



Women in Science, Technology, Engineering and Mathematics

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Outline

- What is the Problem?
 - Survival of scientists in STEM fields, especially women
- What is the overall global trend regarding women's entry into STEM fields?
- The Canadian Situation
- What are the barriers to women's participation in STEM fields?
- Work-personal Life Balance

What is the problem?

Despite increase in educational enrolment of girls

- **Women are underrepresented in the fields of science, technology, engineering and Mathematics/computer science (STEM)**
 - most pronounced in the areas with a strong mathematical component such as physics, pure mathematics, computer science and engineering.
 - these fields are generally perceived as having a “male” culture
- **A relatively small number of scientists do reach the top tiers of their professions**
 - but the majority confront a “glass ceiling” which is thicker in some fields of STEM as compared to others
 - the career pipeline continues to leak women because women are dropping out of science at every stage of their careers
 - the playing field is still far from level for women and men

Global Trends



- **Representation of women decreases as they go up the career ladder: the leaky pipeline**
 - sexism deeply rooted in STEM culture
- **Low representation of women in many STEM post-secondary fields and careers**
 - despite trends in increased levels of education of girls in primary and secondary levels
 - girls are outperforming boys in most fields of education
- **Research indicates**
 - new educational methods benefiting girls because they perform better in open-ended, process-based tasks built on realistic life situations
 - boys tend to do better in traditional learning methods and in standardized tests

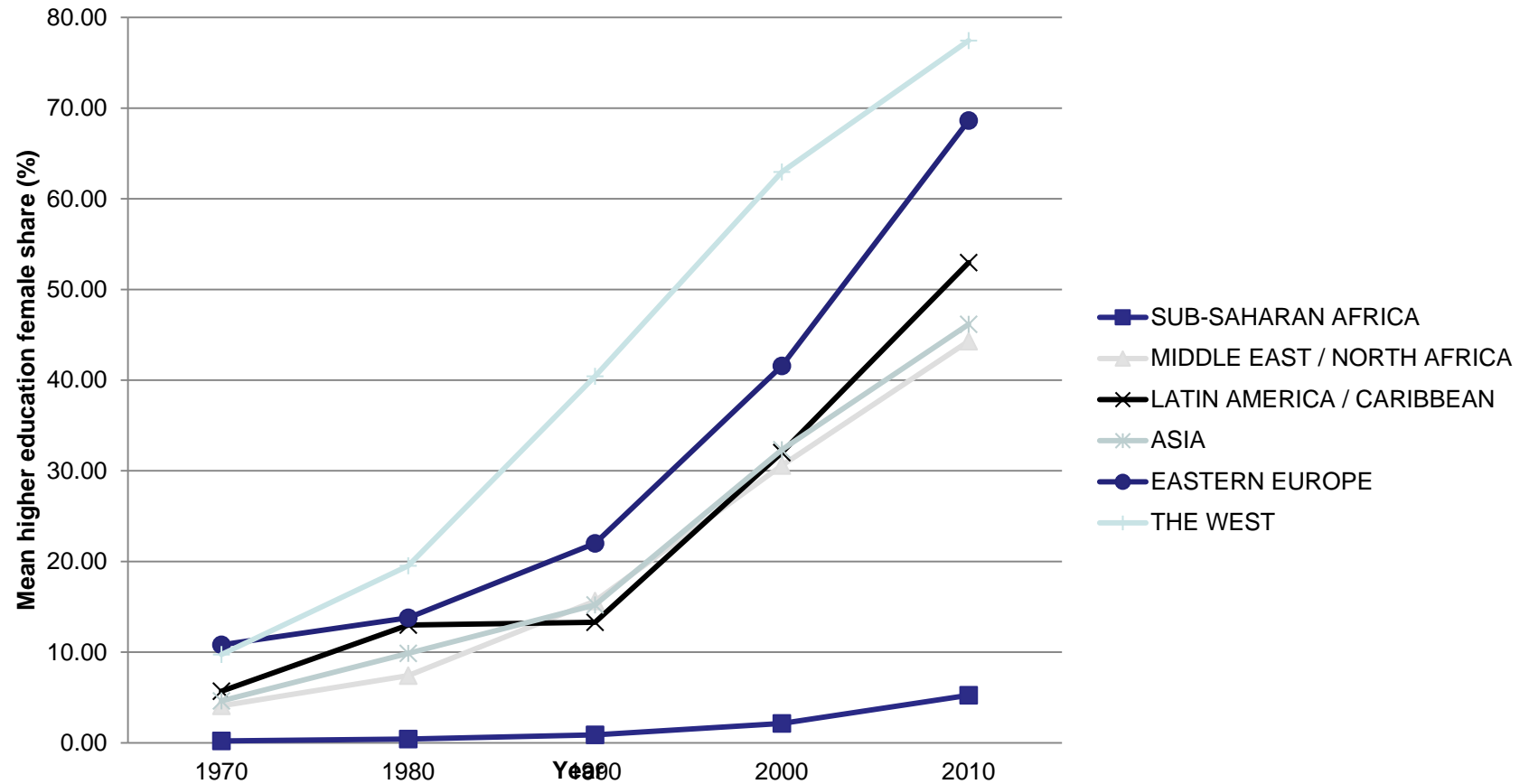
Global trends

- **Expectations (and life choices) for females are defined by gendered sociocultural factors and attitudes:**
 - **Women tend to remain in the education system longer while men join the workforce.**
 - **Marriage, childbearing and childrearing years conflict with career**
 - **Women's different patterns of production (research and publications) are a result of their reproduction functions**
 - **This has implications for careers in physics and mathematics where most original work done in early years**
 - **Work and family still conflicting situations for women**
- **Men trained in STEM fields choosing better paid jobs-**
 - **women filling up vacancies**

