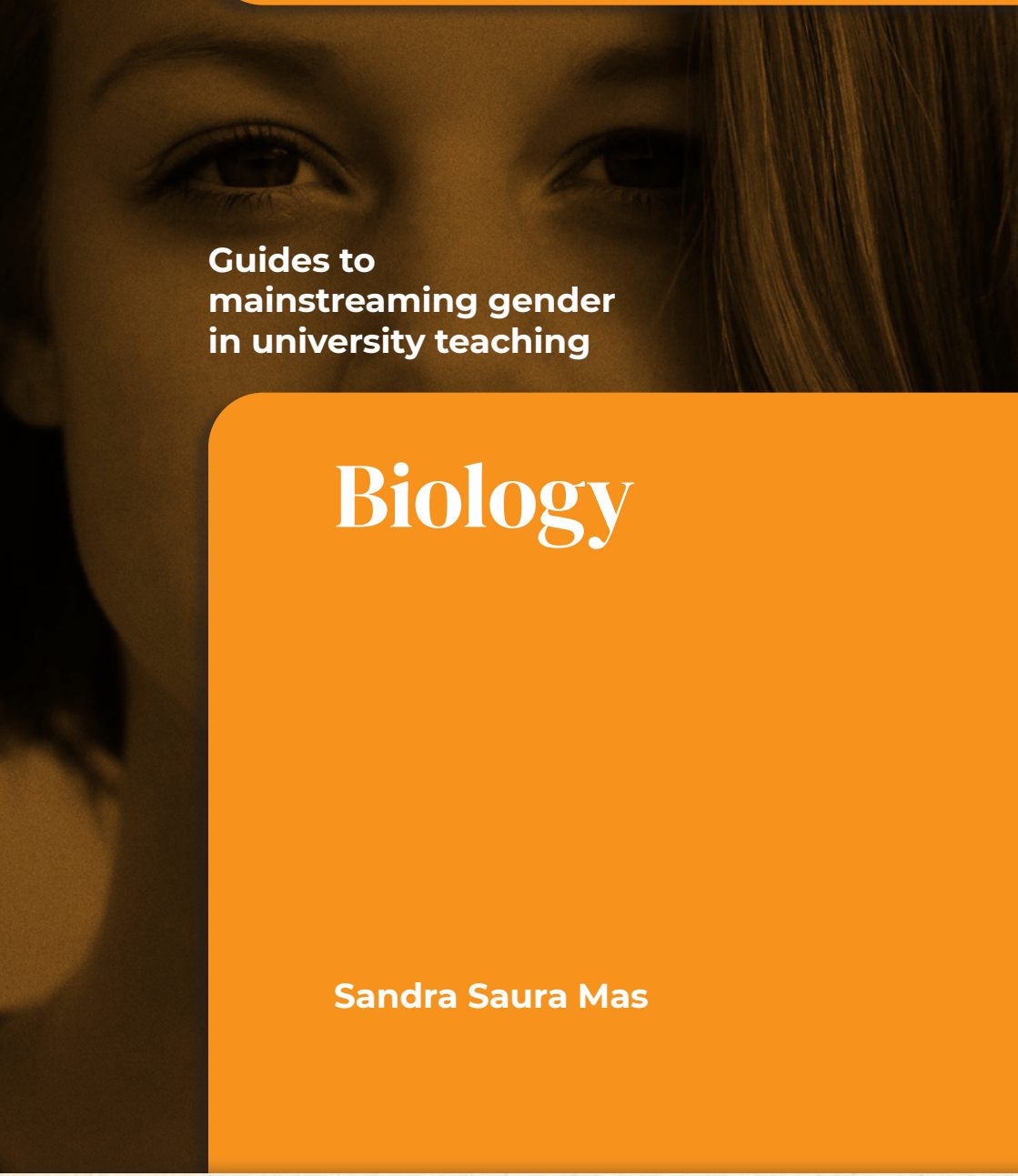
Life sciences



Guides to mainstreaming gender in university teaching

Biology

Sandra Saura Mas

Xarxa Vives d'universitats

BIOLOGY

GUIDES TO MAINSTREAMING GENDER IN UNIVERSITY TEACHING

SANDRA SAURA MAS

Xarxa Vives d'universitats

Published by

Xarxa Vives d'Universitats

Edificio Àgora Universitat Jaume I

12006 Castelló de la Plana · http://www.vives.org

ISBN: 978-84-09-41258-7

Translation from Catalan: María Gonzalo Guzmán

Observatori per a la Igualtat de la UAB

Author: Sandra Saura Mas

Coordinators: José Rodríguez Jaume and Maria Olivella Quintana

Generalitat de Catalunya

This project has been co-financed by the Department of Research and Universities of the Generalitat de Catalunya.

Xarxa Vives d'universitats

This edition has been promoted by Vives Network of Universities with the collaboration of the Universitat Autònoma de Barcelona.

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FOREWORD

What is the gender perspective and what relevance does it have in teaching undergraduate and graduate programmes? When applied to a university setting, the gender perspective or gender mainstreaming is a comprehensive policy to promote gender equality and diversity in research, teaching and university management —all areas affected by different gender biases. As a cross-cutting strategy, it involves all policies taking into account the characteristics, needs and interests of both women and men, and distinguishing biological aspects (sex) from culturally and historically constructed social representations (norms, roles, stereotypes) of femininity and masculinity (gender) based on sexual difference.

The Xarxa Vives d'Universitats (XVU, Vives Network of Universities) encourages a cohesive university community and reinforces the projection and the impact of academe in society by promoting the definition of common strategies, especially in the gender perspective scope of action. It should be highlighted that policies that do not take into account these different roles and diverse needs and are, therefore, gender-blind do not help to transform the unequal structure of gender relations. This also applies to university teaching, where we offer students a compendium of knowledge to understand the world and intervene in their future professional practice, providing sources of reference and academic authority and seeking to promote critical thinking.

Knowledge transfer in the classroom that is sensitive to sex and gender offers different benefits, both for teachers and for students. On the one hand, deepening the understanding of the needs and behaviours of the population as a whole avoids partial or biased interpretations —both theoretically and empirically— that occur when using man as a universal reference or when not taking into account the diversity of the female or male subject. In this way, incorporating gender perspective improves teaching quality and the social relevance of (re) produced knowledge, technologies and innovations.

On the other, providing students with new tools to identify stereotypes, social norms and gender roles helps to develop their critical thinking and skill acquisition that will enable them to avoid gender blindness in their future professional practice. Furthermore, the gender perspective allows teachers to pay attention to gender dynamics that occur in the learning environment and to adopt measures that ensure that the diversity of their students is addressed.

The document you are holding is the result of the biannual 2016-2017 work plan of the XVU Gender Equality Working Group, focused on gender perspective in university teaching and research. At an initial stage, the report entitled La perspectiva de gènere en docència i recerca a les universitats de la Xarxa Vives: Situació actual i reptes de futur (2017) [Gender Perspective in Teaching and Research at Universities in the Vives Network: Current Status and Future Challenges], coordinated by Tània Verge Mestre (Pompeu Fabra University) and Teresa Cabruja Ubach (University of Girona), found that the effective incorporation of gender perspective in university teaching remained a pending challenge, despite the regulatory framework in force at European, national and regional levels of the XVU.

One of the main challenges identified in this report in order to overcome the lack of gender sensitivity in curricula on undergraduate and postgraduate programmes was the need to train teachers in this skill. In this vein, it pointed out the need for educational resources that help teachers provide gender-sensitive learning.

For this reason, the XVU Gender Equality Working Group decided to produce the collection *Guides for University teaching with a gender perspective*. This was coordinated in the first phase by Teresa Cabruja Ubach (University of Girona), M. José Rodríguez Jaume (University of Alacant) and Tània Verge Mestre (Pompeu Fabra University), and in the second and third phase by M. José Rodríguez Jaume (University of Alacant) and Maria Olivella Quintana (Universitat Oberta de Catalunya).

A total of 22 guides have been produced to date. Eleven were produced in the first phase, six in the second and five in the third, and were written by teachers who are experts in applying the gender perspective in their discipline at various universities:

ARTS AND HUMANITIES:

Anthropology: Jordi Roca Girona (Universitat Rovira i Virgili)

Philology and Linguistics: Montserrat Ribas Bisbal (Universitat Pompeu Fabra)

Philosophy: Sonia Reverter-Bañón (Universitat Jaume I)

History: Mónica Moreno Seco (Universitat d'Alacant)

Art history: M. Lluïsa Faxedas Brujats (Universitat de Girona)

SOCIAL AND LEGAL SCIENCES:

Communication: Maria Forga Martel (Universitat de Vic - Universitat Central de Catalunya)

Law and Criminology: M. Concepción Torres Díaz (Universitat d'Alacant)

Sociology, Economics and Political Science: Rosa M. Ortiz Monera and Anna M. Morero Beltrán (Universitat de Barcelona)

Education and Pedagogy: Montserrat Rifà Valls (Universitat Autònoma de Barcelona)

SCIENCES:

Physics: Encina Calvo Iglesias (Universidade de Santiago de Compostela)

Mathematics: Irene Epifanio López (Universitat Jaume I)

LIFE SCIENCES:

Biology: Sandra Saura Mas (Universitat Autònoma de Barcelona)

Nursing: M. Assumpta Rigol Cuadra and Dolors Rodríguez Martín (Universitat de Barcelona)

Medicine: M. Teresa Ruiz Cantero (Universitat d'Alacant)

Dietetics and Nutrition: Purificación García Segovia (Universitat Politècnica de València)

Psychology: Esperanza Bosch Fiol and Salud Mantero Heredia (Universitat de les Illes Balears)

ENGINEERING AND ARCHITECTURE:

Architecture: María-Elia Gutiérrez-Mozo, Ana Gilsanz-Díaz, Carlos Barberá-Pastor and José Parra-Martínez (Universitat d'Alacant)

Computer sciences: Paloma Moreda Pozo (Universitat d'Alacant)

Industrial Engineering: Elisabet Mas de les Valls Ortiz and Marta Peña Carrera (Universitat Politècnica de Catalunya)

Multimedia Engineering: Susanna Tesconi (Universitat Oberta de Catalunya)

Electronic Telecommunications Engineering: Sònia Estradé Albiol (Universitat de Barcelona)

In addition, a methodological guide on online teaching with a gender perspective has also been added to the collection, in response to the changes in teaching that universities had to adopt as a result of the COVID-19 pandemic during the 2019/2020 academic year.

METHODOLOGY:

Online teaching with a gender perspective: Míriam Arenas Conejo and Iolanda Garcia Gonzalez (Universitat Oberta de Catalunya).

Learning to incorporate the gender perspective in subjects merely implies a reflection on the different elements that constitute the teaching-learning process based on sex and gender as key analytical variables. In order to review your subjects from this perspective, the guides to mainstreaming gender in university teaching provide recommendations and instructions that cover all the following elements: objectives, learning outcomes, content, examples and language used, selected sources, teaching methods and assessment, and management of the learning environment. After all, incorporating the principle of gender equality is not just a matter of social justice but also teaching quality.

M. José Rodríguez Jaume and Maria Olivella Quintana, coordinators

01. INTRODUCTION

Biological sciences, understood as the set of disciplines that study life (genetics, microbiology, biology, ecology, biological anthropology, botany, physiology, zoology, biotechnology, cell biology, etc.), are part of an androcentric scientific culture where gender biases are found in both the production and the transfer of knowledge. Sandra Saura Mas, professor of the Ecology Unit of the Universitat Autònoma de Barcelona, presents a guide for overcoming androcentrism while transferring knowledge to universities classrooms from degrees related to biological sciences. In comparison to other university studies, this discipline has a high female enrolment rate, probably —the author argues— because life and its associated caring play a central role in both the discipline and the female gender role.

This guide adds additional university teaching innovation elements to the already innovative practice of gender mainstreaming. We propose a transversal course, Current Science, so bio-scientific degrees include gender perspective, following the example of the biology degree course Forest Ecology or the MOOC Women in Environmental Biology. Gender perspective and its interdisciplinarity nature are the two axes around which this course develops, and its implementation would allow students to: 1) gain an interdisciplinary vision of science; 2) analyse and ponder on the relationships between science and gender; 3) ponder on the transdisciplinarity between science, culture and society; 4) provide keys to knowledge and basic understanding of current science topics; and 5) gain cross-cutting skills related to sustainability and ethics.

Given the teaching methods that have been applied traditionally in biology teaching, the author articulates a proposal that, with gender mainstreaming, revolves around teaching methods that incorporate cares, project-based learning and co-teaching. Lastly, the author offers techniques and strategies for an evaluation and the beginning of researching with a gender perspective, which can be applied in the discipline of biology. The guide gathers many references and teaching resources with which to broaden the outlook, and the experience itself, on what it is and how to include gender perspective in communication (oral, written and visual), the visibility of women in (bio)sciences and the design of the contents of courses and learning environments.

