

DID I SAY HAIRDRESSING? I MEANT ASTROPHYSICS



A FILM BY

**LEEDS'
ANIMATION
WORKSHOP**

DID I SAY HAIRDRESSING? I MEANT ASTROPHYSICS

Notes to accompany the film by

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CONTENTS

Page 3	SCIENCE, ENGINEERING AND TECHNOLOGY (SET):
	WHY STUDY SET?
	WOMEN AND GIRLS IN SET
Page 5	WHY DON'T MORE WOMEN AND GIRLS ENTER SET?
Page 6	LIFTING THE BARRIERS
Page 8	WORKING WITH SET
Page 9	"THERE ARE NO GREAT WOMEN SCIENTISTS"
Page 10	"YES THERE ARE: BUT YOU'VE BEEN IGNORING THEM"
Page 11	SOME POINTS FOR DISCUSSION
Page 12	SOME PUBLICATIONS
Page 13	ORGANISATIONS
Page 15	OTHER FILMS AVAILABLE FROM LEEDS ANIMATION WORKSHOP

SCIENCE, ENGINEERING AND TECHNOLOGY (SET)

WHY STUDY SET?

- It's fun! Every time we cook a meal, wash our hair, ride a bike, or use the phone, we apply scientific principles. Understanding these principles can enrich our experiences and add to our skills and enjoyment.
- It's important! SET affects almost every aspect of our lives: our homes, food, travel, communications, media, medicine, goods, waste disposal and the "natural" environment. Understanding the science, engineering and technology involved helps people make better choices - as individuals, as workers, as consumers, as citizens - and influence change.
- It makes you employable! There are often skill shortages in SET-related fields, offering a wide range of satisfying and well-paid careers.

WOMEN AND GIRLS IN SET

It is in the interests of society as a whole that women should be equally involved in work that increasingly affects all our lives. Women need to understand and be informed about SET so as to play an equal part in changing things for the better, and deciding what kind of changes we need.

There are now as many women as men in the paid workforce of most countries. But although equal in numbers, women still earn on average 20% less. This is the result of gender-based job segregation, both horizontal and vertical. In northern Europe, half of all women and men occupy posts in which their own sex outnumbers the other by more than 9:1. Female-dominated occupations are characterised by lower status, poorer pay and fewer opportunities for development, training and promotion.

Women are heavily under-represented in most areas of SET, and the more senior the position, the smaller the proportion of women becomes.

In the UK, only one generation ago, girls and boys were compulsorily taught a different curriculum, and in many schools, boys learned science and technology while girls learned "domestic science". Recent educational reforms have prevented girls dropping maths and science by the age of 16, and girls now outperform boys in these subjects. But between the ages of 16 and 19, there is a marked gender division. Hardly any young women enter modern apprenticeships in engineering, manufacturing or the motor industry. Of those staying on at school, young women perform slightly better than young men in maths, physics and chemistry 'A' levels, but only a small percentage of them go on to study these subjects at university: most prefer biology or medicine.

More women are lost to SET during their university studies: they drop out or transfer to other courses; and fewer women stay on to study at post-graduate level. Employers in workplaces that have not traditionally employed women are less likely to be aware of equal opportunities issues and good practices (eg. good maternity leave provision, career breaks, job-sharing, etc.) Therefore, many women who have the main responsibility for children leave SET jobs, in favour of more 'family-friendly' employment.

In the UK between 1981 and 1992 the proportion of women working in SET overall rose from 18.5% to 19.5%, but there was still a high degree of job segregation within that total.

A 1997 report showed that women researchers applying for grants had to be 2.6 times as productive as men to achieve the same peer review ratings. These findings, which are in agreement with studies in other fields, were at the Medical Council in Sweden - recently named by the United Nations as the best country in the world for equal opportunities, and with the freedom of information legislation that made it possible to obtain the necessary records. Elsewhere, there is less equality of opportunity, and less legal right to information.