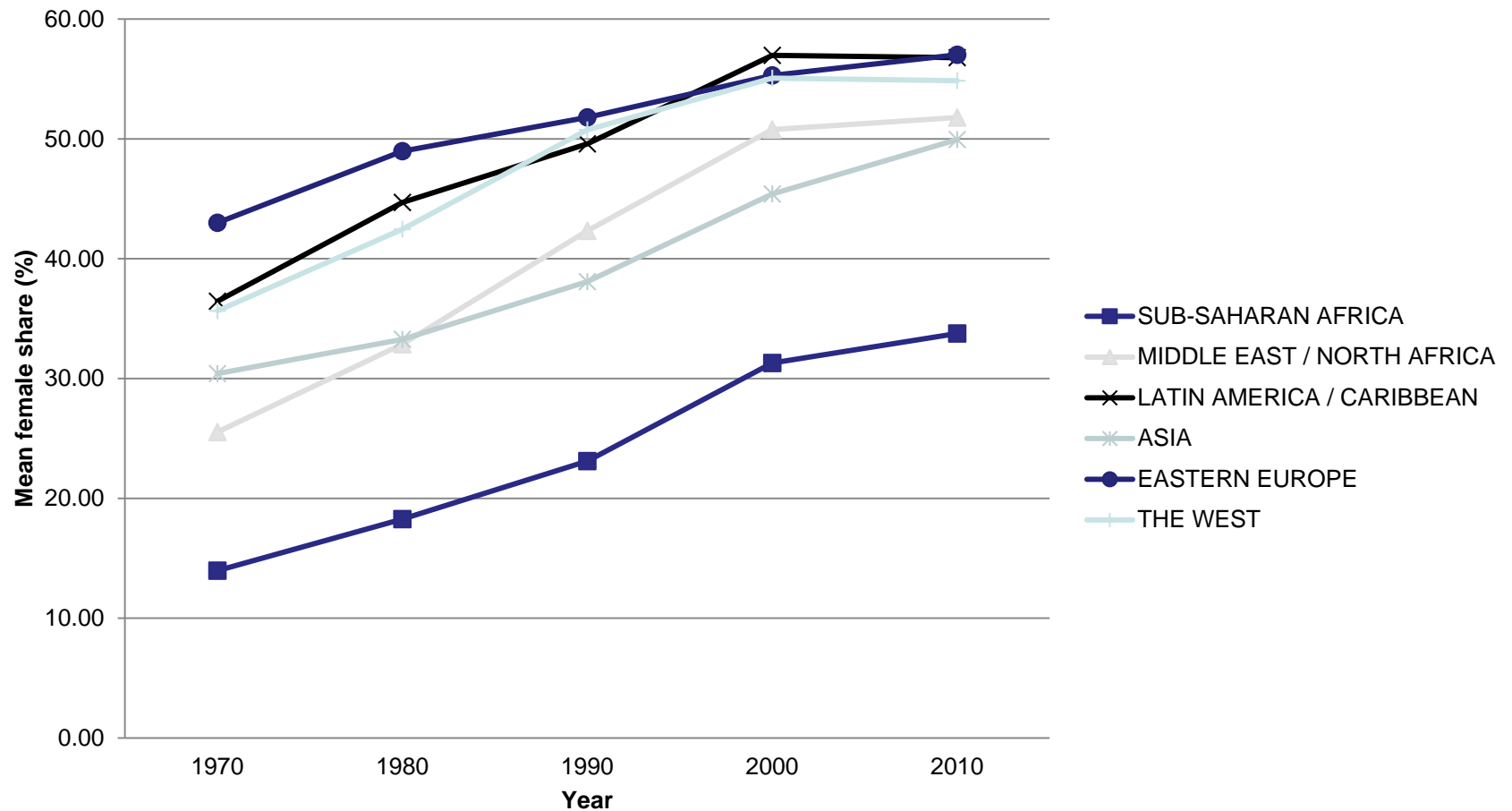
Where is the problem?

- **“Gender” only recently on the agenda of the global science community**
 - **Became an issue probably due to economic implications**
 - **Gender in Science first taken up in UNESCO World Conference in Science , Budapest, 1999**
- **Problems very similar around the world**
- **However, social and cultural differences in Eastern and Western societies make a difference**

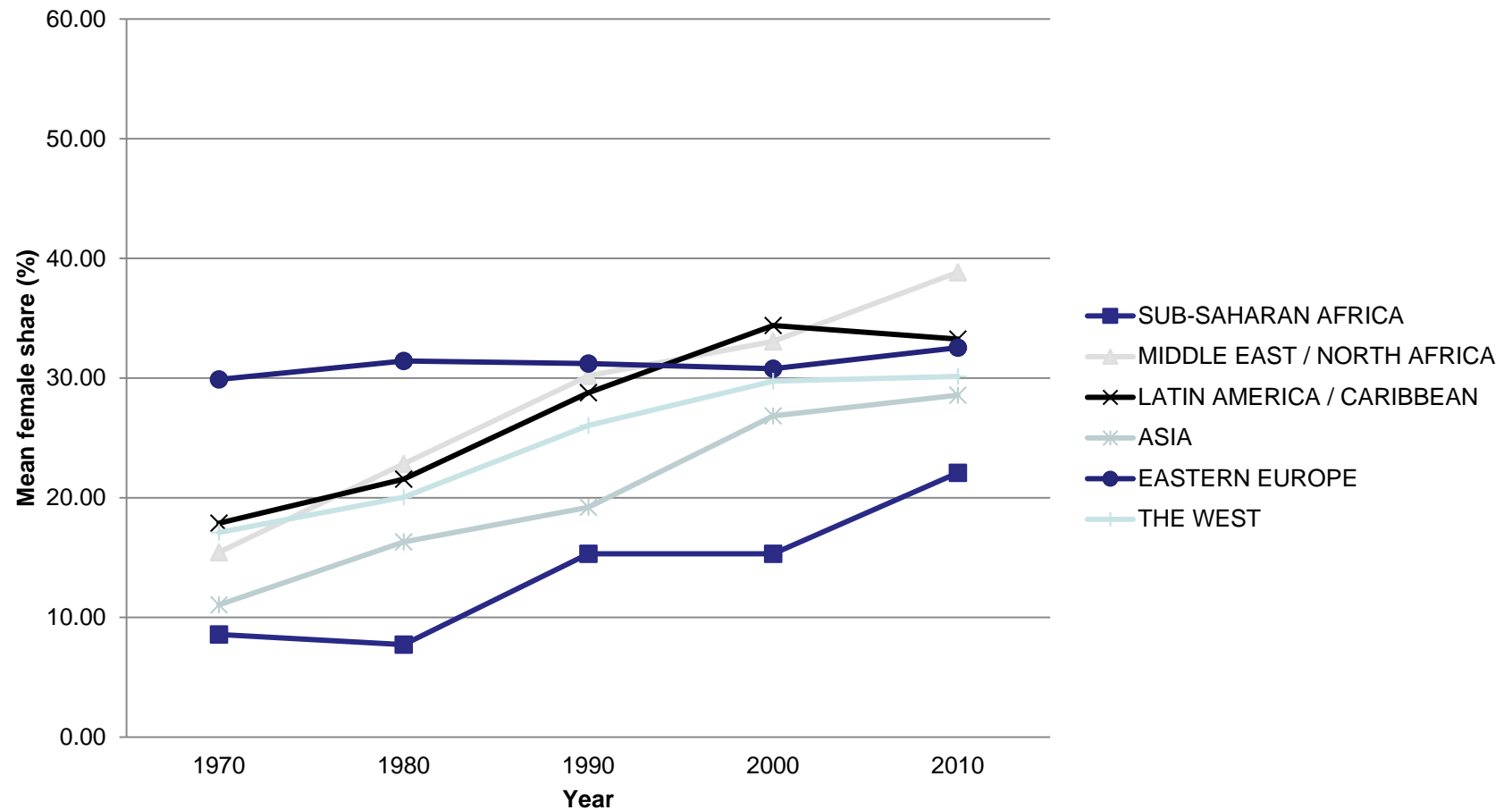
Women's Participation in Higher Education, 1970-2010