02. GENDER BLINDNESS AND ITS IMPLICATIONS

For a long time, biological sciences have suffered from gender blindness. This fact, that it is not only seen in the biology field, but also in a lot of STEM disciplines where the general pattern shows that women are a minority; whereas in Spain, women make up most of the university students. The specific case of biology, however, departs significantly from this pattern, with women being more than half of the students in biology studies, like at the Universitat Autònoma de Barcelona (UAB, 2019). Specifically, in the Faculty of Biosciences, women represent the 50.4% of the teaching staff, as opposed to the Faculty of Science, where women represent the 27.3%. In comparison with the Faculty of Science, where 38.3% of the students are women, in the Faculty of Biosciences women account for the 66.5% of the students (UAB, 2019). This could also be related with the fact that biology is a degree where life is the core of the discipline and also to a certain extent, caregiving, if the focus is on medical research of diseases, for example. The female gender role is linked to caregiving and putting life at the heart (Herrero *et al.*, 2019), a fundamental idea on which ecofeminism is based, which could explain this different pattern compared to other scientific careers.

So, how is it possible that gender blindness still exists even though there are a set of disciplines with a substantial presence of women? And what happens when this blindness appears?

One of the reasons could be that university is still an institution that guarantees formal gender equality, but it doesn't guarantee a real equality of opportunities (Vives Network, 2019). The data on academic and research staff shows the persistence of gender inequalities in higher education (Equality challenge unit 2013, LERU 2018) and the occupational segregations inside university. To begin with, the continuity of the scissors effect —vertical segregation— can be observed in academic careers according to gender: as the academic category rises, the relative weight of women holding different positions is inverted to the weight corresponding to their peers (UAB, 2019).

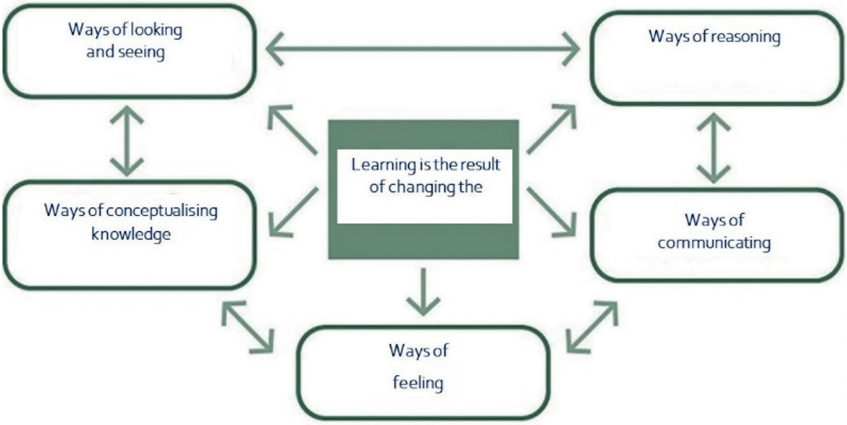
Another reason for the existence of this blindness could be the androcentric view of science, a transversal and intrinsic perspective in the organization and structure of scientific research and teaching. As it is a way of doing and thinking deeply rooted in academia, it is difficult to change; and for there to be a change towards a kind of science where the focus is defined from both female and male

points of view, it is first essential to increase the presence of women in positions of power and decision-making within scientific structures. Until this is achieved, there cannot be any notable and transformative change.

Science should be characterized, by definition, as a story told from one change to another, with the approach that today's theories are probably the outdated ideas of the future, and that mistakes and errors are the basis for learning and progress. As Karl Popper said: "(…) in science, we often learn from our mistakes, and why we can speak clearly and sensibly about making progress there", or as Albert Einstein said about himself: "every year retracts what he wrote the year before". But the history of science frequently becomes a history of resistance to change. Some examples are the theories of internationally acclaimed researchers in the history of biological sciences like Lynn Margulis, Jane Goodall, Vandana Shiva or Ellen Swallow Richards (explained in detail in the second part of this guide), as well as many other female scientists' theories. Female scientists who stand out for proposing transformative theories and discoveries with implications for changing the perspective on how we understand life, theories that have often been made invisible or that have always been left in the background. Therefore, unfortunately, in addition to possible gender discrimination, we must add the fear and resistance to change of scientific theories that the world of biological disciplines has experienced throughout most of its history. A clear example is the theories of Lynn Margulis or Frans de Waal who choose to include cooperation as an important phenomenon to explain evolution and life on Earth and thus break with the more typically androcentric view of biology and the theories based on competition by natural selection described by Charles Darwin.

Science, by definition, should also be characterised by being open and democratic and to be learning on an on-going basis. According to the pedagogical orientations of Neus Sanmartí and Rosa M. Tarín (1998), learning is, above all, changing the previous points of view, in other words, the ways of looking at phenomena, of explaining them, of reasoning, of evaluating, of talking (Figure 1). Thus, in order to put an end to gender blindness, it is important for the field to be ready to change the previous androcentric viewpoint.

Figure 1. Learning means changing prior points of view



Adapted from: Sanmartí & Tarín (1998).

And how to achieve this change? How to remove this blindfold, a consequence of the androcentric view of science throughout history, in biological sciences?

A task that can be carried out through the adoption of strategies by future professionals is learning to reflect on and critically intervene in their own practice, reviewing self-representations and incorporating pedagogical methodologies with a gender perspective. In this sense, initiatives such as teaching guides like this one aim to provide tools to equip the discipline with methodologies with a gender perspective in order to highlight inequalities, be able to change the previous point of view, and to begin acting for change and the achievement of equal opportunities based on respecting diversity.

Additionally, research with a gender perspective to provide data and evidence-based studies is also important to provide a solid basis for a shift in perspective. Therefore, for example, a study on gender blindness in biology, understood as the difficulty of teachers in recognising indicators of inequality, is necessary to obtain data on teachers' difficulties according to gender, as well as on the use of non-sexist language and teaching resources from a gender perspective.

The great advances in science's history are not due only to the work of one person but to the efforts of a team, before and during the discovery. We need to move

on from rewarding only individualistic science to rewarding the cooperative one. The fact that research is usually carried out in teams is not something new, nor is it current; in most cases it has been done this way throughout history. But, due to social and cultural reasons, like scientific androcentrism, there has been a tendency to award prizes and highlight specific individuals, promoting competition rather than cooperation between people and teams. This change of approach, from a science based on individual awards and recognition to a one based on collective awards and recognition, would be a major step towards an egalitarian and cooperative science.

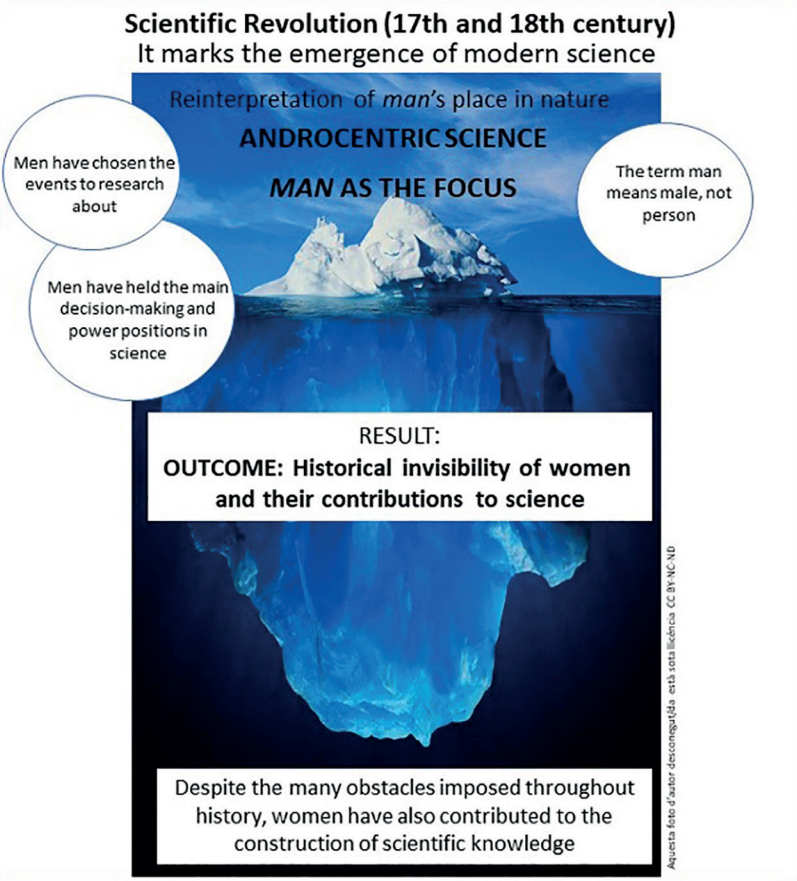
03. GENERAL PROPOSALS TO INCORPORATE A GENDER PERSPECTIVE IN TEACHING

There is an increasing talk about incorporating gender perspective in teaching, but what does this mean? How can we do it? This guide aims to shed light on questions such as these, specifically focused on teaching in the field of biology —understanding biology as a broad discipline that includes everything from genetics, biological anthropology and cellular biology to environmental biology.

Introducing gender perspective in teaching is a wide-ranging objective proposed by a broad movement of university professors and research staff, activists and scientific associations working to reduce and eliminate gender bias in knowledge and training processes, sexual discrimination and gender inequality in the university environment. When we talk about incorporating a gender perspective in teaching biological sciences, we are talking about making changes for improving teaching and innovating courses and syllabuses that have an impact on the different dimensions of the teaching-learning process: skills, learning environments, communication and contents.

The prestigious biologist Ruth Hubbard already warned in 1988 that science, the knowledge about the natural world, is created by an interaction between objectivity and subjectivity and that, therefore, science is often not as sceptical and neutral as it may sometimes seem. In fact, historically, science, and in particular biology, has been under the influence of a dominant androcentric ideology in the occidental culture that has provoked pronounced gender bias in the production of knowledge (Keller, 1985; Pérez & Alcalá, 2001; Martínez, 2006). This fact is one of the biggest determinants of the dominance of male authors in the references used in biology university teaching. Throughout the history of science, men have been the ones who have mainly decided which elements need to be further researched, while women have been relegated to a very secondary role due to their minor participation in tasks and the focus of scientific activities. It should be pointed out, however, that women, despite these barriers, have also contributed significantly and actively to the production of scientific knowledge, even if the androcentric scientific system has, throughout history, made them invisible (Figure 2).

Figure 2. Androcentric science has fostered female scientists' invisibility throughout history.



Nevertheless, several books and resources cite the names of female scientists who have been made invisible throughout history due to this scientific androcentrism (Martínez, 2006; Izquierdo *et al.*, 2009; Cátedra de cultura científica, 2020). This guide aims to collect many of these pedagogical and didactic resources to promote and facilitate these women's visibility and contribute to changing from an androcentric science to a science for gender

equality. To give a specific numerical example, Puig (2020) showed that in the UAB's Biology degree, only the 18.8% of the teaching guides for the degree courses contain bibliographical references where the authors are women. This can probably be explained by science's androcentric history since, despite the increasing presence of women in this discipline, when it comes to designing the teaching programs there is still a lack of work to be done to make women's scientific work more visible throughout history. This shows that it is not enough to achieve equality in the percentage of men and women's presence, but a systemic, structural and deep change in science is also necessary; and when it comes to biology, a change from androcentrism to a science with a gender perspective, where the weight of the male gaze (androcentric) is as important as the female's (gynocentric).

To achieve this objective, science with a gender perspective, it is necessary to make changes in the teaching and transfer practices of scientific knowledge. Changes such as introducing female scientists and their biology theories in the courses' design. It is necessary to make an effort and change the syllabus to be able to explain the theories of many women, which have often been invisible and ignored by most of the scientific community. Although this is a first step, it is not enough to just put the names of female scientists on the list of reference bibliography, it is also necessary to understand and explain their contributions to the science world, and if this means making changes to the historically established syllabus, it should be done without fear. Without chances and transformation, it will be impossible to teach from a gender perspective, or for science to stop being androcentric.

If androcentrism is understood as the fact that man is the point around which everything else revolves, it can be proved that, in the study of biology, this way of thinking has been and still is very present. Androcentrism, by focusing on the male gender, tends to put a lot of the qualities socially attributed to men at the heart of the western world, for example. One of the roles traditionally assigned to men is that of being responsible for the productive activities and political representation, while one of the roles traditionally assigned to women is that of being responsible for affective relationships and providing care for the home and the dependent. This phenomenon is clearly related to Charles Darwin's theory of human evolution and sexual selection (1871), which in fact is well reflected in the title of his book *The Descent of Man and Selection in Relation to Sex* (1871). Martínez (2006) shows, based on an analysis of the texts of Charles Darwin's evolutionary theory, the sexist facet of Darwinian reasoning, which held that

men were superior to women. Charles Darwin's theory of evolution focuses on man, competition and sexual selection, and is mostly explained with examples of species in which the male displays himself and the female chooses, and then takes care of the offspring. But in the biological world there are also species in which the male takes care of the offspring, and the female is larger (Forsyth, 1995), and there are authors like Frans de Waal (2015) or Lynn Margulis (Martínez, 2014b) who choose to include cooperation as an important phenomenon to explain evolution and life on Earth, thus breaking with the more typically androcentric view of biology.

