



Women in **Science**

August 26, 2010, New Delhi

**FINAL REPORT
ON PROCEEDINGS**

*“As women are generally the poorest of the poor ...
eliminating social, cultural, political and economic discrimination
against women is a prerequisite of eradicating poverty ...
in the context of sustainable development”.*

– *International Conference on Population and Development (ICPD) Programme of Action, 1994*

ACKNOWLEDGEMENT

The U.S. Embassy, New Delhi is grateful to the distinguished speakers and guests for their participation in the Women in Science workshop. The workshop deliberations were helpful in understanding issues and challenges, and in assessing the need for creating opportunities for women in science.

The information and data in the report is sourced from Department of Science & Technology's National Task Force on Women in Science report, Indian National Science Academy (INSA) report and Ministry of Human Resource Development's (MoHRD) website. Data is also derived from the websites of United Nations (UN) agencies and the Millennium Development Goal (MDG) 2010 report.

The U.S. Embassy is thankful to the Indo-US Science & Technology Forum (IUSSTF) for supporting speaker's travel and stay for the women in science workshop.

FOREWORD

Indian women have been leaders in politics for many years, dating back to the time of Indira Gandhi. The President, speaker of the Lok Sabha, and the leader of the Congress Party are all women. But in the areas of science and technology, Indian women are advancing, but many barriers still remain. Creating opportunities in science education and increasing equality of opportunity in science professions, are crucial elements in the quest to empower Indian women. Though the education and employment environment in the last two decades for women in science and technology has witnessed a positive transformation, the deep-rooted issues in socio-cultural acceptance have not been adequately addressed. As a result, women are still victims of gender disparity in families and at work places.

Addressing these challenges should be a strong priority for any nation. It is very encouraging that both India and the U.S. share common views on the intrinsic value of creating an environment for women's empowerment, education and participation in science & technology. The U.S. and India have a strong history of scientific collaboration, and both countries have produced preeminent women scientists and science policy makers. Yet despite these achievements, women in both countries still face significant socio-cultural and institutional challenges to establishing, maintaining and advancing their careers in science-related fields.

U.S. Embassy, New Delhi has been proactively engaging with the Indian policy makers, institutions and civil society, to find out ways of harmoniously dealing with this issue. In August 2009, the U.S. Embassy sponsored a small but powerful workshop that brought together a group of women in science to discuss their views of challenges and opportunities. The U.S. Embassy organized a larger workshop this year, which has further expanded those discussions to include a larger group of science leaders from U.S. and Indian government, industry, civil society and academia. This workshop examined issues facing women in science and, more importantly, identified solutions for improving opportunities for women to achieve their full potential in science-related careers.

The report takes into account of the issues and recommendations of these workshops and inputs from secondary data sources. The report attempts to examine the issues and challenges and identify a way forward through compilation of discussions held during workshops and of data from secondary resources.

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ABBREVIATIONS

DBT	-	Department of Biotechnology
DST	-	Department of Science & Technology
GoI	-	Government of India
ICMR	-	Indian Council for Medical Research
INSA	-	Indian National Science Academy
INSPIRE	-	Innovation in Science Pursuit for Inspired Research
IUSSTF	-	Indo-US Science & Technology Forum
MDG	-	Millennium Development Goal
MoHRD	-	Ministry of Human Resource Development
R&D	-	Research and Development
S&T	-	Science & Technology
UN	-	United Nations
UNESCO	-	United Nations Educational, Scientific and Cultural Organization
UNICEF	-	United Nations Children's Fund
U.S.	-	United States of America

WORKSHOP PROGRAM

Inaugural Session

- Dr. Kiran Mazumdar Shaw, Chairman & Managing Director, Biocon
- Mr. Timothy J. Roemer, U.S. Ambassador to India
- Dr. Kerri-Ann Jones, Assistant Secretary of State, Bureau of Oceans and International Environmental and Scientific Affairs
- Dr. T. Ramasami, Secretary, Department of Science & Technology, Government of India

Session I – Nurturing a Science Career

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|--------------------------|---|
| <i>Discussion Topics</i> | 1. Role of mentors, educators and family in promoting science education for girls/women |
| | 2. Need for women science educators |
| | 3. Flexibility in education system & career choice for women in science |
| | 4. How to encourage girl students to study science: primary, secondary and university level |

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| <i>Speakers</i> | - Dr. Manju Sharma, Former Secretary, Department of Biotechnology, Ministry of Science and Technology, Government of India |
| | - Dr. Rama Mukherjee, Managing Director, ARA Healthcare Pvt. Ltd |
| | - Dr. Vibha Dhawan, Vice-Chancellor, The Energy and Resources Institute |
| | - Ms. Paramjeet Shergill, Principal, Rabea Girls Public School |
| | - Ms. Gail Davidson, Principal, Lynbrook High School, CA, USA |

Session – II, Women in Science Professions

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|--------------------------|--|
| <i>Discussion Topics</i> | 1. Women as S&T entrepreneurs, government scientists, academics and in NGOs |
| | 2. Changing cultural paradigms, role of social reform <ul style="list-style-type: none"> - Creating work-life balance - Women as wife, mother vs. women as science professionals |
| | 3. Overcoming prejudices, inequities and restrictions in the workplace |
| | 4. Need for financial incentives, access to loans/financing, role of the media, and need for recognition |

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|-----------------|---|
| <i>Speakers</i> | - Dr. Kiran Mazumdar Shaw, Chairman & Managing Director, Biocon |
| | - Ms. Catherine J. Didion, Director of the National Academy of Science's Committee on Women in Science, Engineering, and Medicine |
| | - Dr. Lakshmi Lingam, Dean – Research and Development & Professor, Centre for Women Studies, Tata Institute of Social Sciences |
| | - Dr. Nita Shah, Head, Vulture Advocacy Program, Bombay Natural History Society |
| | - Dr. Usha Mujoo-Munshi, Head, Library, Indian Institute of Public Administration |

Session – III, Empowering Women in Science

- | | |
|--------------------------|---|
| <i>Discussion Topics</i> | 1. Role of the government in changing the women in science paradigm |
| | 2. The need to promote more women in S&T leadership and management positions |
| | 3. Existing and needed programs/initiatives for empowerment of women in science |

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|-----------------|--|
| <i>Speakers</i> | - Dr. Kerri-Ann Jones, Assistant Secretary of State, Bureau of Oceans and International Environmental and Scientific Affairs |
| | - Dr. Vinita Sharma, Advisor, Department of Science & Technology, Government of India |
| | - Dr. Renu Swarup, Adviser, Department of Biotechnology, Government of India |
| | - Dr. Swati Basu, Advisor, Ministry of Earth Sciences, Government of India |
| | - Dr. Leena Srivastava, Executive Director, The Energy and Resources Institute |

Summary of Event, and Highlights of Suggestions

- Mr. Blair Hall, Minister Counselor for Economic, Environment, Science and Technology Affairs, U.S. Embassy
- Dr. Rama Mukherjee, Managing Director, Ara Healthcare

EXECUTIVE SUMMARY

Marie Curie, Rosalind Franklin, Kalpana Chawla are great examples for women who aspire to reach high levels of knowledge and achievement in science. Though these examples are inspiring, there are some real ground level problems that hinder the progress of Indian women in science.

Inaccessibility of early science education in rural areas, restrictions on education of the girl child, inflexibility of the system to allow woman re-enter the workforce after a break, and gender-based inequities at work places are challenges that must continue to be addressed.

Infrastructure development is in part the solution for rural inaccessibility issues, but there is much to be done in transforming societal mindsets so that every human being, irrespective of gender, has an equal opportunity to study science and to build a successful scientific career.

Families in rural and conservative communities often force girls into early marriages. They rarely allow girls to study after a certain level out of concern that after marriage girls will move to a new family and educating them won't bring advantage to the parents. Poverty is other reason for inaccessibility as it makes it hard for parents to afford education of their children.

Working women handle dual profiles of a homemaker and a professional. There are instances when handling both at the same time becomes challenging, and then at the professional front, they either opt to take break and re-enter or they just move out of it. Re-entering the work force after a period of focusing on the family can be a good option. But re-entry does not happen easily, as either the woman's self-confidence is not that high, or because people at workplace are not confident about their science knowledge after a long absence from the field.

In addition to family pressures, the workplace environment sometimes causes women to leave their jobs. In spite of huge global progress on women's empowerment, these simple issues are major societal challenges in India. Gender based inequities are common at workplaces and women are often underrepresented at senior levels in both the government and private sectors. This discrimination is deeply rooted in longstanding socio-cultural beliefs that influence the way people treat women in professional world.

Government has a prime role to play in the transformation process and towards creating a level playing field for both men and women in science.

This report is an attempt to assess the challenges for women in science in India, and recommend measures for addressing them. The inputs are derived from the U.S. Embassy-hosted 2009 and 2010 women in science workshops, Department of Science & Technology's National task force for women in science report, Indian National Science Academy report, Ministry of Human Resource Development's website, UN agencies websites, and UN's Millennium Development Goal 2010 Report.

“Celebrating Women in Science” workshop, August 19, 2009

The U.S. Embassy-hosted workshop “Celebrating Women in Science” provided a broad view of the Indian science environment and also created an atmosphere conducive to generating new ideas and creating new networks.

In addition to gender, participants pointed to caste, the rural versus urban divide, and the availability of state government programs as key factors in determining opportunities in science. Participants were not looking for a "reservation" or quota system. They instead believed that women should be better integrated into the existing system, and that merit, not gender, should be the main criteria for selection and opportunity.

They noted that women currently are not even on the platform where decisions are made and male-run inner circles do not give women the same opportunities as equally or less qualified men. Though the workshop attendees were diverse, their observations on obstacles to success were almost universally held. The event was so successful that many requested the Embassy to organize a larger workshop focusing on the issues requiring open debate in 2010.

“Women in Science” workshop, August 26, 2010

The U.S. Embassy organized “Women in Science” workshop in August 2010 offered a much larger platform to participants from diverse backgrounds to discuss India’s climate for women in science.

The workshop recommendations emphasized on the need to have more government run programs, to support technical training through e-education in rural areas, for re-training women attempting re-entry into the science workforce, for flexible job timings, and facilitation of re-entry of women into the science workforce after family-related gaps in employment.

The participants also suggested affirmative fiscal policies and incentives to encourage women in science – providing both incentives and recognition. Importance of mentors in education and career and using stories of gender equality in text books were points well received during the workshop. The participants emphasized on the need to have series of lectures or guest speakers at science colleges and institutions, as well as women’s institutions, across the country.

Awareness of the government programs for women in science is important and the participants strongly expressed the need for a dedicated website for Government of India (GoI) programs.

SUMMARY OF ISSUES & RECOMMENDATIONS

Participants expressed appreciation that the U.S. Embassy again hosted this much-needed workshop. Gol participants highlighted the task force receiving feedback on the issue of Indian women in Science, and shared about a number of programs and initiatives that address this challenge. Focused discussions identified a few key areas of focus for the future:

Issue - The “blocked pipeline” for women in rural areas

Recommendation – The participants pointed to the need for practical technological training in rural schools, for investment science laboratories and infrastructure, local-language science textbooks, and training for local teachers in local languages. Partnerships with urban Universities to provide long-distance, e-education may also be a partial solution to promote science education in rural areas.

Issue – Creating gender sensitivity environment in schools

Recommendation – The use of gender-friendly stories in math and science textbooks, as well as ensuring a mix of male and female images in textbooks, was suggested by participants.

Issue - Societal attitudes and stereotypes that steer women away from careers in science at every step are not easy to change.

Recommendation - Participants stressed the need for leaders to use flexibility, liberality, and gender sensitivity when making choices that affect women students and scientists. Participants suggested flexible job timings and facilitation of re-entry of women into the science workforce after family-related gaps in employment. They suggested affirmative fiscal policies and incentives to encourage women in science.

Issue - The “leaky pipeline” for women in science

Recommendation – The issues can be addressed by pro-active programs for retraining women attempting re-entry into the science workforce. Many participants stressed the need for an interactive website for women in science. Many also suggested that the Gol must do more to publicize its various schemes and programs for women in science—women will participate when they know about what is available. This could include a series of lectures or guest speakers at science colleges and institutions, as well as women’s institutions, across the country.

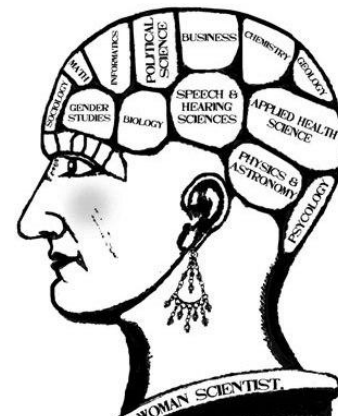
Issue – Need for training programs to prepare women take leadership roles and to enable re-entry in a scientific career

Recommendation - Training programs for women in cross-disciplines like communications, budgeting, and leadership to increase the number of women in leadership positions in scientific institutions.

INTRODUCTION

Women constituting half the population in India, as in other parts of the world, are grossly underrepresented at almost all levels of scientific education, R&D and employment due to a variety of socio-cultural factors.

Women constitute 48% of the total population in India¹, which is home for 17.31%² of the world's population. With women occupying such a large portion of the Indian population, their 54.5% literacy rate (15 years and over, 2007) is a concern.



Government of India statistics show that the enrolment of women students was 41.40% of the total enrolment in the academic year 2009-10. Of the professional course enrolment, 14.72% were women. These data suggest that there is a big need to improve the education of women at the professional level India.

Women in India have been traditionally expected to be home-makers rather than professionals, and this perception has negatively affected participation of women in science. Worldwide, science is traditionally an area that is a stronghold of men, and this perception results in the marginalization of women in science- related careers, and India is no exception to this stereotype.

Though this adverse trend has seen a lot of transformation in the last few years, attitudes and perceptions have not changed to the extent required, and there is more to be done in shaping an environment of equity in science education and employment for women in India.

There are various factors that affect access for women to science education and opportunities in science-based careers. These include:

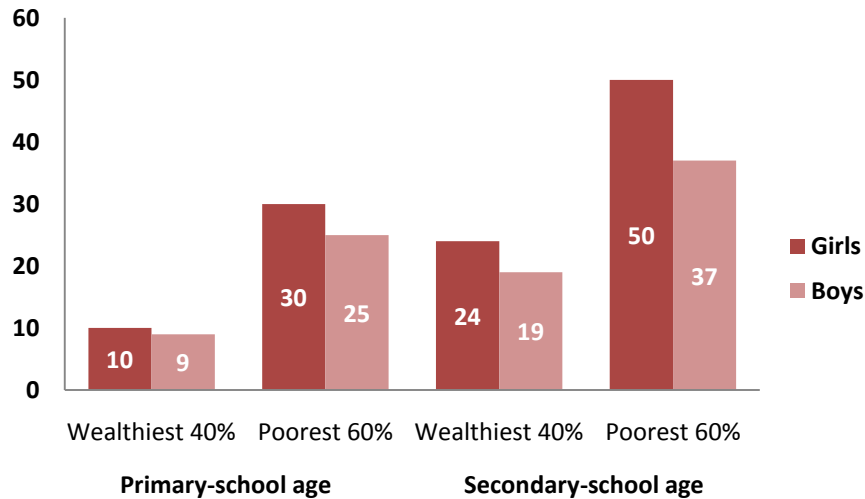
1. Education Infrastructure - In India, where 70% of the population lives in rural areas, educational opportunities are still limited. The schools in rural areas are more focused on the fundamental challenge of imparting literacy and numeracy; expecting science to be a focus of early education in such places seems to be an unattainable dream.
2. Poverty – United Nations Millennium Development Goals Report 2010 highlights that poverty puts girls at a distinct disadvantage in terms of education. Girls of primary-school age from the poorest 60 per cent of households are three times more likely to be out of school as those from the wealthiest households. Their chances of attending secondary school are even slimmer, and older girls in general are more likely to be out of school. (Figure 1.)

¹ MoHRD Annual Report 2010

² United States Census Bureau - International Data Base (IDB)



Figure 1- Proportion of girls and boys who are out of school, by age and household wealth, in 42 countries with surveys during 2001/2008 (Percentage)



Source - United Nations Millennium Development Goals Report 2010

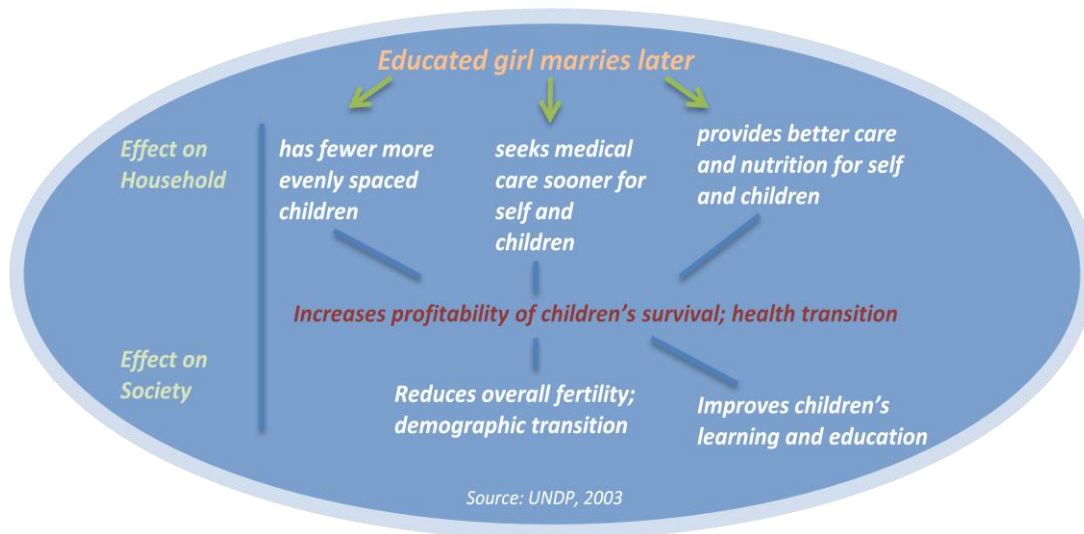
In India, where 37.2% of population is below the poverty line³, the focus on science education in the poor communities is very limited.

3. **Social-cultural factors** – Socio-cultural factors impose various restrictions on women science education. These factors are typically the beliefs that have been into existence from older times, and which influence view-points of people in the society. Women are expected by society to take care of the home and family instead of pursuing a career. Science is presumed to be a masculine subject, and this delusion creates a bumpy road for women aspiring to a career in science.
4. **Family environment** - Family is the first place where a child learns. It provides an initial environment for a child to develop understanding of very basic yet important elements of life. Particularly in rural India, the rural and conservative communities have much social influence. As a result, girls are sent to school only for basic learning; many drop out at an early age. The lack of family support and stringent pressures to leave work and look after house and family often result in women giving up their careers.
5. **Safety** – Concerns about safety often make a young woman’s family members anxious and apprehensive, and they tend to limit her involvement in activities crucial for her development. Families often pressure women to study in fields that involve more in-house operations and less outreach and laboratory work.

³ <http://www.business-standard.com/india/news/povertynumbers/392730/>



6. Early marriages – Early marriage is a trend in rural India, where girls are often seen as financial liabilities for parents. Young married women frequently drop-out from school.



7. School Environment – Schools should be promoted as gender-sensitive environments that are friendly to both sexes and women equally represented in teaching, administrative and educational leadership roles. Textbooks should include inspirational stories on gender equality as essential strategy for ending discrimination and achieving justice in societies.

By combining the right to education with rights within education, we can achieve rights through education.

- United Nations MDG 2010

8. Regional Differences –In India, women's education statistics vary widely from state to state. For example, in the year 2005-06, percentage of total university enrolment in states was the highest in Kerala (61%) and the lowest in Bihar (24.5%).⁴
9. Flexibility in career choice & work life balance –Dual responsibilities at home and at the workplace makes it difficult for women to manage their schedules. When they reach a breaking point, they seek a shift to a career that requires minimal time commitment to strike a balance of their involvement between home and office. For example, shifting from a biotech research scientist profile to a relationship manager profile, can help reduce the commitment level and manage time. This shift in career choice is not easy today.
10. Training for re-entry – For women who decide to restart their careers after a short break, training becomes essential for brushing up of their knowledge and skills. In the absence of training, women face challenges in coping with the gap in their career. Training programs for

⁴ Department of Science & Technology's National Task Force for Women in Science report

re-entry can be a motivation for women who left their jobs, and plan to establish a career again.