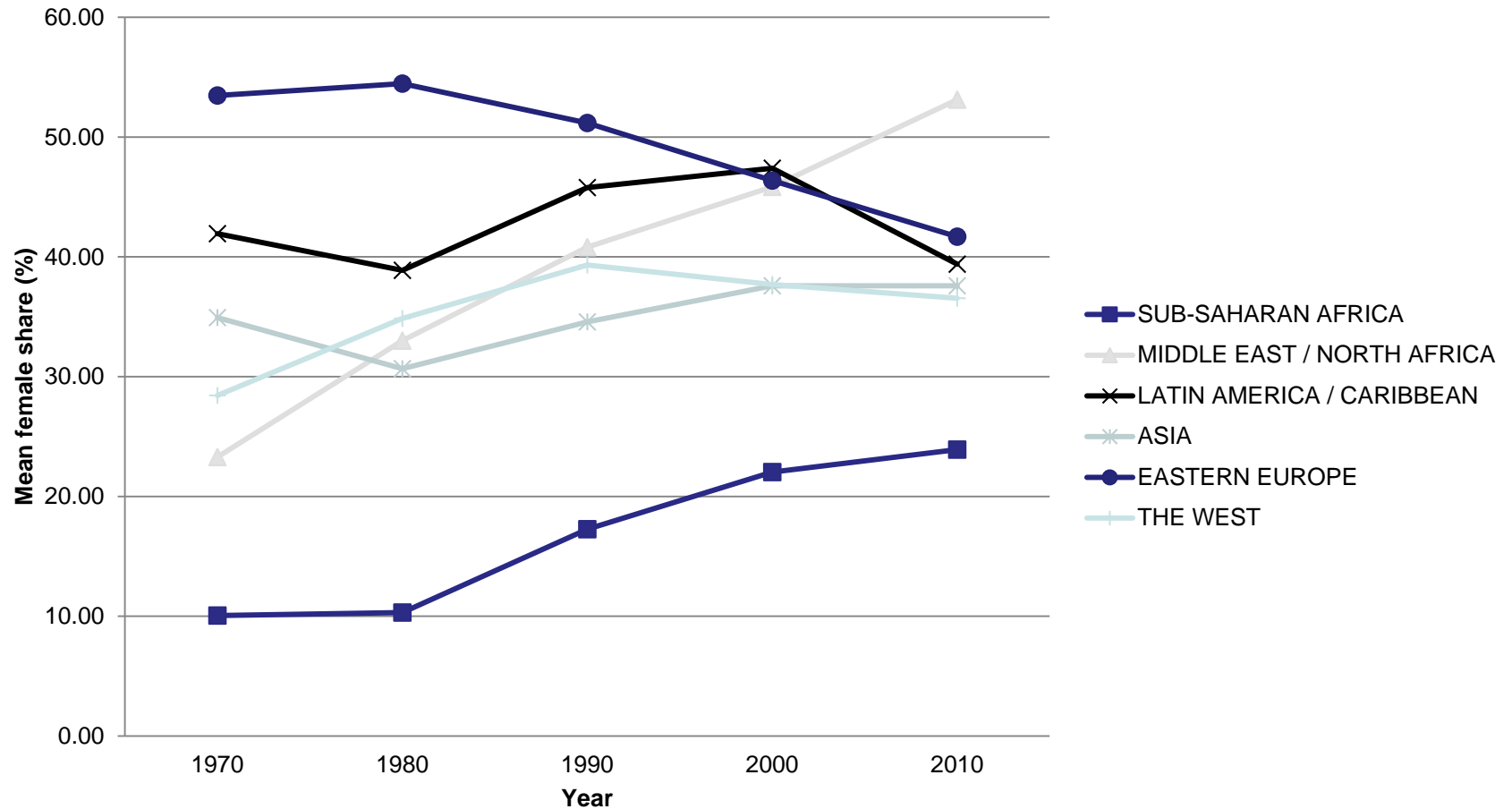
Women's Share of Higher Education, 1970-2010



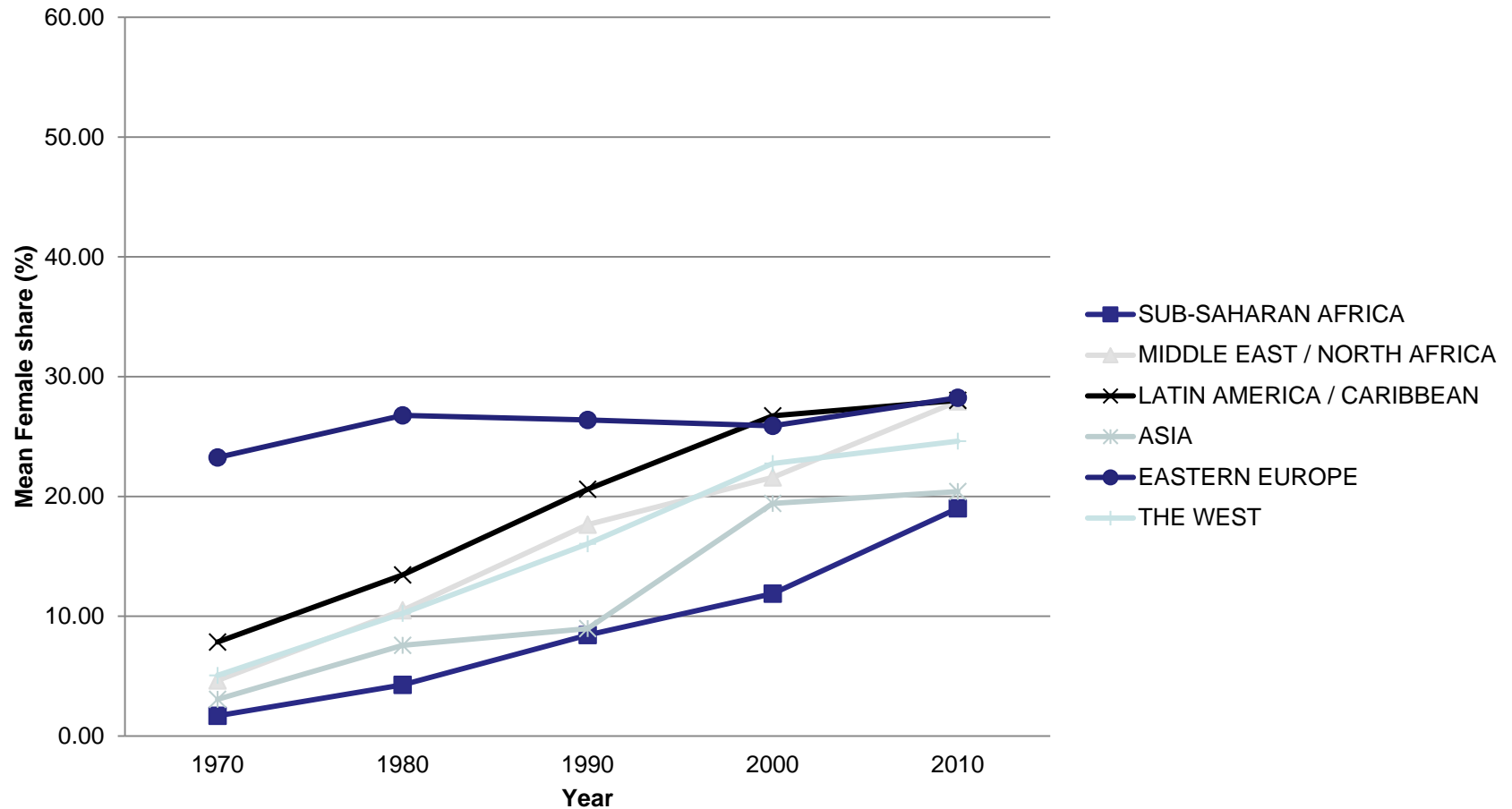
Women's Share in Science and Engineering, 1970-2010