The prestigious biologist Lynn Margulis, an American scientist known above all for having defined the endosymbiotic theory —the theory that the eukaryotic cell is a symbiotic union of primitive prokaryotic cells (Margulis, 1970; Sagan, 2012)—, is introduced in many biosciences' faculties. But this theory goes beyond a discovery in the field of cell biology, as it proposes symbiosis as an evolutionary force. Lynn Margulis' theory revolutionised the way we understand the evolution and functioning of planet Earth, based on the symbiotic relationships between microorganisms (Margulis, 2003; Feldman, 2019). However, Lynn Margulis's theory is rarely explained in evolutionary lectures, perhaps because her theories come into conflict with some of the most established evolutionary theories throughout the history of science. But how does science advance, if not through inquiries and discussions?

Androcentrism has also been very present in primatology (Haraway, 1989) and biological anthropology (Martínez, 2006, 2020b). Throughout the history of science, palaeoanthropology has tended to interpret findings of ancient human remains by associating hunting with men and women with caves, for example, but to what extent is there evidence that this was the case? Caroline VanSickle (2015) shows, from the point of view of feminist biology, that it is difficult to interpret the sex of skeletons found in excavations (VanSickle, 2015), and that many do not have a defined sex; but even so, there are interpretations, for example, of the division of work by sex of our ancestors (Pulido, 2020). Several studies have been done revealing this androcentric view of human evolution (Macintosh *et al.*, 2017) as well as looking for solutions and alternatives to break down this bias, using new methodologies that consider the gender perspective in the experimental design and the rest of the research phases, as some more recent works that show that many prehistoric women are buried next to a full hunting equipment (Haas *et al.*, 2020). This is an example of the implicit gender bias that research in palaeoanthropology can have, and therefore, it is necessary

to mention this problem during the teaching of biology degrees, as well as to show studies with and without bias.

One of the problems of the scientific disciplines is that, historically, there has been a tendency to avoid interdisciplinarity, as if that would downplay the discipline, and there has been a tendency towards specialisation. But the fact is that biology, like so many other scientific disciplines, is immersed in an interdisciplinary social and cultural context. Moreover, the cross-cutting skills present in the teaching objectives of most universities include topics related to ethics, sustainability and, also, gender perspective. Therefore, it is also necessary to incorporate the concept of gender in biology, approaching it broadly, for example, based on the four dimensions proposed by Coll-Planas *et al.* (2018): gender expression, gender identity, affective-sexual orientation and sex. It is important to tackle this concept, even if it has more social or cultural content, as it is key to understanding what gender perspective really means and how to include it in the private and professional spheres within the field of biology. Thus, to achieve a gender perspective in bioscience degrees, it is essential that, during the degree, there are teaching hours given over to explain the meaning of the concepts of sex and gender, as well as other aspects such as those mentioned by Judith Butler in several of her works (Butler, 2000), in which she highlights the difficulties linked to understanding gender perspective in the dichotomy of gender and sexuality and how it is often difficult to differentiate between culture, society, and science when talking about these terms.

More specifically, in compulsory courses of first and second year, like basic biology, human biology or animal physiology, the difference between sex and gender could be explained, as well as a brief history of science concerning androcentrism. Another option would be doing it through a transdisciplinary course, Current Science (see “Proposals to introduce the gender perspective in biology teaching”).

Regarding how to explain the **sex-gender system** as teachers, it is also interesting to take into account the definitions and research done from feminist biology. For many years, sex has been presented as a male-female binary set (Laqueur, 1994), but there are several authors like the prestigious biologist Anne Fausto-Sterling who has shown in many books and essays that scientific texts are, often, cultural metaphors and political representations through which the ideas of femineity and masculinity, heterosexuality and homosexuality have been built on during the last century. After years of reflecting on her speciality, reproductive biology,

this scientist concluded that the binary sex does not exist; there are not only men and women, but also a series of intermediate forms that science has not wanted or dared to confront with clarity (Fausto-Sterling, 1985). In another, later book, the author makes her opinion about the construction of sex very clear: sex, which has been regarded as biological, is, in fact, a cultural instance, as manufactured as gender (Mujeres con ciencia, 2020), and this makes that in most cases science ignores information that would fit in scientific systems capable of accepting the existence of intermediate sex stages (Fausto-Sterling, 2000). Thus, feminist biology proposes that the sex of a body is an extremely complex matter and that there is no black or white, but rather degrees of difference, since it is a continuum, like the spectrum of colours, and that, therefore, only our conception of gender, and not science, can define our sex (Fausto-Sterling, 2000). In fact, sex types can be determined according to different conditions: genetic sex, chromosomal sex, gonadal sex, hormonal sex, genital sex, phenotypic sex, cerebral sex and psychosocial sex (Blanch, 2019) (Figure 3).

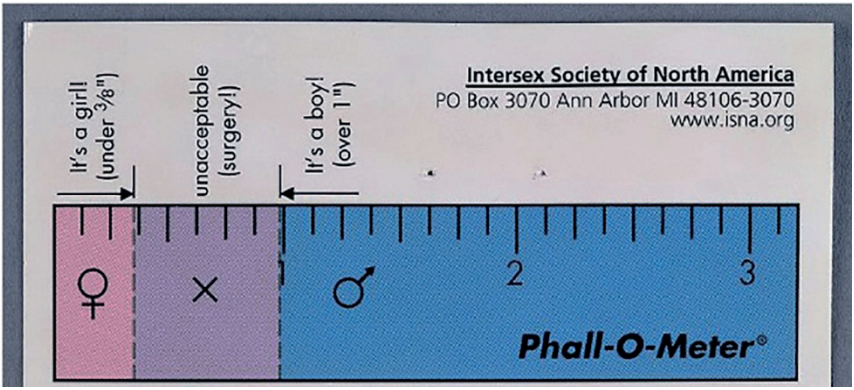
Figure 3. Source: Aura Blanch Torras' Adaptation and Translation (2019).

Genetic sex	Genes (for example, SRY or DAX1) that may or may not be located in a sexual chromosome and which, depending on the dosage with which they are expressed, lead to the development of one and other gonads.
Chromosomal sex	The sexual chromosomes (X and Y in humans) determine one sex or the other depending on the chromosome. This sex determination, however, is not imperative since some chromosomal alterations result from the genes they carry, and there are organisms in which environmental factors are more important.
Gonadal sex	Types of gonads (also called internal genitalia or reproductive organs) formed during embryonic development (ovaries or testicles). In the sixth week, the gene expression defines the differentiation.

Hormonal sex	Hormones (oestrogens or androgens) produced by the gonads and the suprarenal glands which determine part of the physical, functional and behavioural characteristics of the individual.
Genital sex	Types of external genitalia developed from the sixth week of embryonic development thanks to hormonal secretion.
Phenotypic sex	Physical and functional characteristics of the individual (secondary sexual characteristics).
Cerebral sex	Sexual differences in the structure of the cerebral hemispheres and in the degree of hemispheric specialisation in verbal and spatial cognitive skills. Furthermore, the hypothalamus is able to develop, or not, the specialised receptor cells that are highly sensitive to bloodstream oestrogens depending on the presence/absence of testosterone. "Brain sexualisation" only affects a person's reproductive functioning.
Psychosocial sex	Behavioural characteristics of the individual due to the interaction of genetic, hormonal, environmental and sociocultural factors.

In this sense, instead of generating new categories for people with no normative genitalia, the psychologist Suzanne Kessler (1998) advocates looking away from genitalia and admitting that there are men and women (non-binary genders could also be added) with great anatomical diversity. Suzanne Kessler states that normative charts for clitoral length appeared in the late 1980s, while normative charts for penis length appeared more than forty years before. She combined those standard charts to prove the existence of an "intermediate area of phallic length that neither females nor males are permitted to have", in other words, a clitoris longer than 9 mm or a penis shorter than 25 mm. Part of her findings were presented visually and sarcastically by the advocacy organisation Intersex Society of Nort America at the Phall-O-Meter (Figure 4).

Figure 4. Phall-o-meter, showing in actual scale current medical standards employed to determine nature of genital plastic surgery for children born with mixed sex anatomy.



Created by Intersex Society of North America and inspired in Suzanne Kessler (1998). www.isna.org. Wellcome images. Wikimedia commons.

In Catalan-speaking universities, and others in Spain, diversity in **affective-sexual orientation** is also an aspect that is not very visible in science, especially in biology. Following in the footsteps of some associations such as Ciencia LGTBIQ (2020) and PRISMA (2020), it is important to also promote the LGBTQIA role models that exist in the world of science, technology and innovation, to make them visible, to normalise them, and to promote them from a gender equality perspective.

Furthermore, historically, as they have been influenced by a largely androcentric view, there has also been little ethnic diversity in the academic, scientific and teaching spheres of our universities, so most academic role models in the different branches of biology are male, westerner and white. Hence, we must broaden our view of how other cultures approach the key aspects of biology and include them in this discipline's teaching. One example of this is the MOOC "Women in environmental biology", in which female scientific role models from all over the world (South America, India, Africa, etc.) can be found to avoid the bias of Western culture. It is also important to work for equality within diversity, that is, for integration and respect for human diversity in all aspects and for all types of diversity to be treated equally in terms of rights and duties. Lastly, we must also educate ourselves and work to dispel prejudices and stereotypes, which

are often the basis of discrimination and make human diversity, in all aspects, an opportunity for improvement and innovation in scientific thinking.

Another issue addressed by feminist biology is intersectionality. The theory states that people who suffer from intersecting inequalities such as gender/sex inequality with the inequality axis of racism (Williams Crenshaw, 1989; Davis, 1981; Haraway 1984, 1991), suffer greater discrimination. Some of the contributions that can be made from the teaching-learning of biological sciences to work against discrimination of people based on skin colour are related to the idea that skin colour is a gradient. That it is a continuum, and that, therefore, only our cultural conception, and not science, can define human groups according to skin colour. Delving into and discussing studies on human migration and evolution, as well as the genetic and environmental patterns that explain the reason for different skin pigmentation and other biological characteristics, can be a key lesson to teach with a gender and intersectional perspective. For instance, from studies such as Jablonsky & Chaplin (2016), it is possible to deal with this topic when teaching biological sciences, where it is explained that the skin, hair, or eye colouration are variables in humans and that they have been influenced by different combinations of evolutionary forces and that, consequently, human diversity is key to the evolution of the *Homo sapiens*. Also, classroom activities can be carried out to address this perspective with articles such as the one in the journal *Mètode* (Comas, 2014), on genetics and human migration.

If we delve deeper in the design and development of the courses' objectives, it is precise to pay attention to the hidden curriculum, to "prejudices, understood as preconceived opinions and stereotypes, that is, those simplified mental images that distort the perception of reality" (Roset *et al.*, 2008). Analysing the hidden curriculum from a gender perspective means taking into account how the presence of women is hidden, what model of femineity and masculinity is reproduced and, in short, how sexism is perpetuated.

Teacher-student relationship is key for achieving a gender perspective in biology teaching. In a way, this is where we move from theory to practice; if teachers explain the importance of the gender perspective but do not apply it in their day-to-day work, during their classes and through their daily actions, then it can lose all meaning and credibility in the eyes of others. Therefore, it is necessary, for example, to use non-sexist language [see: UAB (200): *Guia per a l'ús no sexista del llenguatge a la UAB* (Guide for the use of non-sexist language at the UAB)], to avoid prejudices and judging people based on their appearance when interacting with

students, and also to avoid falling in gender stereotypes based in, for example, the way they dress.

In this sense, it is also very important to use non-violent communication as a tool to connect teachers and students. This can be achieved through this tool when there is any kind of conflict between these two parties or between students if the teacher is able to listen and explain themselves without aggravating the conflict, but rather promoting the creation of solutions and alternatives that satisfy the parties involved and let the situation of conflicting interests and opinions be solved (Rosenberg & Riane, 2003; Barbeito & Caireta, 2018).

Storytelling, or explaining scientific research experiences where the main characters are women in androcentric scientific contexts in story format, can be used to raise students' awareness about gender stereotypes and gender mandates and about unequal and patriarchal power relations connected to biology. An example would be the case of primatology, a science in which the names of women like Jane Goodall, Biruté Galdikas or Dyan Fossey have stood out since the 60s. The first observations of primates made previously by men, specifically of baboons, described the relationships as highly militarised, in other words, based on descriptions of their fights and power relationships, and they interpreted this as fighting was the key to survival and preservation of the social status within the groups. In contrast, when women began studying primatology (by the way, one of the disciplines of biology where women's names are the ones that stand out the most, although there are also many men), patterns that had not been described until then began to be described.

