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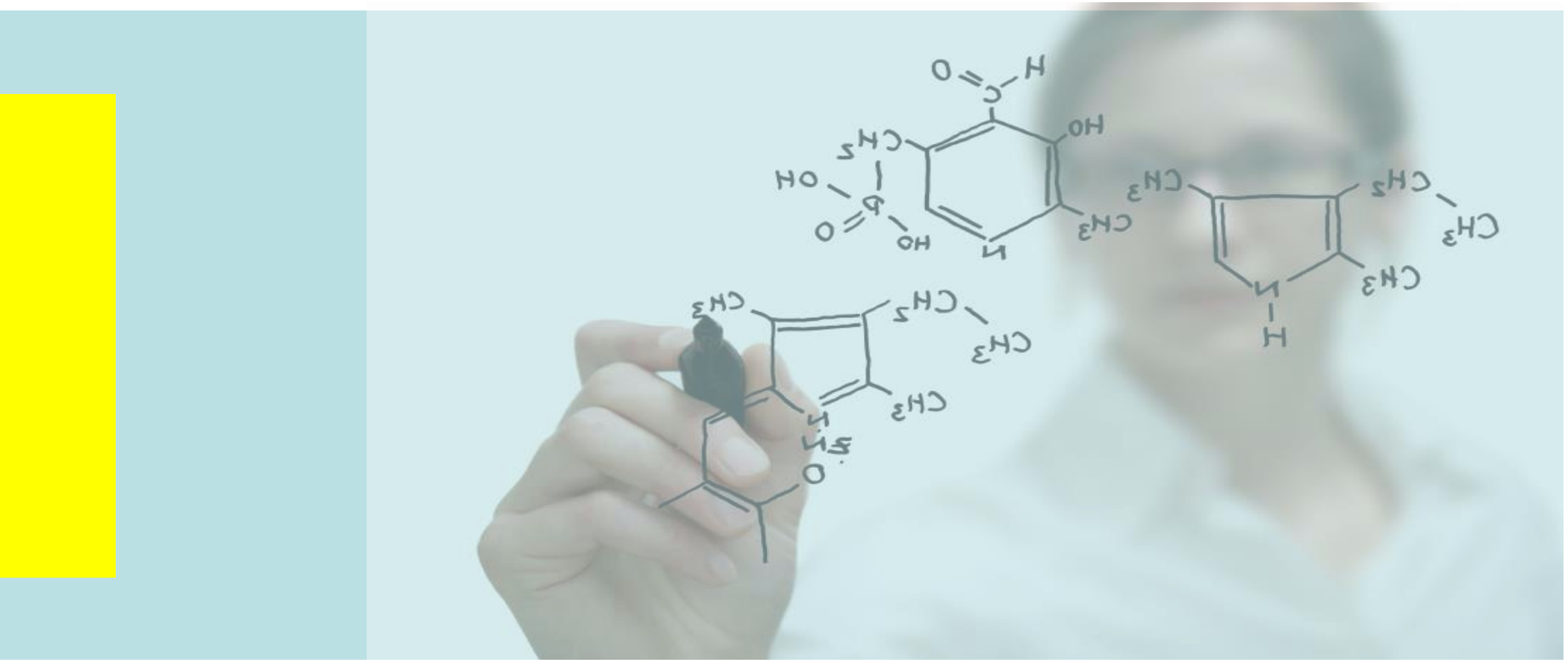
IACCP International Association for Cross-Cultural Psychology Congress

Multiculturalism in a Global Perspective: Benefits and Challenges

1 July - 5 July 2018 The University of Guelph, Canada

Gender gap in STEM and gender portrayal

in science textbooks for upper secondary education



Elena Makarova & Nadine Wenger

The gender gap in STEM fields

- Has been documented at almost all levels of education and career stages and across most OECD countries
  (Lane et al., 2012; OECD, 2006, 2009, 2013, 2017)

- Horizontal segregation fosters the reproduction of gender stereotypes
  (Makarova et al., 2017)

Bridging the gender gap: why do so few girls study Stem subjects?

To attract more girls to study Stem subjects at university, we need to tackle the stereotypes they are exposed to early on

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Theory of Circumscription and Compromise

- Occupational aspirations are incorporated in the individual self-image, which is developed from early childhood through adolescence
  (Gottfredson, 2002, 2005)

> *«Severe threats to sextype […] will be warded off before severe threats to either prestige […] or interests […], because a 'wrong' sextype […] is usually the greater threat to the self-concept»* (Gottfredson, 2002, S. 104).

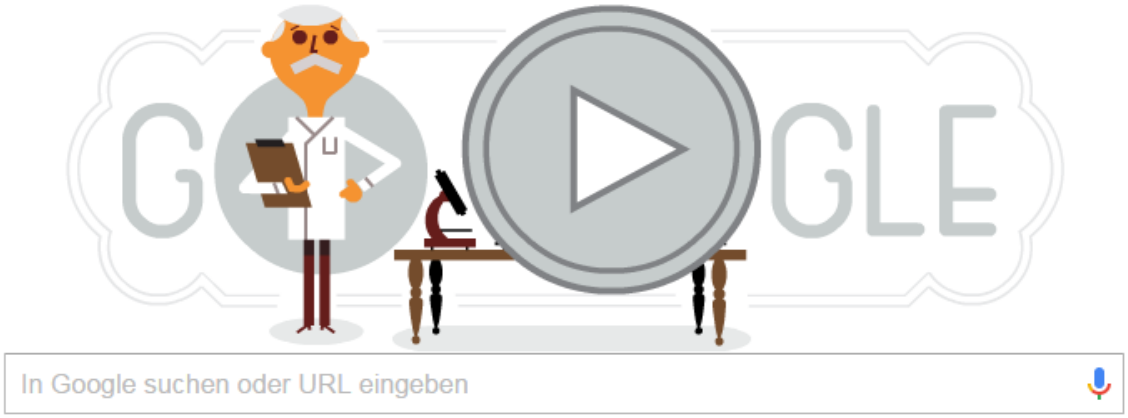
- Research on the impact of the 'matching sextype' on career choice
  (Bubany & Hansen, 2011; Howard et al., 2011; Ratschinski, 2009)

Draw-a-Scientist Test (DAST)

- **28** pictures of a female scientist out of **4807** in total (Chambers, 1983)
- **135** pictures of a female scientist out of **1600** in total (Fort & Varney, 1989)
- **72** pictures of a female scientist out of **223** in total (Huber & Burton, 1995)

Scientist image

«The common image was that of a scientist as a bespectacled male with unkempt hair in a white lab-coat»
(Scherz & Oren, 2006, p. 977).