Women's Share of Natural Science, 1970-2010



Women's Share in Engineering, 1970-2010



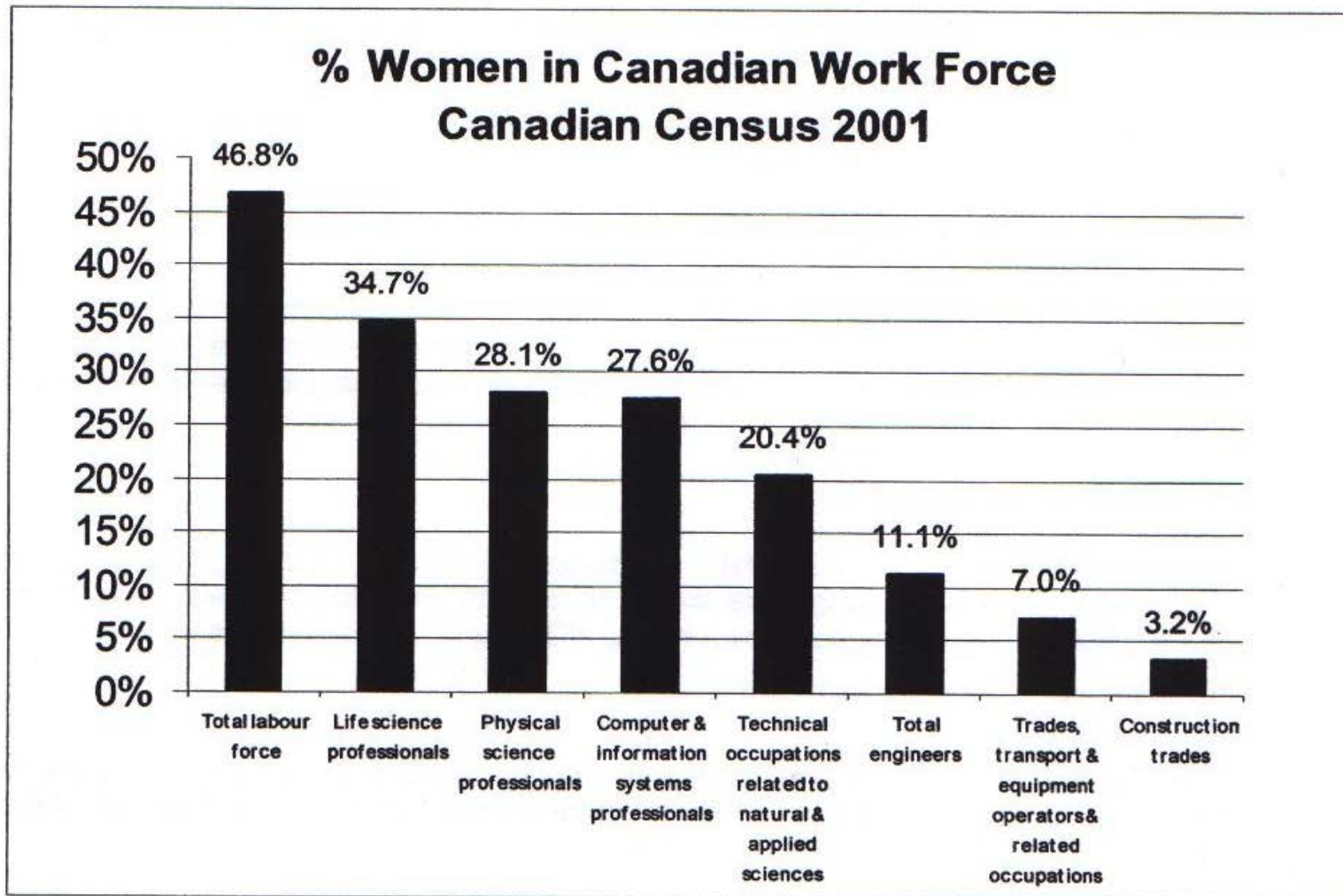
Things are changing

- Due to
 - global legislation
 - evolving social attitudes, social legislation
 - both male and female champions
 - research and statistics
- Feminist theories have challenged
 - the traditional male perspective in knowledge creation
 - the male view of the world as an universal category and representing all of humanity
 - biological determinist theories
 - the patriarchal structure of science, its theory and practice
- Emphasis on
 - the social constructivist nature of knowledge
 - the link between knowledge and power, and production of knowledge as being imbued with relations of power
 - the need to break down hierarchies, change boundaries and **definitions**

Trends in Canada

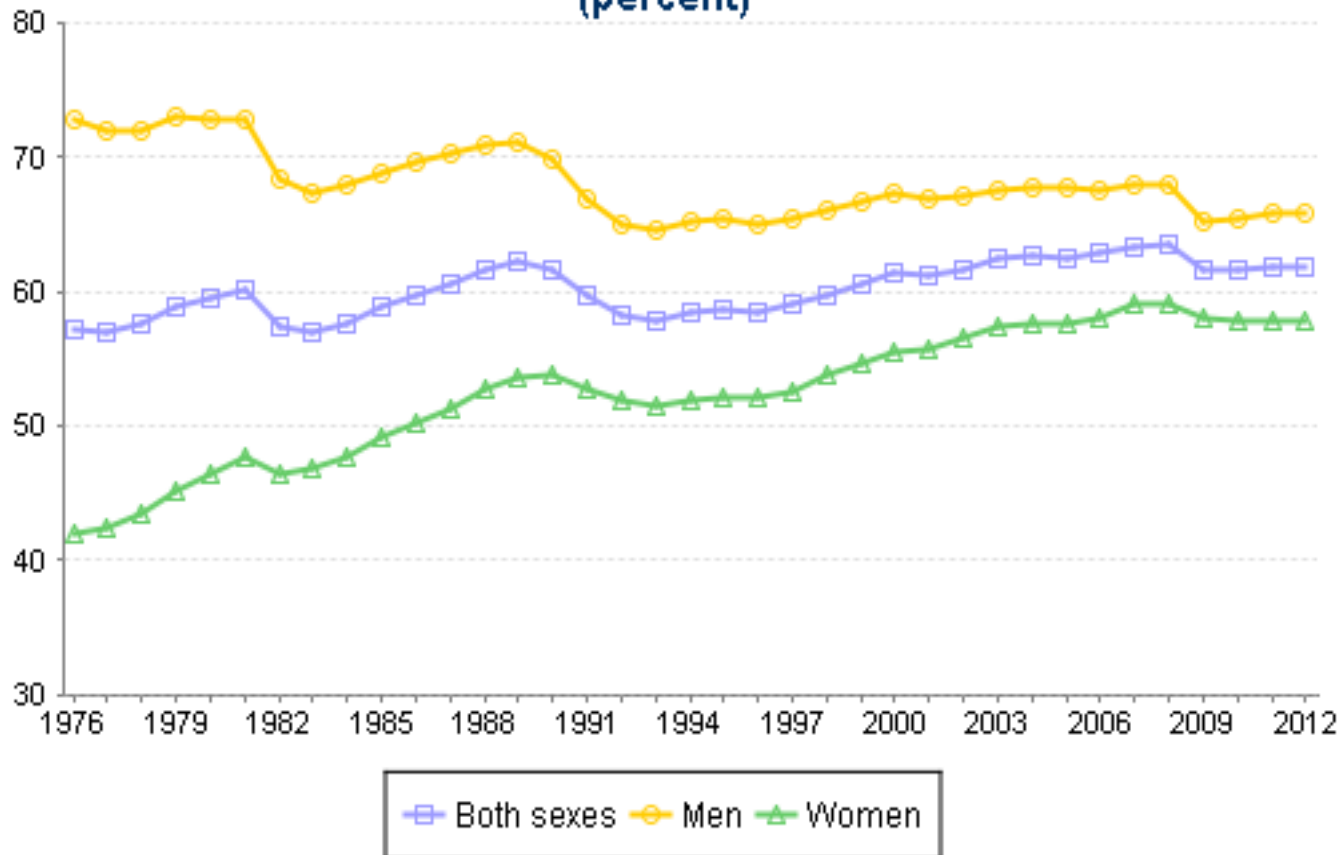
- **More females in the biological sciences but less in technical subjects**
 - feminization of biosciences and health
- **Low enrolment in “hard” sciences, especially physics and engineering**
 - hard sciences and technology still depicted as “male” domains in curricula, lack of role models
 - plateauing of female participation in engineering programs (also in U.S.)
 - declining participation in computer studies (also in U.S.)
 - **Increase in younger women going to STEM fields**
- **Concern about high dropout rates of boys.**