As Marta González (2014) explains, with women entering primatology, methodologies based on the observation of all individuals and not just the most conspicuous or aggressive ones were established, and this was one of the keys to discover new patterns of primate behaviour. Jane Goodall, for instance, establishes the idea that each individual is interesting in their own right, and that females were not just another resource in male-driven societies. Females fought to preserve their hierarchies within the group, hunted, actively sought their sexual partners, and could even commit infanticide on the offspring of other females. Thus, primatology is an example of how an androcentric science can turn towards a more gynocentric science or, at least, more egalitarian, which can also have direct impacts on human culture and behaviour, since the study of primates has always been used to try understanding the human species. In the "Women in environmental biology" (Saura-Mas, 2018) MOOC, there is material to complement this example or to create new stories of women who have

broken away from patriarchal science and what it has implied in terms of gender stereotypes and gender mandates. Other inspiring resources in *storytelling* about female scientists can be audio-visuals projections like *Nomorematildas* (2021) or biographical films like *Jane* (Jane Goodall's biography, directed by: Brett Morgen, 2017), *Symbiotic Earth* (Lynn Margulis' biography, directed by: Dorion Sagan & John Feldman, 2017) or *Radioactive* (Marie Curie's biography, directed by: Marjane Satrapi, 2021).

04. PROPOSALS TO INTRODUCE THE GENDER PERSPECTIVE IN BIOLOGY TEACHING

The incorporation of gender perspective affects the study plan of the degrees. It can be integrated in a specific way through specialised courses, identifying those where sex and gender are relevant (Alonso & Lombardo, 2016); through specialised courses with no apparent relation to sex or gender but where there is gender perspective; or through transdisciplinary courses with a transversal outlook. In this section, specific examples of **teaching objectives and contents** in bio-scientific degrees, and specifically in biology and environmental biology (Faculty of Biosciences-UAB) are given, and they are also seen through experiences in the Forest Ecology course and the MOOC-Coursera UAB Women in environmental biology. Additionally, different elements to be considered related to **assessment, organisation modalities and teaching method** in these degrees are also mentioned. A transdisciplinary course is also proposed.

In the **skills** section, a proposal is made for a cross-cutting skill for bio-scientific degrees, to promote the gender perspective in teaching.

4.1 Cross-cutting skills and learning results

Catalan-speaking universities are integrated in the European Higher Education Area (EHEA), a model based on cross-cutting skills and specific studies. The Agència per a la Qualitat del Sistema Universitari de Catalunya (AQU) [Catalan University Quality Assurance Agency] proposes a cross-cutting competence to be worked on in multiple courses based on the different learning results: *develop the ability to assess inequality on the grounds of sex and gender, to design solutions* (AQU, 2018). In fact, this document does mention the relevance of gender dimension in the area of knowledge of sciences and health sciences, as exemplified in the following cases:

- When the subject matter or its applications affect men and women differently. This is especially relevant when the scientific and mathematical principles are applied to areas such as medicine, engineering or the environment, in both the biological and social senses.
- When gender perspective involves correcting and raising awareness of the scientifically identified gender bias regarding the different response in women and men to exposure to the risk factors underlying the onset, manifestation and patient's experience of an illness.

We can find at the UAB an specific example on how to apply proposals like the one from AQU (2018) at universities, which since from 2018 has had as a general competence: *take inequality on the grounds of sex or gender into consideration when operating within one's own area of knowledge* (UAB, 2018). At the same time, the following elements are proposed as learning outcomes: identify the principal forms of sex- or gender-based inequality and discrimination present in society, analyse the sex- or gender-based inequalities and the gender biases present in one's own area of knowledge, consider how gender stereotypes and roles impinge on the exercise of the profession, propose projects and actions that incorporate the gender perspective and communicate using language that is not sexist or discriminatory. At the UAB, the Observatory for Equality is the body that has designed a set of specific skills as a proposal to incorporate in education. The proposal, in short, aims to prepare students in: a) acquiring critical awareness to tackle gender inequality and gender biases; b) analysing sexism, LGBTIphobia and any other form of discrimination, harassment and gender violence; c) rethinking childhood, adolescence and women's roles in education from a gender perspective; d) incorporating co-education to all levels of the education system; e) transforming knowledge from a non-androcentric and non-phallogocentric perspective; and f) building identities and gender cultures in the professional area (Observatory for Equality, 2017).

Therefore, considering this series of examples and experiences, it would be necessary for bioscience degrees to also include a cross-cutting competence in order to incorporate the gender perspective in future generations of graduates. Following the general competence of the UAB, take inequality on the grounds of sex or gender into consideration when operating within one's own area of knowledge, the following cross-cutting competence is proposed for bioscience's degrees: *have the ability to analyse and incorporate the gender perspective in a professional and private environment*.

When the learning process is based on the achievement of skills, it is very important to define what learning outcomes are expected for each competence. In this regard, the AQU (2018) makes a proposal of learning outcomes linked to gender competence that it proposes for university teaching. In this table, the common learning outcomes for university teaching and the specific ones for biological sciences degrees can be seen (Table 1).

Table 1. Proposal of general learning outcomes for the gender dimension competency in Biological and Earth Sciences (according to AQU, 2018)

Gender dimension competency: ***develop the ability to assess inequality on the grounds of sex and gender, to design solutions***
Learning outcomes for the gender dimension competency
• Students can distinguish, in both theoretical and empirical analyses, the effects of sex and gender variables. • They identify the contributions of gender studies to the subject researched. • They produce, collect and interpret empirical data in a gender-sensitive way. • They can use and create qualitative and quantitative indicators, including statistical ones, to better understand gender inequality and the different needs, circumstances, values and aspirations of women and men. • They can identify the intersection of gender inequality with other dimensions of inequality (age, class, race, sexuality and gender identity/expression, ableness, etc.). • They identify in which way attention to violence against women and other gender-based violence can be incorporated into projects and studies in their discipline. • They know and use women and gender studies' contributions in their profession. • They identify and problematize the biases, stereotypes and gender roles in their discipline or in the exercise of their profession. • They can employ non-sexist and inclusive language.
Learning outcomes of Biological and Earth Sciences (Biology; Biochemistry; Biotechnology; Microbiology; Environmental Sciences; Geology)

- Students recognise the implication of gender for those areas of the discipline that affect men and women differently, in biological, social and cultural aspects.
- They recognise and assess the profession on how gender roles and stereotypes impact on scientific products, processes and policies.
- They can use empirical data and statistical indicators integrating sex and gender variables, with relevance to the problem analysed.
- They can distinguish the effects of sex and gender variables in the analysis of problems/projects.
- They can incorporate the category of gender (and other social distinctions such as social class or ethnicity) in environmental analysis and assessment processes, as well as in environmental policy and sustainability concepts, strategies and programmes.
- They acknowledge, categorise and ethically consider the importance of gender for geosciences applied to social, political and economic processes.

Next, some specific skills of the practical cases presented below are mentioned, in relation to skills in gender perspective, mainstreaming and sustainability:

- Respecting and valuing female leadership and the gender perspective.
- Mastering the theoretical and applied knowledge of the different sciences of environmental biology that allow the development of the analysis and observation skills of the social reality.
- Keeping an attitude of respect for the environment in order to promote values, behaviour and practices that ensure gender equality, equity and respect for human and animal rights.
- Identifying and evaluating the social reality and the interrelation of factors involved as a necessary anticipation of action.
- Respecting diversity and variety of ideas, people and situations. Acknowledging the mutual influence between science, society and technological development, as well as the relevant civic behaviours, in order to promote interest in and respect for the environment and to procure a sustainable future.

- Knowing the scientific methodology and promoting scientific thinking, valuing the relationship between the different disciplines of environmental biology.
- Knowing the most important moments and female figures in the history of science related to environmental biology and their transcendence, in order to value science as a cultural fact.
- Knowing the most relevant contents of the different disciplines that make up environmental biology.
- Analysing and critically incorporating the most relevant issues of today's society that affect the environment: causes and consequences of global change.

4.2 Case studies – subjects and courses: teaching contents and methodologies

Two cases of teaching experiences from a gender perspective are presented below, with the aim of being able to exemplify different ways of applying specific teaching proposals with gender perspective.

Case 1. Analyse the relationship between humans and forests from a gender perspective

Bachelor's Degree in Environmental Biology Forest Ecology (UAB, 4th year, optional, 4 ECTS)

Conceptions of the use of forest resources and the relationship between humans and forests can be revised from a gender perspective. Ellen Swallow Richards defined ecology as the science of the conditions of the health and well-being of everyday human life (Dyball & Carlsson, 2017). It is, therefore, a definition of ecology that understands ecosystems that include human presence and explains how, precisely, this species is related to the planet, that is, what we now call global change, one of the most current issues and the focus of most research projects in ecology. In addition, Vandana Shiva, doctor in physics and one of the founders of current ecofeminism, has several theories to understand ecosystems from a feminist perspective, with life and care at the core. In this sense, the topic of health and forest is also incorporated, as well as the importance of the cultural services of ecosystems. Moreover, many women have studied forest ecology throughout history, but little is known about them. Lastly,

forest professions are always associated with men. However, this has not always been the case, and an example of this are the *trementinaires*, women who used to collect herbs, mushrooms and most importantly, pine resin to transform them into oils, remedies and turpentine or *trementina* in catalan. The contents and examples of the course are made with women from all over the world in order to broaden views and break from the western anthropocentric view, and, therefore, to also approach issues of multiculturalism and other views on gender perspective and the relationship of humans with the environment, and in particular, forests.

Next, an example of already existing contents is presented in the case of the teaching guide of the elective course Forest Ecology of the bachelor's degree in Environmental Biology, which has Sandra Saura Mas as the professor in charge. Specifically, topic 13 of block 4 (Forest multifunctionality) incorporates gender contents:

13. Forests and gender perspective

    13.1 Definition of key concepts to understand gender perspective. The proposal is to understand this broad approach to gender from four dimensions: sex, identity, gender expression and sexual orientation.

    13.2 Feminism and ecofeminism. Examples: hypotheses and theories of Vandana Shiva (India).

    13.3 Women, gender perspective, study of forests. The cultural ecosystem services of forests and their importance for health. Examples: Ellen Swallow Richards (United States), Sandra Díaz (South America) and Liisa Tyrväinen (Finland).

    13.4 Forest professions from a gender perspective. Examples: Wangari Maathai (Africa), the trementinaires (Catalonia).

    13.5 Other experiences on the relationship between women, gender and forests.

Other themes that could be included as contents of this course are:

- The androcentrism in science and the historical conception of the relationship between humans and forests.

Case 2. Women in Environmental Biology (UAB-Coursera)

Massive Online Open Course (MOOC)-Coursera-UAB

Discover women's contributions in the disciplines related to environmental biology.

This free and online course, available on the Coursera-UAB platform, is a complementary training to many UAB degrees and other universities around the world, as it includes three aspects closely related to the general cross-cutting skills of UAB degree courses and essential in today's world, which must be taken into account: gender perspective, sustainability and transdisciplinarity.

This course can be a complement to the degree studies of any bioscience's faculty, as it helps to achieve contents, skills and learning outcomes mainly related to the inclusion of a gender perspective and sustainability. These aspects are currently not fully integrated in this degree, nor in many other degrees in the faculties of Biosciences and Sciences at most universities.

This course has been created by a team of six professors from the Department of Animal Biology, Plant Biology and Ecology (BABVE) of the UAB and has been coordinated by Professor Sandra Saura Mas. BABVE teaches other degrees of the Faculty of Biosciences (Biology, Environmental Science, Microbiology) where this course could also be complementary, for the reasons mentioned above. Therefore, it can also serve as an example of how to include teaching-training of gender perspective in other studies' teaching.

Moreover, the course presented here, by including the gender perspective and interdisciplinarity as main and differentiating focal points, can be complementary to many other masters and postgraduate courses related to education, sustainability or biosciences and environmental sciences.

The course provides students with knowledge, analysis and understanding of the socio-cultural and scientific context that has shaped the current state of the natural environment and enables them to take a critical and constructive stance in the face of the current reality and the transformations that have taken place in all these areas in recent times. This should enable students to become aware of their own involvement in this situation, as well as of the responsibilities they have to assume regarding the elements that make it up, such as the environment, sustainability, education and gender equality.

Next, the MOOC Women in Environmental Biology's contents are presented, 37 audio-visual presentations of between 7 and 15 minutes divided into four blocks or weeks.

BIODIVERSITY

Biological diversity is one of the most important values of the Earth. Humans have evolved and coexist with many other types of living beings. We will find out a little bit more about them and about how can we study their main traits.