Scientist image

«*The scientist is a man who wears a white coat and works in a laboratory. He is elderly or middle aged and wears glasses … He may wear a beard, may be unshaven and unkempt*»

(Margret Mead & Rhoada Metraux, 1957, p. 386).

scale), the relativistic time modifications are negligible for travel within the solar system. For example, a man going to Neptune and stopping there, at an acceleration of 10 g, would spend 5 days on the trip but would gain only 1.5 minutes of time.

Then there is the question of the energy involved. The man who travels for 21 years at 1 g reaches a value of γ equal to 1.2×10^8, at which point his kinetic energy is utterly fantastic. If his vehicle weighs (at rest) 1 ton, then its energy content is equal, in round numbers, to the energy released in the annihilation of 10^9 tons of matter, or in the fission of 10^{12} tons of uranium; it would be sufficient to melt the entire crust of the earth to a depth of about 30 miles. The man who makes the more modest trip to Neptune at 10 g reaches $\gamma = 1.0025$, and the kinetic energy of his 1-ton ship (2×10^{17} joules) corresponds to that released in the fission of about 2 tons of uranium; because of the limited efficiency of rocket propulsion, the actual energy needed would be much greater. The use of such energy quantities in a rocket ship is so far beyond any foreseeable practical limits, and the time gain in that case is so small, that it is hard to picture a practical case of space travel in which the time dilatation can be considered important. This conclusion, of course, does not detract from the interest of the fundamental principles involved in the "clock paradox" (4).

References and Notes

1. W. H. McCrea, *Nature* 167, 680 (1951); 177, 784 (1956); 178, 681 (1956); 179, 909 (1957).
2. H. Dingle, *Nature*, 177, 782, 785 (1956); 178, 680 (1956); 179, 865, 1242 (1957).
3. F. S. Crawford, Jr., *Nature* 179, 35, 1071 (1957).

4. I would like to express my appreciation to Frank S. Crawford, Jr., David L. Judd, W. K. H. Panofsky, Henry P. Stapp, and Edward Teller for many useful discussions. Since I have not read widely in the literature of this subject, I apologize to any authors who may have already published any of the material given.

Image of the Scientist among High-School Students

A Pilot Study

Margaret Mead and Rhoda Métraux

This study is based on an analysis of a nation-wide sample of essays written by high-school students in response to uncompleted questions. The following explanation was read to all students by each administrator. "The American Association for the Advancement of Science (*1*), a national organization of scientists having over 50,000 members, is interested in finding out confidentially what you think about science and scientists. Therefore, you are asked to write in your own words a statement which tells what you think. What you write is confidential. You are not to sign your name to it. When you have written your statement you are to seal it in an envelope and write the name of school on the envelope. This is not a test in which any one of you will be compared with any other student, either at this school, or at another school. Students at more than 120 schools in the United States are also completing the statement and your answer and theirs will be considered together to really find out what all high-school students think as a group of people."

In general, the study shows that, while an official image of the scientist—that is, an image that is the correct answer to give when the student is asked to speak without personal career involvement—has been built up which is very positive, this is not so when the student's personal choices are involved. Science in general is represented as a good thing: without science we would still be living in caves; science is responsible for progress, is necessary for the defense of the country, is responsible for preserving more lives and for improving the health and comfort of the population. However, when the question becomes one of personal contact with science, as a career choice or involving the choice of a husband, the image is overwhelmingly negative.

This is not a study of what proportion of high-school students are choosing, or will eventually choose, a scientific career. It is a study of the state of mind of the students among whom the occasional future scientist must go to school and of the atmosphere within which the science teacher must teach. It gives us a basis for reexamining the way in which science and the life of the scientist are being presented in the United States today.

Objectives

Our specific objectives in this study were to learn the following.

1) When American secondary-school students are asked to discuss scientists in general, without specific reference to their own career choices or, among girls, to the career choices of their future husbands, what comes to their minds and how are their ideas expressed in images?

2) When American secondary-school students are asked to think of themselves as becoming scientists (boys and girls) or as married to a scientist (girls), what comes to their minds and how are their ideas expressed in images?

3) When the scientist is considered as a general figure and/or as someone the respondent (that is, the student writer) might like to be (or to marry), or, alternatively, might not like to be (or to marry), how do (i) the postive responses (that is, items or phrases, not answers) cluster, and (ii) the negative responses (that is, items or phrases) cluster?

4) When clusters of positive responses and clusters of negative responses are compared and analyzed, in what respects are the two types of clusters of responses (i) clearly distinguishable, and (ii) overlapping?

5) Is a generally positive attitude to the idea of science, an attitude which we

There is a great disparity between the large amount of effort and money being devoted to interesting young people in careers as scientists or engineers and the small amount of information we have on the attitudes those young people hold toward science and scientists. The Board of Directors of the AAAS has on several occasions discussed this disparity and the desirability of learning more about what high-school students actually think of science and scientists. This paper is one result of those discussions. Hilary Deason, director of the association's Traveling High-School Science Library Program, made all of the arrangements with the high schools and supervised the collection of the students' essays. The analysis of those essays and the preparation of this report were the responsibility of the two authors, Margaret Mead and Rhoda Métraux. Dr. Mead is associate curator of anthropology, American Museum of Natural History, New York, and Dr. Métraux is a research fellow at Cornell Medical College, New York.