Canadian Women in STEM



Survival Skills for Scientists

Employment rate, by gender, 1976-2012
(percent)



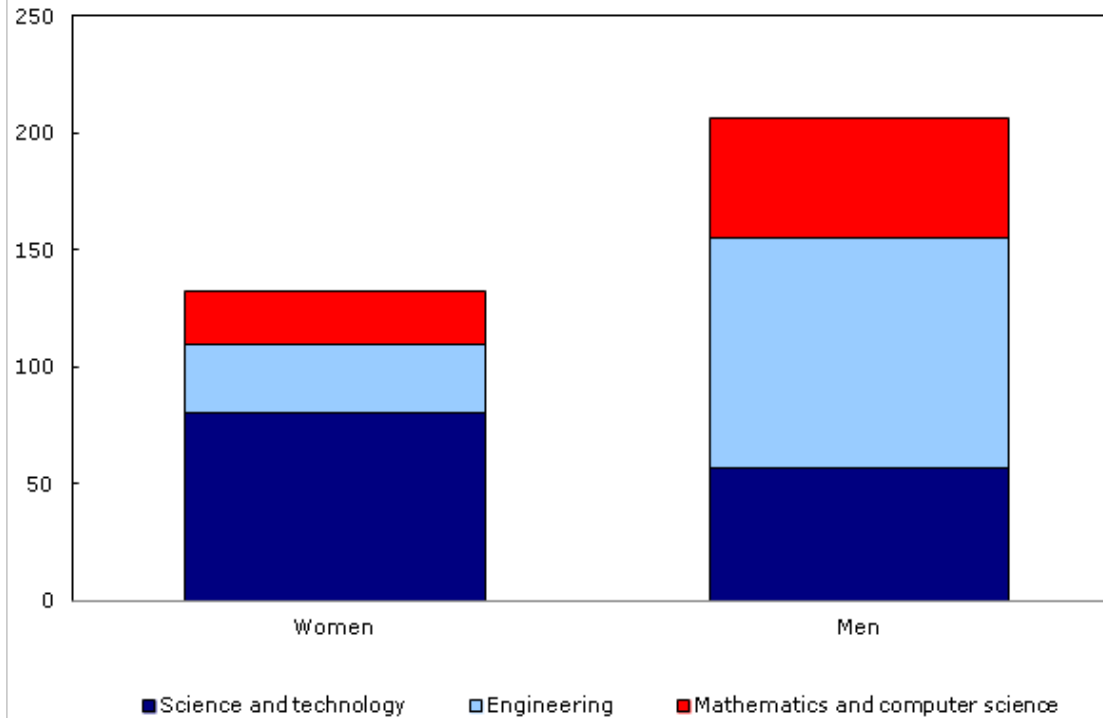
Who are the STEM degree holders in Canada?

- STEM university degree holders aged 25-64:
 - Immigrants: 50.9 %
 - 59.3 % engineering degrees,
 - 55.7 % math and computer sciences degrees,
 - 39 % science and technology degrees.
 - Non-immigrants: 49.1 %
- - Canadian born
 - Men: 67.4 %
 - Women: 32.6 %

(Source: Statistics Canada, 2013)

Chart 1
Number of STEM university graduates aged 25 to 34, by sex, 2011

thousand



Note: STEM includes science, technology, engineering, mathematics and computer science.

Source: Statistics Canada, National Household Survey, 2011.

Why do we have this problem?

- There are two main issues involving gender imbalance in STEM fields:

- The two issues are related`

1. Gender bias:

- due to **socialization/school culture** leading to biased attitudes regarding women's abilities and aptitudes: Male students' perceptions of themselves higher than females'
- these **limit women's aspirations**, opportunities and access to possibilities.

2. The leaky career pipeline: women who enter the professions with the required credentials generally face:

- sticky floors and **glass ceilings**
- **exclusion** from and invisibility in prestigious and **leadership** positions in all spheres but particularly in some science fields (e.g. Physics), Engineering and Technology.
- Work-life **conflict**

I'M TRYING TO
WRITE A CHAOS
THEORY PROGRAM
AND YOU WANT
DINNER?



Why do we *still have* this problem worldwide?

Legislation cannot change the hearts of people, but it can restrain the heartless

Martin Luther King, Jr.

- **Absence of active discrimination is not enough: positive action is needed**
- **Broadly speaking the following CULTURAL and ATTITUDINAL factors must be considered:**
 - The image of science
 - *Specifically how women view science*
 - How society views girls and science
 - The culture of science
 - The perception of opportunities leading from science
 - Disadvantages faced by women: “chilly climate” in STEM fields
 - Factors that drill holes in the career pipeline
- **Studies and observations indicate that in STEM the pipeline is leaking women at every stage:**
 - In the educational pipeline girls in middle school are not inspired by science subjects
 - The sharpest drop is after high school
 - Next large-scale attrition is at the point of entrance to grad school
 - For female researchers career breaks, tenure and promotion are points of attrition
 - Work-life balance



Canadian Women

Some Canadian Initiatives

- Government, industry, post-secondary institutes, unions, local councils, NGOs working together to effect change
- Sharing critical information on the many positive policies and practices that are already in place
- Gender-based analysis for policy development
- Specific programs:
 - **NSERC Chairs for Women in Science** (matches private sector contributions) and Engineering program (96) to increase participation, provide role models
 - **University Faculty Awards** -25 annually each 5-year term to promising female and Aboriginal researchers in Natural Sciences and Engineering, NSERC provides \$40,000 towards salary and benefits and money for Discovery grant
 - **WISER Canada- UK exchange program** administered by Royal Societies of Canada and UK, funded by major funding agencies and DFAIT, now Japan-Canada exchange program

Canada

Women's rights movements in West closed gap between public and private spheres

Is there Gender Equality?

