Notes for teachers

on module 8:

A scientist's job

What does a scientist do all-day long? Stare at a whiteboard with equations or mix colourful, wild steaming liquids while waiting for an explosion?

School children as well as adults will usually recognize that these are stereotypes. But not many of them can say what a scientist or engineer actually does. The following two lessons are meant to give your class a clearer idea of what a 'normal' working day in these professions looks like. It also gives each student a good opportunity to see if working and living as a scientist or engineer would suit her or him. Last but not least, these lessons let your students find out what it takes to become a scientist or engineer and who is better suited for a career in these fields – men or women?

Summary: The goal of this module is to give your students a chance to picture themselves as researchers. The first lesson is designed to identify and overcome prejudices and stereotypes of scientists, while the second part gives insight into the work of different researchers, and discusses how to become a scientist or engineer.

Designed for: both lower and upper secondary level

Duration: Each chapter is designed for ca. 40 min;
in total 2 lessons or 80 min

What students should already know:

- no previous knowledge required

What students will learn:

Facts

- what a scientist or engineer does on a day-to-day basis
- to identify her or his own preferences for a career
- what qualities are needed to work as a scientist or engineer
- if men or women are better suited for a career in science
- what it means to study at a university

Skills

- the critical interpretation of statistics

This module includes:

- 1 video in two parts
- 1 worksheet
- 3 sets of statistics

Chapter 1: What it takes to be a researcher

Suggested lesson outline

Students will discuss the public image of scientists and engineers. They will then examine their own career aspirations and compare them with what scientists and engineers say about their professions.

Timing in minutes	**Activity**	**Material**
Homework	Students collect jokes and cartoons on scientists.	
0 – 10	Discussion based on the homework: What stereotype of a scientist is generated in by the public? Ask your students if they would like to become scientists. What reasons do they give for their choice?	
10– 25	In-a class poll on students' career expectations: Analyse the results and compare them to the data from other classes (in I8.1). Compare to scientists' responses in I8.2	WS08.1 I08.1 I08.2 *(not yet available)*
25 – 40	Discuss why women are underrepresented in science and engineering	I08.3

Description of suggested lesson

Homework

Please ask students to search for and collect jokes and cartoons on scientists. They should be in a form that can be shared with the class, e.g. by reading them aloud. If you have a projector in your classroom, maybe students can send you their contributions by email beforehand, so that you can project them in class.

Students can find such jokes and cartoons in newspapers and magazines, search for them on the internet or might just ask friends and family.

Discussion on the stereotype of scientists

Please let your students go through the jokes and cartoons they provided as their homework. Then try, together with the students, to find a pattern in the description of a scientist and to define the stereotype. Condense this stereotype into a one sentence description, e.g. by writing "A typical scientist is" on the board and then let students complete the sentence (e.g. "A typical scientist is a escapist eccentric with poor social skills who is only interested in his work...").

Next, ask your students if they could picture themselves as scientists. Would they like to become a researcher? Do they think that they have the abilities needed to become a scientist?

Who is the better scientist?

The worksheet WS8.1 requires students to think about their career preferences and strengths. This, in itself, is a valuable exercise. However, the two main points of the following experiment are: 1) to let your students find out by themselves whether there are gender-related differences in career choices and if one gender is better suited for careers in science than the other; 2) to let students gain a better understanding of what it takes to become a scientist and to make at least some of them reconsider their choice. Besides these two points, they will establish how to critically interpret statistics.

To make the in-class poll, we suggest the followings steps:

1) Please hand out the worksheet WS8.1 and ask your students to fill it in.

2) Then ask the students to cut off the bottom parts of their sheets and to collect them.

3) Shuffle the sheets (to provide a certain degree of anonymity) and then read the numbers on the responses to the class. While you read to your students, count how often each answer was chosen by filling in the tables on the second page of the worksheet – differentiating between women and men.

4) Each student should then have the 'raw data' of the poll on her worksheet. Ask your students if they find any differences between men and women.

Most probably, your class will consist of either more men or women. If so, help your students to see that they need to divide the count in each field by the sum of responses in each column – that is the number of women and men in your class, respectively. Without going into the mathematical details of statistics, ask the students how accurate these statistics are. For instance, how much could the statistics change if one student in the class would have been absent that day?

If time allows, you may also shuffle the sheets again, divide the stack into two equal parts and repeat the counting exercise, this time ignoring the women/men criteria, but differentiating between 'stack 1' and 'stack 2'. A comparison between these two arbitrary groups (stack 1, stack 2) can serve as a reference if the differences previously identified in the statistics of men and women are really significant.

Next, show the students the data collected from several classes across Europe. If possible, please project the document I8.1 in class instead of making photocopies. Can they find any gender-related differences in this data?

Ask your students what qualities they think a good scientist should possess. Are these qualities generally more pronounced in men or in women? Then show them the responses of scientists and engineers (I08.2), stating the strengths and qualities that are important for those keen to work as scientists and explaining what a career in science can offer. Ask your students to compare the responses from scientists with their poll and the data from other classes: 1) What conclusions can they draw, 2) how does the results of the 'experiment' support their conclusion; and 3) what are the limitations of their conclusions?