Science, 30 Aug 1957: Vol. 126, Issue 3270, p. 384-390

The science-gender stereotype

- Being interested in physics was associated with the male gender (Kessels, 2005; Kessels et al., 2006)
- Being interested in physics endangers the “newly acquired identity as a woman-to-be” (Kessels et al., 2006)
- Science subjects were associated with male traits (Herzog et al., 1998)

The science-gender stereotype

Semantic profiles of gender and science in the perception of female students

Female Traits	Science Traits
Soft	Hard
Playful	Serious
Soulful	Distant
Dreamy	Sober
Lenient	Strict
Frail	Robust
Flexible	Rigid

(Makarova & Herzog, 2015)

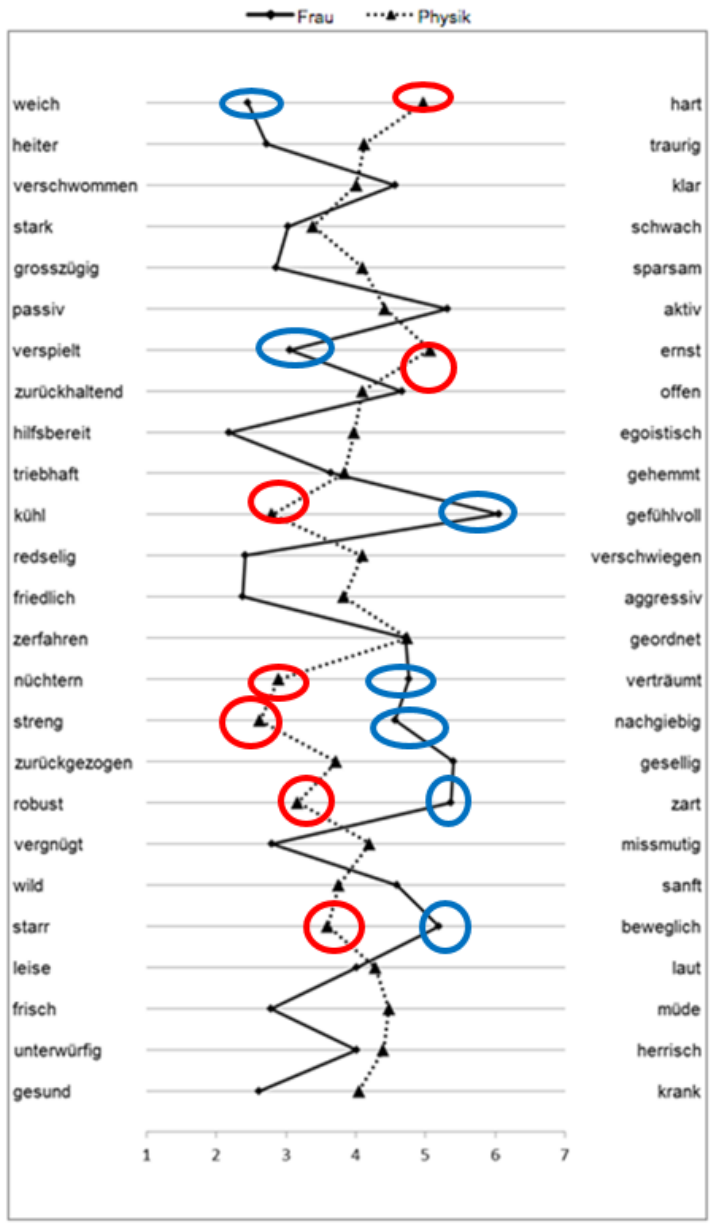
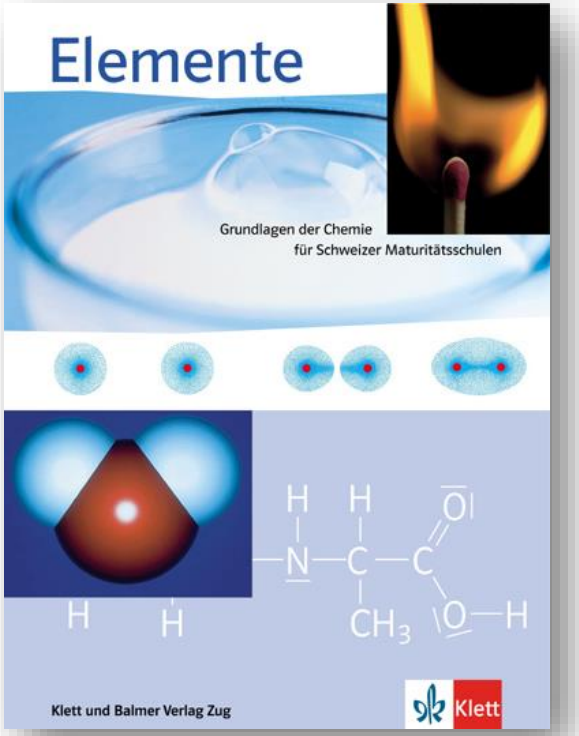
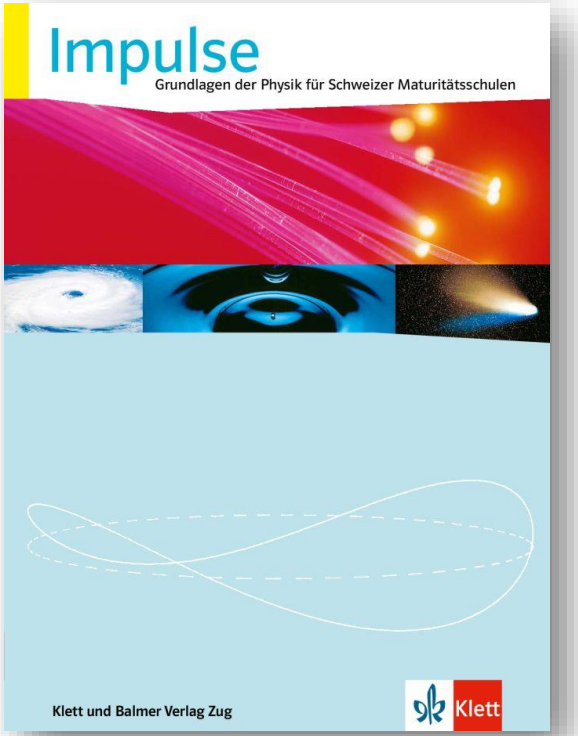
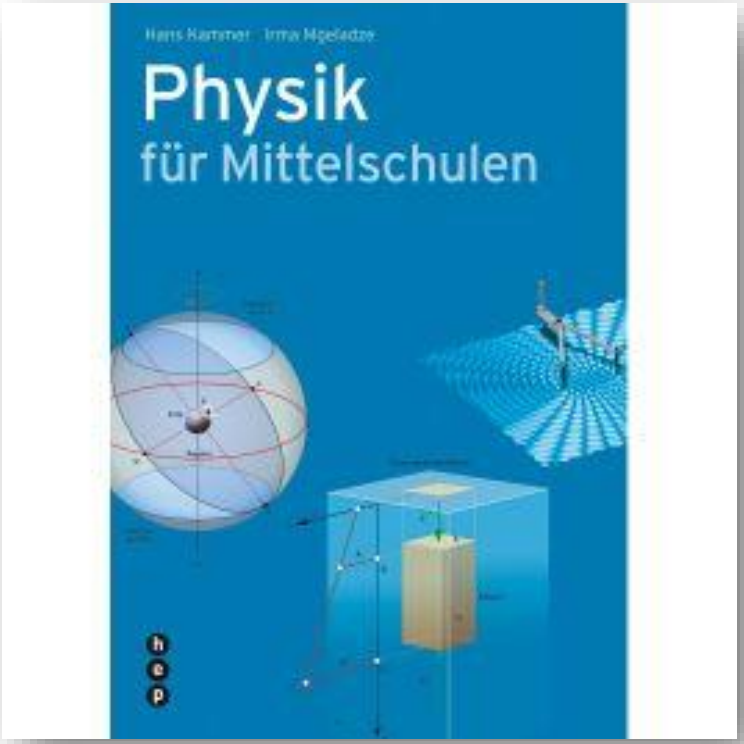