- Decades of campaigns for equality in workplace and at home have still not succeeded in closing gender gap
- On the whole women still underpaid, overworked, and frustrated: “have-it-all dream turned into a do-it-all nightmare”
- **BUT more women going to higher education and health fields: more leaders**
- **Women have more opportunities and choices than ever before**

Crucial Issues for STEM careers

- **Urgent need to recognize that**
 - that men's and women's career experiences are different because motherhood is a pivotal issue
 - that “difference” should be treated with “equity” rather than “equality”
 - that women often lack mentors
- **Need to change definition of success and criteria assessing excellence**
 - now based on male standards and characteristics
 - recognize female characteristics such as collaborative work, people oriented activity, emphasize quality rather than quantity in publications
 - recognize special situations women face in their career trajectories

Crucial Issues for STEM careers

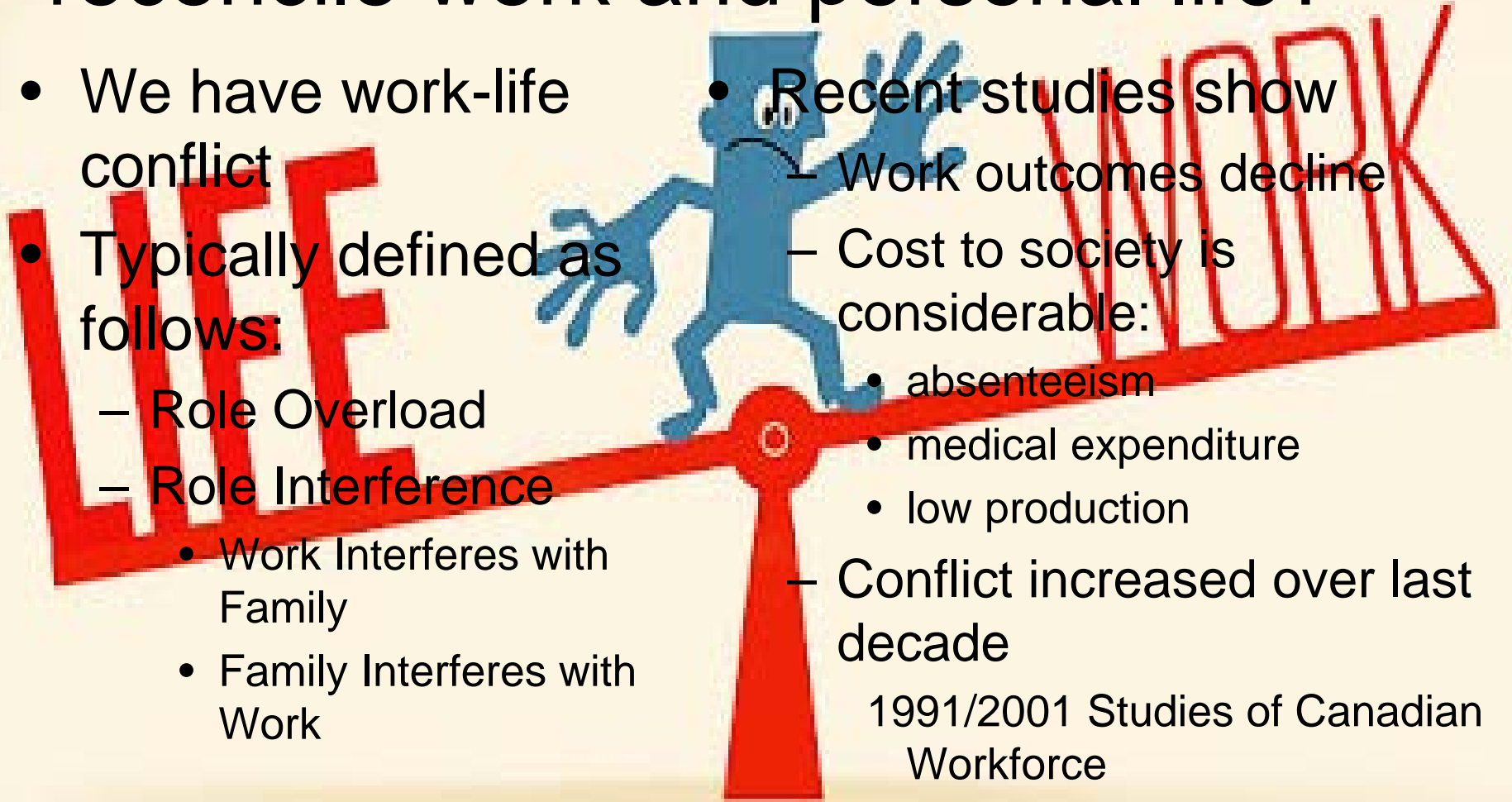
Need to look at how science is organized-

- What possibilities for a life as well as a career?
 - *Work and live smarter not harder*
- How would science be structured if the perspectives of women were mainstreamed?
- Science might take on
 - the needs of the great majority of the world's population
 - create conditions for sustained and sustainable economic and technological growth