11. Work-place environment – Women often become victims of gender-based inequities at work places. They do not get the same set of opportunities as their male counterparts, and are seldom offered to lead at senior levels. As a result, women are hugely underrepresented at decision-making levels in most of the scientific organizations.

Women in India are qualified, accomplished, and ready to overcome barriers. The challenge will be to raise the quality of science education and research while making it more inclusive.

“Women in Science” Workshop

The U.S. Embassy-organized workshop on “Women in Science” discussed these issues and highlighted some of the recommendations participants made during the workshop. The workshop focused on three themes suggested at last year’s inaugural Women in Science Workshop: Nurturing a Science Career; Women in Science Professions; and the Role of Government in Empowering Women in Science.

The workshop brought together over 150 men and women from a broad cross-section of specialties and experience levels, including press, scientists with policy and advocacy roles, science educators, and researchers working in industry, defense, agriculture, conservation, astronomy, physics, nutrition and pharmaceuticals. University and secondary students with an interest in science also actively participated. The diverse group of attendees provided a broad view of the Indian science environment and also created an atmosphere conducive to generating new ideas and creating new networks.



The workshop was inaugurated by Assistant Secretary of State Dr. Kerri Ann Jones, U.S. Ambassador to India Mr. Timothy J. Roemer and featured remarks by Department of Science and Technology (DST) Secretary Dr. T. Ramasami and Biocon Chairperson Dr. Kiran Mazumdar Shaw.

Lively discussions focused on blocked and leaky pipelines in the supply of women scientists, and the Government of India’s growing response to the problems.

Last year, during the U.S. Embassy organized workshop, “Celebrating Women in Science” discussed the environment in which these women work and what it took for them to become successful. The event was so well received that many people asked for a larger workshop this year.

Dr. Kiran Mazumdar Shaw opened up the workshop by calling it a “wonderful, relevant, and timely workshop.” She said that the drivers of economic growth are science and technology (S&T) and gender equity. She noted that S&T has been at the heart of India's political and economic manifesto since independence. Five decades of S&T investment have enabled a knowledge-led economy to develop in the last ten years. She observed that despite advances in last 10 years (women now comprise 30% of information technology positions and nearly 50% of positions in biotechnology/life sciences) women currently occupy only 30-35% of all science positions. But the mindset of women is unchanged; not inclined to pursue engineering sciences or physics degrees- perhaps they are trapped by societal prejudices? How do we break free of these shackles?

Mr. Timothy J. Roemer emphasized how both U.S. President Mr. Barack Obama and Secretary of State Ms. Hillary Rodham Clinton have taken a strong personal interest in both the empowerment of women and the importance of science in bringing people together around the world. The Ambassador spoke of the potential women scientists have of solving the basic problems of people at the bottom of the pyramid using innovative technologies for energy, lighting, and water purification.

Mr. Roemer acknowledged Human Resource Development Minister's emphasis on education, even though he was unable to attend the workshop due to urgent parliamentary duties. Mr. Roemer also observed, “Indian women are active participants in Indian society and have excelled in many fields. The President, speaker of the Lok Sabha, and the leader of the Congress Party are all women. In business, women lead some of the biggest companies such as ICICI Bank and Apollo Hospitals. In the future, maybe as a result of this conference, we hope to see even more women active and contributing across scientific disciplines. The world today faces serious and difficult challenges. We need to put the energy and talents of our best people - whatever background, whatever gender - to work to address these challenges.”

Dr. T. Ramasami, described "INSPIRE"⁵ programme for youth involvement in science. This programme has connected 1.5 million youth to science. A scholarship programme for the top 1% of students has benefitted 23500 in the past year, 63% of whom were from small towns. Out of 389 top-ranked students who won scholarships, 66% were girls. He noted that modern women need provisions for re-entry into science after completing familiar responsibilities; science requires parity where both genders work together. He said the DST was open to receiving suggestions to create equal partnership between both genders who will work together for the global good.

Dr. Kerri-Ann Jones said that “Women in Science” is not a women's issue but a societal issue. She said global challenges require scientific solutions; societal sectors benefit from science translated to practical use (in health, agriculture, etc.) She noted that founders of both India and the United States recognized the need for science. The partnership between the two countries in the fields of science has reflected this for years. This is also reflected in the Strategic Dialogue, bilateral discussions, etc. Dr. Jones quoted Secretary Clinton “Talent is universal, opportunity is not” and identified three key issues:

1) Young women lose confidence in middle school, and stop science studies;

⁵ <http://www.inspire-dst.gov.in/>

2) “Leaky pipeline”—women leave the scientific stream at various points due to familial needs and barriers to advancement;

3) Women are under-represented in science leadership.

Dr. Jones called for a review of institutional culture, policies, and practices. She said “Today we are looking for a list of actions the GOI/USG can take forward together. Both countries are science leaders yet both have gender inequality in sciences.”

In spite of the diversity of participants in terms of age, religious, and socioeconomic backgrounds, participants emphasized several common themes. In addition to gender, participants spoke about the “leaky” pipeline—at every step of the way, starting in secondary school, girls drop out of the pipeline of future scientists. Part of this is due to societal stereotypes (so fewer girls enter the pipeline in the early stages); part is due to family pressures (the need to get married early, to help with family problems); part is due to women taking several years off from their careers to get married and have children.

Participants talked about the “blocked pipeline” in rural areas, where the girl child has great difficulties even getting an education. They spoke about a lack of knowledge about government programs as key factors in determining opportunities in science. They discussed that a lack of leadership and administrative training often stops women from taking on leadership roles in scientific institutions, and women are often not included in decision making processes. And many emphasized the valuable role that positive female mentoring can play in developing more women scientists. Participants were not looking for a quota system but instead believed that women should be better integrated into the existing system and that merit, not gender, should be the main criteria for selection and opportunity.

The Embassy was surprised and encouraged by the level of enthusiasm and excitement surrounding this year’s event. It was also heartening to know that despite of these challenges, women in India are demonstrating their true and hitherto under-estimated skills across every sphere of science, be it regulatory, policy, research, trade or science education.

The workshop was featured on the Embassy website⁶ and social media outlets, was covered by the press (including the Wall Street Journal⁷) and raised the issue of Indian women in science to a new level of awareness.

⁶ <http://newdelhi.usembassy.gov/pr082610.html>

⁷ <http://blogs.wsj.com/indiarealtime/2010/08/26/getting-more-indian-women-to-study-science/>

HIGHLIGHTS FROM LAST YEAR'S WORKSHOP

In August 2009, the U.S. Embassy, New Delhi organized "Celebrating Women in Science" workshop, where more than 60 attendees from a variety of backgrounds discussed India's climate for women scientists.

The workshop brought together women from a broad cross section of specialties and experience levels, including scientists with policy and advocacy roles, science educators, researchers working in industry, defense, agriculture, conservation, astronomy, physics, nutrition and pharmaceuticals. University students and students in grades 9-12 with an interest in science also participated. The diverse group of attendees provided a broad view of the Indian science environment and also created an atmosphere conducive to generating new ideas and creating new networks.

During the workshop discussion, in addition to gender, participants pointed to caste, the rural versus urban divide, and the availability of state government programs as key factors in determining opportunities in science. Participants were not looking for a "reservation" or quota system but instead believed that women should be better integrated into the existing system and that merit, not gender, should be the main criteria for selection and opportunity.

They noted that women currently are not even on the platform where decisions are made and male-run inner circles do not give women the same opportunities as equally or less qualified men. Though the workshop attendees were diverse, their observations on obstacles to success were almost universally held.

Following are highlights from the workshop:

- Although no laws or official policies explicitly prohibit women from entering or advancing in science, Indian women are expected to place family considerations above all others. Moreover, social and cultural restrictions create work environments that prevent women from rising to the senior ranks, particularly in government and education organizations. There is a generally held presumption that women cannot do the job, though studies show that there are no differences in ability between the sexes and women often are more productive than men in the same positions. Many of the participants noted they felt the need to be twice as good and work twice as hard as their male colleagues to be taken seriously.
- Senior policy makers give lip service to advancing the rights of women, but do not follow through with hiring more women into the senior ranks or demanding and enforcing equal treatment. At senior ranks, Indian women scientists were either not present or significantly underrepresented and this was particularly apparent across disciplines in senior scientific positions and in government institutions, although somewhat less so in Indian commercial pharma and biotechnology firms where there are more women executives and senior scientists. Participants urged that S&T leaders in the Ministries, government institutes and schools be held accountable for creating a level playing field and bringing more qualified women into the ranks of senior scientists, educators and S&T policy advisors. For this to happen, a significant social and cultural shift needs to take place.

- There is little flexibility in scientific careers in India. The Indian scientific establishment tends to be rigidly stove-piped with scientists often spending their entire careers climbing the ladder within a single institution. This organizational structure offers little or no consideration for work-life balance. Those who take time off for family often find they are not welcome back in the workplace, and that there are no opportunities for part-time work, flexible hours or work based childcare facilities to accommodate family demands. Nor are there opportunities for lateral movement between research, policy or advocacy organizations. Scientists who wish to move to related career fields or to go back to school are hindered by age or other policy restrictions.
- Several state and central government programs designed to provide science instruction exist for girls and women in rural areas. However, a severe shortage of qualified trainers, outdated textbooks, and a focus on agriculture to the exclusion of other science results in less than optimal implementation and significantly disadvantages those girls who have no other options.
- Participants, no matter their field, uniformly identified a strong supporter - family, teachers or mentors - as critical to their success. One of the high school students recognized the inspiration and support of her school administrator during her remarks at the workshop. A university student, who came with her professor, said that when the time came to choose between science and humanity studies, her family told her to pick the easier one because she was a girl; she chose science anyway.
- Participants observed that women need to be more assertive in marketing their contributions and benefits to their organization, and asking for what they need and want rather than expecting it to be handed to them. Other participants agreed, but noted that this goes against many cultural norms and may be a difficult behavior to change.
- By and large, women are not effectively integrated into the professional networking organizations or the "water cooler" and inner circle networks in their institutions. This means they are both excluded from many decisions and are often unaware of the programs and opportunities available to them. Participants strongly emphasized the need to be better connected with the larger scientific community, not just with women scientists, in order to achieve any equality.



NURTURING A SCIENCE CAREER

Promoting gender equality and empower women is Goal 3 of the United Nations Millennium Development Goals Report 2010⁸. The goal describes that the developing regions as a whole are approaching gender parity in educational enrolment. But despite this progress, gender parity in primary and secondary education is still out of reach for many developing regions.



Gender has acted as a basis in shaping the careers of scientists for centuries. Dogmas of gender and science developed over different periods of time have resulted in the exclusion of women from science for a long time all over the world. Women, in fact, were barred from education itself earlier on. Later on they were allowed education but were barred entry to universities. The idea prevailed that education would distract women from their natural roles as mothers.

Science education is pivotal for upscaling a student's level of thinking. It not only enhances knowledge but it also builds a mindset with an ability to distinguish between good or bad and right or wrong. It provides a scientific approach to thinking, and helps people understand the foundation and building blocks behind the phenomena they can see. It is essential that every individual gets an opportunity to study science at all levels of education.

Women Science Education in India

The year 2008 estimates of state of education across the globe by UNICEF, place the number of out-of-school children at 93 million and majority of these children are girls, and almost 80 per cent of them live in sub-Saharan Africa and South Asia.⁹

In India, vast geographical, ecological, and socio-cultural diversity pose enormous challenges for the government in ensuring its constitutional commitment to every citizen's right to education. Though promoting girls' education has been a priority in India for over a century, coverage is still not universal. Schools meant for educating rural poor girls are largely focused on imparting literacy and numeracy skills. Schools for the urban poor are too few in number. The focus on access has brought many girls into school, but assuring quality remains a challenge.¹⁰

Gaps at Primary, Secondary and Tertiary Levels

In India, according to the GoI statistics¹¹, in the year 2004-05, the drop-out rates of girls from classes I-VIII was about 50.8%. For classes I-X the drop-out rate of girls was about 64 % in the same year. Hence, only 36% of the country's girl students stayed in school up to class X. Statistics from



⁸ United Nations Millennium Development Goals Report 2010

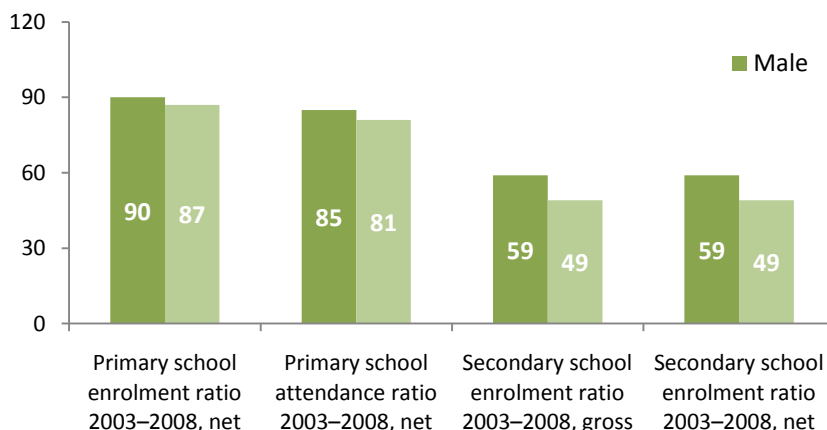
⁹ http://www.unicef.org/education/index_bigpicture.html

¹⁰ United Nations Children's fund 2009 report - Overcoming barriers to girls' education in South Asia

¹¹ <http://education.nic.in>

United Nations of year 2001/2008 shows that there is a significant difference between primary and secondary school enrolment ratio for boys and girls.

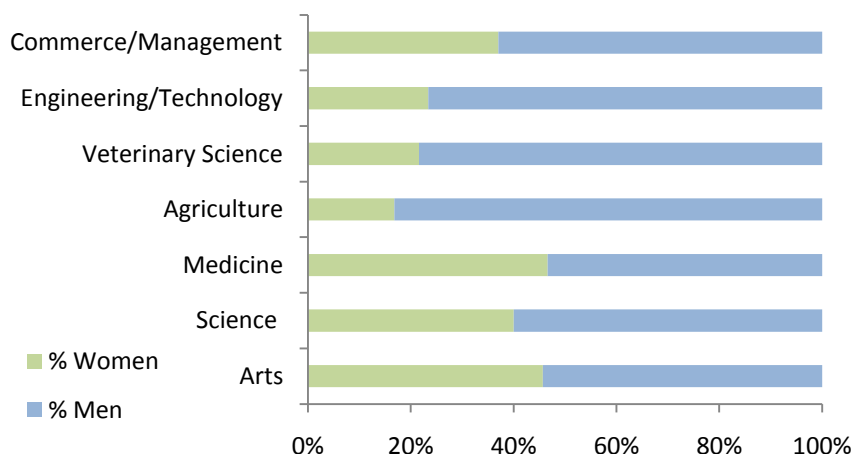
Figure 2 - Proportion of girls and boys who attended primary and secondary schools in India during 2001/2008 (Percentage)



Data Source – India Statistics at United Nations Children’s Fund (UNICEF) website

Tertiary level enrolments gaps in case of women are also prominent in India. Women are 20% lower than that of men in university level enrollment, highlights a report of Department of Science & Technology’s National Task force for Women in Science.¹² The report also highlights that women in India are being overrepresented in the humanities and social sciences and significantly underrepresented in science, technology and, in particular, engineering. Figure 3 shows the subject-wise university enrolments of women in comparison to the total enrolments in the year 2005-06.

Figure 3 - University Enrolment in 2005-06 (Percentage): University Grants Commission



*Source: Department of Science & Technology’s National Task Force for Women in Science report

¹² Department of Science & Technology’s National Task Force for Women in Science report

Government of India Programs & Initiatives

Ministry of Human Resource Development (MoHRD), Gol has been proactively addressing the issues for women education at all levels. MoHRD have programs that facilitates elementary, secondary and higher education for women. The Ministry acknowledges the fact statistics reveal that despite the efforts that have been made, gender disparities persist in enrolment of girls, especially in rural areas and among disadvantaged groups. The disparity is more acute in the enrolment of Scheduled Castes and Scheduled Tribes, especially at upper primary level.

Government of India is committed to achieving universalization of elementary education by 2010. This entails a special thrust on girls' education as well as greater rigour in planning, targeting and actual implementing the interventions designed. Sarva Shiksha Abhiyan has limited financial provisions for girls' education in the form of free textbooks and innovations at district levels. The National Programme for Education of Girls at Elementary Level (NPEGEL) has been formulated for providing additional support for education of underprivileged/disadvantaged girls at elementary level. NPEGEL is a part of SSA and will be implemented under its umbrella but as a distinct and separate gender component plan of SSA.¹³



For secondary school education, Kasturba Gandhi Balika Vidyalaya Scheme (KGBVS) of the MoHRD launched in 2004, focuses at providing education to the underprivileged girls, predominantly of Scheduled Caste, Scheduled Tribe, Other Backward Classes and minority groups. Under the Centrally Sponsored Scheme "Incentives to Girls for Secondary Education" announced in 2006, KGBVS received fund allocations for opening 1,000 new residential schools for girls from SC, ST, OBC and minority communities in 2006-07.

As per year 2009 status, out of the 2573 KGBV sanctioned, 2511 KGBV with 191123 Girls enrolled were operational.

The "Incentives to Girls for Secondary Education" announcement also allocated funds for providing special incentive to the girl child who passes the VIII standard examination and enrolls in secondary school. The incentive is a sum of Rs.3, 000 (66 USD) that will deposited in her name, and she would be entitled to withdraw it on reaching 18 years of age. The announcement was made to promote the girl child's enrolment of 14-18 years age group at secondary stage, who passes class VIII and subsequently drops out for various socio-economic reasons.

Mahila Samakhya (MS) is an ongoing scheme for women's empowerment that was initiated in 1989 to translate the goals of the National Policy on Education into a concrete programme for the education and empowerment of women in rural areas, particularly those from socially and economically marginalized groups. The critical focus within MS is the centrality of education in empowering women to achieve equality. MS is Gol's main scheme targeted at addressing the

¹³ <http://education.nic.in>

barriers that prevent rural women and girls from accessing education, such as problems of their relative isolation, struggle for livelihoods, lack of self confidence, oppressive social customs etc. Currently the programme is being implemented in 102 districts of ten States viz. Andhra Pradesh, Assam, Bihar, Chhattisgarh, Jharkhand, Karnataka, Kerala, Gujarat, Uttar Pradesh & Uttarakhand.¹⁴

Education for Women Equality is another programme of MoHRD that aims to evolve a modality of planning involving government institutions and voluntary agencies reaching out to village women. This program involves continuous dialogue so that the educational quality is not subordinated to the desire for immediate results. This program adopts an area-intensive approach to integrate the existing efforts to provide formal and non-formal schooling, adult education upgradation of educational qualifications through condensed courses and vocational training.¹⁵

Saakshar Bharat, a versatile new variant of the National Literacy Mission, MoHRD launched in 2009, is a flagship programme to provide adult non-literates and neo-literates, a package of opportunities including those for Basic Literacy, Basic Education (Equivalency), Skill Development and Continuing Education. The thrust of Saakshar Bharat is to promote a rapid increase in literacy levels among rural women.¹⁶

Workshop Discussions

The first panel session was on “Nurturing a Science Career,” and was moderated by Dr. Manju Sharma, former Secretary of the Department of Biotechnology, Ministry of S&T. Joining her were panelists Dr. Rama Mukherjee, Managing Director, ARA Healthcare Pvt. Ltd.; Dr. Vibha Dhawan, Vice Chancellor, The Energy and Resources Institute (TERI); Ms. Paramjeet Shergill, Principal Rabea Girls Public School; and Ms. Gail Davidson, Principal, Lynbrook High School, CA, USA.