Abbildung 9: Profile Frau und Physik: Perspektive der Gymnasiastinnen

Gender portrayal in science textbooks



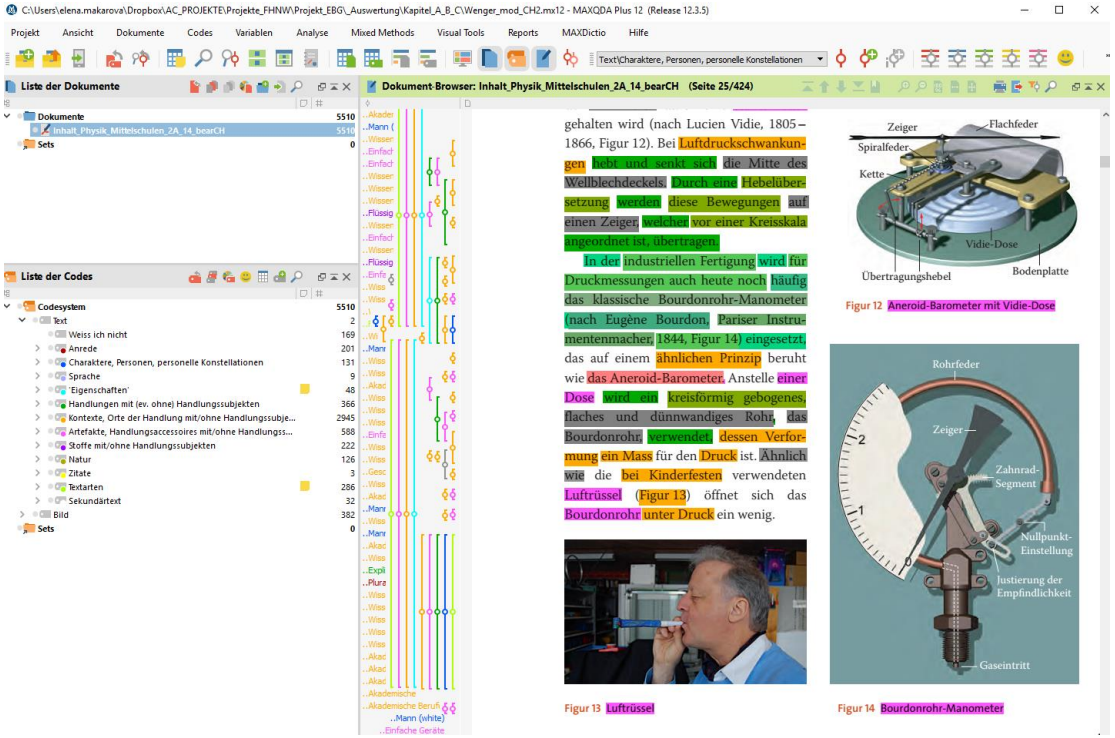




- Stieger, Markus (2010). *Elemente. Grundlagen der Chemie für Schweizer Maturitätsschulen* (3., korr. Nachdruck). Zug: Klett und Balmer.
- Germann, Elisabeth, Jankovics, Peter, Vogel, Werner & Zürcher, Christoph (2009). *Impulse: Grundlagen der Physik für Schweizer Maturitätsschulen*. Zug: Klett und Balmer.
- Kammer, Hans & Mgeladze, Irma (2014). Physik für Mittelschulen (2. Auflage). hep: Bern.

Textbook analysis

- Qualitative content analysis
- Deductive category system
- Two analysis units: text and pictures (e.g., illustrations, photographs, illustrations)
- The smallest text component to be coded comprised a word (e.g., pronoun, noun)
- Pictures were coded either as a whole or one element of a picture was coded (e.g., a male or a female person)