- Introduction to the course.
- What is biodiversity?
- Citizen science as a tool to study biodiversity.
- Opening the door to the plant world.
- Why are flowers so important?
- Plants: how can we study them?
- Opening the door to the animal's world.
- What do I see when I snorkel?
- The invisible world under the sea.
- Why are insects so important?
- Vertebrates: how can we study them?

ECOSYSTEMS AND HUMANS

Living beings live together, in constant interaction with each other and with the natural environment. We will try to understand these relations.

- A look into ecology.
- Discovering freshwater ecosystems.
- Going deep into marine ecosystems.
- What do we know about forests?
- Global change: Changing the Earth.
- Climate change and its effects on Human Health.
- How can we stop global change?

HUMAN HEALTH AND ENVIRONMENT

A good quality natural environment provides multiple benefits for human health and well-being. Sustainable management of forestry, agriculture and fisheries are key for the future.

- Human health depends on the environment.
- A major health problem: Pollen and allergies.
- Could humans live without bacteria?
- Ethnobotany: relations between humans and plants.
- Benefits of nature on human health and well-being.
- Nutrition and contaminants in the food chain.
- Agriculture and soils in the contemporary world.
- Sustainable Agriculture.
- Genetic Improvements in Agriculture.
- Insights of the sustainable fisheries.
- Interview to Rosa Maria Poch.

STRATEGIES FOR THE CONSERVATION OF THE ENVIRONMENT

We need to save the planet. The big question is how to do it. Ecofeminism, a culture of peace and environmental education are some ways to conserve the environment. We will learn from experiences.

- Insights into ecofeminism.
- Culture of peace and sustainability.
- The key for the future: environmental education.
- What are ecosystem services?
- The Red List of threatened species.
- The role of zoos in conservation biology.
- Past, present and future in marine conservation.
- Stories about conservation of big mammals.

4.3 Proposal: a transdisciplinary course in biological sciences degrees

In this section, specific proposals have been made based on examples that include the gender perspective in specialised courses, but another option could be to do so through transdisciplinary courses. The general competencies of a university are often expanded over time and if they are to be included in teaching, changes must be made in the study plans and in the teaching plans and courses.

In this sense, a transdisciplinary course would allow the different bio-scientific degrees to be contextualised within a current and transdisciplinary framework where the boundaries between disciplines are blurred, and scientific issues can be integrated with cultural and social issues such as ethics, cooperation, sustainability or gender perspective. With time and dedication, this may make it easier to tackle these cross-cutting skills, which are often difficult to deal with in courses with syllabuses that are difficult to adapt to the cross-cutting skills more closely associated with today's society issues. The proposal made in this section is inspired by the course Current Scientific Matters (Muñoz, 2019) taught as first year course (compulsory) in the Mathematics, Physics and Applied Statistic degrees, and as a fourth year course (optional) in the Chemistry, Environmental Science, Nanoscience and Nanotechnology degrees (of the Faculty of Science) and in the Biology, Microbiology and Genetics degrees (of the Faculty of Biosciences) at the UAB.

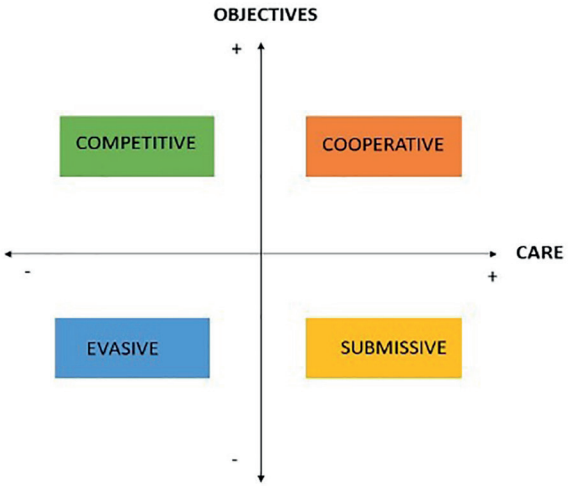
Thus, a compulsory first-year course, Current Science, is proposed, forming part of the basic training of the bioscience degrees, as is done in the degrees of the Faculty of Sciences of the UAB with the course Current Scientific Matters. The aims of this course would be to broaden students' vision and interest in different fields of science, beyond the speciality they are currently studying, specifically: 1) to acquire an interdisciplinary vision of science, 2) to analyse and reflect on the relationship between science and gender, 3) to ponder on the transdisciplinary nature of science, culture and society, 4) to provide students with the keys to basic knowledge and understanding of current science topics, and 5) acquire cross-cutting skills related to sustainability and ethics.

4.4 Organisational modalities and teaching methods: care, project-based learning and transdisciplinarity.

To achieve skills and learning outcomes in the gender perspective, changes must be made in the subjects' organisational modalities, seen as the organisation of the teaching staff, the syllabus, the course modalities, as well as the attitudes and approaches. Biology is a discipline with a broad methodological tradition applied to conducting experiments, in the field and in the laboratory, as well as in traditional large-group theoretical classes. In bioscience studies, laboratory and field practicals are of great importance in the development of problem-solving and diagnostic skills and competence. Thus, most courses are based on theoretical classes that are combined with specific topics or problem-solving seminars, either individually or in group, and are reinforced with practical classes in which students are shown how to carry out the experimental part of the scientific method.

Caring is an aspect that is culturally very associated with the female gender role, and key to the criticism of androcentrism and sexism in teaching. One of the biggest challenges for teaching from a gender perspective is to apply the **notions of care and provision** (Mora & Pujal, 2014), in other words, the **cooperative attitudes** in the elaboration of university teaching projects. In short, the idea is to educate and promote a teaching-learning relationship in which the importance of achieving objectives is taken into account, but also the respect and needs of the other person or group of people—that is, care. Figure 5 shows the four basic attitudes (competitive, evasive, submissive and cooperative) that emerge from the combination of two axes: objective achievement and care, thus showing the compatibility of the two axes when there is a tendency towards cooperative attitudes.

Figure 5. Chart of the four basic attitudes according to the degree of priority given to the two axes: achievement of objectives and care. Adaptation and translation of Paco Cascón's original figure (2001).



This proposal aims to feminise university teaching projects, based on the promotion of qualities related to care, without neglecting the achievement of objectives. According to Mora & Pujal (2014), care is a type of social relationship characterised by the action of satisfying the needs of one person on behalf of another, this being the purpose of the action. In the work, they differentiate between two types of care: 1) care focused on things depending on people and 2) care focused on people. Moreover, they define provision as the relationship oriented towards the pursuit of objectives, where the aim is the achievement of the objective, with little attention to the impact it has on the rest, with two types of provision: 1) provision focused on things and 2) provision focused on the equivalence between people and things. Mora and Pujal (2014), present a very inspiring case study (with concrete proposals for course objectives, training activities, assessment tools and competence indicators with a gender perspective) to incorporate care and provision focused on the equivalence between people and things in the university teaching project.

The promotion of problem or project-based learning (PPBL) faced in small teams in the field of biological sciences, is also essential to the students' education (Domenech, 2017, 2018). This type of learning shifts the focus of the educational

process and focuses on the student and their learning process, instead of on the teacher and the teaching. University education has been changing over time and, since the introduction of the European Higher Education Area, it has been working through the proposal of skills and achievement of learning outcomes for some time now. This is normally a collaborative learning process, which helps to generate new ideas creatively, increases respect for diversity, promotes reading, oral and written communication skills, and helps developing social and work skills. Therefore, the teaching projects based on PPBL are an opportunity to acquire cross-cutting skills such as those related to the gender perspective dimension, which otherwise, with teaching-learning models based on unidirectional master classes, are more difficult to acquire. It must be said that the intermediate model in which theoretical master classes are participative, combined with practical classes and seminars in which debate, initial and constant student interaction are promoted and continuous assessment tools are used— taking into account care and provision —, can also be a suitable tool for achieving learning outcomes from a gender perspective (Mora & Pujal, 2014).

Transdisciplinary education is another key element for educating, bearing in mind the cross-cutting skill in the gender perspective dimension. In this framework, the educational process and the design of the educational programme is done having in mind transdisciplinarity, that is, considering that the subject or subjects have a global view that goes beyond the boundaries between disciplines, including all the knowledge involved and their connections (Saura-Mas *et al.*, 2021). In order to carry out an effective transdisciplinary education, that is, one that achieves the course's objectives and skills, **co-teaching** is often necessary. Co-teaching is an organisational model in which teachers from different disciplines intervene and which allows working on cross-cutting and interdisciplinary skills, as in the case of gender perspective. Saura-Mas *et al.* (2021) present a series of inspiring teaching experiences of transdisciplinary co-teaching, with sheets with materials and specific training activities adaptable to subjects and projects of the biological sciences field.

Teaching method

Methodological actions

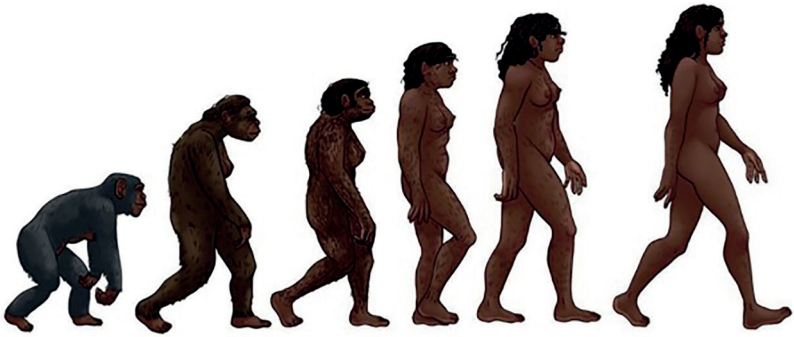
Some **methodological actions** that may be important for implementing the organisational models mentioned in the previous section are:

- Designing the course with methodological actions aimed at acquiring skills within the gender perspective. Mainly through the three main types of

methodological actions: the contents of the course, the bibliography and online resources and the learning environment.

- Dynamizating the group and respect speaking time with the purpose of no downplaying.
- Working in group in a collaborative and cooperative manner.
- Analysing the tendency or evolution that the matter of interest reflects on women and men.
- Selecting topics that the practices that motivate and engage students revolve around.
- Developing examples, exercises and practices that highlight the inequalities between women and men.
- Explaining and discussing participatorily about the basic concepts linked to gender perspective: sex, gender, gender roles, stereotypes and androcentrism. Knowing these concepts is key to be able to comprehend why it is important to include gender perspective in science, specifically in ecology. This can be done through pictures or small debates in the subjects, depending on the different themes (for example, Figure 6).

Figure 6. The female human evolution Font: Stadtpflaenzchen. Wikimedia Commons



- Making women visible in biological sciences in the past, present and future, by broadening the view of female bioscientists who have been made invisible for a long time. This can be done through examples in class, the

course's bibliographical references, etc.; and by creating or using existing activities or materials that serve as sources and databases of biology topics with a gender perspective. In this sense, the MOOC Coursera UAB *Women in Environmental Biology*, presented in the previous point and which is active online, would be an example.

- Promoting training with gender perspective in different fields transversally to the staff of the university community (teachers, students and PAS, the administration and services staff).
- Employing non-sexist communication and language (UAB,2008) during professional activity.

Decolonial and 'queer' feminist pedagogies

Teaching with a gender perspective is closely linked to educating to empower people, who seek to create practices of freedom through critical education. Far from the white-western-bourgeois-heterosexualnormalizers feminists, the decolonial feminist pedagogies mark different strategies to work on empowering people (Rifà 2014), and at the same time they are a unique opportunity to work on intersectionality from a gender dimension. According to Martínez (2015), the main key points and strategies to build a feminist pedagogy that has in mind the mentioned empowerment values, freedom and criticism, must consist of the following points:

a) Inclusion of diversities.

b) Making inequality and the impositions of the patriarchy visible.

c) Being aware of the spaces, knowledge and experiences of different women, from different perspectives to ease individual and collective empowerment processes.

d) Community participation active in equity.

e) Horizontal and transversal interventions.

f) Generating skills for self-criticism, and individual and collective awareness.

g) Dissemination and explanation of history, culture and knowledge from a feminist and intercultural point of view, discovering the value of hidden knowledge and not only the dominant and globalising ones.

h) Emphasis on fostering women's networking for a social model based on the common good, mutual support, in solidarity networks and citizen networks.

From **feminist and queer pedagogies**, Rifà (2018) citing Britzman (2005), outlined the following challenges for education and curriculum that have a direct implication on the teaching methods in class:

1) Bringing up complexity, reflexivity and diverse affections and sexualities at the heart of the curriculum and educational practice.
2) Breaking down organisational and institutional boundaries in education, and also strong boundaries imposed on the knowledge that is learnt and taught in the classroom.
3) Becoming aware of the micro-politics of identity, sexual diversity and relationships' forms.
4) Promoting the creation of weak boundaries that blur the frontiers between bodies, identities, sexualities and knowledge.
5) Advocating learning more about the everyday life of people and their lives, biographies and desires.
6) Changing time and space management to make them more flexible.
7) Working with other forms of representation while questioning hegemonic technologies and means of representation and replacing them with options that allows diversity to be visible.
8) Understanding the curriculum as a space where aspirations, sexualities, bodies and diverse identities engage in dialogue.
9) Moving away from the margins to the centre, in order to place the subaltern identities: life stories of women, children, the elderly, lesbians, immigrants, etc.