Female A Level students - proportion of all students, by subject, 1997

Biological science	60.4%
Chemistry	43.4%
Maths	34.8%
Physics	21.5%
Craft, Design, Technology	18.7%
Computer studies	16%
<i>Total sciences</i>	39.7%
<i>Social sciences</i>	53%
<i>Arts subjects</i>	66.5%

Female university students - proportion of all students, by subject, 1997

	<u>graduates</u>	<u>postgraduates</u>
Biological sciences	61.1%	53.1%
Medicine & dentistry	48.2%	47.6%
Mathematical sciences	39%	27.2%
Physical sciences	37.7%	31%
Computer sciences	20.7%	23.3%
Architecture, bldg. & planning	21.7%	38.5%
Engineering & technology	15%	14.7%
<i>Total SET</i>	38.8%	35.4%
<i>All subjects</i>	51.1%	48.7%

Female Open University students - proportion of students completing advanced electronics courses, 1992

Microprocessor based computers	9.22%
Digital communications	3.34%
Electronic materials & devices	2.61%
Analogue & digital electronics	2.47%
Control engineering	1.32%
<i>All Open University course subjects</i>	50%

Women in SET jobs - proportion of employees by subject area, 1991

Biological scientists	33%
Chemical scientists	20%
Electronics, planning & quality control	11-12%
Engineering	2-6%

WHY DON'T MORE WOMEN AND GIRLS ENTER SET?

Some common problems, as seen in "Did I Say Hairdressing?"

Girls and boys are often treated differently from birth: *"Which one's the boy?"*

Low expectations of girls: *"Only a son," he said, "can inherit my genius."*

Girls are often discouraged from using technical equipment: *"Don't go near," he said, "or they will cut you to pieces."*

Women have to perform better than men to achieve equal treatment: *"You must win the Golden Medal of the School of Science..."*

Cultural assumptions: *"This is a Site of Sexist Stereotyping and Intimidation."*

Old-fashioned prejudice: *"Girls can't do science..."*

Lack of positive images and role models: *In the School of Science, the portraits of scientists are almost all men.*

Women are often made to feel conspicuous: *"Did you understand that, girls?"*

Boys are often brought up to be more competitive: *"She even had to fight to get a turn on the equipment."*

SET workplaces may not be family-friendly: *"I don't want any women on my project. They go off and have babies."*

Sexual harassment: *"You'll be the best-looking scientist in this department."*

Discrimination - for instance being given lower status jobs: *"He told her to make tea and sweep the carpets."*

Women have often been denied credit for their work: *"When the results were published... her name did not appear."*

Women are often not promoted to the same extent as men: *"You are only an assistant, and you always will be."*

Women's achievements throughout history are undervalued: *"There are no great women scientists."*

Workplace culture often excludes women: *"Women are made invisible here..."*

Molly's Pumpkin Carriages

Electrical power can be obtained from fruit and vegetables.

If you dip two different metals in a chemical bath, a difference in potential will appear between them, and an electrical charge will pass through a wire connecting the two metal terminals.

A fruit or vegetable will become a source of electrical energy if two nails, one copper and one zinc, are stuck into it and connected with a wire.

HOW TO LIFT THE BARRIERS

In early years:

Give girls and boys equal encouragement and access to activities, knowledge and skills

In education:

make teaching and learning gender-inclusive
challenge sex role stereotypes and assumptions
ensure language, classroom interactions, teaching and assessment methods are free from gender bias
make students aware of historical bias, and encourage questioning
include references to both women's and men's achievements in the history of technology
build on women's prior and informal experiences of SET
provide opportunities to see SET problems in a social, ethical or environmental context
because women in SET often feel isolated, offer female-only courses, networking and mentoring schemes

In the job market:

provide equal opportunities training for managers and other staff
monitor equal opportunities policies to ensure they are effective
train interviewers to recognise and avoid stereotyping assumptions
provide images of women as well as men in relevant literature
ensure equal representation of male and female managers at recruitment fairs etc.
ensure equal encouragement and access to further training and career development
calculate 'academic age', rather than chronological age, of women applicants following a career break

In the workplace:

family-friendly policies, for male and female employees, eg flexible working, career breaks, emergency leave for parents and carers, maternity/paternity benefits, part-time work, job-sharing, childcare facilities, etc.
'keep-in-touch' and 'return-to-work' schemes for women on maternity leave - equipment and procedures change fast in SET fields, so knowledge and skills soon become out of date

Charter For Women In SET:

(Drawn up by **The Science Alliance**, a group of unions representing over 200,000 SET workers)

- equal pay on appointment, and throughout their careers, for women and men with comparable knowledge, skills, qualifications and experience;
- non-discriminatory promotion and reward systems, with fair and transparent procedures;
- an equal chance for women to be acknowledged for excellence in teaching, research, development and the application of ideas;
- equal access and transparent standards for all aspects of peer review;
- family-friendly policies which enable women to combine domestic responsibilities with a career;
- equal access to all conditions of employment, with pro-rata entitlement for those on part-time or atypical working patterns;
- equal access to training, research time and facilities;
- appointments to fixed-term contracts only in exceptional circumstances;
- management procedures for dealing with discrimination, including harassment;
- targets, timetables and effective monitoring systems to ensure that these goals are properly implemented.