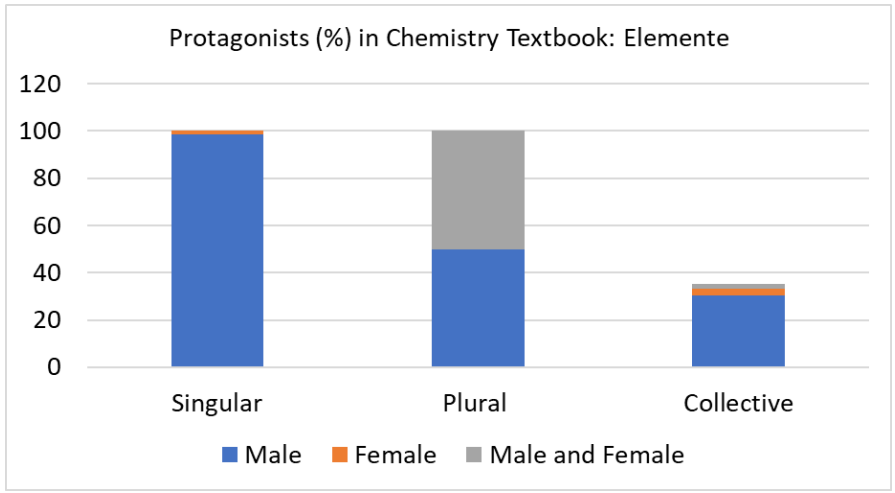


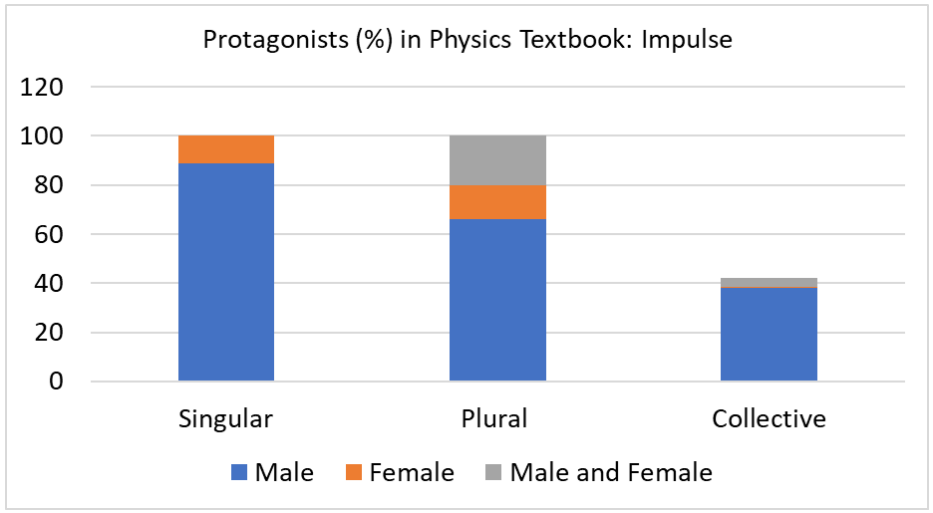
Analysis using MAXQDA software

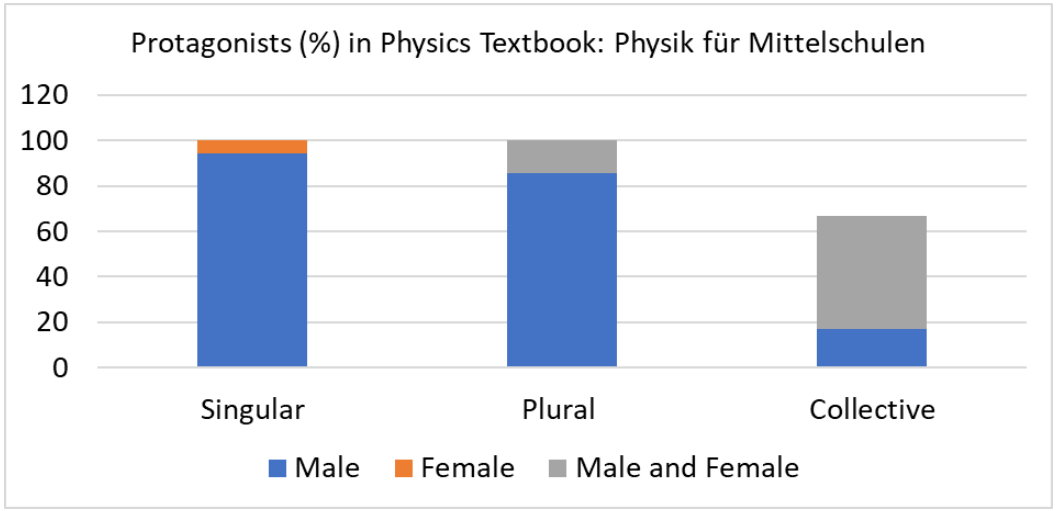
Protagonists in science textbooks: Text analysis

Protagonists	Chemistry: *Elemente*		Physics: *Impulse*		Physics: *Physik für Mittelschulen*	
	N	%	N	%	N	%
Singular	**199**		**548**		**118**	
Male	196	98.5	486	88.7	111	94.1
Female	3	1.5	62	11.3	7	5.9
Plural	**2**		**50**		**7**	
Male	1	50.0	33	66.0	6	85.7
Female	0	0	7	14.0	0	0
Male and Female	1	50.0	10	20.0	1	14.3
Collective	**108**		**197**		**6**	
Male	33	30.5	75	38.10	1	16.7
Female	3	2.8	1	0.5	0	0
Male and Female	2	1.9	7	3.6	3	50.0
Gender- neutral	70	64.8	114	57.9	2	33.3

Protagonists in science textbooks: Text analysis





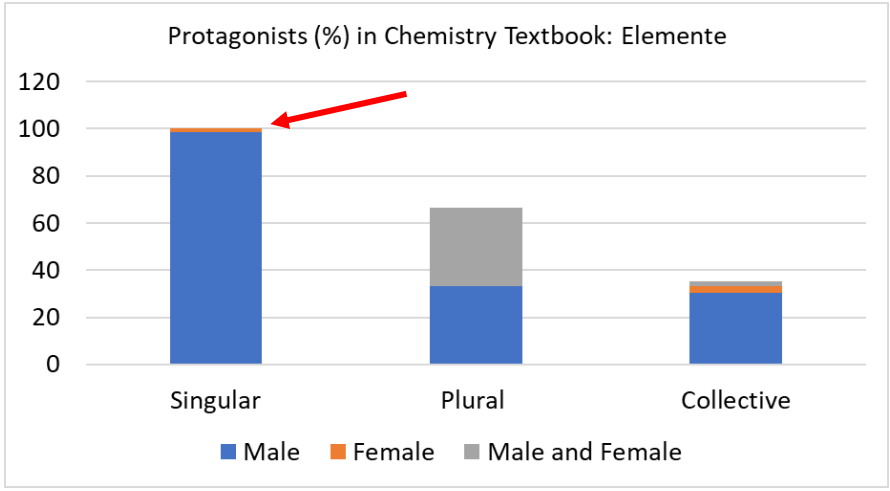


Female Protagonists: Chemistry textbook

“This occurs predominantly when the mother does not produce enough thyroid hormone during pregnancy" (p. 138).