Assessment

Assessment of the gender perspective in teaching

Furthermore, sometimes there is innovation in the contents of a subject, adapting them to new skills, but there are no structural changes in the teaching project and methodology that are important enough to make learning effective for the students, and adequate assessment from a gender perspective by the teaching staff.

The UAB Education and Gender Group defines the four dimensions that are considered key to making it possible to materialise the gender perspective in education (Grup d'educació i gènere, 2020a) [Education and gender group] (Table 2). And it is on the basis of these four dimensions that a tool is defined to assess gender perspective in teaching, with the aim of identifying potentialities and weaknesses in the approach to the contents, methodologies, assessment and organisation of the teaching space.

Table 2. There are four dimensions to organise the conceptual framework to make education with a gender perspective possible, according to the Grup d'educació i gènere (2020) [Education and gender group].

WHO? — The subjectivity and possible gender blindness of educational agents	**WHAT?** — The androcentric bias of the contents that are included or omitted in teaching
HOW? — Recognition of the importance of the learning-training process	**WHERE?**—The context and infrastructure, that is, the specific educational space and timeframe

For each of these four dimensions, the Grup d'educació i gènere (Education and gender group) of the UAB proposes key analytical elements and aspects to be taken into account when analysing teaching practice (Table 3). Therefore, the proposal is that the bioscientific degrees should use this evaluation tool for the different subjects of the degrees, for example, specifying whether or not each analytical element is present, and thus obtain assessment indicators in order to be able to assess how teaching from a gender perspective is being carried out, and also to check in which aspects it can be improved. The self-assessment of the teaching activity is essential for innovation and improvement and allows us to continue advancing towards a university public and of quality. The self-assessment processes of the teaching projects proposed here also allow us to broaden our perspective and take into account elements and dimensions that may not have been applied initially, prior to the assessment process.

Table 3. Elements of assessment according to the four key dimensions to make possible gender mainstreaming in education (Source: Grup d'educació i gènere, 2020b) [Education and gender group].

WHO Identify and review the cultural burden of patriarchal values, both of teachers and students, which leads to the reproduction of attitudes that generate inequalities.	
Analytical elements	**Aspects to bear in mind**
Gender blindness	Ability to identify gender and social injustices [knowledge – power – gender]
	Education received on gender perspective and feminist pedagogies [educational and professional trajectories]
	Identifying hegemonic educational mechanisms (sex-gender-sexuality) and generators of inequalities [gender binarism and patriarchy].
	Questioning privilege and power from an intersectional perspective [social, racial and gender justice | axes of structural, institutional, historical and individual discrimination]
Taking a stance on Gender Perspective	Gender world view [Levels of gender awareness: 1. Non-existent awareness; 2. Awareness of resistance- does not propose changes; 3. Critical awareness- makes proposals for transformation]
Taking a stance on objectivity	Questioning universality and essentialism [contextualised, embodied, argumentative knowledge].
	Questioning neutrality (one's own and content neutrality) [democratic, socially constructed knowledge, integrating all voices].
	Taking a stance on knowledge [to state one's view and stance: situated knowledge]
Teaching as a political act	Political-ethical orientation on learning [1. Learning to look while feeling: to get excited, to experiment, to break with given, limited and excluding views; 2. Learning to think while devising: reflecting, discovering, connecting different ideas, participating in the creation of new ideas; 3. Learning to act ethically: to devise real processes of change in the immediate and contextualised environment].

WHAT Critically review the theories being taught, and not assume content neutrality.	
Analytical elements	**Aspects to bear in mind**
Theoretical benchmarks of the subject	Diversification of benchmarks [challenging androcentric, ethnocentric, adultcentric, heterocentric, overpositive biases].
Typology of knowledge generated in the teaching process	Situated knowledge [questioning essentialisms: arguing, knowing the epistemologies, contextualising, assuming the partial point of view, accepting the diversity of views found in class].
	Experience as a source of knowledge [1. Undocumented experiences in academic work; 2. Experiencing transformative learning; 3. Experience and knowledge of social movements].
Curriculum	Curriculum tailoring [1. Tailoring the curricular content to the needs of the group; 2. Personalised attention in diversity: intersectionality of gender, sexuality, class and ethnicity]
	Hidden Knowledge [model of femininity and masculinity, perpetuation of sexism, invisibilisation of non-hegemonic ways of existing]
Introduction of specific content on gender and sexuality	Introducing feminist and queer theories and their contribution to education [explicit or implicit intentionality; punctual or transversal presence]
	Mainstreaming gender and sexuality education theories [sexuality education that overcomes binarism and heteronormativity; from an affectivist approach: skills to know one's own body, to understand one's own sexuality, to establish healthy and satisfying relationships, to be aware of one's own and others' well-being].
	Introducing feminist critical theory [relationship between knowledge and power, hierarchies and inequalities].

HOW Diversify, make teaching and learning processes more flexible, contextualised and participative.	
Analytical elements	**Aspects to bear in mind**
Teaching methodologies	Feminist pedagogies [learning based on: 1. Identifying and analysing the patriarchal reality and acting to fight heteropatriarchal normativity. 2. Questioning and reasoning about the knowledge – power relationship, hierarchies and gender inequalities. 3. Questioning and becoming aware of one's privileges and oppressions, and their origin].
	Use of diverse, flexible and contextualised methodologies [adjusted to the abilities, needs, students' levels, and to the specific circumstances].
	Use of participative methodologies [ensuring that participation is equal and contributes to eradicating the reproduction of gender roles].
	Decolonial pedagogies [valuing subaltern knowledge; basing pedagogy on people's reality and their subjectivities; starting from other ways of being, doing and living]
	Engaged pedagogy [giving voice to all people, experiences and diverse realities; challenging students and teachers to think, wonder and share].
Relationship-based Care	Subversion of power relations [teachers and students working together to break vertical and authoritarian relationships, for instance: making decisions on content and session design...].
	Acknowledgement of all presences [listening to the voices and interests of everyone in the classroom, generating enthusiasm for learning collectively].
Communication and use of language	Use of non-sexist language [free of prejudices and stereotypes, respectful of oppressed and/or vulnerable groups]
	Use of inclusive examples [that include identities, cultures, body diversity, avoiding discriminatory identities (LGTBI-phobic, sexist, androcentric, racist)].
	Use of non-stereotypical images or iconography [inclusive visual language, free of gender stereotypes, that make visible diverse family models, non-normative bodies, non-imposed aesthetics...].

Assessment	Assessing to transform reality [ability of applying knowledge, skills and attitudes in different contexts, and of evaluating the transformation of these contexts].
	Assessing the process [responsibility lies on the students; the teaching work helps students to fully develop their abilities].
	Diversification of assessment tools [assessment as learning: tools that give more agency to students (self-assessment rubrics, peer assessment, participatory co-assessment...)].

WHERE Analyse the forms of oppression in the configuration and structuring of spaces (male-chauvinism, classism, racism, functionalism, adult-centrism...).	
Analytical elements	**Aspects to bear in mind**
Physical elements	Classroom space [structural spaces that symbolise and constitute vertical hierarchies between teachers and students, which exclude some people and do not encourage equal participation].
	Other spaces [aspects that establish excluding binarism and are based on a presumption of heterosexuality, cisgenderism and functional normativity in toilets, changing rooms, outdoor spaces, cafeteria...].
Symbolic space	Safe spaces [ongoing dynamic and relational work process, to foster cooperation, with dynamics that include all people in a fair and equal manner].

Techniques and strategies to assess students with gender perspective

According to Ortiz & Morero (2018) even methods considered as objective, such as the multiple-choice tests, can have a different impact on men and women. There is a large amount of literature (Bolger & Kellaghan, 1990; Rosser, 1989; Figueiras *et al.* 1998; Salvador & Salvador, 1994) that shows how significant biases appear depending on whether the exam is multiple-choice or open-ended. Some research (Aboides n. d., Bridgeman *et al.*, 1992) shows that multiple-choice test grades women below their actual performance in the tested subject when compared to open-ended evaluations. These results can be interpreted by patterns such as those described by Luigi *et al.* (2008) which, when interpreting the learning outcomes of girls and boys in mathematics and reading (based on data from PISA reports) in different countries, they observed different patterns based on the degree of equality of the country's culture. Specifically, in this analysis, Luigi *et*

al. (2008) describes that girls' poor performance in mathematics, compared to boys, is erased in more gender-equal cultures. Specifically, they conclude that in more gender-equal societies, girls' performance is on par with the boys' in mathematics, and they perform better than boys in reading activities.

Thus, there is ample evidence that assessment techniques and strategies may be flawed, and that attention needs to be paid to how and which ones we use when teaching biological sciences. In order to ease the work for teachers, **some proposals for gender-sensitive assessment techniques and strategies** are listed below, which also promote awareness of the learning processes of students and take into account diversity. This list is the result of a bibliographic search, so the author and the publication where it is proposed are indicated on the back of each proposal.

- Blind assessment: when it comes to tests, exams or assignments, it is convenient to set up mechanisms to render the grading process anonymous (Rifà, 2018).
- However, grading should not be mistaken for assessment. Feedback on the learning outcome and a qualitative assessment allows to incorporate changes in the study processes and to feel supported (Rifà, 2018).
- Even though girls participate less in class, they also tend to request more tutoring or follow-ups to resolve doubts and improve their performance. This is an element to take into account when assessing (Rifà, 2018).
- Self-evaluation allows working on aspects related to self-knowledge, self-assessment and the self-criticism (Rifà, 2018).
- Including co-assessment or peer assessment methods, which contribute to the development of critical and analytical skills among students. As suggested by Torres-Guijarro & Bengoechea (2017), it will be necessary to carry out an analysis beforehand to assess how gender influences co-evaluations, as female students tend to underestimate their own performance and that of their female peers (Ellis *et al.*, 2008).
- The entry of one's own biography and first-person accounts about learning reveal dynamics that often remain invisible (Rifà, 2018).
- Co-assessment or peer assessment activities can be promoted, so that students are co-responsible of assessing learning and analysing the results from a gender perspective (Rifà, 2018).

- In addition to taking into account the gender balance in the groups, feedback formulas and comments can be established in small groups or individually to promote exchange and participation (Rifà, 2018).
- The way how group leaders are selected needs to be reviewed, to see whether it responds to a division of labour from a gender perspective, so we can establish rotation mechanisms (Rifà, 2018).
- Rubric writing should incorporate the meaning of gender when learning and getting to know about how sexism and androcentrism work in biology (Rifà, 2018).
- Class and internship diaries allow considering and assessing the meaning of gender in the stories about people's education (Rifà, 2018).
- Attention to diversity and to gender inclusion can be made explicit as an assessment criterion (Rifà, 2018).
- Assessing through learning portfolios also allows reconstructing learnings: by searching for evidence that invites to reflect on the process carried out and establishing specific objectives for the course (Rifà, 2018).
- Including questions related to specific topics that address equality issues in written evaluations (Ruiz, 2018; Moreno, 2018).
- Including questions with a gender perspective and not about sex-based differences (Ruiz, 2018).
- Revising the gender biases that are usually introduced, unconsciously, in the formulation of the question when generalising statements (or denials) related to health problems (from the onset of symptoms, through the course of the evolved health problem or disease, to the prognosis and differential diagnosis). Also, when these statements (or denials) are made about the causes and impact of risk factors, as they may be different depending on the sex and gender of the person. Finally, review possible responses when they allude to health outcomes or interventions (including drug therapy) (Ruiz, 2018).
- Another factor to have in mind it is the threat of stereotyping, which is displayed when tests unconsciously highlight stereotypes of women and men, reacting in the way they expect the respective genders to do (Fine, 2011).

- That the aspects to be assessed are always clear and explicit. The final degree dissertations (TFG) have a specific type of assessment, based on a jury that assesses the dissertation following a certain criterion, and which is the result of an oral presentation.

Bengoechea (2014) describes, in a specific case study, how female students have lower marks in their TFG than male students. Faced with this pattern, the author of the study proposes that in contexts where the masculine style is the hegemonic and standard of communication, one should not renounce one's own style (identity) but prepare them and take into account the rules of the game. In this sense, in order to change these patterns, Bengoechea (2014) proposes that the aspects to be assessed should always be clear and explicit. In this regard, it would be interesting to investigate whether this pattern repeats itself at the bioscientific degrees and, as long as the results are not available, to promote this transparency in the student's assessment criteria.