Highlights of this session included:

- Panelists agreed that India must find ways to encourage female students to study at primary, secondary, and university levels. They observed that education now is deemed acceptable for girls only to the extent that it leads to employment opportunities. Science often involves further study, and girls drop out at various stages due to financial, social, and family pressures: the “leaky pipeline.” Some families prefer that their daughters study at women’s colleges for societal reasons; but many women’s colleges have weak science programs. The GoI is giving grants to improve scientific infrastructure in all-women’s colleges. Unavailability of flexible or part-time work in science hinders women who may have other obligations. There is a big need for role models for girls and women who aspire to be scientists, and

¹⁴ MoHRD Annual Report 2010

¹⁵ <http://education.nic.in>

¹⁶ MoHRD Annual Report 2010

female mentors. Panelists noted the importance of young women hearing supportive words at critical decision making points in their lives.

- Panelists also noted that while more girls have been studying science in urban areas in recent years, the lack of infrastructure for women in rural areas that make it hard for women to take the first steps in obtaining a science education. Basic healthcare and family planning information is still not making it to women in rural areas, and those issues prevent potential progress in academic/professional quality. This is the “blocked pipeline” for those in the rural area.

In her opening remarks, the moderator, Dr. Manju Sharma emphasized the importance of looking beyond the total number of women that studying science or working in scientific fields. Success for initiatives to nurture women in science should be by judged by the diversity and quality of science education available to women as well as their ability to get good jobs, sustain careers, engage in entrepreneurialism, and obtain decision-making positions in the public/private sector. Dr. Sharma guided the panelists toward five core topics:

- How do we encourage female students to study at primary, secondary, and university levels?
- What is the appropriate role for mentors, educators and family in promoting science education for girls/women?
- How would encouraging more women to be science educators make a difference?
- What behaviors and activities would encourage girls/women to be more successful within the system? How can social stereotypes be challenged to encourage girls to be more assertive and self-endorsing?
- How could the education system and career selection process be more effective at including girls/women in science?



Mrs. Paramjeet Shergill shared her challenges and successes encouraging girls from a low-income, conservative Muslim neighborhood to overcome the social moors that de-value education for women. She cited key problems in Indian society that were echoed by the other panelists:

- To the extent that education now is deemed acceptable for girls, it is linked to employment opportunities. The employment opportunities are few because of the so-called “leaky pipeline” problem where even women who start off in science drop out for various reasons, most often because of family obligations.
- There are few role models for girls in science fields.
- Now that women are getting more education, they compromise by not pursuing science jobs, which are perceived to be more time and labor intensive. They opt instead for part-time work in education or childcare.

Ms. Gail Davidson built her remarks around the concept of community and the importance of girls hearing supportive words at critical decision-making points in their lives. Her school in the U.S. was a center of community life and reflected the diversity of the town. AP science courses were filled with equal numbers of males and females, and students were driven to excel. Some girls were interested in science because their family pushed them; others simply liked it from the beginning and were personally driven to excel. In a recent competition sponsored by Intel, the student finalists were cheered on by their peers in the same manner as star athletes are at other schools. Over 1600 students honored the two student finalists at a special school assembly.



Ms. Davidson reflected on the lack of role models for girls considering science careers in India; that is not the case in the U.S. She noted that the presence of role models for young women is very important. In addition, she pointed out the importance of guidance counselors, parents, siblings, and other community members that can shape the way they think about themselves and what they can achieve professionally and academically.

Dr. Rama Mukherjee focused on the lack of infrastructure for women in rural areas. This makes it hard for women to take the first steps in obtaining a science education. For the small number who achieve academically, it is harder still to sustain careers, much less excel in them. Opportunities are about more than more classrooms and teachers.

Dr. Mukherjee is optimistic that the Indian government's goals to build college and university and other educational facilities will be achieved. But Indian society is still engineered to discourage women from striving for science education and work. She worked with NGOs in Mumbai to help women from slums and rural areas outside the city and found that they were well-equipped to address the social infrastructure problem. She encouraged NGOs to continue engaging girls and women. Educationally, she pointed to the need for practical training; she cited nanotechnology as an example of a field that is as much about hands-on practice partly as classroom/textbook time. Those opportunities/facilities are lacking, and women generally have less access.



Dr. Vibha Dhawan began her presentation on the upbeat note that disparity between males and females in the classrooms has reduced drastically from the past, where private schools used to be 80% boys, and families with a boy and a girl would send the boy to the superior private school and the girl to a government school. She pointed to the near gender equality in engineering programs, especially software engineering. However, just 100 miles outside of Delhi, the picture is quite different. Basic healthcare and family planning information is still not making it to women in rural areas, and those issues prevent potential progress in academic/professional quality.

Referring to the "leaky pipeline" problem, she pointed out that there are no "part-time" jobs in science. She also pointed out that some, if not many women, really want to take care of their children, but the workplace penalizes women who cannot commit the same amount of working hours

as male counterparts. Long hours come with the territory in science careers because the pace of knowledge change is so rapid. If you do not stay ahead of the curve, you lose ground in the job market. Dr. Dhawan also suggested that employers need to provide more flex-time for female employees.



WOMEN IN SCIENCE-BASED PROFESSIONS

Women scientists in India are every bit as intelligent and hard working as their male counterparts, but seldom reach the senior ranks and face significant obstacles - primarily cultural and organizational - to achieving success in India.

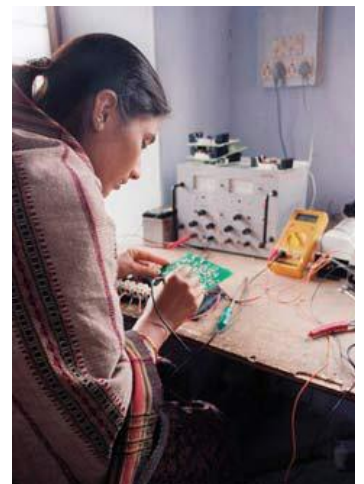
According to UN's MDG report 2008, globally, the share of women in paid employment outside the agricultural sector has continued to increase slowly and reached 41 per cent in 2008. But women in some regions are seriously lagging behind. In Southern Asia, Northern Africa and Western Asia, only 20 per cent of those employed outside agriculture are women. In countries where the agricultural sector predominates, women are mostly employed in agriculture and largely in vulnerable jobs—in subsistence farming, as unpaid family workers or as own-account workers—with no or little financial security or social benefits.¹⁷

Women in India are a part of every sphere of science be it research, trade, policy or education. They are competent, sharp and knowledgeable and being admired contributions in the professional as well as social community groups.

Though this is an indication of a positive growth, there is also a side to it on what it takes for them to achieve these positions in science, which include their constant struggle with the gender inequity issues, and compromises they make to bring a balance between their personal and professional life.

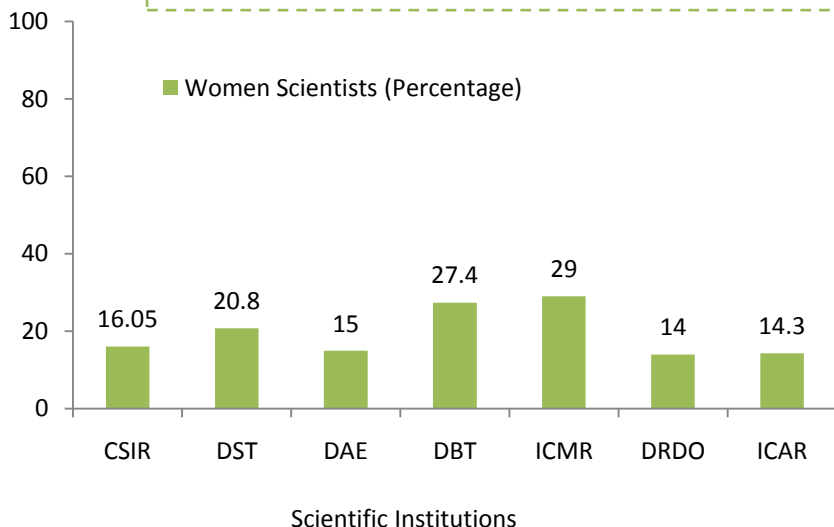
Challenges in Increasing Women Participation in Science Based Professions in India

According to DST's National Task Force on Women in Science report, women form less than 25% of scientific faculty in various institutions and universities, except those under Indian Council of Medical Research (ICMR) and Department of Biotechnology (DBT), which are primarily engaged in biological research (Figure 4).



¹⁷ United Nations Millennium Development Goals Report 2010

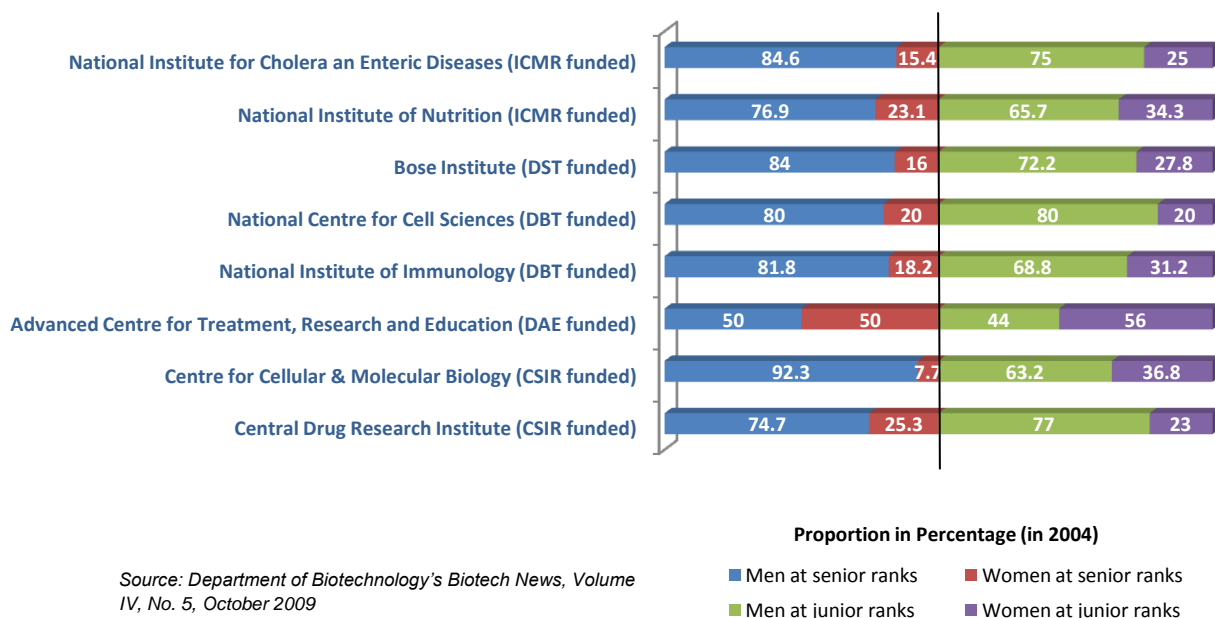
Figure 4 - Women Scientists in Government Scientific Institutions in India (Percentage)



Source: Department of Science & Technology's National Task Force for Women in Science report

The paucity of women at the senior most administrative and policy making positions in the Indian scientific institutions is striking. There are just three women Directors in Science & Technology Institutions in India is also highlighted during the Women in Science Workshop. Department of Biotechnology's 2004 newsletter, presented the difference in percentages of men and women occupying senior and junior positions (Figure 5.).

Figure 5 – Women Scientists at junior and senior ranks in Government Scientific Institutions in India (Percentage)



Source: Department of Biotechnology's Biotech News, Volume IV, No. 5, October 2009

Besides underrepresentation at senior levels, women also do not get their fair share of scientific fellowships and awards. The lack of recognition is noted in DST's National Task Force on Women in Science report, which says that in 2008, out of the total Indian National Science Fellowships awarded, only 3.2% were women. Also, women constituted only 5.1% of the total fellowships awarded in Indian Academy of Science, and 4% of the total fellowships awarded at National Academy of Agricultural Science, in the year 2008.¹⁸

The gender disparity is also evident in the distribution of scientific awards. Out of the total 333 Shanti Swarup Bhatnagar¹⁹ awards since 1958, only 9 were awarded to women.

Government of India programs & Initiatives

Department of Science & Technology (DST) has been proactively undertaking initiatives for Gender Mainstreaming in Science & Technology in India.

In 2003, DST initiated two fellowship programs, one for research in Science & Technology based societal programs, and other for training in Intellectual property rights. Under the Science & Technology based societal programs fellowship scheme, 220 fellowships have been awarded and 78 papers are published. Four batches of 150 candidates have been trained under the training in Intellectual property rights fellowship program. 89 of these candidates are now successful patents search agents. The other programs initiated by DST is the fellowship scheme for training in S&T communication

DST's "Women Scientist Scheme" fellowship for research in basic and applied science started in 2003, has awarded 679 fellowships out of 3976 proposal received in life sciences, chemical sciences, physics & mathematics, engineering science and earth & atmospheric science. The scheme contributed almost 436 research papers in the kitty of country's total research publications and 30% of the women scientists have got employment in universities and National R & D Labs.



In 2007, DST started "National programme for training of Women scientists and technologists". The programme targeted to induct 10 training programs per year, of 1-2 weeks duration, for students from universities & Colleges, S&T Institutions. Stress and time management, Issues of sustainable development for women scientists, General Management Program for women scientists, High performing team and leadership issues for women scientists, Communication and presentation skills, Gender, Ethics and Law for Women scientists, were few of the programs conducted by DST. The programme has trained approximately 250 women scientists.

In 2008-09, DST started a special initiative, "Consolidation of University Research for Innovation & Excellence in Women Universities" (CURIE) to support 'Women Universities' for improving R & D

¹⁸ Department of Science & Technology's National Task Force for Women in Science report

¹⁹ The Bhatnagar Prizes are given to scientists for their outstanding scientific contributions made primarily in India during the last five years preceding the year of the prize.

infrastructure. Till date, two women universities have been supported under CURIE in 2008 by Rs.5.50 crore (1.23 million USD) each for 3 years.

DST's future initiatives include, replacement of Task Force for Women in Science by a high level Standing Committee chaired by Minister for Science & Technology & Earth Sciences, Implementation of the recommendations of the task force under defined timelines, cooperation between state science & technology councils & women universities for gender initiatives, and expansion of the fellowship programme to include new areas such as training in Regulatory areas in R&D.

Workshop Discussions

The second panel session was on “Women in Science Professions,” and was moderated by Biocon MD and Chairperson Dr. Kiran Mazumdar Shaw. Joining her on the panel were Ms. Catherine J. Didion, Director of the National Academy of Sciences’s Committee on Women in Science, Engineering, and Medicine; Dr. Lakshmi Lingam, Dean of R&D and Professor at Center for Women Studies in the Tata Institute of Social Sciences; Dr. Nita Shah, Head of the Vulture Advocacy Programme at the Bombay Natural History Society; and Dr. Usha Mujoo-Munshi, Head of the Library at the Indian Institute of Public Administration.



Highlights of the session included:

- Panelists pointed out that it is extra hard for women entrepreneurs to raise start-up funds due to societal doubts and prejudices. Societal attitudes translate into barriers that reduce women’s access to relevant infrastructure and resources as their careers develop. One panelist noted that men who submit articles to scientific journals in India have a 26% publication rate, whereas women only have a 7% success rate. Panelists noted the importance of establishing strong network relationships to ensure publication, promotion, and leadership opportunities. They observed that these networks are often dominated by males, with male gatekeepers.
- Panelists observed that if women are to succeed in scientific careers there needs to be more flexibility and a more “liberal mindset” in how to approach scheduling, family, and other issues. Indian families often do not support their daughters going into science. Many organizations do not emphasize work-life balance. Sexual harassment is still a big concern for women researchers spending long hours in the lab. A major issue that arose during group discussion and question and answer periods was the need to facilitate “re-entry” of women back into the science workforce after five or ten-year gaps taken to raise families.

In her opening remarks, the moderator, Dr. Kiran Shaw Mazumdar, identified several key milestones in the women in science career path or pipeline:

- Initial entry to science field
- Getting a science degree
- Getting fellowships/awards in science
- Being accepted to associations and recognized as an achiever
- Breaking into the science and technology field as a female entrepreneur

Dr. Shaw shared about how as a young woman, it was very difficult for her to raise capital as a biotechnology entrepreneur. She faced the barriers of lack of age credibility; working in a new industry; lack of business experience; and no assets to guarantee a loan. Banks told her that she was a “high-risk” loan candidate.

But Dr. Shaw encouraged women to find a way to go through open doors by staying committed to overcome the challenges. She observed that failures bring about success as an entrepreneur. Failures teach us ways to overcome challenges. Don't give up. Stick with it and doors will open. She said that in the area of scientific and technological research, women are still discouraged by their families, who prefer for them to get married and follow their husbands instead of working long hours in a laboratory.

Dr. Shaw said the pharmaceutical industry is a growing business in India where women should feel empowered to gain access and find opportunities. She concluded by observing that most challenges are of perception, which can be overcome.

Dr. Usha Mujoo-Munshi said that women are underrepresented in science and technology. For this to change, we must change the social fabric, improve access to relevant infrastructure and resources; and provide economic and societal guidance. She spoke about the education system in India, saying that there are equal opportunities in liberal arts but not so in science and technology. She suggested a few ways to address this:

- Incentives: need scholarships for women to push greater training; travel grants; training exposure; economic promotion is one of the key motivating factors – get merit pay for membership to academies but women largely absent from these academies.
- Promotions: Not much reported by media of success of women in science and technology; need more public outreach to school-age women that success is possible. She observed that networking is key as science is collaborative effort. She suggested special events for women to get them connected. She stressed the need for a national web portal to cover all policies and strategy for young women interested in science programmes as well as current women scientists (awards, academies, conferences).



- Achievements/Recognition: publications need to increase for scientists (in 38 journals surveyed there was only a 15-20% contribution from women). Men have a higher success rate of publication – 26%; women success rate of publication – 7%.
- Leadership: Offer more awards; the path ahead is to get women leadership roles and not just membership – goal is to obtain top-level jobs.

Ms. Catherine Didion talked about looking at career pathways: academia, government, business. She spoke about stereotypes of women in America, where science and technology is still male dominated. She shared about a survey of HS students in which engineering as a career for women ranked last. She explained that in the U.S., higher educational institutions are trying to hire women, but there just are not enough candidates. There is a need to motivate more women to pursue Ph.Ds in science.

She observed that good mentoring leads to greater results for individual and institutions by promoting access to information and stronger networks. Dr. Didion spoke about the challenges of retaining women in academia. She talked of the need for flexibility, since when women have children the perception is that they are not committed.

Dr. Didion noted that in Silicon Valley, 52% of founders of startups were born outside of US from 1995-2005, of whom 15.5% were Indian. She encouraged women to network and be proactive about their careers. She encouraged those who wanted to have an impact on women in science in India to focus on proactive action and pick particular community to help, like rural women; returning students from US; high school students; women re-entering the science workforce, etc.

Dr. Lakshmi Lingam shared how she works for Tata Institute for Social Sciences, which is predominated mostly by women. She noted that in India, many organizations do not have work-life balance protection. There are laws in India, but private companies generally do not abide by them. She said that in India you will find women in government research, but not private research institutions, because it is easier to balance work and life in a government job. Companies look at what women can do like men; not separately what women can do as women. She spoke of the need for equity—women will not function exactly like men. It is unfair to expect this; it is not a level playing field. Sexual harassment is still big concern for women as researchers spending long hours in lab

Dr. Lingam said we need to understand trends of increasing numbers of women interested or entering in science and technology – most are coming from urban areas, upper and middle-class socioeconomic backgrounds, more Hindus than Muslims. There is a need to remove blocks to allow disadvantaged women to have same opportunities (rural schools need science labs, Muslim girls need to be encouraged about measures to safeguard them in the labs, etc.).

There is a major impediment to girls (and boys) pursuing science in rural versus urban areas. Rural girls and boys lack resources to understand and prepare for science and technology (need school science labs and textbooks, teacher training to conduct education in science and technology in local languages). When science education and training is only based in English language – most of India's children lack possibilities for the future.

Dr. Nita Shah spoke about intellectual, social, and culture themes that impact women in S&T. She observed that it takes five years to get a PhD. That is a lot of time and commitment. So women need family support. She shared about her own adventures in pursuing a science career in the area of conservation. She talked about the need for women scientists to consider careers in environmental fields. She observed that 60% of India is rural population – agriculture and livestock are very important in this country.