“Since the body of the woman has a lower proportion of water than that of the man, the alcohol consumed is less diluted” (p. 330).

“Therefore, in the formula for calculating the blood alcohol content, [...] a correction factor r is introduced; it is 0.68 for men and 0.55 for women” (p. 330).



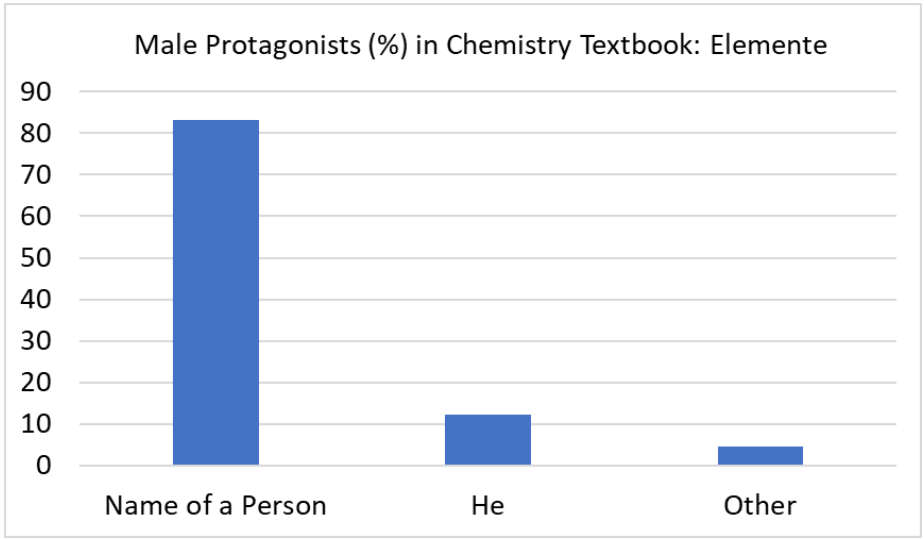
Male Protagonists: Chemistry textbook

“DALTON could not directly prove the existence of atoms" (p. 62)

“VOLTA was Professor of Physics at the Universities of Pavia and Padua in Italy" (p. 263).

“He [DEMOCRITUS] set them [the atoms] firm and differently shaped, but immutable” (p. 62).

A scientist does not speak of energy consumption; a fundamental law of nature states that energy can neither be created nor destroyed” (p. 160).

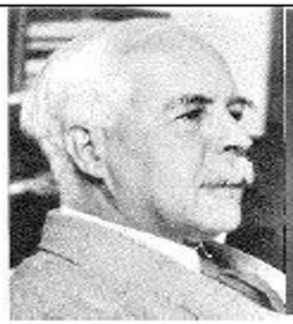


Protagonists in Chemistry textbook: Picture analysis




4 Women
(10.26%)

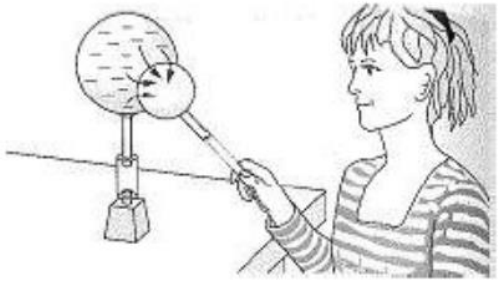



35 Men
(89.74%)

Protagonists in Physics textbook: Picture analysis

(ebd., p. 49)



(ebd., p. 206)

(ebd., p. 273)

28 Women
(30.77%)

Thomas Young

(ebd., p. 321)

Galileo Galilei

(ebd., p. 74)

Hans Christian Oersted

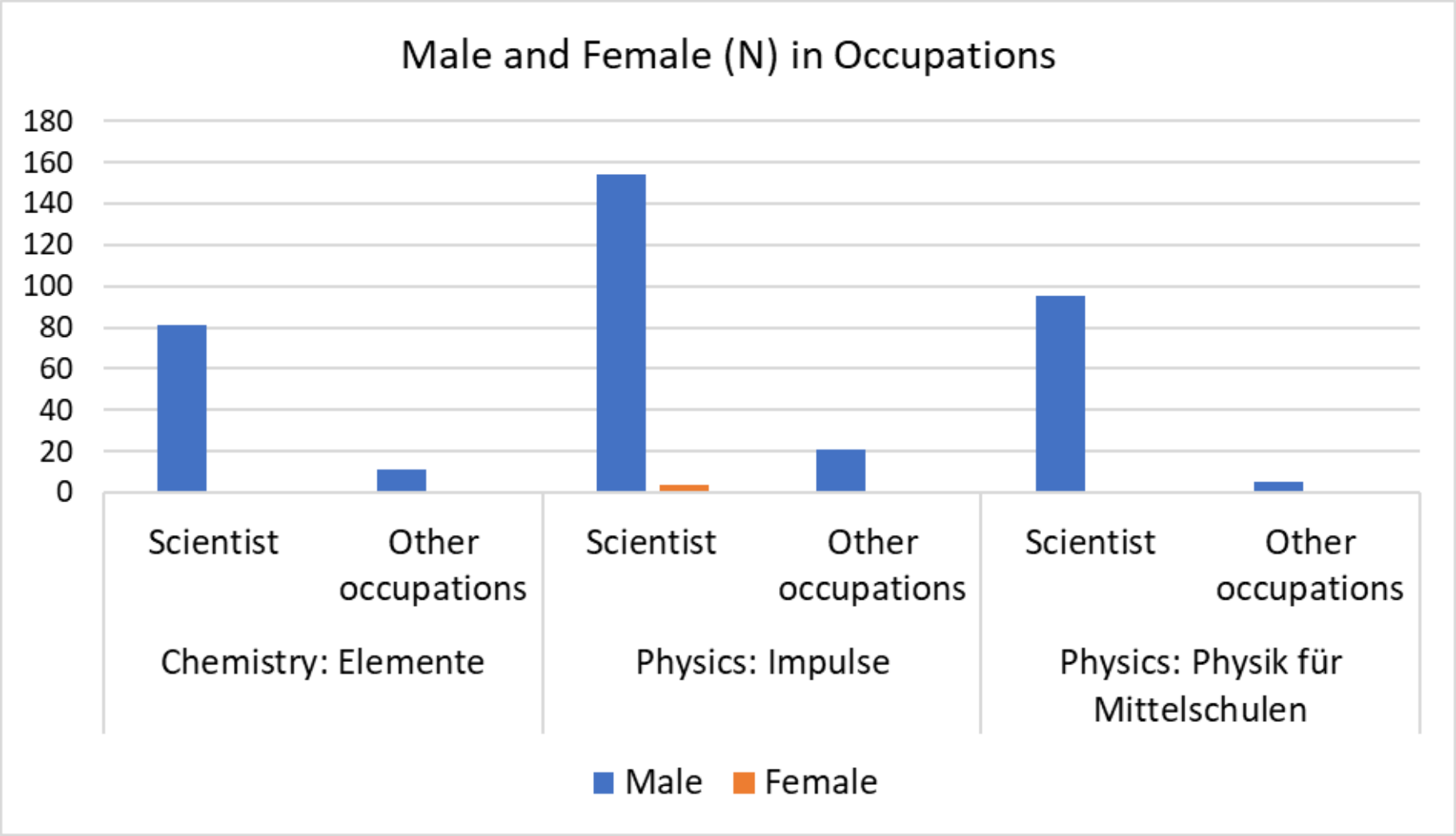
(ebd., p. 204)