The sexist bias in professors' assessment

There is little evidence as to whether there is a sexist bias in the assessment of the subjects of the bioscience degrees in particular, and therefore one of the proposals of this guide is to assess this fact. By collecting, for example, data disaggregated by sex and analysing whether there is any discrimination, it would be possible to find out where it would be advisable to take measures to avoid the sexist bias in assessment and to consider how the androcentric view of science affects bioscientific studies.

Moreover, several studies in other university teaching contexts show that female professors systematically receive lower evaluations than male professors (Boring *et al.*, 2016). A study carried out at a French university (Boring, 2014) shows that male students tend to give higher satisfaction ratings to male professors in surveys, rewarding them for their perception of higher quality in teaching style. Mengel *et al.* (2016) describe the same pattern and show that this fact can have indirect effects on the progress of women's scientific careers. Specifically, affecting the confidence of new female researchers and causing a reallocation of resources away from research and towards teaching. In this regard, it is urgent that universities act to avoid gender bias in the assessment of the teaching staff by revising the instruments, analysing the representations that are involved in the students' answers, and above all, being careful about the use and implications that the results of these surveys have, for example, in the promotion of teaching staff (Rifà, 2018).

05. SPECIFIC TEACHING RESOURCES FOR MAINSTREAMING GENDER

5.1 Resources for an oral, written and visual communication with a gender perspective

Communication with a gender perspective goes beyond the use of feminine or masculine plurals in languages like Spanish or Catalan and the use of inclusive vocabulary, it also embraces other aspects such as visual language, metaphors and stereotypes. The anthropologist Emily Martin (1991) shows, for example, how gender stereotypes can be hidden in the scientific language of biology through concepts and biological processes like spermatogenesis or oogenesis. The importation of cultural ideas about passive females and heroic males into the "personalities" of gametes is an example of how language may be helping in creating an androcentric science without a gender perspective. Emily Martin (1991) also proposes as a key idea to turn this situation around, firstly, the milestone of awakening what she calls "sleeping metaphors" in science, such as those related to the description of eggs and spermatozoa. Although there are those who say that these sleeping metaphors are dead, this is not the case in many fields of biology. Therefore, paying attention to how we interpret and explain phenomena, and trying to do so from a non-androcentric point of view, as well as innovating and rethinking language and visual representations are key to incorporating a gender perspective in biological sciences.

As for **oral and written communication**, the use of an inclusive vocabulary continues to be a pending task in many aspects. As the philosopher of language George Steiner said: "what isn't named doesn't exist". For this reason, it is necessary to make an effort in the language used during teaching in order to create a space in which men and women see themselves reflected. To achieve this, non-sexist language must be normalised during oral communication with students, as well as when generating work materials such as exercises or teaching guides. Some of the actions that can be carried out include:

- In languages like Catalan, using collective nouns (l'alumnat vs. l'alumne) or abstract nouns (la persona encarregada de l'administració del sistema operatiu vs. l'administrador del sistema operatiu). To refer to an indeterminate person, we can use gender-invariable names or, if we do not have one that works, we can use the double form. Obviously, if we are referring to a specific person, we must use the masculine or feminine form

according to the gender that this person identifies with. In English, when gendered nouns appear (chairman; freshman), use neutral equivalents that include both genders (chair/chairperson; first-year student). Obviously, if we are referring to a specific person, use the pronoun that the person identifies with

- Avoiding stereotyped or sexist terms and phrases. Whenever possible, using invariable, generic, neutral or depersonalised expressions to refer to a group that may include people of different sexes or genders.
- Making women visible in all areas. For example, in bibliographies and websites, it is always necessary to indicate the first name, as well as the surname or surnames, in order to make authors visible, and raise awareness of stereotypical or sexist terms and phrases.
- Avoiding talking about women as passive subjects.

Moreover, in the current digital and technological context, visual language is as or more important than ever when it comes to communicating with gender sensitivity, and images play a crucial role in communication. Some of the actions that can be carried out are:

- When we use images for our audio-visual presentations, we must ensure that there are equal references and images of different genders and sexes.
- Visualisations of data images, for example graphs and figures, may include gender assumptions, probably due to implicit or unconscious gender biases. Then, when generating hypotheses and also the visualising of data to interpret them, it is important to take into account gender perspective (Schiebinger *et al.*, 2011-2020).
- Using creativity in the visual representation of ideas and data, breaking out of established patterns and discovering new ways of representing data is crucial. Works such as that of Giorgia Lupi and Stefanie Posavec (2016) can inspire us in this sense, as well as train us and provide us with tools and methodologies related to what is now known as “visual thinking”, a methodological tool that represents ideas or thoughts through drawings and images.
- If images of men or women are used, we must avoid any kind of sexist stereotype. Let’s use adjectives or expressions that can work for people of all sexes and genders. Let’s avoid expressions that imply a value judgement

about being a woman or man or a stereotype about how a man or a woman should be (such as expression with masculine or feminine adjectives: a masculine attitude, some feminine movements) (for instance, Rifà 2017).

- Let's not refer to people by their physical appearance, if it is not really relevant to the message, since often when we do so we are expressing discriminatory stereotypes.

Online resources about how to use gender-sensitive **language (textual and visual):**

- Emakunde/Instituto Vasco de la Mujer (2008). *Guía de lenguaje para el ámbito educativo*. Available at: https://www.emakunde.euskadi.eus/contenidos/informacion/pub_guias/es_emakunde/adjuntos/guia_leng_educ_es.pdf
- Ferrer, Cristina; Mateu, Joana M.; Pons, Maria; Barceló, Catalina; Pont, Catalina and Roig, Miquela (2006). *Llenguatge per a la igualtat a l'educació. Illes Balears: Institut Balear de la Dona*. Available at: http://oficinaigualtat.uib.cat/digitalAssets/297/297562_llenguatge-per-la-igualtat-a-leducacio.pdf
- Marçal, Heura; Kelso, Fiona and Nogués, Mercè (2008). *Guia per a l'ús no sexista del llenguatge a la Universitat Autònoma de Barcelona*. Servei de Llengües i Observatori per a la Igualtat de la Universitat Autònoma de Barcelona. Available at: https://www.uab.cat/doc/llenguatge
- Bengoechea, Mercedes. *Guia para la revisión del lenguaje desde la perspectiva de género*. https://www.bizkaia.eus/home2/Archivos/DPTO1/Noticias/Pdf/Lenguaje%20Gu%C3%ADa%20lenguaje%20no%20sexista%20castellano.pdf?hash=ce929cea311e2aab07412168d230dfcd
- Schiebinger, Londa; Klinge, Ineke; Sánchez de Madariaga, Inés; Paik, Hye-Young; Schraudner, Martina and Stefanick, Marcia (eds.) (2011-2020). *Gendered Innovations in Science, Health & Medicine, Engineering and Environment*. Available at: https://genderedinnovations.stanford.edu/methods/language.html
- Bengoechea, Mercedes. *Influencia del uso del lenguaje y los estilos comunicativos en la autoestima y la formación de la identidad personal. Jornada de Trabajo con el profesorado de escuelas piloto del proyecto Nahiko Emakunde*. Eusko Jaularitza. Available at: http://intercambia.educalab.es/wp-content/uploads/2016/05/MERCEDES-BENGOECHEA-

Uso-del-lenguaje-y-estilos-comunicativos-en-autoestima-e-identidad-personal.pdf

5.2 Resources for making female scientists visible

Raising women's visibility can also be done through references to documents (bibliography and webography). The way we cite our documents, and which documents we cite, are two important factors for women's visibility in biosciences. In this case, there is an international consensus on how to cite literature from a gender perspective: it is necessary to cite with the full first name and not just the initials. It is recommended to do so because the academic authority is associated with a male production, and giving the full name helps to make women and their work more visible. Reaching a consensus regarding the bibliography we cite and how we choose it is more controversial and difficult, but after coordinating the MOOC 'Women in environmental biology', in which the references are all women, we discovered that there are many more women than we think in our fields of study, who for diverse reasons have been made invisible. In this sense, and seeing that in the biology field it is possible to find many scientific works written by women, it is recommended that at least the 50% of the bibliographical citations should be of works in which there are women as first authors, if possible.

Below there is a list of resources where women in biosciences have visibility:

- Diverse authors. *Mujeres con ciencia. Cátedra de cultura científica, de la Universidad el País Vasco*. Available at: https://mujeresconciencia.com/
- Martínez Pulido, Carolina (2001). *También en la cocina de la ciencia. Cinco grandes científicas en el pensamiento biológico del siglo XX*. Universidad de la Laguna.
- Macho, Marta (2019). Exposición: "Mujeres de ciencia. Mujeres con ciencia". Available at: https://mujeresconciencia.com/2019/06/07/exposicion-mujeres-de-ciencia/
- Diverse authors. *Women in science. The bumbling biochemist*. Available at: https://thebumblingbiochemist.com/lets-talk-science/women-in-science/
- Monzón, Maximina; Bengoechea, Esperanza; Bobolenta, Paola and González, Berta (2009). *Mujeres en biología*. Available at: http://mujeresdeciencias.ftp.catedu.es/4.BIOGRAFiAS/mujeres%20en%20Biologia.html

- DIVERSE AUTHORS. *Sin las biólogas, la biologia no sería lo que es hoy en día. Blog oficial del col·legio oficial de biólogos de la comunidad de Madrid*. Available at: https://cobcm.net/blogcobcm/2020/03/11/biologas-biologia-hoy-en-dia/
- DIVERSE AUTHORS. *Dones de ciència, Murals*. Universitat Politècnica de València. Available at: http://www.donesdeciencia.upv.es/
- MARTÍNEZ PULIDO, Carolina (2006). *La presencia femenina en el pensamiento biológico*. Ed. Minerva.
- IGNOTOFSKY, Rachel. *Dones de ciència. 50 Pioneres valentes que van canviar el món*. Ed. Estrella Polar. Col·lecció Grans llibres.
- IZQUIERDO AYMERICH, Mercè; GARCIA PUJOL, Clara; SOLSONA PAIRÓ, Núria (eds.) (2009). *Gènere i ensenyament de les ciències: representacions i propostes*. Col·lecció Materials 206. Servei de publicacions de la Universitat Autònoma de Barcelona.
- UNIVERSITAT ROVIRA I VIRGILI. Webs de dones científiques per disciplines. Available at: https://www.urv.cat/ca/vida-campus/universitat-responsable/observatori-igualtat/websdisciplines/
- INSTITUT CATALÀ DE LES DONES (2020). *Dones de ciència* (exposició). Available at: https://dones.gencat.cat/ca/ambits/activitats/exposicions/dones_ciencia/
- EDUCAWEB (2020). *6 científicas españolas para inspirarte a estudiar Ciencias*. https://www.educaweb.com/noticia/2020/02/11/6-cientificas-espanolas-inspirarte-estudiar-ciencias-19078/
- MACHO, Marta (2019). *La tabla periòdica de las científicas. Mujeres con ciencia*. Available at: https://mujeresconciencia.com/2019/01/01/la-tabla-periodica-de-las-cientificas/
- MNATEC. *Dones, indústria, ciència i tecnologia. Taula periòdica, també de dones*. https://mnactec.cat/blog/dona-industria-ciencia-tecnologia/taula-periodica-tambe-de-dones/
- GENERALITAT DE CATALUNYA. UNIVERSITATS I RECERCA. *Gencat-Universitat i recerca. Dones i ciència a l'història*. Available at: http://universitatsirecerca.gencat.cat/ca/03_ambits_dactuacio/ciencia_i_societat/dones_i_ciencia/dones_de_ciencia_i_historia/

- AMIT. 2021. #Nomorematildas. Available at: https://www.nomorematildas.com/

In the 'For further information' section of this guide it is possible to find more resources about women's visibility, classified according to the different disciplines of the biological sciences: ecology, environment, marine biology, botany, zoology, biological anthropology, cellular biology, immunology and molecular biology, genetics, reproductive biology, biochemistry, biotechnology, microbiology, genetics and evolution.

5.3 Resources for designing course contents with a gender perspective

Actions can also be taken through the **design of course contents**. When designing the syllabus of the subject, it is important to select the topics so that they can reflect the interests of both women and men, that they make the research done by men and female scientists equally or as equally as possible, and that they make visible examples of androcentric science versus science with a gender perspective. The following actions can be taken to ensure that the **syllabus covers the interests of the different genres** represented in class:

- Assessing the interests and analyse the data by gender, in order to know if the interest in a specific part of the subject has been higher in one gender or another.
- At the beginning of the course, proposing that a percentage of the syllabus should be chosen according to the students' interests and that it should reflect interests for both genres, according to a deliberative and participatory process (like for example, a list of proposed topics and online voting).
- Showing sleeping metaphors and counter-narratives, through examples of how biology has been androcentric throughout history. Reading exercises of articles can be proposed. In them, the history of the androcentric view of some biological concepts is analysed, or sleeping metaphors can be awakened, as proposed by Evelyn Martin (1991). At the same time, it is important to deal with counter-narratives with a gender perspective that exist in front of a sleeping metaphor, or to promote the creation of **counter-narratives** if they do not exist in that field.