ROLE OF GOVERNMENT IN EMPOWERING WOMEN IN SCIENCE

Empowering women in science is a high priority for the GoI, which is apparent from the various schemes and programmes the government undertakes towards promoting science education and bringing equity in science-based professions.

With the support from GoI, in the last few decades, the Indian women has traveled huge distances, from the time when women weren't allowed to move out of the house, to a new beginning of empowering in science.

There are enormous seen and unseen challenges though, that doesn't allow the benefits fully reaching to women. One of the main challenges is huge and diverse population in India that the GoI's limited resources cannot cater at the same time. The progress is taking time, nonetheless it is steady.

Workshop Discussions

The third panel session was “Empowering Women in Science,” and was chaired by Assistant Secretary of State Dr. Kerri Ann Jones. Panelists included Dr. Vinita Sharma, Advisor, DST, GoI; Dr. Swati Basu, Advisor, Ministry of Earth Sciences, GoI; and Dr. Leena Srivastava, Executive Director, The Energy and Resources Institute. Highlights of the session included:

- Panelists noted that because India is a vast and diverse nation, policy measures must be flexible to adapt to local conditions. The GoI has promoted S&T schemes for women since 1986, with mixed results. The DST was the first department to take advantage of gender-based budgeting, introduced in 2005, which helped it to substantially expand its budget to promote women in science. Panelists said funding was not the major barrier for women's empowerment initiative, but noted that adequate implementation was a concern—many women are not aware about what schemes are available.



- A Taskforce on Women in Science, with 1800 women from all regions of India, was created last year to address the concerns of women in scientific professions. Govt Departments are in the process of implementing many of its recommendations



(<http://indianwomenscientists.in/Recommendations.html>),

including launching a website (www.indianwomenscientists.in). The DST Fellowship Programme helps women re-enter the science workforce by providing opportunities for research in basic/applied sciences and science and technology-based social programs.

- Training has been identified as a key measure that can increase the number of women in leadership positions in the Indian scientific community. A National Science and Technology Training Scheme has also been launched to help women develop general management and leadership skills. This scheme includes one to two-week training sessions in subjects such as stress/time management, budgeting/management, communications, and ethnic/community resource management.
- Panelists raised the issue of the unequal treatment women faced during interviews and selections processes. They said scientific leadership must be trained to have greater gender sensitivity regarding parenting roles. They highlighted the importance of using new technologies (online/on demand training and teleworking) to allow some women to retain their positions when they have to move with their husbands. Participants agreed there is also a need for more women in high-level government positions that set scientific policy. Additional cross-training and multidisciplinary workshops are required, so that women will not be afraid to pursue leadership positions.

In her opening remarks, the moderator, Dr. Kerri Ann Jones, emphasized three main challenges:

- Students: how to attract students to the field and provide adequate mentoring?
- Career Conditions: how to provide opportunities through flextime to ensure work and family balance?
- Women in Leadership: how to develop certain skill sets and training to enable women to pursue leadership opportunities within scientific fields?

She observed that initiatives to address the blocked pipeline for women's education in rural India could include textbooks in local languages, partnerships between universities and rural communities.

Dr. Vinita Sharma began her presentation by noting that gender equality in the scientific field is not a new concern. The Indian constitution allows for positive discrimination and the Government of India (GOI) began to implement gender equality/sensitivity initiatives years ago. However, it is important to note that the country represents a vast diversity of languages, regions, politics, etc. Policy measures must be flexible to be effective throughout the country. There is also still a great vacuum of technology access for women in rural India. According to Sharma, the GOI has promoted objective and skill-relevant, Science and Technology Schemes for women since 1986. In the 1980s

many of the top achievers (gold and silver medal science graduates) were female, but this did not translate into similar numbers of women in research or working in labs. At that time, women represented about 30 percent of women.

Dr. Sharma presented statistics about the state of women's education in various regions. More than 50 percent of women in Southern states such as Kerala pursue higher education. In contrast, less than 35 percent of women in Arunachal, Bihar, Jharkhand, Orissa, and Rajasthan pursue higher education. She said the greatest obstacle to gender equality in rural India was at the primary and secondary level. She noted that most Indian women who obtain a bachelor's degree go on to pursue graduate degrees or post doctoral fellowships.

The concept of gender budgeting was introduced in 2005 and the Indian Prime Minister's Office monitors GOI Department's compliance for this budgeting. Dr. Sharma explained that the Department of Science and Technology (DST) was the first department to implement a women's empowerment initiative with a gender budgeting component. Several fellowship and training opportunities were created, which increased DST's total budget allocations. She indicated that it was not difficult for departments to obtain GOI funding for gender initiatives. She said funding was not the major barrier for women's empowerment initiative, but noted that adequate implementation was a concern. A Taskforce on Women in Science, with 1800 women from all regions of India, was created to address the concerns of women in scientific professions. A standing committee has been created to promote the issues raised by the taskforce and the Minister of DST will chair the standing committee. A website for women in science has also been launched (indianwomenscientists.com) as a part of the recommendations.

DST fellowships include opportunities for research in basic/applied sciences and science and technology-based social programmes (<http://www.dst.gov.in/scientific-programme/women-scientists.htm>). Training programmes include workshops on intellectual property rights and scientific communications (http://www.dst.gov.in/admin_finance/training-prog.htm). According to Dr. Sharma, there is a huge demand in India right now for editorial work in this field. Scientific journals, textbook publishers, and media all need additional editors who are scientifically literate. Some of the training offered by DST is home-based, which allows women to balance family needs. These training initiatives are working well in urban areas with good IT infrastructure. The current upper age limit for these initiatives is 50. DST has plans to increase the age limit to 55.

Dr. Sharma noted that very few women in India pursue veterinary, material, or dairy sciences even though there is a great demand in these specialties. Traditionally, Indian women have tended to pursue careers in the life sciences and medicine, when they have pursued higher education in the sciences. Parents want daughters to study at women's colleges for a variety of societal and security concerns, but the infrastructure for science and technology education is inadequate at these institutions. DST is providing grants to these colleges to boost scientific infrastructure.

Dr. Sharma noted that research methodology was another major area of weakness in India. DST has launched workshops to address this inadequacy. These workshops are especially important for women returning to research after gaps in employment due to family reasons. The workshops help refine research projects and improve their scientific validity. This programme has resulted in 436 research papers. A fully-sponsored, National Science and Technology Training Scheme has also been launched to help develop general management and leadership skills. This scheme includes 1-2 week training in subjects such as stress/time management, budgeting/management, communications, and ethnic/community resource management.



The taskforce has led to other empowerment initiatives including analysis of textbooks to improve gender equality, gender-based audits of GOI Science and Technology Institutes, addressing shortcomings in secure transport/housing for female student/researchers, and gender sensitivity training for management. Sharma identified regulatory issues as another area where additional training initiatives would prove beneficial to increasing the number of women in scientific professions. About 80 percent of quality assurance officers at pharmaceutical companies in India are women.

Dr. Sharma stated that it is sometimes difficult to address gender inequalities exclusively through government policymaking because stakeholders often disagree about the effectiveness of different women's empowerment initiatives. For example, the Bhatnagar Prize has been awarded to 333 since 1958, but only 9 women have received it to date. The GOI has tried to address this shortcoming by creating awards specifically for women, but some prominent women scientists have declined to accept these awards. Instead, women scientists want to be recognized for the same awards/prizes as their male counterparts. They want to compete on a level playing field, which is difficult to address in the short-term. Similarly, it has been difficult to recruit male managers to participate in gender sensitivity training. New and creative thinking is required to address these challenges.

Dr. Swati Basu noted that the Ministry of Earth Sciences is a fairly new one. The GOI has coupled climate change and atmospheric issues under one department now. Dr. Basu noted that traditionally, very few Indian women have pursued careers in physics or meteorological sciences. However, she was optimistic about the changes she has seen in the younger generation and in metro areas such as Pune, where women are leading at government research institutions. Dr. Basu also identified the need to maintain awareness of empowerment efforts, beyond one-time events such as Women's Day. Students need role models in the field and media partnerships are required to build up the image of science for younger students.

Women scientists need to find time to go speak to students and their parents to change the mentality that it is easier to get an MBA or work in the corporate sector, if pursuing higher education. Her ministry has received basic GOI approval to create an Advance School of Training in Earth Sciences. The programme will fund education at the Masters of Technology and Doctorate level.

She also noted that India's youth population is used to new technologies, so a lot of the existing training and information could now be provided to larger audiences through the internet.

Dr. Leena Shrivastava shared that she is an economist by training, and that many of the points she wanted to make have already been raised by the excellent speakers who have already shared. Dr. Shrivastava also raised the issue of the unequal treatment women faced during interviews and selections processes. She noted that in addition to government initiatives, societal and family attitude would also need to evolve further. She wondered why scientific careers did not have the same societal approval as IT professions currently do.

Dr. Shrivastava said gender sensitivity regarding parenting roles also needs to be promoted. She explained that men in government and private sector employment were often transferred throughout India during their careers and their wives followed them during these moves, which forced many of these women to leave good scientific positions behind. She highlighted the importance of using new technologies (online/on demand training and teleworking) to allow some women to retain their positions when they have to move with their husbands. Dr. Shrivastava also noted that women were afraid to pursue management opportunities that arise during their careers because they were uncomfortable working outside of their core competencies.

OUTCOMES

Participants expressed appreciation that the U.S. Embassy again hosted this much-needed workshop. Gol participants highlighted the task force receiving feedback on the issue of Indian women in Science, and shared about a number of programmes and initiatives that address this challenge. Participants made several recommendations including, need for practical technological training in rural schools, for investment science laboratories and infrastructure, local-language science textbooks, and training for local teachers in local languages. They also urged the need for partnerships with urban Universities to provide long-distance, e-education may also be a partial solution to promote science education in rural areas. The use of gender-friendly stories in math and science textbooks, as well as ensuring a mix of male and female images in textbooks, was suggested by participants.

Participants stressed the need for leaders to use flexibility, liberality, and gender sensitivity when making choices that affect women students and scientists. Participants suggested flexible job timings and facilitation of re-entry of women into the science workforce after family-related gaps in employment. They suggested affirmative fiscal policies and incentives to encourage women in science. Many participants stressed



the need for an interactive website for women in science.

Many also suggested that the Gol must do more to publicize its various schemes and programmes for women in science—women will participate when they know about what is available. Training programmes for women in cross-disciplines like communications, budgeting, and leadership to increase the number of women in leadership positions in scientific institutions was another recommendation.

Participants admired U.S. Embassy’s initiatives on prioritizing issues of “Women in Science”. Participants expressed the need to have more of such programmes organized for discussing issues in details. They thanked the Embassy for providing an important platform to express issues and make recommendations towards Gol programs.

APPENDICES

Workshop Speakers Biographies

DR. KIRAN MAZUMDAR SHAW, CHAIRMAN & MANAGING DIRECTOR, BIOCON

A successful technocrat of global standing, Ms. Shaw heads India's leading Biotechnology enterprise, Biocon. She is highly respected in the corporate world and was recently named among TIME magazine's 100 most influential people in the world. Ms Shaw chairs Karnataka's Vision Group on Biotechnology and also served on the Board of Science Foundation, Ireland. She presently serves on the Advisory Council of the Government's Department of Biotechnology. She is also part of the Prime Minister's Council on Trade & Industry in India and the US-India CEO Forum. Ms. Shaw also serves as Member, Governing Body and General Body of the Indian Pharmacopoeia Commission, an Autonomous Body of the Government of India. She is also a founder member of the Society for the formation of "Institute for Stem Cell Biology and Regenerative Medicine". Ms. Shaw has been nominated as Member of the Board of Trade, Directorate General of Foreign Trade, Ministry of Commerce & Industry.

Ms. Shaw is the recipient of several prestigious awards including the Nikkei Asia Prize, 2009 for Regional Growth, Express Pharmaceutical Leadership Summit Award 2009 for Dynamic Entrepreneur, the Economic Times 'Businesswoman of the Year', the 'Veuve Clicquot Initiative For Economic Development For Asia, and many others. Her most cherished awards are the national awards, PADMASHRI (1989) and PADMA BHUSHAN (2005) presented to her by the President of India, for her pioneering efforts in Industrial Biotechnology.

Ms. Shaw received a graduate honors degree in Zoology from Bangalore University (1973) and qualified as a Master Brewer from Ballarat University, Australia (1975). Ms Shaw also received an honorary Doctorate of Science in 2004, from her alma mater, Ballarat University, in recognition of her pre-eminent contributions to the field of Biotechnology. She has also been awarded honorary doctorates from University of Abertay, Dundee, U.K. (2007), University of Glasgow, U.K. (2008) and Heriot-Watt University, Edinburgh, U.K. (2008).

MR. TIMOTHY J. ROEMER, U.S. AMBASSADOR TO INDIA

Ambassador Timothy J. Roemer leads one of America's largest diplomatic missions, broadening and deepening the strategic U.S.-India partnership and expanding public diplomacy throughout India. Nominated by U.S. President Barack Obama as the 21st U.S. Ambassador to the Republic of India on May 27, 2009, Ambassador Roemer was confirmed by the U.S. Senate on July 10, 2009, and sworn in on July 23, 2009. He presented his credentials to Indian President Pratibha Patil on August 11, 2009.

As one of the youngest Ambassadors appointed to India, Ambassador Roemer immediately reached out to the people of India, strengthening the ties that form the foundation of the growing U.S.-India

relationship. He has done this by visiting sites around Delhi as part of his "Delhi Days" program, traveling across the breadth of India to see first-hand the vibrant diversity of this country, and communicating the shared vision of the U.S. - India partnership. The Ambassador has made a particular effort to visit villages, experience religious diversity and interact with Indians from all walks of life, strengthening the relationship between the U.S. and Indian people with each visit. He has used "basketball diplomacy," driven a rickshaw, and worked closely with women's empowerment groups to highlight shared American and Indian values.

Prior to his nomination as Ambassador to India, Ambassador Roemer was President of the Center for National Policy (CNP) in Washington, D.C. a moderate think-tank dedicated to finding bipartisan solutions to America's most important national security challenges. Ambassador Roemer holds a B.A. from the University of California, San Diego, and an M.A. and Ph.D. in American Government from the University of Notre Dame. He and his wife, Sally, have four children: Patrick, Matthew, Sarah, and Grace. He enjoys coaching his children in sports, reading biographies, collecting first edition books, and playing basketball.

Dr. KERRI-ANN JONES, ASSISTANT SECRETARY OF STATE, BUREAU OF OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS

Dr. Kerri-Ann Jones was sworn-in as Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs on August 20, 2009. Dr. Jones joins the leadership of the U.S. Department of State after serving as an independent consultant specializing in strategic planning and the development of research and education portfolios. Her most recent position in federal government was as Director of the National Science Foundation's (NSF) Office of International Science and Engineering (2002-2005). Her prior professional experience includes serving as the Director for the Experimental Programme to Stimulate Competitive Research (EPSCoR) for the state of Maine (2000-2002), and as Associate Director for National Security and International Affairs at the White House Office of Science and Technology Policy (OSTP). She has also worked in management and technical positions with the U.S. Agency for International Development (USAID) and the National Institutes of Health (NIH).

At the National Science Foundation, Dr. Jones was responsible for coordinating NSF's international activities and managing a programme investment focused on fostering international collaborative research and providing international research experiences for U.S. students and researchers. In her Senate-confirmed position as Associate Director at the White House Office of Science and Technology Policy (1996-1999), Dr. Jones was responsible for policy development, budget analysis, and interagency coordination of security and international science and technology issues, including nuclear non-proliferation, counterterrorism, emerging infectious disease and international cooperation. During her tenure at OSTP, she testified before the Senate and served as interim Director of the Office. Dr. Jones also served on the National Security Council as the Senior Director for Science and Technology Affairs. At USAID Dr. Jones worked with the Science and Technology and the Asia Near East Bureaus.

Prior to U.S. Government service, Dr. Jones worked as an independent consultant. She served for a year in New Delhi, India as the Biotechnology Advisor to the USAID mission. In 1985, she was the recipient of a Science Engineering and Diplomacy Fellowship from the American Association for the Advancement of Science (AAAS).

Dr. Jones obtained her Ph.D. from the Department of Molecular Biophysics and Biochemistry at Yale University, where she studied the effects of stress on protein expression and metabolism, using nuclear magnetic resonance. Before her graduate study, she worked as an assistant for research at the Rockefeller University in immunology and development biology. She holds a bachelors degree in chemistry from Barnard College, Columbia University.

DR. T. RAMASAMI, SECRETARY, DEPARTMENT OF SCIENCE & TECHNOLOGY

Dr T Ramasami has assumed the role of Secretary S&T in the Government of India in May 2006 and after four years of his successful leadership, the Centre recently gave an extension to his services as Secretary, DST for further two years.

He is currently engaged in the development of policies and programmes for attraction of talents for study and careers with science, rejuvenation of research in universities, stepping up of international S&T cooperation, development of public-private partnerships in R&D sector and accountability of public funded research, development and demonstration.

Dr T Ramasami holds a Master's degree in Leather Technology from the University of Madras, India and PhD in Chemistry from the University of Leeds, UK. He has also worked on energy research in Ames Laboratory Iowa, USA and on electron transport phenomena in the Wayne State University, USA prior to returning to India for undertaking his scientific career. He joined the Central Leather Research Institute, Chennai as a scientist in 1984 and served as its Director for more than 10 years during the period up to May 2006. Dr Ramasami has a large number of publications in highly peer-valued journals and significant number of patents, which are under commercial exploitation. His research experience spans over several fields and areas in both basic and applied sciences. He has made some important contributions in the fields of inorganic chemistry as well as chemical and leather related technologies.

He is known among the scientific establishments in the country for his leadership to the Central Leather Research Institute. His contributions to the understanding of the chemistry and applications of chromium as well as leather science and environment related technologies have earned him several professional recognitions in both India and abroad. These include Shanti Swarup Bhatnagar Prize for chemical sciences in 1993, election to all major science academies as a fellow as well the Third World Academy of Sciences and the National civilian award Padma Sri in 2001.

DR. MANJU SHARMA, FORMER SECRETARY, DEPARTMENT OF BIOTECHNOLOGY, MINISTRY OF SCIENCE AND TECHNOLOGY, GOVERNMENT OF INDIA

Dr. Manju Sharma completed her M.Sc. from Lucknow University in 1961 with first rank, and conducted post-doctoral research at Purdue University, USA. She has worked in the Forest Research Institute, Dehradun, the department of Science and Technology, the Planning Commission, the Office of Scientific Adviser to the Prime Minister, and the Department of Biotechnology. She was a nominated member of the State Planning Board, Government of Himachal Pradesh and Chairperson of the Vision Group of the State Government of Orissa for Biotechnology and also a Member of the Biotechnology Advisory Council of the Government of Gujarat. She was responsible for the conceptualizing the setting up of the Biotech Consortium India Ltd. (BCIL) to bridge the gap between industry, academia and research scientists. Dr. Sharma has received numerous awards including the VASVIK Award (1994), Norman E. Borlaug Award (1995), Distinguished Scientist Award from the Indian Science Congress Association. G. Modi Science Award (2002), K. N. Bahl Memorial Gold Medal (1997), FIE's National Award (1998), Shri Om Prakash Bhasin Award (1998), National Science and Technology Award for Excellence (1998), Asutosh Mukerjee Memorial Award 2000-2001, Distinguished Fellow Award (2000) by Institute of Directors, New Delhi, Delhi Ratan (2003), Pt. Jawaharlal Nehru National Award (2000), Vigyan Gaurav award, Ojaswini Shirsh Alankaran (2002), 'Special Distinction Medal' (2003) by ISCA, and the Life Time Achievement Award of the ISCA (2004).

DR. RAMA MUKHERJEE, MANAGING DIRECTOR, ARA HEALTHCARE PVT. LTD.