Nikolaus Otto

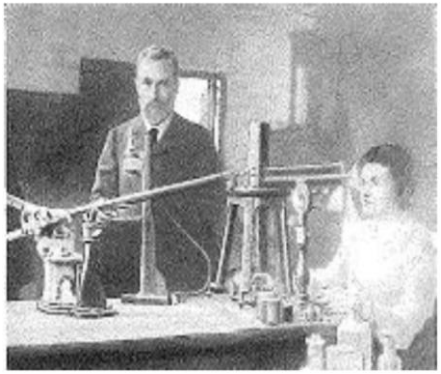
(ebd., p. 195)

63 Men
(69.23%)

Gender representation in occupations: Text analysis

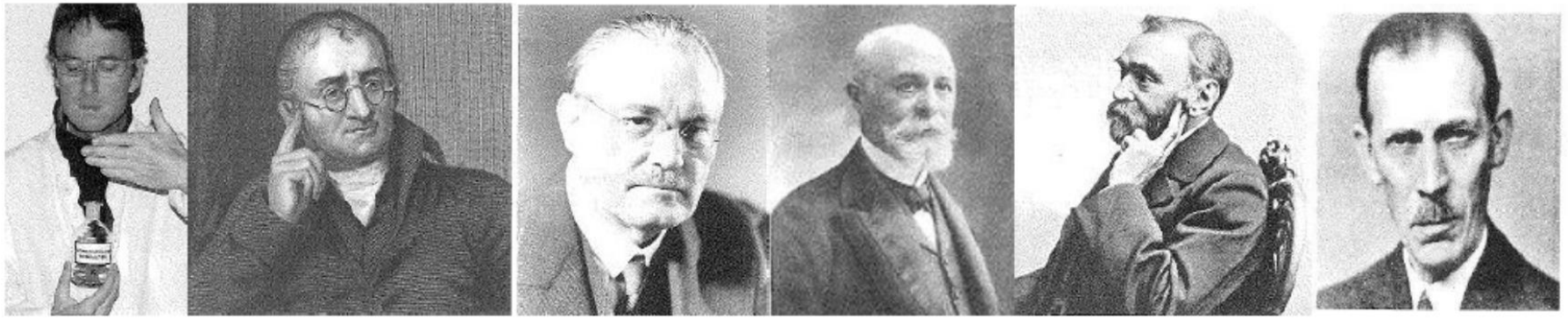


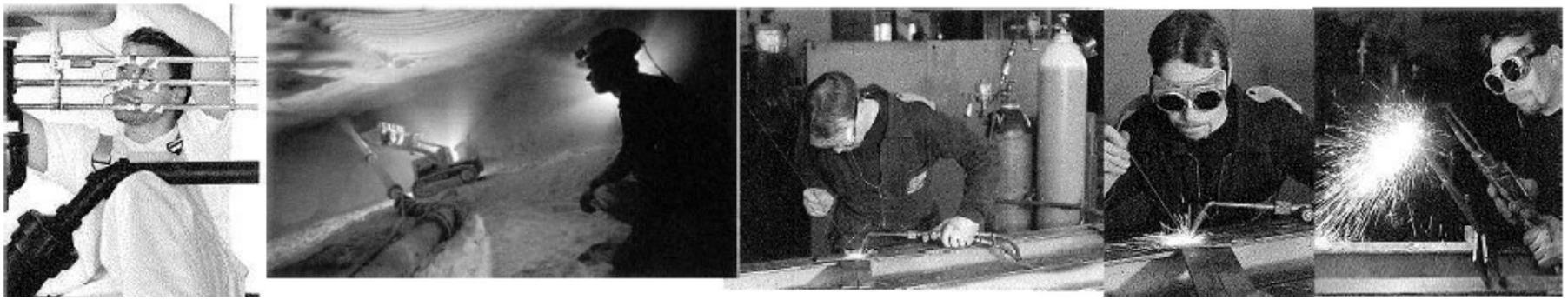
Gender and occupations in Chemistry textbook: Picture analysis