The following bibliography provides an example of this teaching proposal:

- Martin, Emily (1991). «The Egg and the Sperm: How Science Has Constructed a Romance Based on Stereotypical Male-Female Roles». *Signs* 16 (3), 485-501. The University of Chicago Press.
- Biology and Gender Study Group (1988). «The Importance of Feminist Critique for Contemporary Cell Biology». *Hypatia*. 3 (1): 61-76.
- Fox Keller, Evelyn (1997). *Developmental Biology as a Feminist Cause? Osiris*, Vol. 12, *Women, Gender, and Science: New Directions*, p. 16-28. The University of Chicago Press on behalf of The History of Science Society. https://www.jstor.org/stable/301896.
- Gossard, Julia (2018). «Teaching the Early Modern "Penis-Vagina".» In: *NOTCHES, international history of sexuality blog*. Available at: https://notchesblog.com/2018/03/27/teaching-the-early-modern-penis-vagina/
- Martínez Pulido, Carolina (2004). *Gestando vidas, alumbrando ideas: mujeres y científicas en el debate sobre la biologia de la reproducción*. Ed. Minerva (colección Estudios sobre la mujer).
- Martínez Pulido, Carolina (2018). *El papel de las mujeres en la evolución humana*. Ed. Santillana Educación.

5.4 Resources for designing a learning environment with a gender perspective

- When ***debates and scientific discussion*** or opinion ***processes*** take place in class, it is important as teachers to try to promote that people, regardless of their sex or sexual orientation, can feel comfortable participating and assuming the gender roles they feel represented by. Therefore, during these types of participatory dynamics, it is important for teachers to have a clear role when stimulating the debate and to manage speaking time, as well as to avoid possible interruptions among students, and to give them tools for active listening, non-judgment and respect for different opinions.

  In this sense, the following materials can be good teaching preparation resources:

  - Rosenberg, Marshall B. and Seils, Gabrielle (2011). *Resolver los conflictos con la Comunicación NoViolenta*. Editorial Acanto.

- De la Torre, Pilar (2019). *Fundamentos y prácticas de comunicación no violenta: El primer manual práctico de comunicación no violenta (CNV)*. Ed. Arpa.
- Cascón, Paco (2001). *Educar en y para el conflicto*. Cátedra UNESCO sobre Paz y Derechos Humanos.

- Educating from a gender perspective in the biology field involves transdisciplinarity, **integrating knowledge from different disciplines**, from specialisations within biology such as genetics or reproductive biology to anthropological, social and cultural concepts. Therefore, to achieve the objectives presented in this book, it is necessary to integrate a cross-cutting education. This implies educating in a cross-cutting way, that is, applying different methodologies to find knowledge that goes beyond the disciplinary systematics (Albargonzález, 2011; Barrera *et al.*, 2018; Wang, 2019), and to do so in a network of connection whose backbone is our experience of the world, and our multiple experience in the world that we interpret and build (Saura-Mas *et al.* 2021).

- **Transperformative education** can also be a key teaching resource when designing biology teaching, in other words, performative strategies integrated into transdisciplinary methodologies. The performative method provides the epistemological connection between creativity, criticism and civic engagement (Conquergood, 2002). Thus, the teachers become performers interested in the communicative process and the empathic understanding of the agents participating in the educational setting (Barrera *et al.*, 2018).

  An interesting teaching resource where one can find specialised teaching resources on transdisciplinary and transperformative education is the book titled *Co-teaching transdisciplinario: experiencias docentes* [Transdisciplinary co-teaching: teaching experiences] (Saura-Mas *et al.* 2021).

06. TEACHING HOW TO CARRY OUT GENDER-SENSITIVE RESEARCH

Gender perspective in biology research can be done specifically or in a cross-cutting way. Below are a series of considerations and resources for revising whether our research is done from a gender perspective, and in which aspects it can be improved. We can use guides and checklists already created and cited in this section. Or we can take inspiration of these existing materials and the considerations made here, to adapt them to our discipline and thus create new tools, guides and checklists.

Gender perspective can be incorporated in a specific and concrete way from feminist biology, a discipline born from the contributions of female scientists such as the well-known biologist and primatologist Donna Haraway (born in 1944), who directed the first chair of feminist studies in the United States (University of California, Santa Cruz) (Martínez, 2020). This is a branch of research and teaching that attempts to reveal and reverse possible gender biases in biological disciplines. This discipline aims to develop new theories and methods that reflect a feminist approach able of proposing questions and suggesting innovative and inclusive solutions. An example can be found in the first postdoctoral programme in feminist biology created at the University of Wisconsin-Madison (2014), one of the most important public universities in the United States, with the aim of researching to uncover and reverse gender biases in biological research.

Considerations to take into account if the **research object is relating to gender issues:**

- When we research, we tend to project our own gender roles on the work we do, regardless of whether we are men or women, and this inevitably tends to bias the observations. Therefore, what needs to be done is to carry out studies and experiments that manage to be as unbiased as possible.
- If the research is done with animals, it is important to take into account how sex (biological characteristics) interacts with gender (sociocultural or environmental factors and processes) (Schiebinger *et al.*, 2011-2020).

Further below is the checklist for conducting gender-sensitive research, by phases, when the research is associated with gender issues. This list is part of the *Manual of gender in research*, a reference manual for research with a gender perspective (Yellow window management consultants *et al.*, 2004) (Table 4). In the 'For further

information' section there is a list of other tools that serve as a checklist on the gender perspective in research.

Table 4. Checklist on how to conduct gender-sensitive research (Yellow window management consultants *et al.*, 2004)

***Checklist* on how to conduct gender-sensitive research (Yellow window management consultants *et al.*, 2004)**
Research ideas phase: • If the research involves humans as research objects, has the relevance of gender to the research topic been analysed? • If the research does not directly involve humans, we must ensure that possibly differentiated relations of men and women to the research subject are sufficiently clear. • A review of the literature and other sources relating to gender differences in the research field should be carried out. Likewise, we must ensure that the references to previous studies that we search do not all belong to the same gender, whenever possible.
Proposal phase: • The proposal must specifically and clearly explain how gender issues will be handled in research. • The proposal must ensure, whenever possible, that gender differences will be investigated, that means that sex/gender-differentiated data will be collected and analysed in such a way that will be part of the final publication. • The differentiated outcomes and impacts of the research on women and men must be considered.

Research phase: • Questionnaires, surveys and focus groups must be designed to unravel potentially relevant sex and gender differences in data. • The data must be analysed according to the sex variable or other relevant variables related to it.
Dissemination phase: • Statistics, tables, figures and descriptions must also focus on the relevant gender differences that may have come up in the course of the project. • Institutions, departments and journals must also be included among the groups for dissemination that focus on gender. • Specific publications or dissemination actions on gender-related findings must be considered.

Gender perspective can also be applied **in a cross-cutting way** in the biological sciences' research, specifically when creating, publishing and assessing final degree and master's theses, doctoral theses and other publications. Next, some **strategies and reflections** are outlined *for carrying out gender-sensitive research* during the whole process, in a cross-cutting manner and regardless of whether or not the research object is associated with gender issues:

- Using non-sexist, gender-sensitive and queer-sensitive language.
- Remembering the importance of considering designing experiments and hypothesis taking into account the possible differences that may exist according to sex and doing a gender-sensitive data analysis and outcomes interpretation.
- Ensuring that there is a gender balance in the work team and at all levels (technical or decision-making).
- Ensuring that the working conditions allow members of the research team to find a balance between work and family life in a satisfactory manner.
- Ensuring that there is a gender balance in round tables, congresses and other scientific research events.

- Ensuring that there is a gender balance in the decision-making bodies of research centres and scientific associations.
- Ensuring that there is a gender balance in selection process and personnel selection boards, final degree and master's degree projects, doctoral theses and other research work that can be assessed.
- When selecting people with similar cognitive and intellectual abilities and similar academic records, it is necessary to make sure that the system in place does not indirectly discriminate against one person over another. Bengoechea (2014) suggests five factors that can have a decisive influence on the final grade of the bachelor's degree final project (TFG), adaptable to other academic tests in which there is an examining board and an oral presentation made by the person being assessed: self-worth, the work done, the topic chosen, the oral performance when defending the project and the board's deliberation.
- Training in performative oral presentation and other techniques to be able to have skills in front of boards based on androcentric criteria. The relevance of gender in power and in discourse at a professional level is a controversial and complex issue (Holmes, 2007), with strong cultural and social factors within an androcentric context that makes it difficult to explain what, how and why it happens. There are different proposals for approaching this topic, but one option is to perceive the oral presentation of the discourse as a performative action. According to Judith Butler, gender can be understood as a performative performance, an action based on a set of obligatory practices, including linguistic practices imposed from birth and repeated throughout life (Bengoechea, 2014).
- Ensuring that staff selection processes use gender-sensitive techniques, criteria and evaluation processes. In this sense, there are recommended resources such as the CERCA Institute's audio-visual presentation (2016) and the checklist for transparency and excellence in selection processes (Van den Brink,2015).
- Creating committees, observatories or other types of entities that work for equality in research centres and universities and work for the creation, fulfilment and monitoring of strategic plans for equality.

- Creating research environments (physical, virtual spaces, etc.) with a gender perspective, in other words, with the dynamisation of participation, speech turns, etc.
- Making decisions in a transparent and democratic manner; transparency lets the rules of the game be known and makes having equal opportunities easier.
- Promoting gender equality bearing also in mind transactionality.
- Making visible, in a planned and strategic way (for example, through communication plans) the research done by women and the research done with a gender perspective in our universities and research centres.
- Creating assessment tools for monitoring, innovating and improving the gender perspective of the university or research centre.
- Creating tutoring done by women, following examples such as the *Mentoring program* of *Women in science'* (Several authors, 2020).
- Research teams' continuing education in gender and queer perspective (research with gender perspective, gender-sensitive communication, male-chauvinist violence, women and (bio)science, legislation and gender perspective, sexual diversity, intersectionality, etc.), especially for people in decision-making bodies.
- Being aware of new tendencies associated with gender equality policies such as the queer perspective or types of feminism such as post-colonial, ecofeminism or intersectionality.
- Creating resource banks with information on biographies and theories made by women in bioscientific research.
- Promoting women's empowerment at the research centre or university, which means increasing women's individual and collective power within the organisation. Emotional intelligence, communication, leadership, and conflict management aspects will be worked on from a gender perspective. More specifically, actions such as creating women's networks, doing training activities in emotional and communication skills, or promoting the participation of women in positions of power (CIRD - Centre per a la Igualtat i Recursos per a les Dones, 2017) [Centre for Equality and Resources for Women] can be carried out.

- Preventing and intervene against sexual and gender-based harassment in research centres and universities, establishing protocols and guarantees (CIRD - Centre per a la Igualtat i Recursos per a les Dones, 2017) [Centre for Equality and Resources for Women]
- Conducting studies and research, based on data analysis, on the employment status of the universities and research centres, segregating data by gender, to be able to highlight possible differences and gender blindness (Stanford University, 2021).
- Innovating the design of any element with a gender perspective and inclusivity. Stanford University has a toolkit for integrating gender in design, a box with very interesting tools to promote designing with gender perspective.
- Ensuring that bioscience research projects are previously designed with a gender perspective (Table 5):

Table 5. Checklist: 10 points to apply gender perspective in biosciences research projects.

Checklist: 10 points to apply gender perspective in biosciences research projects.	
Is gender perspective taken into account in the definition of the project context?	
Do the study groups have gender balance? Can the results be analysed with gender equality aspects? (If possible, according to the living organism under study).	
In the workplaces where the project will be carried out, does the staff there have conditions that allow them to combine work and family life satisfyingly?	
Will the project staff selection be done with a gender perspective?	
Are the skills and attitudes associated with the female gender role equally represented as those associated with the male gender role in the wording and objectives of the project?	

Can the project contribute towards improving equal opportunities?	
Is there a gender balance (at least 50% women) in the consortium, coordination or team at all levels of decision-making?	
Will the coordination team and the research teams decide and design the research in a research environment where equal participation between men and women is promoted (transparent environment, dynamisation of round tables, etc.)?	
Do the research and coordination team members have training in gender perspective? How many training courses in gender perspective have they done and on what topics?	
Have the research and coordination teams made public commitments to gender equality? Which ones?	

07. PEDAGOGICAL RESOURCES

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Biological sciences as a set of disciplines that study life are part of an androcentric scientific culture where gender biases are found both in the production and the transmission of knowledge. They have long suffered from a gender blindness that is not unique to the field of biology, but is also present in many other STEM disciplines.

The *Guide for mainstreaming gender to university teaching in Biology* offers proposals, examples of good practices, teaching resources and consultation tools as a guidance to improve and promote teaching innovation in subjects and study plans that affect different dimensions of the teaching-learning process.

Check out the guides from other disciplines at vives.org

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