Dr Rama Mukherjee Ph.D. has devoted thirty seven years of her career in carrying out research in understanding molecular pathology and in developing products for the treatment of human diseases. Her research and development focus has been in the field of leprosy, tuberculosis, inflammation and cancer. She has significantly contributed to the understanding of molecular pathology of nerve damage in leprosy ranging from development of novel in vitro model of nerve damage in leprosy and model for testing sensitivity and resistance of anti leprosy drugs.

She was instrumental first as co investigator and coordinator and subsequently as Principle Investigator in designing and conducting of Phase II and Phase III clinical trial of Mw vaccine and then in technology transfer and commercialization of the vaccine. Her group demonstrated therapeutic as well as prophylactic effect of this vaccine against tuberculosis. Simultaneously, she also carried out original research on the role of neuropeptides in cancer and came up with a combination of peptides called MuJ-7 for the treatment of colon cancer, the technology was transferred to Dabur. It is a non cytotoxic targeted and mechanism based approach which is the focus of international cancer research today.

As President – R&D Dabur Research Foundation she led a team of 350 scientists in developing generic and novel anticancer drugs, diagnostics and Biotherapeutics for the global market. She directed the new drug delivery system consisting of nanoparticle, liposome and micro sphere technologies. Nanoxel – a Paclitaxel nano-particle developed by her group was commercialized in

2006. Currently she is the Managing Director of ARA Healthcare Pvt. Ltd, a company founded by her. Focus of the company is on the development of novel and generic Biotherapeutic molecules. Company has a deep pipeline of molecules at different stages of development. It also provides molecular diagnostic services.

DR. VIBHA DHAWAN, VICE-CHANCELLOR, THE ENERGY AND RESOURCES INSTITUTE

Dr. Vibha Dhawan, presently Executive Director (Planning and Coordination) had completed her Ph.D in Botany from University of Delhi in 1985 was associated with The Energy and Resources and Institute. She was involved since inception, setting up of a modern tissue culture laboratory at TERI. She was actively involved in conceptualization of Project Monitoring Unit (PMU) of DBT's Mission for North-East for Quality Planting Material. As a Coordinator for all the eight states of NE, she is responsible for overall coordination, networking and facilitation, monitoring and evaluation, to conduct regular training programmes for the stakeholders of the mission and to study the change in the economic status of the target population. Dr. Dhawan is the Coordinator of DNA (Department of Biotechnology's Natural Resource Awareness Programme Club. TERI has been entrusted with the responsibility of implementation of a Project in all the seven North-Eastern states of India. Under this program, we will be working with 651 schools (approximately 4% of the total number) in the NE region. TERI will be the implementing organization for the Assam State in which 191 schools will be taken up. Dr. Dhawan is also the coordinator of the Technology Advancement Unit (TAU), an initiative of ISCB (Indo-Swiss Collaboration in Biotechnology).

Dr Dhawan has recently completed her assignment as Vice Chancellor, TERI University. She was deeply involved in defining vision of the University, developing courses in the niche areas; developing collaborations with foreign universities for research, student/faculty exchange etc. Dr Dhawan is actively involved in policy development both at the national and state level. She is task force member of number of committees of the Department of Biotechnology including those reviewing projects for rural development and climate change. Apart from being executive council member of five prestigious universities; member of task force of selection panels of DBT, CSIR, DRDO etc. She is presently, Advisor, Bioresources & Biotechnology to the Chief Minister of Assam. Dr. Dhawan is associated with Michigan State University and is offering distance learning programme on food laws in India since 2004. She has been appointed as Adjunct Professor & Consul General (Regional Coordinator) under College of Agriculture and Natural Resources (CANR) South Asia Partnership. Recently Dr Dhawan has been appointed as Non Executive Director of CABI.

Dr. Dhawan has more than 60 publications including six books and has won many prestigious awards including, AIBA award in the category of Individual Scientist, Kamal Kumari Foundation award for Science and Technology, First Biotech Product & Process Development and Commercialization Award of the Department of Biotechnology. Dr. Dhawan is an elected Fellow of National Academy of Sciences, Allahabad

MS. PARAMJEET SHERGILL, PRINCIPAL, RABEA GIRLS PUBLIC SCHOOL

After joining the Rabea Girls Public School, a school for Muslim girls in the walled city of Delhi some thirty five years ago, she saw that the distance of girls of the community from the mainstream was huge and that they had no genuine means to upgrade their understanding of the world to participate in a more productive and a fruitful manner. It was then that she decided to dedicate her effort to the cause of the girls of the community. It was very clear to her that it was going to be a tough call as it would require building a system piece by piece consistently over a period of long time that would equip these girls for the challenges of the changing world. The school was started in 1973 by Padma Shree Hakim Abdul Hameed (of Hamdard Dawa Khana), but it did not receive community support for a long period of time. The community was skeptical about the benefit of the English medium education to their daughters. Seeing the resistance, she realized that it would require going door to door convincing people to send their daughters to this school and to its system of modern education.

Ms Paramjeet, along with some other dedicated colleagues went around the streets of the Muslim dominated localities visiting homes, trying to convince them that the school would protect traditional values even while providing modern understanding. It was indeed tough to break through the rigid stand of the people towards the education of the girl child. The issues were many. Where the resistance to English medium was very stiff, acceptance of Science education was even stiffer. It was with this backdrop that her entire effort began.

After meandering through unbelievable number of hurdles she is now the proud Principal of a school that provides quality education to the girls of walled the city of Delhi, in the English medium to develop a rational and scientific outlook supported by effective science education. The alumni of the school are now happily placed in professions like Engineering, Medicine, IT and other technology based occupations all of which require science as the foundation. Today Ms Paramjeet Shergill looks back with a sense of deep contentment to see the transformation the School has been able to bring to the life of the Muslim girl child and to the attitude of the community towards education of this girl Child.

MS. GAIL DAVIDSON, PRINCIPAL, LYNBROOK HIGH SCHOOL, CA, USA

Gail Davidson brings an international perspective to her career in education. She has been a teacher, principal and superintendent in the USA and Australia. She is currently Principal of Lynbrook High School in San Jose, California.

Lynbrook High School is a National Blue Ribbon School and one of the top high schools in the USA. It is a dynamic comprehensive 4-year public high school of 1800 students in Silicon Valley whose students have achieved national and international recognition in science and mathematics including two finalists in the 2010 Intel Science Talent Search.

Gail was previously Principal of Northcote High School in Melbourne Australia, a State Science and Technology Centre. She was nominated and selected as one of 1,000 participants in the

government's Australia 2020 Summit as a member of the Productivity Stream looking at science, technology and innovation.

Gail has a Bachelors Degree in Mathematics and Masters Degree in Education Administration. She was selected Secondary Principal of the Year by the Placer County Chapter of the Association of California School Administrators and represented Melbourne in delivering the Toast to the Gown at the 2007 University of Melbourne Town and Gown Dinner.

MS. CATHERINE J. DIDION, DIRECTOR OF THE NATIONAL ACADEMY OF SCIENCE'S COMMITTEE ON WOMEN IN SCIENCE, ENGINEERING, AND MEDICINE

Catherine "Kitty" Didion is the Director of the Committee on Women in Science, Engineering, and Medicine (CWSEM) of the National Academies. The mission of CWSEM is to serve as a resource for organizations and individuals seeking information and analysis about the status of women in science and engineering as well as an institutional focal point on women in science, engineering and medicine for the National Academy of Sciences (NAS), the National Academy of Engineering (NAE), and the Institute of Medicine (IOM).

In addition to her work for CWSEM, she is a Senior Programme Officer at the National Academy of Engineering (NAE). As part of her responsibilities she is the Project Director for the \$2.5 million Engineering Equity Extension Service Project (EEES) which is working with engineering societies to enhance their gender equity principles within their programs. Didion previously served 14 years as the Executive Director of the Association for Women in Science (AWIS). During her tenure AWIS was awarded the U.S. Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring and she was the principle investigator for 17 U.S. government and foundation grants. Didion has presented testimony before the United States Congress and U.S. federal agencies.

Didion is an internationally recognized expert on issues of equity and gender in science and engineering. She has worked extensively with the European Commission, the South African Ministry of Science and Technology, the Organization of American States, and many other organizations on these issues. She was the editor for Women in Science Column for the Journal of College Science Teaching from 1993-2002. Didion has extensive experience on Capitol Hill in Washington, DC including staff positions at the U.S. Senate Commerce, Science, and Transportation Committee, Office of Senator Robert Packwood (R-Oregon), the U.S. Senate Computer Center, and the U.S. Senate Press Gallery. Didion's honors and awards include AAAS Fellow (2005); AWIS Fellow (2001); Drucker Foundation Fellow (2000); Texaco Management Institute Fellow (1999); Secretary of the U.S. Air Force Inaugural Environmental Civic Leaders Tour (1996); and a Certificate of Commendation and Distinguished Service, Embassy of the United States of America, Riyadh, Saudi Arabia (1989).

DR. LAKSHMI LINGAM, DEAN – RESEARCH AND DEVELOPMENT & PROFESSOR, CENTRE FOR WOMEN STUDIES, TATA INSTITUTE OF SOCIAL SCIENCES

Lakshmi Lingam is Professor in the School of Social Sciences. Currently she is the Dean, Research & Development at the Tata Institute of Social Sciences, Mumbai. In this position she is in-charge of the Doctoral programme as well as overall research activities of all Faculty and students at the Institute. She has been on the Faculty of the Centre for Women's Studies for the past 20 years. She teaches courses on 'Gender, Health and Rights', 'Women, Development Practice and Politics' 'India's Gender and Development Trajectory' for Masters students and Study Abroad students at the Institute. Dr. Lakshmi holds a Ph.D degree from the Indian Institute of Technology, Mumbai. Her research interests range from exploring the social and gender specific implications of health sector reforms and other macroeconomic policies; urban poverty and women's livelihoods; studying women's movements and other social movements in the period of globalization; understanding women's health and reproductive rights; and exploring issues of culture, women's identity and agency. She has undertaken several research projects and published extensively on gender, health, development; structural adjustment & urban poverty; micro credit & women's empowerment and public policies. She was a Fulbright New Century Scholar during the period 2004-5. She was a Visiting Scholar and resource person at the University of Michigan, Ann Arbor (2003 & 2005), at Uppsala University, Sweden (2000 & 2002) and the Institute of Social Studies, The Hague, Netherlands (2002).

Dr. Lakshmi is on the Curriculum Advisory Boards of several Women's Studies Departments in Indian Universities as well as Technical and Ethical Advisory Board member of NGOs. In addition to her outstanding teaching and research activities, She has contributed to gender and equity mainstreaming activities of Government departments in a number of states in India. She was the General Secretary of the Indian Association for Women's Studies during the period 2000 -2002 and was a member of the Organizing Committee that hosted the International Women's Health Meeting in 2005 in New Delhi.

Lakshmi Lingam is coordinating a National Review of Maternity Protection Policies and Programmes commissioned by the International Labour Organization and the Ministry of Labour and Employment, Government of India. She is currently engaged in an international collaborative project with University of Montreal funded by the Canadian Institute for Health Research Seed Grant (GGH-169582): "Integrating gender sensitivity in TB programmes in India: Building international partnerships and models for equitable access". She is the Programme Director for a South Asian region project titled: 'Crossing Boundaries: Regional Capacity Building on Integrated Water Resource Management, Gender, Equity and Water, funded by Wageningen University, Netherlands.

DR. NITA SHAH, HEAD, VULTURE ADVOCACY PROGRAM, BOMBAY NATURAL HISTORY SOCIETY

Dr. Nita Shah is an active member of the IUCN/Equid Specialist Group, Coordinator - Asia for kiang & khur. Dr. Shah has worked as a lecturer Faculty of Science, Dept. of Zoology at Maharaja Sayajirao University of Baroda (1993-1997) . She was a consulting scientist to Gujarat Ecology and Education Research Foundation (1997-1998), Corbett Foundation (1999) and Wildlife Institute of India (2001-2002). She Headed the Vulture Advocacy Program, for Bombay Natural History Society

(2004-2010). Since late 2008 elected as Honorary General Secretary for World Pheasant Association (WPA India), She also function as the coordinator of WPA-India 's Technical Advisory Committee .

Working in field of wildlife conservation for over 24 years, Dr. Shah's major efforts & contributions have been for hangul, wild ass (khur & kiang), vulture, Tibetan Antelope, and arid ecosystems. Dr. Shah has conducted intensive research through Wildlife Institute of India (1988-93) deployed radio transmitters on endangered Indian wild ass (Khur) in the hot saline desert which led to making of sanctuary management plan. Her studies provided mitigation measures on impact of Sardar Sarovar Canal construction around the sanctuary. Presently Dr. Shah also continues to monitor the khur population. Dr. Shah did Evaluation of the habitat and the status for Tibetan wild ass (Kiang) and other species along Indo-Tibet borders since 1994 in India and in NW China. She was involved as a Lead on World Bank Project "Biodiversity Conservation and Rural livelihood Improvement Program" at two arid landscapes: Rann of Kutch & East Ladakh. She was part of the consultation in the preparation of conservation monitoring plan for the World Bank Project in Gir National Park for Asiatic Lion, its prey and habitat (2001-2002) in collaboration with Wildlife Institute of India.

Dr. Shah also studied illegal trade in Shahtoosh of Tibetan antelope, human wildlife conflict in arid ecosystems, conservation of native agro-crop diversity in the arid environment, and mapping of mangrove forest along the Orissa coast (2003). Her recent contribution has been on the Gyps vultures that face a catastrophic decline in South Asia due to the use of a veterinary painkiller diclofenac in the livestock sector. Dr. Shah's ongoing research work includes, Monitoring Veterinary Painkillers/NSAIDs around vulture landscapes, Habitat Occupancy and monitoring Populations of Flamingos & Cranes, Validating population estimation techniques for wild ass and other large animals.

DR. USHA MUJOO-MUNSHI, HEAD, LIBRARY, INDIAN INSTITUTE OF PUBLIC ADMINISTRATION

Dr. Usha Mujoo Munshi, a Fulbright Scholar is currently with Indian Institute of Public Administration (IIPA), where she is heading the Library and Information Services. Prior to joining IIPA, she has served at many prestigious organizations such as INSDOC (CSIR), New Delhi, Indian National Science Academy, New Delhi and Indian Statistical Institute, Kolkata. Has over 167 research publications and a few books to her credit, besides a number of other publications. Her forthcoming publication entitled "Multimedia Information Extraction and Digital Heritage Preservation" being brought out by World Scientific is a detailed & distinctive anthology on various facets of the research issues in the area contributed by the world experts and likely to be in the market by October 2010.

Recipient of several national and international awards that includes Raizada Memorial Award 1994 for Young Information Scientist of the Society of Information Science (SIS); SIS Fellowship in 1999; Fulbright Fellowship in 1996-97. ASSIST International Best Paper Award by ASSIST, USA in 2002. Received Indo-French Fellowship in the area of Information Science and Technology in 2008 and in 2009, Dr. Munshi obtained post of DEA (directeur d` etudes associe), an academic recognition

given to her by Fondation Maison des sciences de l'homme, Paris, (France). She is on the editorial board of a few national/international journals in the area of Information science and technology. Acting as a member of various national and international committees and has been nominated as a member for the Steering Committee of IAP (Inter Academy Panel) and Task force on Digital Resources - US National Academy of Sciences, USA.

DR. VINITA SHARMA, ADVISOR, DEPARTMENT OF SCIENCE & TECHNOLOGY, GOVERNMENT OF INDIA

Dr. VINITA SHARMA is Advisor & Head, Science for Equity Empowerment & Development Division, Department of Science and Technology. Dr. Sharma holds a doctorate in Natural Product Chemistry from, a post-graduate degree in Chemistry and a graduate degree in Biology. Dr. Sharma has a decade of research and teaching experience in University of Rajasthan and over 12 years experience in handling Technology lead interventions for Rural Women and Gender Initiatives for women scientists in the Department of Science and Technology. Dr. Sharma was a faculty in Rajasthan University Department of Chemistry in 1989- 1995. Dr. Sharma has served as Principal Scientific officer/Scientist D and Scientist G and is currently Advisor/Scientist G, in Department of Science and Technology.

Since induction in the Department of Science and Technology in 1998, Dr. Sharma have been handling all the gender initiatives of the Ministry. The Department gained the unique distinction of being the first Department to introduce the Gender Budgeting both in letter and spirit. The budget allocated under the women component plan by the department was increased from 300 lakhs in 2001 to the present day allocation of 2400 lakhs. The fellowship scheme for women scientists a pioneering initiative was taken up in three categories WOS-A, WOS-B, WOS-C. This gender sensitive initiative was worked out in consultation with gender experts and women scientists themselves and has provided opportunities to several women to reenter research in science.

Dr. Sharma looked after the scheme S&T For women in which, several projects were planned and initiated for S&T based interventions for food & livelihood security and income generation.

Dr. Sharma is a member of, Research Advisory Committee - Central Institute of Medicinal and Aromatic Plants (CIMAP), Ethics Committee - Fortis Hospital, Task Force for women - Department of Biotechnology, Technical group on higher education - All India Council for Technical Education (AICTE), Task force for mainstreaming gender - Government of India, Expert Group on Gender Budgeting - Government of India, Subcommittee on Ethical issues – Indian Council for Medical Research (ICMR), Organization for Economic Co-operation and Development (OECD) Working Group on Good Laboratory Practices.

DR. SWATI BASU, ADVISOR, MINISTRY OF EARTH SCIENCES, GOVERNMENT OF INDIA

Dr. Swati Basu is currently Adviser/Scientist G in the Ministry of Earth Sciences (MOES), Government of India. Dr. Basu holds a doctorate in Atmospheric Sciences from IIT Delhi, Masters in Space & Astrophysics and Graduate degree in Physics from Delhi University. Her present responsibilities at MOES involve, policy, planning, coordinating and strategizing all the atmospheric science programmes of the country including International collaborations.

Dr. Basu has over 27 years of Research Experience after acquiring PhD. in Atmospheric Science. Dr. Basu's research Work at IIT Delhi includes research work related to air pollution modeling, environmental impact studies, development of coupled modeling (atmospheric model and dispersion model) etc. Dr. Basu's Research at National Centre for Medium Range Weather Forecasting (NCMRWF) includes work pertaining to Numerical Weather Prediction with special emphasis on the Boundary layer, Impact studies by implementing different schemes in the global spectral model, analysis of performance studies by different boundary layer schemes, utilization of various data from different field campaigns, operationalisation of more suitable boundary layer parameterization, development of 'Unified' boundary layer scheme for improving monsoon forecasts are some of the research and developmental work.

Dr. Basu is Co-Principal Investigator in a DST-NSF project on "Planetary Boundary Layer Formulation for Improving Monsoon Forecasts" with Florida State University. She is also involved in evaluation of thesis for award of PhD degree, evaluation of papers for National and International journals, evaluation of projects, and compilation of progress reports.

Dr. Basu received START fellowship of American Geophysical Union during 2003, WMO Fellowship in 1993 for attending Meteorological Training course at ECMWF, Reading, UK, IIT scholarship in 1979 for carrying out PhD work at the Centre for Atmospheric Sciences, IIT, Delhi. Dr. Basu has received Dr. B.N. Desai award conferred by Indian Meteorological Society in 1999 for the research paper entitled 'Objective determination of onset, advancement and withdrawal of the summer monsoon using large scale forecast fields of a global spectral model over India'. Dr. Basu has several papers published in renowned international journals.

DR. LEENA SRIVASTAVA, EXECUTIVE DIRECTOR, THE ENERGY AND RESOURCES INSTITUTE

Dr. Leena Srivastava is currently the Executive Director, TERI, New Delhi – an independent not-for-profit research institution working in the areas of energy, environment and sustainable development. In her 26+ years of experience at TERI she has worked on a range of issues covering energy and environment policy/planning, energy economics and climate change. Dr Srivastava held additional charge as Dean, Faculty of Policy and Planning, TERI University from June 2000 – June 2008. She has a PhD. in Energy Economics from the Indian Institute of Science in Bangalore, India and has a number of publications to her credit. She is on the Editorial Boards of various international journals dealing with energy and environment issues.