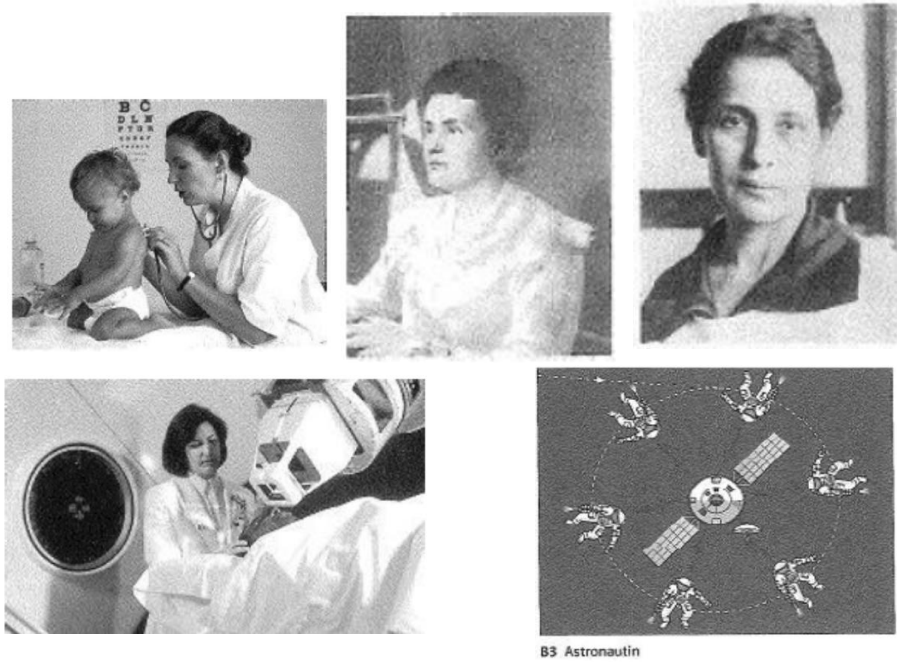
1 Female Scientist
(2.6 %)

37 Male Scientists
(97.4 %)





Gender and occupations in Physics textbook: Picture analysis



B3 Astronautin

5 Female Scientists
(17.9 %)

23 Male Scientists
(82.1 %)

Thomas Young

Galileo Galilei

Hans Christian Oersted

Nikolaus Otto

Summary

- Male protagonists predominated in text- and image-based representations.
- Male protagonists were portrayed in an agentic role, whereas communal traits were attributed to female protagonists.
- Science was represented as a male domain.
- An ongoing project:

gesbi | gender equality school book index

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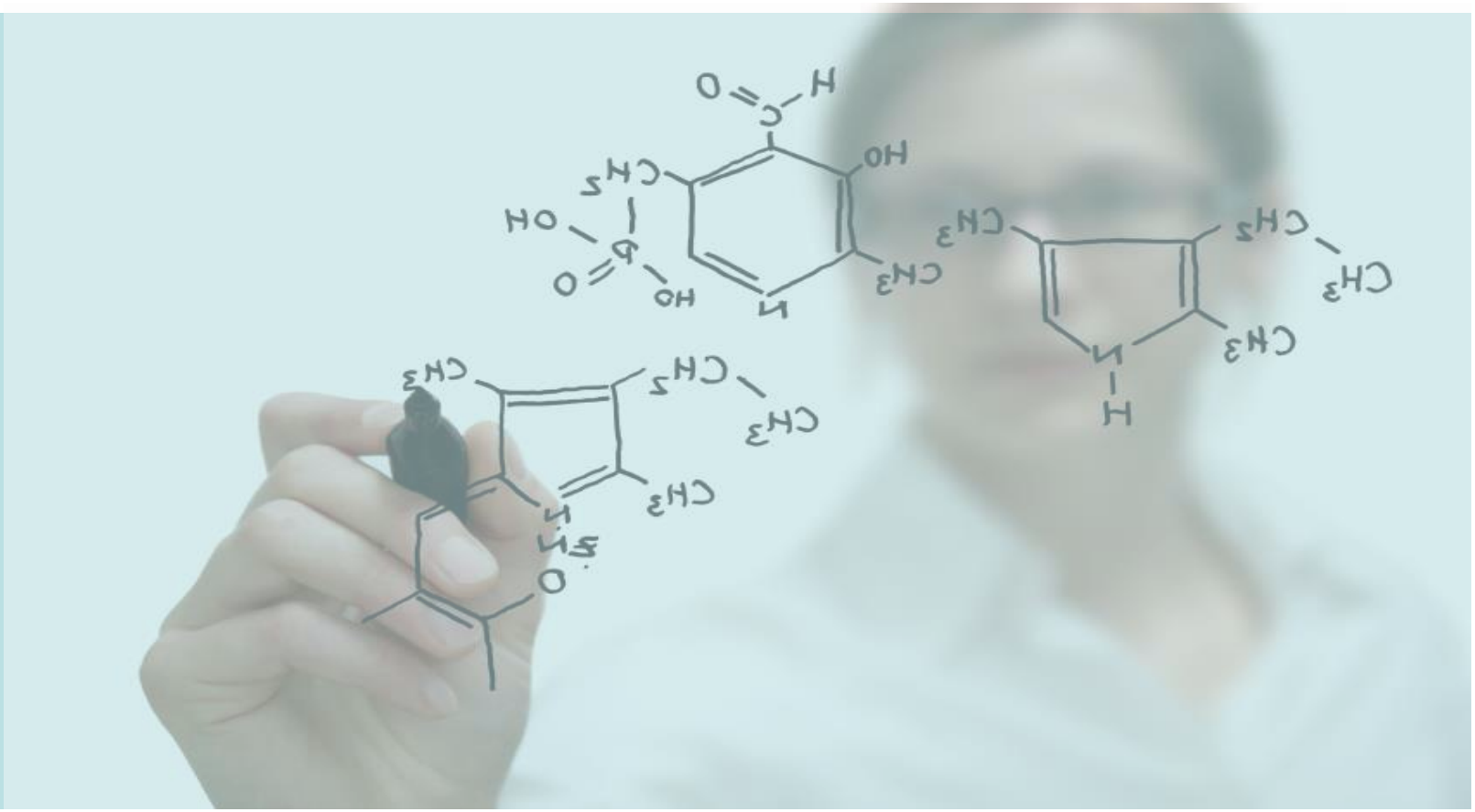

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