The last question is especially important and should be considered carefully. Most people tend to over-interpret statistics. What factors have not been taken into account that might influence the results? Even if a certain conclusion seems obvious at first sight, it might be a mere interpretation, which is not based on scientific observations. For instance, the data might suggest that, "Women are more creative, which makes them good scientists." In fact, the results of the poll may merely show that, in a self-evaluation, more young women than men at secondary schools consider 'creativity' to be one of their primary qualities. It does not determine whether women are really more creative, if young women underestimate, e.g. their analytical skills, or if men prefer to think of themselves as 'taking risks' rather than being 'creative'.

Why are women underrepresented in science and engineering?

Use the statistics provided in I08.3 to engage your students in a discussion about why science and engineering seems to still be a 'male domain'. Please give your students time to understand the different graphs and tables. It might be helpful to do this work in groups– in which each group studies a different statistic – and then to compile one picture from all the sources.

The statistics only list numbers, but don't give reasons. Please show your students how to extract relevant information from these statistics and how to build arguments from them as the basis of a constructive discussion. What conclusions can be drawn from these statistics? What needs to be changed in order for everyone to be given the possibility to succeed in a career that corresponds to her or his interests and full potential?

Chapter 2 | “I, scientist”

Suggested lesson outline

A video documentary portrays 3 researchers and their working environments. The class then learns about different career paths in science or engineering.

Timing in minutes	**Activity**	**Material**
homework	none	
0 – 15	Ask students what they believe researchers do during a workday. Video “I, scientist”, part 1, shows scenes from the work of three researchers.	video V08.1
16 – 20	Let your students guess what kind of people these three researchers are (gender, age, etc.), where they work, and what they might be working on.	
20 – 30	Video “I, scientist”, part 2, shows interviews with the three researchers. Discuss how the ‘real’ work life of these researchers differs from the student’s original ideas or the common stereotype.	video V08.2
30 – 40	How to become a researcher Discuss different career paths into science. What does it mean to study at university? Please share your own experience from your time at university.	*Not included in the kit:* your personal experience, material on local education programs

Description of suggested lesson

Introduction

Open the lesson by asking the students what they think a researcher does during a regular working day. It should become clear during the discussion that researchers work in many different jobs and in a variety of environments.

Video “I, scientist”

The video in this module has been specifically designed to involve students instead of their being just passive observers. It is produced in two parts: the first part presents situations in the working day of three different researchers without showing the researchers themselves. The second shows interviews with these researchers. A break between these two parts gives students a chance to reflect on their idea of a ‘typical’ researcher.

Before you show the first part (V08.1), let your students know that they will see scenes from the work life of three different researchers. All of them work in research, yet in different environments and on different topics. The student’s task is to find out:

- what kind of person these researchers are (gender, age, etc.),
- where they work (research is not only done at university), and
- what they might be working on.

After showing the first part, discuss your students’ impressions of the points above.

Then show the second part of the video (V08.2). In this part the researchers give interviews, talk about their work and explain what they are working on:

– Stijn Rolandt is a PhD candidate in the field of photonics and works at a university on video projection systems that allow us to see three dimensional images without special glasses.

– Alisia Peters has a PhD in chemistry and works for a company that develops and produces machines to make computer chips. This technology is based on imaging the chip structure on a very small scale and thus requires absolutely clean optics. Dr. Peters is researching methods of cleaning these optics.

– Birgit Morlion has a master in photonics and is now using her skills to help elderly people stay in contact with their family and friends.

After watching the second part, discuss with the students what they guessed correctly and in what aspects they were wrong. With regard to the latter: What was misleading them?

To summarize the video, ask your students: What makes a researcher (also refer to the background information, point 1) and what does a researcher do? What working environment do they like best? Has the image that they had of a researcher changed?

How to become a scientist and studying at university

Probably more than half of the students in your class will study later at university. However, usually only very few of them have an accurate idea of what studying at university means. Especially if they want to pursue a scientific career, this will be an essential part of their life, and it will be beneficial for them to know what to expect.

Some of the researchers in the video share how they became scientists. However, your students would benefit even more from your personal experience as you probably studied in the country in which you now teach this lesson. Please give students a brief survey of:

- what is needed to study in your country;
- the different degrees, such as bachelors, masters, PhD etc. and what they mean;
- approximately how long it takes to study;
- the good side of student-life and its challenges;
- what you consider important to know before choosing a university course; and

encourage them to ask questions.

Due to the Bologna process, some aspects of studying in your country might have changed and you might have to search for some up-to-date information. However, this lesson does not aim to discuss the higher educational system in detail. Rather, it should help your students to picture themselves in a scientific career.

Background information

1. What is the difference between a scientist, an engineer and a researcher?

In this context we define these as:

A researcher is somebody who performs research, the search for knowledge or, in general, any systematic investigation to establish facts. Researchers can work in academic, industrial, government, or private institutions.

Scientists, in the broadest sense, are people who engage in a systematic activity to acquire knowledge. They usually try to discover something completely new.

Engineers, on the other hand, work to develop economic and safe solutions to practical problems. They try to find and implement the best (and cheapest) answers by applying mathematics, scientific knowledge, creativity and ingenuity.