WORKING WITH SET

Many people don't realise that jobs in SET can be full of human interest: engineers don't just build motorways, they also design body scanners. Most jobs in SET require not only an understanding of maths, physics, biology or chemistry, but also good interpersonal and communication skills. The image of the scientist as a lonely, eccentric character is out of date: team discussions and group involvement are an integral part of almost all SET work. Nowadays, very few SET jobs require brute strength or steel-capped boots - though they do usually need computer skills.

Science qualifications are essential or helpful in most jobs and careers: whether nursing, catering or hairdressing.

Examples of jobs for science graduates, as advertised in *New Scientist* magazine:

Analyst/programmer: working on international cancer trials.

Astronomer: making observation, interpreting data, involvement in space missions.

Biochemist: investigating the results of cancer treatment.

Biochemist: medical research into obesity and metabolic disease: clinical trials.

Chemical engineer: designing improvements for Blood Transfusion Service.

Chemist: developing lubricants and detergents, working with customers and on the Internet, as part of a team

Chemist: develop bakery products, manage projects, advise customers, communicate with suppliers

Chemist: analysing pesticide residues.

Engineer: study/design/review pharmaceutical machinery; presentations to clients.

Engineer: developing methods of working in space; making safe space-ships.

Environmental scientist: impact assessment of civil engineering projects.

Field study residential instructor.

Geo-ecologist: work on ecology of the atmosphere and aquatic systems.

Information scientist: work on food allergy and intolerance; maintain databank, produce bulletins.

Journalists and report writers for environment protection agency.

Marine conservation officer.

Medical technical officer: research, travel for donor organ retrieval, part of liver failure unit team.

Overseas development: research on natural resources management.

Physicist: research into protective clothing and textiles.

Physicist: work on car safety measures.

Programmer: work on study of heart disease.

Statistician: investigating relapses following treatment of childhood leukaemia.

TV researchers for science/natural history series.

Zoologist: studying animal behaviour.

"THERE ARE NO GREAT WOMEN SCIENTISTS"

The Mother of Invention

It is now known that women were at least equally represented amongst the very first scientists and technologists. Many important prehistoric discoveries and inventions, for example in agriculture, pottery, textiles and medicine, it is believed, were made by women.

For most of recorded history, however – at least from the time of the Ancient Greeks until the latter part of the 20th century - women have been denied access to education. They were forbidden to enter universities or libraries, or to take up any profession outside the home. For hundreds of years, most people believed that the study of science or mathematics was bad for a woman's health and character, and would interfere with her ability to have children. She was supposed to devote herself to looking after others.

For centuries, women had few civil rights, and for them to be seen or heard in public as individuals, without chaperones, was "not respectable". The extent to which women were imprisoned by family life is difficult to imagine now: but until the mid-20th century there was almost no possibility of divorce, no means of birth control, and very little opportunity to lead an independent life as a woman.

Until the introduction of universal free education, most men were also excluded from pursuing scientific research unless they had money. But wealth, too, was almost impossible for women to achieve: in the UK, for example, until the Married Women's Property Act of 1882, anything a woman had became the legal property of her husband as soon as she was married.

When gifted women did manage to overcome the obstacles placed in their way and made discoveries, wrote books or created inventions, they generally found their achievements were credited to their husbands, brothers, or fathers, on the grounds that a woman could not do such things.

Women were amongst the first healers, herbalists and midwives, but were not allowed to study medicine professionally in any numbers until well into the 20th century: there is more than one case in history of a determined woman disguising herself as a man in order to practise as a doctor. Fellowship of the learned societies was also closed to women until very recently: the Royal Society admitted women fellows for the first time in 1945.

Fields where women are still least represented are those allied to physics – which, historically, was closely linked to religious study; and engineering, which was from ancient times seen as part of advanced military training. As there have been extremely powerful cultural taboos on women entering either the priesthood or the army, it is not surprising that these barriers have been slow to fall. It is also interesting to note that space travel and defence are the areas of science, engineering and technology which have persistently been able to attract the highest levels of research and development funding, from governments all over the world.

"YES, THERE ARE: BUT YOU'VE BEEN IGNORING THEM"

Agnodike of Athens [4th-3rd century BC] doctor: originally disguised as a man in order to be allowed to study.

Hypatia of Alexandria [370-415] mathematician, and inventor of scientific instruments: the astrolabe and the hydrometer.

Trotula [?d.1097] her book "On the Diseases of Women" was a standard medical text for hundreds of years.