Dr Srivastava is a member of the Advisory Group on Energy and Climate of the UN Secretary General; Member, and also a member of a few Advisory Committees and Boards. She was a member of the Expert Committee to formulate India's Energy Policy, Planning Commission, Government of India and Member, National Security Advisory Board, Government of India. She serves on the research advisory councils of various academic institutions of international repute. She was a Coordinating Lead Author for Working Group III of the Third Assessment Report of Intergovernmental Panel on Climate Change (IPCC) and cross-cutting theme Anchor on "Sustainable Development" for the Fourth Assessment Report of the IPCC.

Speakers' Presentations & Informative Articles

Gender Sensitive Initiatives for Indian Science

Department of Science & Technology
New Delhi

States with >50 women enrolment in Universities

States with > 50-% women enrolled in University 2000-01, values in parenthesis, 2005-06

State	Total	Science	Engineering & technology	Medicine	Agriculture	Veterinary science
Goa	58.6 (59.2)	59.8	26.2	61.4	-	-
Kerala	60.0 (61.0)	63.9	30.6	56.5	53.8	47.6
Punjab	53.2 (51.8)	53.8	19.4	56.0	26.4	22.9
Pondicherry	54.5 (51.2)	57.3	29.2	47.3	-	41.3

States with < 35% women enrolment in University
Values in parenthesis are 2005-06 data

State	Total	Science	Engg/ Tech	Med	Agric
Arunachal	29.7 (30.2)	33.0	13.5	--	--
Bihar	23.9 (24.5)	21.3	11.8	20.2	25.2
Jharkhand	30.5 (30.6)	26.9	6.8	33.8	29.6
Orissa	34.6 (36.0)	28.9	18.6	23.7	29.2
Rajasthan	32.6 (34.1)	39.2	11.4	24.3	10.1

Table 4: Level-wise, student enrolment Percentage of women

Year	Graduation	PG	PhD
Science	39.0	42.5	37.2
Engineering/ Technology	21.8	15.8	16.5
Medicine	45.5	34.4	29.3

Percentage of women faculty in various government organizations and central universities poor (3%-30%)

- Academy fellowships (% women) - INSA-3.2, IASC – 4.6, NAAS – 4.0.
- Bhatnagar prize: 333 awards since 1958, 9 women. One in last 8 years including 2006.
- Three women director in S&T Institutions in the country.

Steps Taken for Gender Mainstreaming in S&T

- Gender budgeting introduced in 2005
- Monitoring by PMO under 27 beneficiary oriented schemes of the government (since 1986)

Steps Taken for Gender Mainstreaming in S&T

- Fellowship scheme for women scientists 2500 women scientists have availed the fellowship -2001.
- Women Scientist Cell "Protshayaki" setup(2001).
- Annual National Awards for Women Scientists-19 awardees
- National Training programme for women scientists (2008)
- Task Force for Women in Science.
- Standing Committee for Women in Science
- CURIE (Consolidation of University Research for Innovation & Excellence in Women Universities) support for women only universities
- Website : www.indianwomenscientists.in

Fellowship schemes for Women Scientists

- Fellowship for research in basic and applied science : WOS-A
- Fellowship for research in S&T based societal programmes : WOS-B
- Fellowship scheme for training in Intellectual Property Rights : WOS-C
- Fellowship scheme for training in S&T communication : WOS-D

Enabling Measures in the Fellowship Scheme

- Special concession to women's scientists in terms of maximum age – 50 years.
- Workshops for project development and confidence building.
- Provision for part-time/work form home.
- Provision for transfer of fellowship if incumbent relocated to new location.

WOMEN SCIENTIST SCHEME – A (WOS-A)

- The scheme was started in the year 2003.
- 679 fellowships have been awarded out of 3976 proposal received in different disciplines.

S.No.	Disciplines	No. of Fellowships
1.	Life Sciences	356
2.	Chemical Sciences	115
3.	Physics & Mathematics	95
4.	Engineering Science	71
5.	Earth & Atmospheric Science	43

- 70% of selected candidates are in the age-group of 35-50 years, which seems to justify the aim of the scheme.

Outcome:

- 436 Research Papers in the kitty of country's total research publications.
- 30% of the women scientists have got employment in universities and National R & D Labs.

Fellowship for research in S&T based societal programmes WOS-B

Women Scientist Scholarship Scheme (WOS-B)	
Scheme launched in the year	2003
Total number of fellowships availed	220
Number of Patents applied for	8
Number of Papers published	78

Fellowship scheme for training in Intellectual property rights WOS-C

Women Scientist Scholarship Scheme (WOS-C) (Women can work from home)	
Scheme launched in the year	2003
Duration of training in IPR	1 year
Number of batched trained	4
Candidates trained in 4 batches	150
Number of Patent Agents in 4 batches	89
Candidates selected in 5 th batch	84

National programme for training of Women scientists and technologists

- Started in 2007.
- No of training programmes per year 10.
- Average Duration 1-2 weeks.
- Trainees from Universities & Colleges, S&T Institutions.
- Women scientists trained 250.

Training Programme for Women Scientists (contd.)

S.No.	Training Programme / Duration	Institution
1.	Stress and time management (one week)	IIM, Ahmedabad
2.	Issues of sustainable development for women scientists (one week)	M. S. Swaminathan Foundation, Chennai
3.	General Management Programme for women scientists (two weeks)	ASCI, Hyderabad
4.	High performing team and leadership issues for women scientists (one week)	ASCI, Hyderabad
5.	Communication and presentation skills (one week)	Xavier Institute of Management, Bhubaneswar
6.	Gender, Ethics and Law for Women scientists (one week)	ASCI, Hyderabad

National Training programmes for Women Scientists (contd.)

S.No.	Training Programme / Duration	Institution
7.	Ethnic issues and community resource management (one week)	Indian Institute of Management, Bhopal
8.	Financial Management and Audit Sensitization (one week)	National Academy of Audit and Accounts, Shimla
9.	One day in-house training programme on "Gender Budgeting" and	DST, New Delhi
10.	One day in-house training programme on "Supreme Court Guidelines on Gender Issues"	DST, New Delhi
11.	One day in-house training programme on RTI	DST, New Delhi

CURIE (Consolidation of University Research for Innovation & Excellence in Women Universities)

- In 2008-09 DST has taken special initiative (CURIE) to support 'Women Universities' for improving R & D infrastructure.
- Two women universities have been supported under CURIE in 2009 by Rs.5.50 Crore each for 3 years.
 1. Avinashilingam University for Women, Coimbatore
 2. Banasthali University, Banasthali, Rajasthan

Some other initiatives of the Task Force

Analysis Of Illustrations In Textbooks

- Science Textbooks of Standards III To X Published by NCERT and in use till 2007-08 were Selected for Analysis
- Homi Bhabha Centre For Science Education, Tata Institute of Fundamental Research, Mumbai

A Book has been commissioned on the Lives and Achievements of Indian Women Scientists

- To be ready by March 2010

Study on women's universities and their contribution to science education and research

- Based on the report, CURIE Programme has been launched

Fostering & Supporting women resources in S&T

- Time bound recruitment target system (TRS)
- Annual gender-audit in all S&T institutions.
- Providing opportunity to women scientists to avail fellowships even after 5 years.
- Age limit for recruitment and re-entry programme may be further relaxed.
- Special scientific, technical and administrative orientation to be put in place for re-entry programmes.
- Mandatory inclusion of women in selection committees/ speakers in conferences.

Support related issues at work place

- Preferential on campus housing,
- Safe transportation,
- State of art creche with proper management,
- Compliance of supreme court guidelines
- Gender sensitization of scientific managers

Future Initiatives

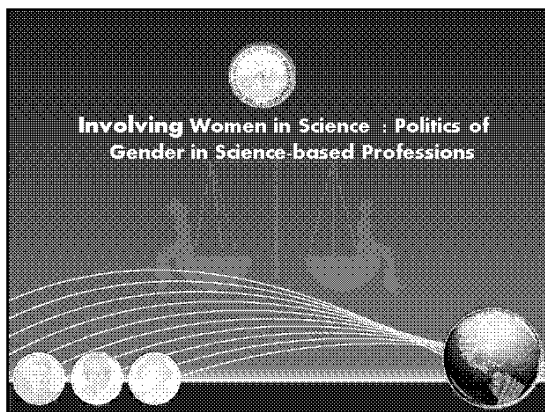
- **Task Force for women in science replaced by a high level Standing Committee chaired by Hon,ble MST&ES.**
- **Recommendations of the TF to be discussed and put in force along with time lines**
- **State S&T Councils & Women universities to have a unit for gender initiatives.**
- **Expanding the fellowship programme to include new areas such as training in Regulatory areas in R&D.**

Some current Issues

- Women scientists working in private colleges/ universities.
- Entrepreneurship programmes for women.
- Dropout rate in fellowship programmes.
- Special package for NE.
- Collaborative programmes with state of art institutions in the country & other Institutions.

THANK YOU

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Background

- ➔ To spread achievements globally and reap its plausible paybacks, harnessing potential of all population - a must for scientific endeavours
- ➔ Half of population, (women) -underutilized & under-valued talent
- ➔ (Women in general) do not have a strong presence in S&T (Perhaps) Attributed to two broad issues:
 - ➔ Women's perception of their role
 - ➔ Society's expectation of their contribution
- ➔ Studies show:
 - ➔ Regarding Denial of career Options, and its consequences:
 - ➔ 35.6% Scientists (could not pursue) had denied themselves career options
 - ➔ 22.7% (mid career) of such denial affected adversely their career
 - ➔ 20.3% (respondents) denied promotion &
 - ➔ 42.3% among them attributed it to gender bias &
 - ➔ 50% (felt absence of network) to lack of connections
 - ➔ Regarding the limited recognition:
 - ➔ 50% (approx) have mentioned appropriation of women's work

Source: IICA Report - Science Career for Indian Women: A comparison of Indian women's society and research in scientific career

Point Forward

- ➔ Ability in women to make good careers in Science & technology is a function of – the social fabric around them, access to relevant infrastructure/resources, economic and societal status and guidance
- ➔ Endeavours on generating any scheme or programme need to be targetted on the conditions surrounding the target group
- ➔ Networking, Visibility and recognition – interwoven concepts

Interestingly - In India

Disinclination Growth in Women's Enrolment

Year	% Women
1950-51	10.9
1960-61	16.2
1970-71	22.0
1980-81	27.2
1990-91	29.2
2000-01	39.4

Women students enrolled in different faculties-change over time

Course	1978-79	1995-96
Arts	64.3	54.4
Commerce	1.9	24.4
Science	25.7	20.1
Scholarship	2.2	3.9
Law	0.4	1.0
Engineering	0.1	3.2

In different faculties in the year 2000-01

Course	Enrol.	% of Women
Arts	44.2	44.5
Science	28	47.5
Engineering/Technology	21.6	15.5
Medicine	46	24.4
Agriculture	17.2	18.0
Veterinary Science	21.6	18.0

- ➔ Education system provides equal opportunities in arts and science for men & women
- ➔ The environmental conditions determine the... **Yet**
- ➔ Employment statistics show -there is Leakage of women from the professional pipeline
- ➔ This is the real concern
- ➔ the Indian subcontinent -
- ➔ Education & Employment is associated with esteem, brand & privilege
- ➔ Women seek employment as a means of economic sustenance while

Curative measures to improve women's participation in science

Women in Science Professions: Agenda

- ➔ Incentives
- ➔ Promotion
- ➔ Recognition

Scenario I Economic Incentives

- ➔ **National Assessments & Initiatives**
 - ➔ Governments around the world have felt the need for recognizing the need to make women and men equal partners in science ...
 - ➔ Government & Private enterprises creating special privileges for women
 - ➔ Creating opportunities for alternative career paths for women, Government is encouraging more start-up ventures for women & facilitating their increased access to venture capital.
- ➔ **Two effective concepts**
 - ➔ **Women Component Plan (WCP) &**
 - ➔ **Gender Budgeting**

Intend to play a complementary role to each other, So as to ensure both preventive and post-facto action in enabling women to receive their rightful share from all the women-related general development sectors

Women's Component Plan: 30% of funds were sought to be earmarked in all women related sectors

National Assessments and Initiatives

MWCD's Mission Statement: 'BUDGETING FOR GENDER EQUITY'

Women Scientists Programs

- DST's Scholarship Scheme for Women Scientists and Technologists
- Women Scientists Scheme (WOS*) - 30-50 years of age
- Category of Scholarships**
- Scholarships, with research grants, are available for Indian citizen. Scholarships are envisaged in both institutional and non-institutional modes. Various categories of Scholarship available are indicated below:
 - Scholarship for Research in Basic/Applied Science (WOS-A)
 - Scholarship for Research in S&T - based Societal Programs (WOS-B)
 - Internship for the Self-Employment (WOS-C)
 - The scheme is meant to encourage women candidates, preferably those having a break in career and not having regular employment.
 - in all sectors- Not specific to S&I**

Action- Proactive & Reactive

- Programmes that are beneficial to women scientists
- Gender Mainstreaming: Fiscal and Monetary Policies, More gender friendly
- Implementing Women Specific Schemes
- Schemes of Empowerment, Advocacy, Awareness Generation & Support Services for Women
- Monitoring macro indicators participation
- Quantum and Trend analysis: resources allocated and spent on women
- Gender Audit of schemes and other incentives: Economic criteria is (one of) the key motivating factor
- Fill a gap with an innovative programme that will create change?
 - Women Professional Charges
 - Incentives for Achievements

Attracting more women to study science, and later practice science

Special Programmes - Liberal Attitude

Travel grants to women scientists

Economically deprived society: Travel support to girls Merit Scholarships

Training Exposure: Opportunities to do summer projects in good labs.

Opportunities for women science teachers from colleges to do short term research projects

Model programme: Fellowship to eminent women scientists (to visit, give lectures, & interact with students & teachers in univ.)

Scenario II Achievements /Recognition

Recognition of science - judged on the basis of variety of factors

Indian Scenario

Relative presence of women as scientific and technical staff in Government R & D institutions, and some universities.

Parameters:

- Positions
- Research grants
- Publications and patents
- Role in conferences/invited/plenary
- Travel fellowships
- Membership of Professional Bodies
- Representation in - policy making, & Review/Award committees
- Awards
- Academy Fellowships
- Others.....

Women Scientists in Various Organizations

Positions	Organisat. as % Women	Scientists & Techn. as % Women
CSIR	13.0	14.0
DBT	31.8	23.1
ICMR	27.3	20.1
DAE	16.5	-
DOD	8.7	-
ICAR	30.1*	-
ICAR	6.2	-
ICAR	2.5	-

*Asst. Prof.=10.4; Assoc. Prof.=8.2 & Prof.=3.5

Women Faculty in Universities: An illustration

	B.Sc.	M.Sc.	Ph.D.
Hyderabad Univ.	16.3*	14.7	-
JNU	16	0	-

Increase in recruitment of women to premier research institutions

Achievements /Recognition

Studies show: Assessment of the performance of Indian women biological scientists based on the publications (Vineeta Bal 2004)

- 38 high impact Journals (Impact factor >= 5)
- 85.7% of the papers from India had men as the corresponding/senior authors &
- only 14.3% had women.

Identifying authorship pattern of Indian Women Sc. (Usha M Munshi & Divya Srivastava 2006)

- 10 year period data from WOS
- Author Affiliation - ICMR, CSIR, IITs, IISc
- 15-20% contributions come from women scientists irrespective of their proportion of representation in the organization in that cadre
- In terms of the output, the women scientists are fairly positioned well with whatever putative limitations,
- Where input indicators are far from matching levels.

Achievements /Recognition

Corroborated by:

During selection of post-doctoral candidates by Medical Research Council

Scene I Applicants Success rate for

62 men and Men - 26%

52 women applied women - 7%

Scene II Analysis scores given by the review committee based on publications quality etc. Mismatch between this objective parameter of scoring and the rank given to judge competence

Recognition & Rewards

- Women scientists do not get their due recognition either in India or outside
- Women Scientists elected as Fellows of National Academy of Science:
 - Indian Academy of Science, Bangalore 4.8%
 - Indian National Science Academy, Delhi 3.9% (4.7% -2010)
 - NAAS 4.0%
 - Royal Society, London 5.83%

Women Fellows are abysmally dismal

Achievements /Recognition

Awards/Honours

- Bhatnagar Prize (CSIR) - 2.4% of Women Sc. Considered (1958-2004)
- Young Scientist Awardees (INSA) - 16.80% (1975-2009) better up to 2004 +9%
- INSA's Various Awards --60 (Under different categories -- - 1.84% (WS)

- ISWA - (since 1973) ~1400 members
- Awards/Honours & Scholarships to deserving candidates

Alternate mechanisms for Evaluation - Subjective & Objective

Women Scientist's representation in major policy making bodies/committees

- Policy on transparency in selection, & evaluation procedures
- Mandatory composition of one-third

Scenario III **Visibility : Promoting Achievements**

Visibility of the Beacons of Light - Not much reported ; many un-noticed & unsung


Role of Media - Media can play an Important role

- Articles on achievements of women scientists
- Such Stories - Generally Don't find place on the FIRST page (a small item)
- Life histories of successful past and present women scientist should be chronicled
- Need to bring a change in the mindset of parents of girl students.
- So newspaper articles/TV shows etc to increase the social awareness.

INSA : Science and Media (Programme)
IAS : **Women in Science** (initiative) (IAS-NIAS Research Report Apr 2010)

Action - **Proactive & Reactive** : **Academies can again help in this by acting as a conduit between Science, Media and society**

- A session on "Women in Science" should become a regular feature of the Academy's Meetings (Annual)



Scenario III

Networking & Visibility - Science grows through interaction and group work

- Travelling is an important means through which women scientists can move, learn & build contacts
- Networking, visibility in conferences as speakers & participants, eMentoring
- Facilitate special Grants for women Scientists**


Action - Proactive & Reactive : Roles that Institutions, private and Public sector organizations and Voluntary and Non profit-making Organizations have to play cannot be overstated

Women in Science & Technology Initiatives

- Appointment as SIG Leader
- For current Scientific & technical women, promote their involvement in key projects as a core member (**not just at membership level but at Leadership level**)

Special Events
 Women Leadership Conferences

Building an Inclusive Work Culture
 Range of programs to build inclusive leaders



Scenario III

Use of IT necessary in networking women scientist

National Web Portal - Information Gateway to Women in Science (to Showcase their visibility and achievements Women in S&T)

- Directory of women scientists, giving professional profile (facilitate - to identify speakers for conferences, appointment to committees etc)
- Designing and development of "Decentralised Community for Women in S&T" - e- discussions forums
- Nurturing & Mentoring - Young Talents (Mentoring young scientists to help them cope with multiple roles)

One stop shop for

- Engendering Policies and Strategies
- Schemes of Empowerment, Advocacy, Awareness Generation and Support Services for Women in S&T
- Financial Incentives - Scholarships /Loans/Alternate Career Paths (Providing them high quality peer reference groups and enabling them to work from home wherever feasible/capital venture)
- Festuring Role Models
- Social Networking Tools (facilitating Networking)
 - Blogs & Tweets
- Special Events


Action: Can be taken at national level (DST or Vigyan Prasar...)?