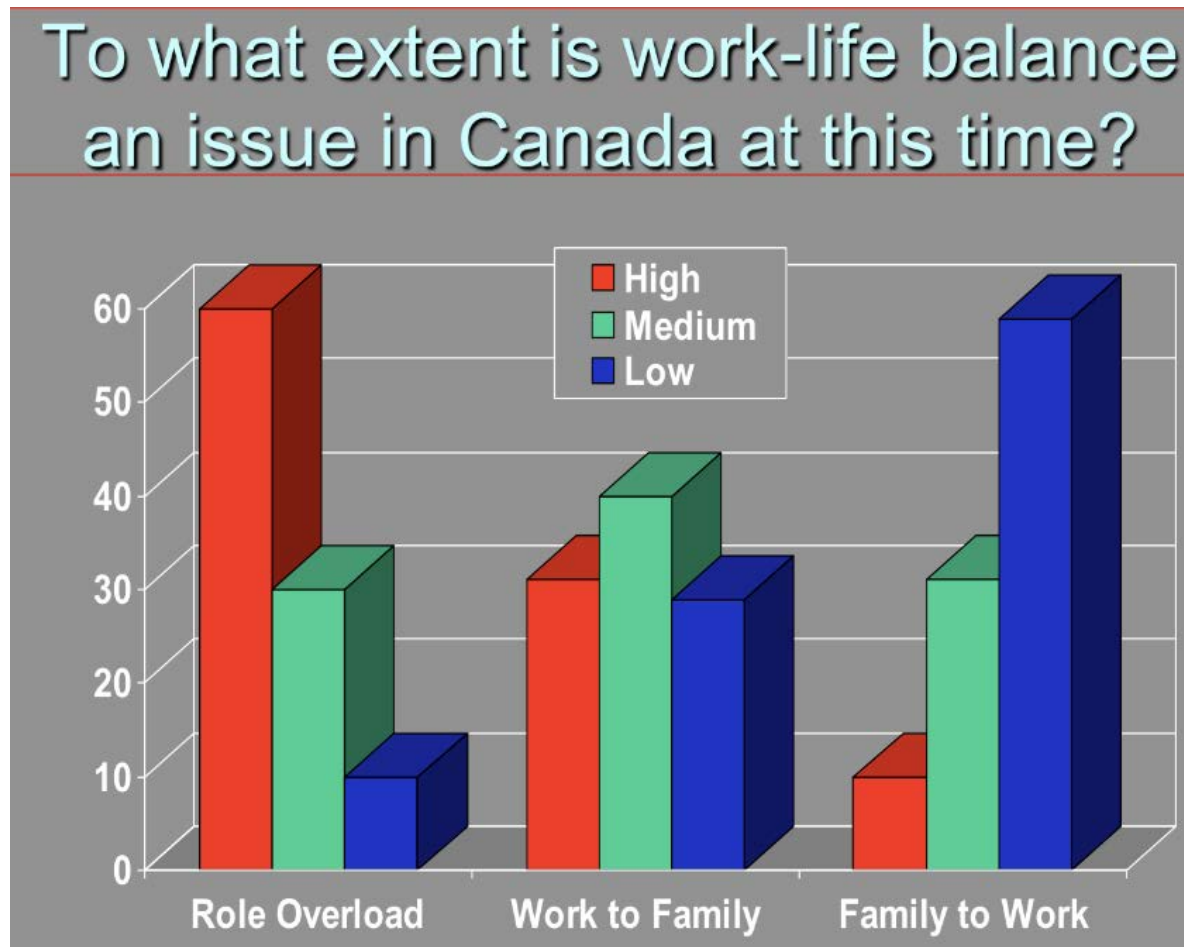
What happens when we do not reconcile work and personal life?

- We have work-life conflict
- Typically defined as follows:
 - Role Overload
 - Role Interference
 - Work Interferes with Family
 - Family Interferes with Work

- Recent studies show
 - Work outcomes decline
 - Cost to society is considerable:
 - absenteeism
 - medical expenditure
 - low production
 - Conflict increased over last decade
- 1991/2001 Studies of Canadian Workforce

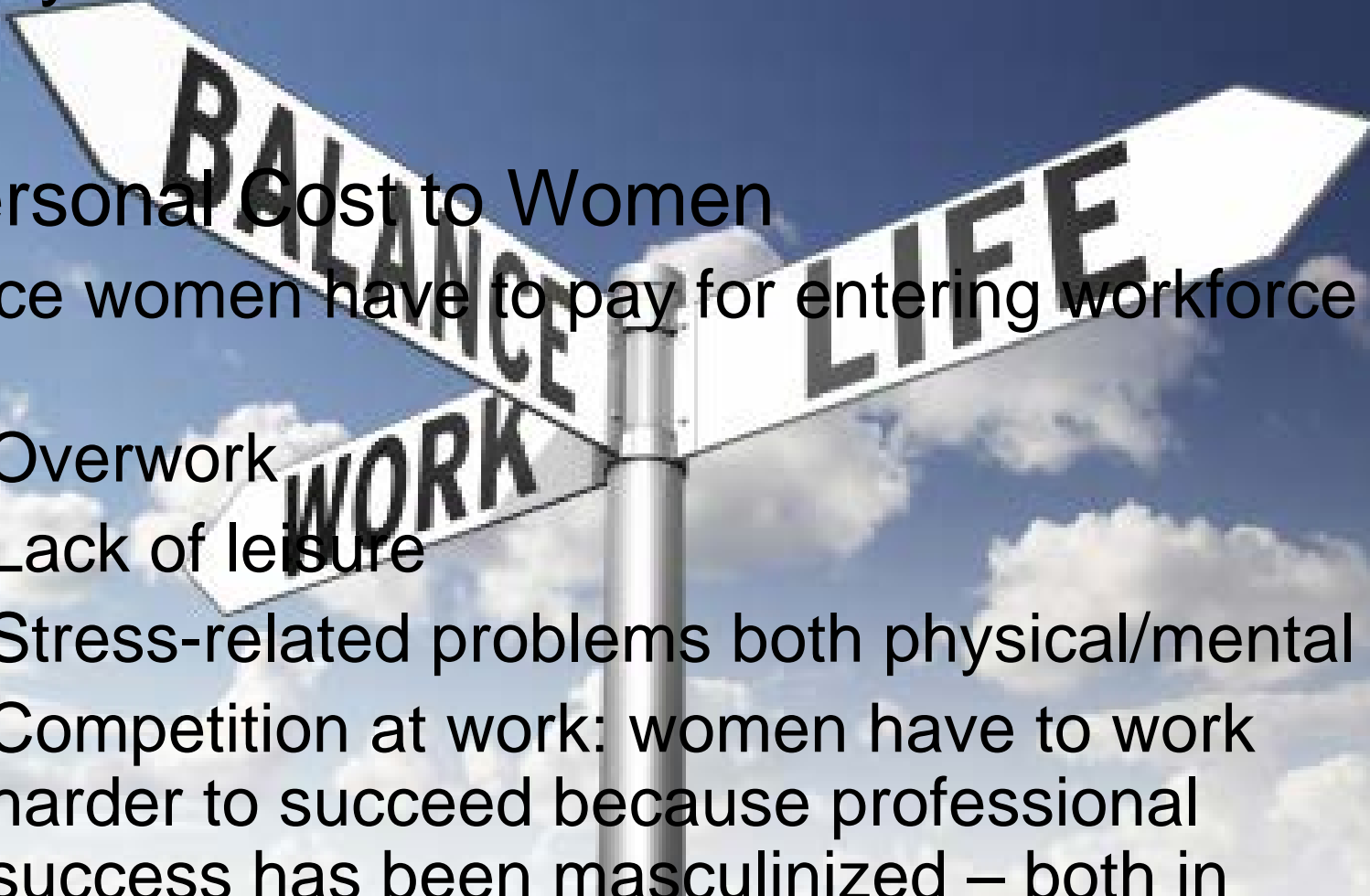


To what extent is work-life balance an issue in Canada at this time?



Who pays the cost for overburdened workers?