Hildegard of Bingen [1098-1179] naturalist and medical writer.

Maria Cunitz [1610-1664] astronomer who devised tables for calculating positions of the planets.

Anna Morandi Manzolini [1716-74] internationally famous medical anatomist.

Caroline Herschel [1750-1847] astronomer

Mary Somerville [1780 - 1872] mathematician

Miranda (James) Barry [1795-1865] enrolled at university in 1809 disguised as a man, became eminent doctor; gender discovered on her death.

Ada Byron Lovelace [1815-52] "the mother of computer programming".

Ida Hyde [1857-1945] physiologist, invented the microelectrode, 1921

Marie Sklodowska Curie [1867-1933] discovered radium; only person to receive Nobel Prize for both chemistry and physics.

Irene Joliot-Curie [1897-1956] daughter of Marie. Nobel Prize for chemistry.

Barbara McClintock [1902-1992] geneticist, awarded Nobel Prize for medicine, 1983

Maria Goeppert-Mayer [1906-72] Nobel Prize for physics, 1963

Grace Murray Hopper [1906-92] mathematician, devised the computer language COBOL, 1960

Rachel Carson [1907-64] marine biologist, alerted the world to the dangers of pesticides.

Chien-Shiung Wu [1912-97] nuclear physicist

Janet Vaughan [1899-1993] devised effective treatment for anaemia; important work on the effects of radiation on bones, and on the storage and administration of donated blood.

Dorothy Hodgkin [1910-94] crystallographer, discovered structure of penicillin, vitamin B12 and insulin. Nobel Prize for chemistry 1964.

Rosalind Franklin [1920-58] one of those who discovered DNA structure

Rosalyn Sussman Yalow [1921-2011] nuclear physicist, Nobel Prize for medicine, 1977

Jocelyn Bell Burnell [1943-] discovered first pulsar (but Nobel Prize later awarded to a man)

And many, many more ...

see for instance

www.britannica.com/EBchecked/topic/1725191/Women-in-Science

SOME POINTS FOR DISCUSSION

Things they have said about SET:

- "Jobs in SET have the reputation of being difficult, dirty, dangerous, and damaging to the environment. But they can be creative, cooperative, caring, and essential to conservation."
- "Girls and women are under-represented in SET as students, teachers and workers. This is self-perpetuating: because there are few role models of women as scientists, technicians or engineers, girls are less likely to choose these careers themselves."
- "Who does more to help people - the therapist who gives grief counselling to the survivors of a fatal accident, or the engineer who designs a safer form of transport?"
- "If there were more women in SET, they wouldn't spend all their time designing space rockets, computer games or flashy cars: they'd work on positive, practical projects."
- "Staff are not able to work to optimum efficiency if they feel uncomfortable, or even undermined, in the work environment."
- "Imagination is far more important than knowledge" - Albert Einstein.

Questions about "Did I Say Hairdressing? I Meant Astrophysics":

- What made Zod a "great man of science"?
- Was Joanne right to free the guinea pig? and was Zod right to be angry?
- When the twins visit Zod's factory, Joseph asks:
"How do you make these?" and Joanne asks:
"WHY are you making them?"
Which question would you ask?
- What made Joanne "uncomfortable at first" when she entered the School of Science?
- The Mother of Invention says: "I taught Zod all he knows - but not all I know, of course."
What does she mean?
- Compare and contrast the books written by Zod, seen at the beginning of the film, with those appearing at the end:

"Bomb-making for Boys" "Sums With Tears" "How to Make Guinea Pigs Very Poorly" "Chemistry - Hard" "Tough Technology" "Behaviour of Dead Rats" "Physics Without Fun" "Very Heavy Engineering"	"Well-Reasoned Recipes" by Zod "Sense and Sensibility in Science" by J. Zod "Fun With Sums for Girls and Boys" by J. & J. Zod "The Health and Well-Being of Animals" by G. Pig "Eco-Friendly Experiments" by J. Zod "Elegant Engineering" by J. Zod "Astrophysics for Beginners" by Dot Zod
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SOME PUBLICATIONS

ALIC, Margaret: Hypatia's Heritage (Women's Press, '86)

BURSZTYNSKY, Sue: Potions to Pulsars - Women doing science (Allen & Unwin, '95)

CARSON, Rachel: Silent Spring (1962)

CARTER, Ruth & KIRKUP, Gill - Women in Engineering: A good place to be? (Macmillan '90)

COCKBURN, Cynthia & DILIC, Ruza Furst (Eds.): Bringing Technology Home - Gender and technology in a changing Europe. (Open Univ., '94)