Path Ahead

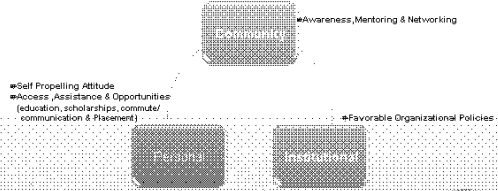
Influx of women into S&T Awareness, Understanding and Action

- To address problems of women's employment in all the top policy & decision making & executive personnel
- To make progress not only in the number of women in S&T but in their levels of achievement and influence
- Problems of stereotyping, isolation, & exclusion must be tackled
- Provision for focused support to girls & women in order to fully integrate them into the S&T enterprise**

A Gender-sensitive and inclusive environment



Measures for Access, Participation, & Progression




Facilitate - Awareness, Mentoring & Networking

Participate - Self Propelling Attitude

Improve - Favorable Organizational Policies (education, scholarships, commute/ communication & Placement)

Changing society through individual change through a continual process of actions & reflection




Empowerment

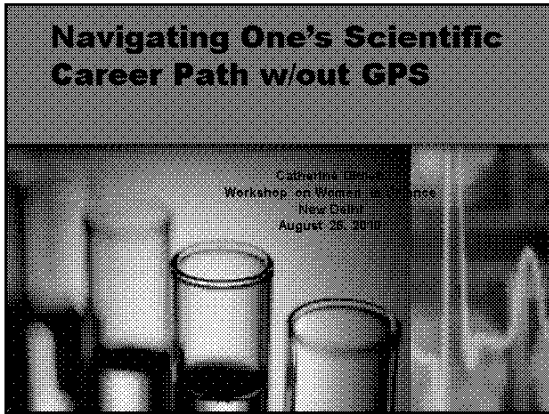
Holistic Universal Participative

Thank You

Usha Mujoo Munshi
 Indian Institute of Public Administration
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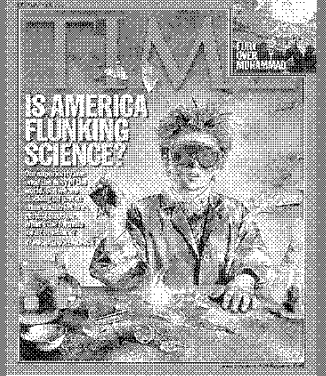


Navigating One's Scientific Career Path w/out GPS



Catherine Desjardins
Workshop on Women in Science
New Delhi
August 26, 2010

Assumptions and stereotypes about who does science and engineering still exist in the U.S.




PAKISTAN'S SHADOWY WAR YOUR MIND & YOUR BRAIN
Newsweek Sept. 22, 2008

What Women Want

By Julia Baird

Assumptions about who will be the future leaders in S & E impact students' choices. This is a full page ad in the February 17, 2006 *Chronicle of Higher Education* for CDW-G & its slogan - "The Right Technology Right Away"

We're getting technology to the people who shape the future



Gender - Science Implicit Association Test

(www.implicit.harvard.edu)

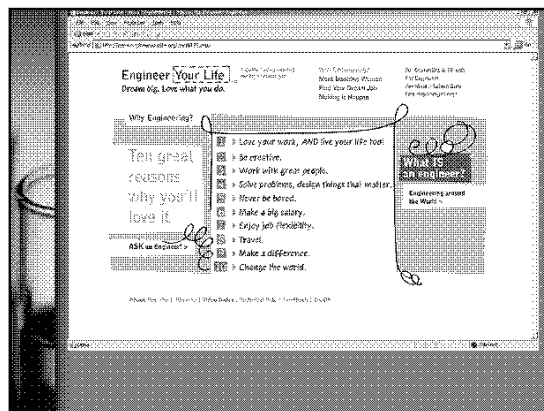
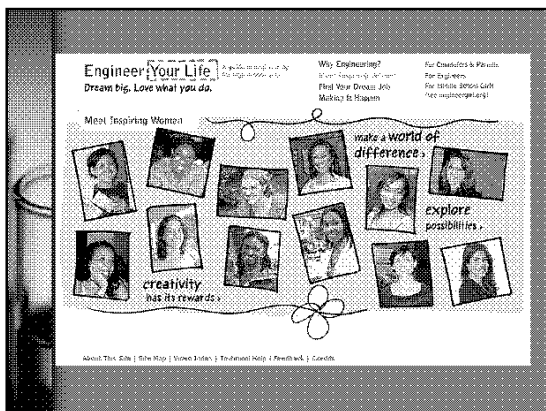
Percent of web respondents with each score

Strong automatic association of Male with Science and Female with Liberal Arts	26%
Moderate automatic association of Male with Science and Female with Liberal Arts	28%
Slight automatic association of Male with Science and Female with Liberal Arts	18%
Little to no automatic preference between gender and academic domains	18%
Slight automatic association of Male with Liberal Arts and Female with Science	6%
Moderate automatic association of Male with Liberal Arts and Female with Science	3%
Strong automatic association of Male with Liberal Arts and Female with Science	1%

Click for detailed testimony

Results from Survey of High School Students: Engineering as a Career - "For Someone like You"

- Engineering as a Career - **Engineering ranks last** on professions tested behind teacher, doctor, lawyer, and business.
- 51% of boys versus 29% of girls** say it would be a good or very good profession.
- Non-white girls (41%) are more likely than white girls (25%)** to say engineering is a good career.



Academic Transitions: Ph.D. to tenure-track by field at RI Institutions Surveyed

	Doctoral Pool	Pools for Tenure-Track Positions		
		% women Ph.D.s (1999-2003)	Mean % of applicants who are women	Mean % of applicants invited to interview who are women
Biology	45	26	28	34
Chemistry	32	18	25	29
Civil Engineering	18	16	30	32
Electrical Engineering	12	11	19	32
Mathematics	25	20	28	32
Physics	14	12	19	20

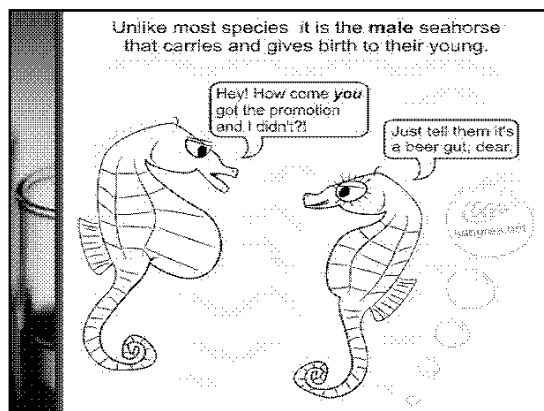
Good Mentoring = Greater Results for Individuals & Institutions

- Female asst professors w/ mentor had a higher probability of receiving grants than those who did not have a mentor.
- Chemistry female asst professors w/ mentors had a 95% probability of having grant funding vs. 77% for those without mentors.
- All six fields surveyed female asst professors w/ no mentors had a 68% probability of having grant funding vs. 93% of women w/ mentors.
- Contrasts with the pattern for male asst professors, those w/ no mentor had an 86% probability of having grant funding vs. 83% for those w/ mentors.

Challenges to Retaining Women in Academia: Existing Career Flexibility Policies

Type of Institution	Average #
Research Universities	3
Doctoral & Masters Granting Institutions	1
Baccalaureate Degree Granting Institutions	1
Associate Degree Granting Institutions	<1

Source: University of Michigan Center for the Education of Women



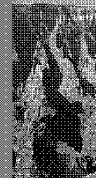
Diversity Fuels Innovation

- From 1995 to 2005 52% of founders of Silicon Valley startups born outside U.S.
- During 1980's very few Indian start ups. From 1995 to 2005 15.5% of startups.
- Need to create environment conducive to startups – seed financing, access to networks, tax breaks.
- Entrepreneurial training and exposure to opportunities is needed in graduate programs.

A SCIENTIST ENTREPRENEUR MUST CROSS THE "CULTURAL DIVIDE"

SCIENCE

- Focus: Methodology
- Values: Openness and sharing
- Demands: Validity (Is it Valid?)
- Success: Prestige & Contribution to a Body of Knowledge
- Lifecycle: Progressive & long term development



BUSINESS

- Focus: Results
- Values: Competitive Advantage
- Demands: Utility (Is it Useful?)
- Success: Financial Performance and Shareholder Value
- Lifecycle: Emphasis on accelerated development

Photo: Getty Images/Photo.com
Illustration: The Atlantic, 2007. For more on this topic, see: [http://www.theatlantic.com/business/entry/31891](#)

Recent Research on Entrepreneurs Raises Some Concerns

- Having a **technical background** helps men & women w/ social contact or no social contact.
- **Not having a technical background** hurts women more than men in terms of entrepreneurial ratings.
- However having a **trusted colleague vouch for the entrepreneur** helps women more than men in terms of getting more favorable reviews.

Source: C. Hutchins and J. Venturi, "The Gender Gap in Entrepreneurial Ratings: The Role of Technical Background and Social Networks," 2009

Some Attributes for Success in Science

Individual

- S&E expertise & competence
- Ability to establish goals & take risks
- Strong communication skills
- Self-confidence
- Openness to change

Effective Manager/Entrepreneur

- Positive attitude
- Sense of humor
- Desire to help others
- Leadership
- Ability to seize opportunities

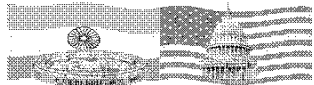
Source: "Women Scientists and Engineers Engaged in Industry: Why or Why Not?" National Academy Press

What Can Your Organization Do? Select a Target Population & Engage Them

Effective Programs have three components:


- **Commitment to take corrective action**
- **Collection of data** for organizational change; and
- A **framework** for monitoring progress.

Source: Beyond Bias and Barriers, 2008

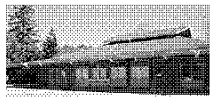


Women in Science
Lynbrook High School
San Jose, California
USA
Gail Davidson, Principal

Indo-US Science & Technology Forum
Women in Science Workshop
Constitution Club, New Delhi
26 August 2010




Lynbrook High School...

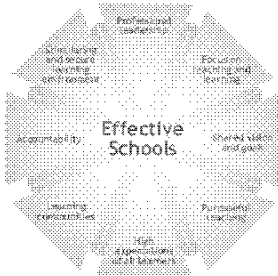


- A School
- A Community
- A Culture


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A School




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A Community



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Location

- Heart of Silicon Valley
- Many parents work in "high tech" industry
- California school funding is declining, but the Lynbrook community values and supports education

Ethnic distribution since 2004

- Asian population from 68% to 77%
- Caucasian population from 28% to 19%

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A Culture



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Where science is alive, exciting and important...



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Lynbrook High School

Vision and Values

Lynbrook High School's vision is to create a dynamic environment of respect and achievement where ALL can learn deeply, apply their knowledge and contribute purposefully.



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Learn deeply, apply knowledge, contribute purposefully in and beyond the classroom

- 43 student STEM researchers (23 girls and increasing)
- Six Intel Talent Search Semi-finalists, Two Finalists
- Hundreds attend COSMOS at University of California
- Over 75 students complete summer internships
- 300 in Bio/Chem/Physics Olympiads & Science Bowls
- Over 400 in State and National Math Competitions

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Our girls have...

- Strong family, teacher, school support
- A community that values education and science
- Role models, mentors, peer buddies
- Excellent mathematical skills
- Opportunities to pursue what is important to them

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Lynbrook (Indian) mothers working in science

• "My uncles and aunts were doctors and so from 5, I was going to be a doctor. My grandmother said she was going to make me a doctor."

MD Gastroenterology

• "I loved science and no-one was going to tell me what I was going to be. My dad was a doctor and I am an engineer."

Electrical/software engineer

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Lynbrook Women Science Teachers

- *"My (woman) professor showed me that science had the power to answer the mysteries of life."*
- *"It is critical to see other women in science and engineering."*
- *"Girls need to see science as a creative venue...to solve today's and tomorrow's problems."*
- *"Math skills make the difference."*
- *"Physics leaves the door open to all sciences."*
- *"Role models, mentoring, counseling are so important"*



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Lynbrook girls

- *"My brother (an electrical engineer) inspired me. As President of JETS (Junior Engineering Technical Society), I want to inspire others."*
- *"My teachers have been so supportive."*
- *"I think each girl has to get over that initial barrier (that science or engineering might be daunting.)"*
- *"At school, it is great to see the (older) girls. They are role models."*



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"All progress is based on relationships."

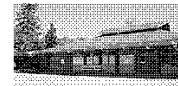
Margaret Wheatley, Worldwide Leadership Conference



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Lynbrook High School...



- A School
- A Community
- A Culture

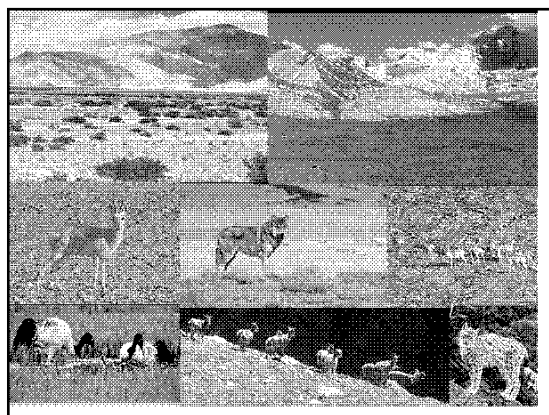
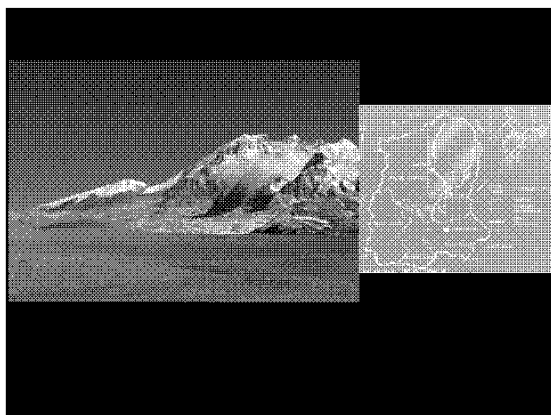
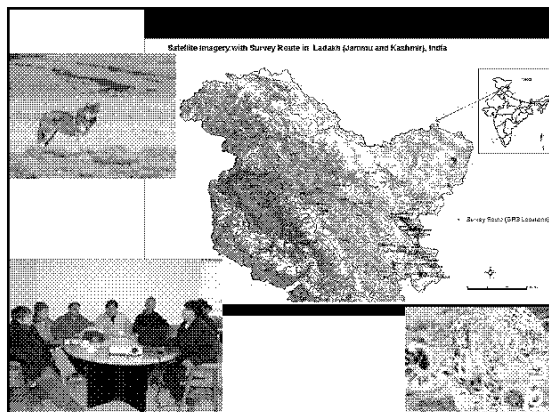
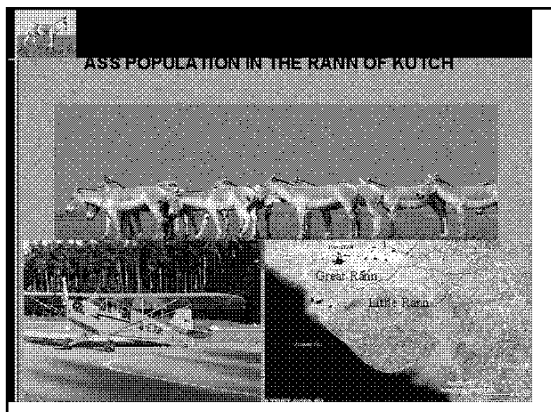
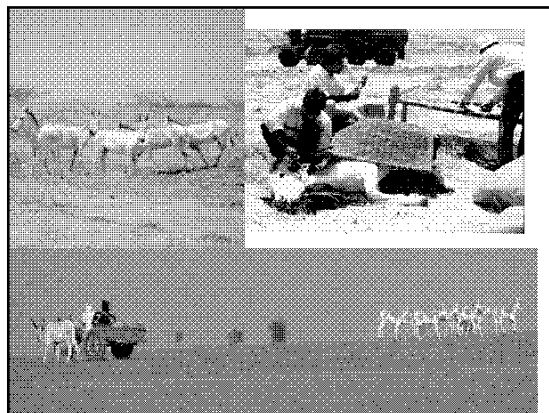
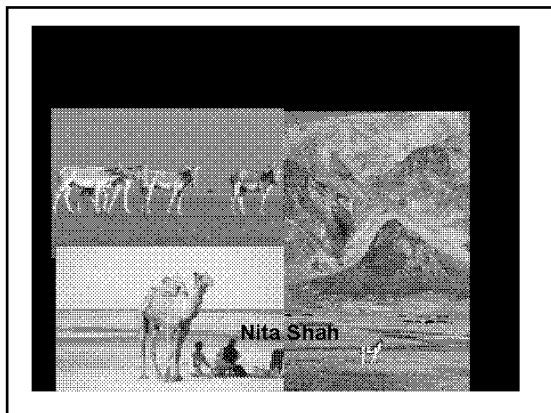
Supporting ALL to learn deeply, apply their knowledge and contribute purposefully

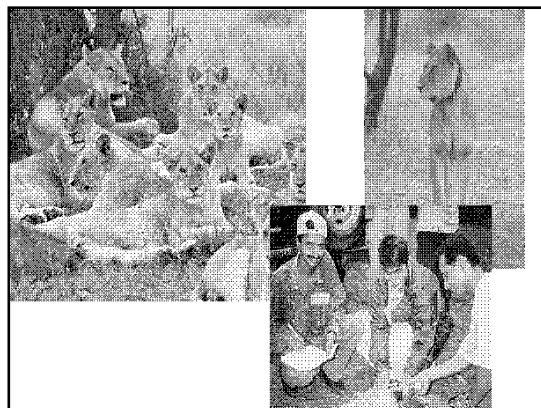
Supporting and empowering girls in science!



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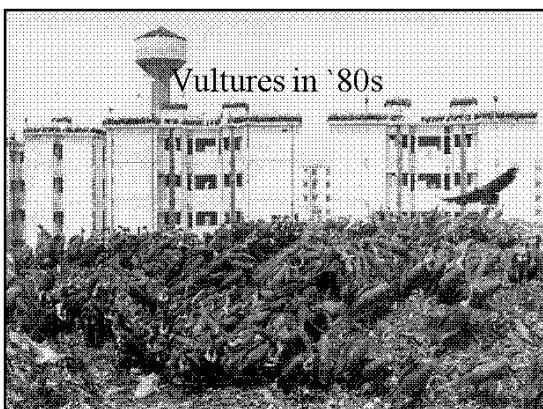
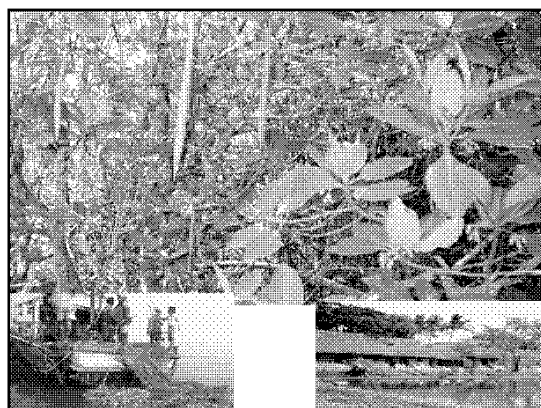
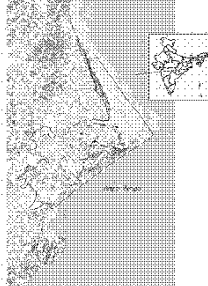


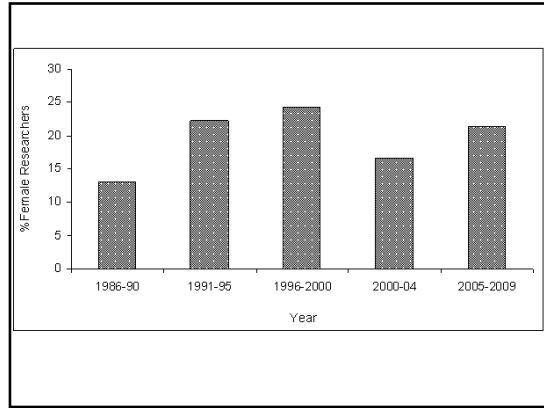
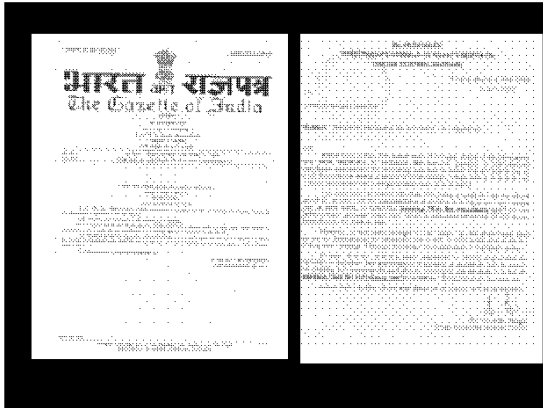




**UNDERSTANDING BHITARKANIKA
MANGROVE ECOSYSTEM**

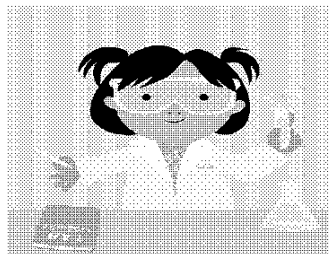
Bhitarkanika NP : 145 km²
Bhitarkanika WLS : 672 km²
Gahirmatha MS : 1435 km²







A Case Study of Science Education in a Girls' School

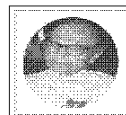


Introduction

- The Case study is of **Rabea Girls' Public School** situated in the walled city of Delhi.
- The school is for the Muslim girls of Old Delhi area.
- The study presents the social background of the times when the school was started (37 years back) and takes us through the situations that posed serious barriers to acceptance of science education by the first generation students of the community;
- A glimpse of the long battle and the success story.