Society

- 
- Personal Cost to Women
 - Price women have to pay for entering workforce is
 - Overwork
 - Lack of leisure
 - Stress-related problems both physical/mental
 - Competition at work: women have to work harder to succeed because professional success has been masculinized – both in **presentation** (expected behaviour) and in **style** (e.g. leadership style)

Need for Work-Life Balance

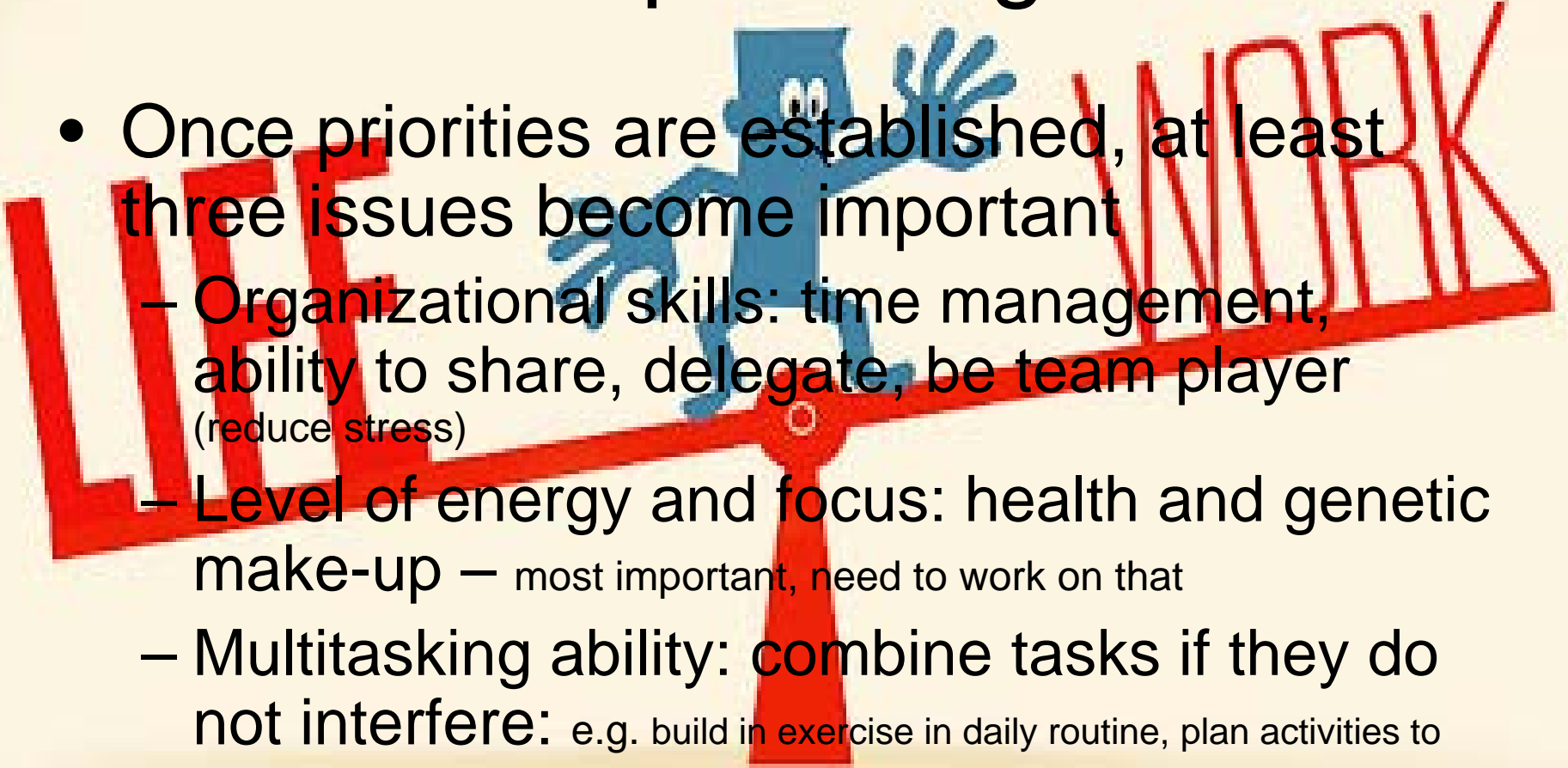
- Historically men have done both – i.e. have a family life as well as work
- For women, this has been a question
 - can they or should they do both?
 - if they do both, how can they reconcile the two spheres?
- So, while men and women both have multiple roles, the need to balance work and personal lives is greater for women because they still tend to have primary responsibility at home
- Yet, to balance the two they need to have control over their own destiny and life chances (decision making, time, ability to make choices)

Fundamental Question



- How does one reconcile work and personal lives?
- Answer depends on one's values: what is most important for you? Family? Profession?
- Goals need to be prioritized: nobody has time for everything, some things will be sacrificed- need to compromise
- “Time Famine” vs “Time Affluence”: Having free time most desired by people (Pew Research)
- Rethink work: challenge assumptions how things done
- Research shows answer is co-operation/collaboration: work in teams at home and at work

How do we optimize goals?

- 
- A blue cartoon character with a white face and large eyes is balancing on a red seesaw. The character is standing on the right side of the seesaw, which is tilted upwards. The word 'MARK' is written in large, red, outlined letters on the right side of the seesaw. The character has its arms outstretched, and its feet are on the red beam. The background is a light yellow gradient.
- Once priorities are established, at least three issues become important
 - Organizational skills: time management, ability to share, delegate, be team player (reduce stress)
 - Level of energy and focus: health and genetic make-up – most important, need to work on that
 - Multitasking ability: combine tasks if they do not interfere: e.g. build in exercise in daily routine, plan activities to optimize contact/quality time with family, plan weekends...

Other factors



- Several factors help achieving balance
 - Interpersonal skills (reduces tensions, complications)
 - Understanding partner (most important)
 - Support from family, friends (children, parents)
 - Government policies (childcare, health benefits, maternity benefits)
 - Work place policies (sensitivity to women's needs, promotion policies, benefits)
 - Career path (SSHRC)

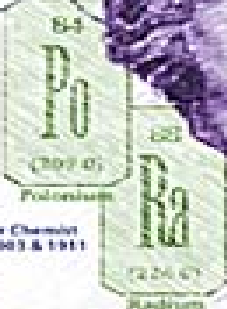
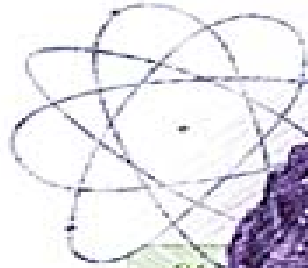
Conclusion

- **Now generally recognized that there are social and economic costs for the underutilization of the talents of half of humanity**
 - **Societies cannot afford to be deprived of half the world's brainpower: the abilities and potentialities of women scientists, engineers and technologists**
 - **Under representation of women in science and technology creates an imbalance in society**
- **The issue of gender disparity is of significance in all modern societies**
 - **The disparity is most significant in fields related to the knowledge economy – STEM**
- **Recognition of the value that women bring**
 - **by enhancing diversity through a**
 - **wider range of approaches**
 - **problem definitions**
 - **strategies**

Science

INDUSTRIAL MEDICINE

Chemistry & Physics



Marie Curie
1867-1934
Physicist and Nuclear Chemist
Two Nobel Prizes - 1903 & 1911



Dr. Alice Hamilton
1869-1970
Initiated industrial safety reforms
by focusing attention on toxic
materials in the workplace

Merci



Rachel Carson 1907 - 1964
Writes *Sea Change* & *Silent Spring*
Created public awareness of
pesticide hazards

GENETICS

1912-1984
Geneticist

Dr. Jane C. Wright
1912-
Increased cancer survivability
through improved chemotherapy



Barbara McClintock
1902 - 1992
Pioneered work in Cellular
Biology and Genetics
Nobel Prize in Genetics - 1982