COMMITTEE ON WOMEN IN SET: The Rising Tide - A Report on Women in Science, Engineering and Technology (HMSO, '94)

DRIVER, Rosalind: The Pupil as Scientist? (OUP, '83)

FAULKNER, Wendy & ARNOLD, Erik (Eds.): Smothered by Invention (Pluto '85)

GORNICK, Vivian: Women in Science (Touchstone, '83)

HARDING, Jan: Perspectives on Gender and Science (Falmer Press '86)

HARDING, Sandra: The Science Question in Feminism (Open Univ., '86)

KELLY, Alison (Ed.): Science for Girls? (Open Univ., '87)

KIRKUP, G. & KELLER, L.S.: Inventing Women: Science, technology and gender (Polity Press '92)

MILLAR, David, Ian, John & Margaret: The Cambridge Dictionary of Scientists

RICHARDS, Alison, & WOLPERT, Lewis: A Passion for Science (OUP '88)

ROTHSCHILD, Joan, (Ed.): Machina Ex Dea - feminist papers on technology (Pergamon '83)

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SPENDER, Dale: Women of Ideas (and what men have done to them) (RKP, 1982)

SPENDER, Dale & SARAH, Elizabeth: Learning to Lose: Sexism and education (The Women's Press, '80)

VARE, E.A. & PTACEK, G: Mothers of Invention (Wm.Morrow, '88)

WAJCMAN, J: Feminism Confronts Technology (Allen & Unwin, '91)

WERTHEIM, Margaret: Pythagoras' Trousers - God, physics and the gender wars (Fourth Estate '97)

WHYTE, J.: Girls into Science and Technology (RKP '96)

ORGANISATIONS

Association for Science Education 01707 283 000 www.ase.org.uk

BBSRC (Biotechnology & Biological Sciences Research Council) 01793 413200 www.bbsrc.ac.uk

British Science Association 0870 770 7101 www.britishtscienceassociation.org

EPSRC (Engineering & Physical Sciences Research Council) 01793 444 000 www.epsrc.ac.uk

The Engineering Council 020 3206 0500 www.engc.org.uk

The Open University 0845 300 6090 www.open.ac.uk

National Alliance of Women's Organisations (NAWO) 0207 324 3045 www.nawo.org.uk

Natural History Museum 0207 942 5000 nhm.ac.uk

STFC (Science & Technology Facilities Council) 01793 442000 www.stfc.ac.uk

Trades Union Congress 020 7636 4030 www.tuc.org.uk

Women's Engineering Society 01438 765506 www.wes.org.uk

Women's Environmental Network 020 7481 9004 www.wen.org.uk

WISE (Women Into Science & Engineering) 01274 436485 www.theukrc.org/wise

Other films available from Leeds Animation Workshop

THEY CALL US MAIDS: THE DOMESTIC WORKERS' STORY women migrant workers
THROUGH THE GLASS CEILING equal opportunities at work
NO OFFENCE harassment at work (sexist, racist and homophobic)
WORKING WITH CARE balancing work, life and caring responsibilities

GRIEF IN THE FAMILY for parents and carers of bereaved children
TEENAGE GRIEF adolescents and bereavement
NOT TOO YOUNG TO GRIEVE for parents and carers of bereaved under-fives

BRIDGING THE GAP parenting teenagers
JOINED-UP FAMILIES being a parent in a stepfamily
OUT TO THE FAMILY about lesbian, gay, bisexual & transgender teenagers

TELL IT LIKE IT IS gender and bullying in secondary school
HOME TRUTHS for children, about domestic violence
A WORLD OF DIFFERENCE racial harassment in schools
BELIEVE ME for children, about sexual abuse
BEYOND BELIEF supporting children who have been sexually abused

DADS INSIDE AND OUT fathers in prison and their children
GOOD TO BE HOME how couples are affected when one of them goes to prison
GIVE US A SMILE street harassment and everyday sexism

EVERYONE CAN SAVE ENERGY fuel saving, for people with learning disabilities
GETTING TOGETHER relationships, for people with learning disabilities
GETTING BETTER primary health care, for people with learning disabilities
GETTING BETTER IN HOSPITAL for people with learning disabilities

EVERYBODY'S DIFFERENT, EVERYBODY'S EQUAL for union equality reps
OUT AT WORK equal rights at work for gay, lesbian and bisexual employees
ALL STRESSED UP stress at work

CROPS AND ROBBERS an international history of trade, food aid, and famine
WHO RUNS THE WORLD? about the World Bank
WASTE WATCHERS energy saving and global warming

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