Her Mind – Verizon Video](#) 1:02
- [WISE Women Showcase – demystifying careers in STEM and entrepreneurship.](#) Video 2:51
- [University Students Discuss their journeys in STEM fields – Inclusion WISE program.](#) Video (2:48)
- [STELR WISE Project - From High School to a STEM Career.](#) Video 3:06
- [Gendered toys could deter girls from career in engineering: written article](#)
- [The importance of gender neutrality in STEM toys](#)
- [When women stopped coding: what happened to women in computer science?](#)