The Birth of the School

- The school was started in 1973 by the renowned Hakeem Abdul Hameed Sahab of Hamdard Dawa Khana, one of the oldest Yunani (Greek) Medicinal Centers in India.



Padamshree Hakeem Abdul Hameed
September 1908 – 22nd July 1999

- The school was Hakeem Sa'ab's dream project. He had envisioned bringing the Muslim girls of the Walled City into the mainstream by blending valued traditions (handed down by lineage) with the modern values and opening the doors to futuristic options for these girls.

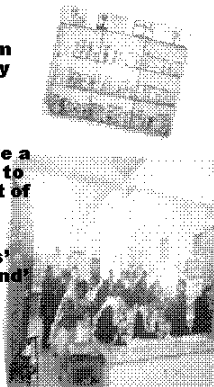


The Beginning

- The school began in an old building with five rooms in the Qasim Jaan Street a by-lane of Balli Maran and offered education in the English medium;
- The community of the Muslims living in the walled city were not willing to send their girl child to school that did not teach in the Urdu medium;
- Therefore there were not many takers of the 'modern' education that the school offered;

The Stumbling Block

- They were looking for a system that re-enforced the customary values that would govern the lives of their daughters;
- A school that was going to give a scientific and rational outlook to the girls was not their concept of education;
- The thought of their daughters' awareness of 'the world beyond' was too threatening;
- In short 'Change' was not desirable;

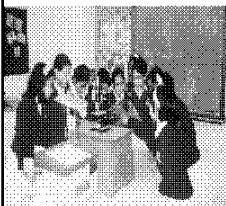


Half the Battle Won !



- It required a lot of visiting the homes and meeting with the parents that the 'deadlock' began to thaw a bit;
- To explain the standard of students who joined the school by the proverbial 'first generation scholars' would be an understatement;
- Their orientation for education was too little;
- To apply the theory of 'concrete to abstract' was a big problem;
- They were too distant from the mainstream!

So what did we do!



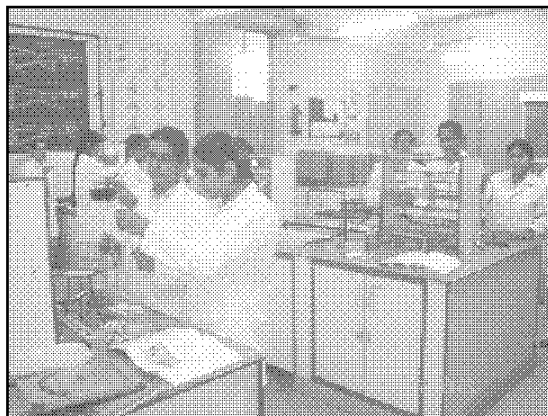
- Out of the five rooms the biggest room was the science room;
- And what were the activities we carried out – almost anything and everything that would catch the fancy of the girls;
- What amazed them most were the ones (experiments) that explained some facts about their physical environment;
- The ball was set rolling for scientific temperament;
- But science instruction in the formal sense remained a challenge.

Why were the students not taking Science in Senior Secondary levels?

- The genesis of the problem ran deeper than we had thought;
- Education in the Indian subcontinent is directly associated with employability prospects;
- The kind of professions that result from pursuing science are generally male dominated. At least that was the case in the late 70s and early 80s and therefore did not interest girls;
- In any case our girls were not too career conscious; Pursuing science was going to be too much slog to no avail;

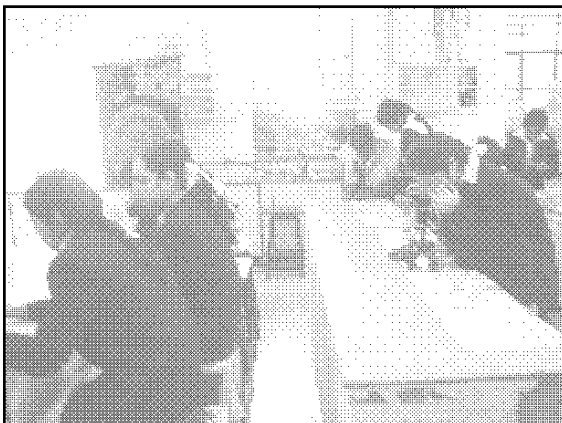
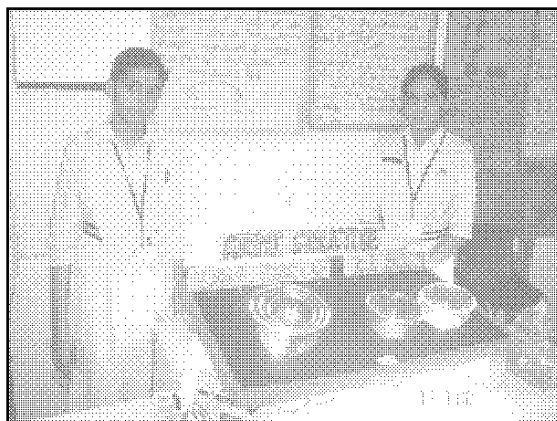
Other reasons

- Education has been too examination oriented;
- And, myth or reality, to pass in science required diligence in which case the girls must have a lot of time to study for science at home ;
- For the girl child who is expected to lend a helping hand in the house hold chores there would not be enough time to do so;
- And if the girl child failed it was considered wasting time and money on her; she would have to drop out;
- So she had to play it safe by taking other subjects.



And some more

- She was traditionally supposed to be only a home maker which required a non questioning attitude whereas science education required a questioning mind; the two were not matters of the same plain;
- The kind of rationality associated with understanding of scientific concepts was never supposed to be the attribute of the human female, in the minds of people;
- It was okay for the girl child to study humanities which was convenient.



Yet more

- The duration of pursuing studies for conventional science oriented professions like engineering or medicine would be too much and expense would also be too high;
- Parents may see the education of daughters as a waste of money because daughters will eventually live with their husbands' families, and the parents will not benefit directly from their education;
- But it was okay for her to be ambitious 'just enough' to be able to get into a school teacher's job in humanities because that would mean she is educated in reasonable time without running the risk of flunking;

Most importantly

- Science education for girls in the country has suffered due to not enough role models;
- And the problem gets compounded for girls in Rabea School when they look for role models from within their community which is a major problem.



To top it all – Generally...

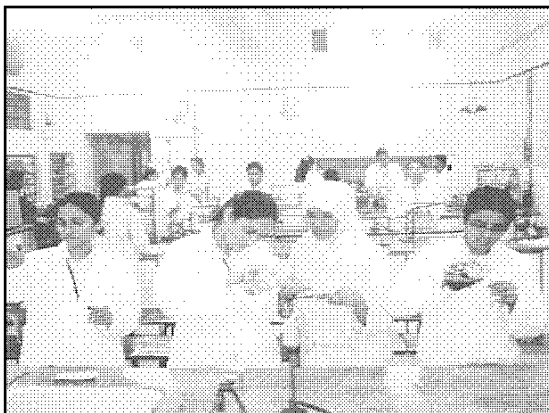
- Schools have a stringent admission policy for science streams;
- The standard of entry level cut off is rather forbidding for most students;
- A genuinely keen follower of science may not win the favour of the admission in-charge of her school because of inadequate percentage;
- Then the admission councilors at the admission desk discourages students by scaring them with the **monster** called science;
- Now with the introduction of Continuous & Comprehensive Evaluation (CCE) things might change but it is almost certain schools will develop admission policies for science which will pose fresh challenges.

Some more

- The delivery mechanism of the teacher is also somewhere responsible for the discouragement of students;
- Some imperfect practices of Science Teaching are responsible for the unpopularity of science;
- The experience of science is too limited to text book and class room;
- There is over emphasis on memorizing and Exam the only purpose of science in school.

And...

- Emphasis on teaching in lecture mode;
- Little or no exploration mode;
- Science being conceptual has to be experienced and not taught;
- Exam the only source of assessing the scientific knowledge;
- Answering questions as Class work–home work the only means of application of scientific understanding;
- Lab work also too academic in form;
- No real motivation for the learner;

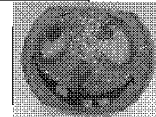
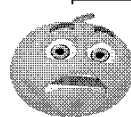


The Art of Science Teaching is about overcoming ...
the A B C Syndrome

AFRAID-

BORED-

CONFUSED



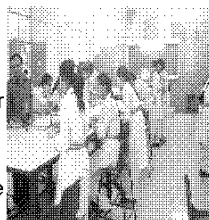
We tried to change a little bit

Text Book became:

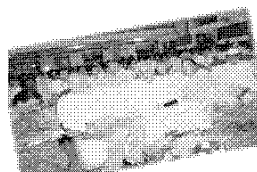
- A resource book for reference;
- Source for guidance for class room activities;
- And for setting the perimeters of exploring.

The Teacher becomes:

- The proverbial friend philosopher and guide;
- The ultimate motivator;
- A source of role model in attitude towards science.

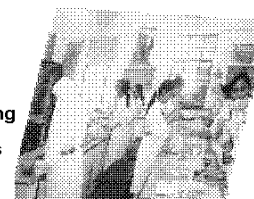


What else did we do?



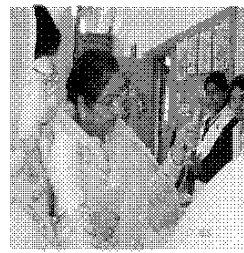
- We approached the related issues differently

- This time along with educating the girls we counseled the parents to let their daughters adopt science in senior secondary;





- To meet the requirement of 'extra instruction' we ran the tutorials in the school for science students.
- After a bit of counseling and a bit of coaxing we made steady progress;



- Then after struggling with our results for a bit we are now doing really well in science;
- Our own students (with success in their S&T related careers) have become the Role models for others in the school.

But is Science loosing out again?

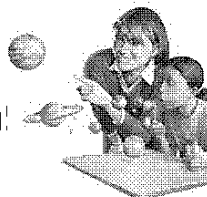
- Science was always on flimsy ground as long as it was to be associated with employability prospects alone;
- It lost out to subjects like Commerce which provided lucrative job prospects without having to face the ABC syndrome;
- Now science has a new challenger – the BBA and MBA;
- One can follow any subject and get into these courses with relative ease and hope to make a reasonable living in life.

- We are constantly trying to find solutions to problems faced by girls with respect to science.
- We shall find a reasonable solution to substantiate the importance of science.
- Science will remain our primary pre-occupation as it was deep desire of the founder to educate the Girl Child in such a way that it brings about a rational and scientific out look in her.

Cheers to the

**WOMEN
IN
SCIENCE**

Thank You!



GENDER DIFFERENCES

AT CRITICAL TRANSITIONS IN THE CAREERS OF SCIENCE,
ENGINEERING, AND MATHEMATICS FACULTY



S U M M A R Y

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES



COMMITTEE ON GENDER DIFFERENCES IN CAREERS OF SCIENCE, ENGINEERING, AND MATHEMATICS FACULTY

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THOMAS N. TAYLOR, (NAS) Distinguished Professor, Department of Ecology and Evolutionary Biology and Biodiversity Research Institute, University of Kansas

LILIAN WU, Program Executive, Global University Relations, IBM Technology Strategy and Innovation

PRINCIPAL PROJECT STAFF

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PETER HENDERSON, Study Director (from October 15, 2005 until August 31, 2007)

JONG-ON HAHM, Study Director (through October 14, 2005)

CONSTANCE F. CITRO, Director, Committee on National Statistics

MICHAEL L. COHEN, Senior Program Officer

JOHN SISLIN, Program Officer



SUMMARY

The 1999 report, *A Study on the Status of Women Faculty in Science at MIT*, created a new level of awareness of the special challenges faced by female faculty in the sciences. Although not the first examination of the treatment of female faculty, this report marked an important historical moment, igniting interest in the difficulties experienced by many women, particularly those at the higher levels of academia. Since the release of the Massachusetts Institute of Technology report, many other institutions have studied equity issues regarding their faculty, and several have publicly pledged to use their resources to correct identified disparities. Although academic departments, institutions, professional societies, and others have paid more attention to the topic in the past 10 years, some experts are concerned that remedial actions have approached a plateau.

Unquestionably, women's participation in academic science and engineering (S&E) has increased over the past few decades. In the 10 years prior to the start of this study, the number of women receiving Ph.D.s in science and engineering increased from 31.7 percent (in 1996) to 37.7 percent (in 2005). The percentage of women among doctoral scientists and engineers employed full-time, while still small, rose from 17 percent in 1995 to 22 percent in 2003. However, women continued to be underrepresented among academic faculty relative to the number receiving S&E degrees. In 2003, women comprised between 18 and 45 percent of assistant professors in S&E and between 6 and 29 percent of associate and full professors.

In 2002, Senator Ron Wyden (D-Oregon) of the Subcommittee on Science, Technology and Space of the

U.S. Senate Committee on Commerce, Science and Transportation, convened three hearings on the subject of women studying and working in science, mathematics, and engineering. Soon after, Congress directed the National Science Foundation (NSF) to contract with the National Academies for a study assessing gender differences in the careers of science and engineering faculty, based on both existing and new data. The study committee was given the following charge:

Assess gender differences in the careers of science, engineering, and mathematics faculty, focusing on four-year institutions of higher education that award bachelor's and graduate degrees. The study will build on the Academy's previous work and examine issues such as faculty hiring, promotion, tenure, and allocation of institutional resources including (but not limited to) laboratory space.

The committee interpreted its charge to imply three tasks: (1) update earlier analyses, (2) identify and assess current gender differences, and (3) recommend methods for expanding knowledge about gender in academic careers in science and engineering. It developed a series of guiding research questions in three key areas to organize its investigation: (1) academic hiring, (2) institutional resources and climate, and (3) tenure and promotion.

The committee also limited its exploration of science and engineering to the natural sciences and engineering, defined here as the physical sciences (including astronomy, chemistry, and physics); earth, atmospheric, and ocean sciences; mathematics and computer science; biological and agricultural sciences; and engineering (in all its forms).





FACULTY AND DEPARTMENTAL SURVEYS

Recognizing at the outset the need for new data, the committee conducted two national surveys in 2004 and 2005 of faculty and academic departments in six science and engineering disciplines: biology, chemistry, civil engineering, electrical engineering, mathematics, and physics. The first survey of almost 500 departments focused on hiring, tenure, and promotion processes, while the second survey gathered career-related information from more than 1,800 faculty. Together the surveys addressed departmental characteristics, hiring, tenure, promotion, faculty demographics, employment experiences, and types of institutional support received. In addition to results from the surveys, the committee heard expert testimony, examined data from NSF, the National Center for Education Statistics (NCES), and professional societies, and reviewed the results of individual university studies and research publications.

As it would be impossible to survey all "science, engineering, and mathematics faculty at four-year institutions of higher education," the committee limited the scope of the surveys in four important ways. These limitations must be kept in mind in the interpretation of the survey results:

1. The data present a snapshot in time (2004 and 2005), not a longitudinal view.
2. Six disciplines are examined: biology, chemistry, civil engineering, electrical engineering, mathematics, and physics.
3. Institutions are limited to major research universities, referred to as Research I or research-intensive (RI) institutions.
4. Only full-time, regularly appointed professorial faculty who are either tenure eligible or tenured are included.

In other words, except in its review of historical data and existing research, the report does not examine gender differences outside of the six disciplines covered in the surveys or at institutions other than RI institutions. It also does not examine the careers of instructors, lecturers, postdocs, adjunct faculty, clinical faculty, or research faculty, who may experience very different career paths.

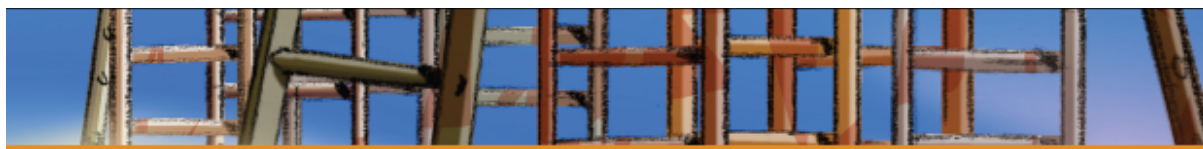
Many of the "whys" of the findings included here are buried in factors that the committee was unable to explore. We do not know, for example, what happens to the significant percentage of female Ph.D.s in science and engineering who do not apply for regular faculty positions at RI institutions, or what happens to women faculty members who are hired and subsequently leave the university. And we know little about female full professors and what gender differences might exist at this stage of their careers.

We do know that there are many unexplored factors that play a significant role in women's academic careers, including the constraints of dual careers; access to quality child care; individuals' perceptions regarding professional recognition and career satisfaction; and other quality-of-life issues. In particular, the report does not explore the impact of children and family obligations (including elder care) or the duration of post-doctoral positions on women's willingness to pursue faculty positions in RI institutions.

COMPARISONS TO OTHER NATIONAL ACADEMIES' REPORTS

This report does not exist in isolation. The committee has benefited greatly from three other National Academies' reports on women in academic science and engineering.





In 2001 the Committee on Women in Science and Engineering (CWSE) published *From Scarcity to Visibility: Gender Differences in the Careers of Doctoral Scientists and Engineers*, a statistical analysis of the career progression of matched cohorts of men and women Ph.D.s from 1973 to 1995. The 2005 CWSE report, *To Recruit and Advance: Women Students and Faculty in U.S. Science and Engineering*, identifies the strategies that higher education institutions have employed to achieve gender inclusiveness, based on case studies of four successful universities.

A third report, *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering*, was released in 2006 under the aegis of the Committee on Science, Engineering, and Public Policy (COSEPUP). The study committee was charged to "review and assess the research on sex and gender issues in science and engineering, including innate differences in cognition, implicit bias, and faculty diversity" and "provide recommendations . . . on the best ways to maximize the potential of women science and engineering researchers." The committee considered all fields of science and engineering (including the social sciences) in a broad range of academic institutions, relying primarily on existing data and the experience and expertise of committee members. Its report provides broad policy recommendations for changes at higher education institutions.

In contrast, the current report examines new information on the career patterns of men and women faculty at RI institutions—with particular focus on key transition points that are under the control of the institutions. The findings and recommendations here are based primarily on the data from our two surveys, which were not available to the COSEPUP committee.

Like the COSEPUP committee, this committee found evidence of the overall loss of women's participation in academia. That loss is most apparent in the smaller fraction of women who apply for faculty positions and

in the attrition of women assistant professors before tenure consideration. Unfortunately, our surveys do not shed light on why women fail to apply for faculty positions or why they may leave academia between these critical transition points—underscoring the fact that our work is not done.

Our survey findings do indicate that, at many critical transition points in their academic careers (e.g., hiring for tenure-track and tenured positions and promotions), women appear to have fared as well as or better than men in the disciplines and type of institutions (RI) studied, and that they have had comparable access to many types of institutional resources (e.g., start-up packages, lab space, and research assistants). These findings are in contrast to the COSEPUP committee's general conclusions that "women who are interested in science and engineering careers are lost at every educational transition" and that "evaluation criteria contain arbitrary and subjective components that disadvantage women."

After providing a brief overview of the Status of Women in Academic Science and Engineering in 2004 and 2005, the report presents the results of the survey findings in the three areas: Academic Hiring, Climate, Institutional Resources, Professional Activities, and Outcomes, and Tenure and Promotion. Finally, the report provides an overall summary of key findings and recommendations, including questions for future research.

KEY FINDINGS

The surveys of academic departments and faculty have yielded interesting and sometimes surprising findings. For the most part, men and women faculty in science, engineering, and mathematics have enjoyed comparable opportunities within the university, and gender does not appear to have been a factor in a number of important career transitions and outcomes. The find-





TABLE S-1 Representation of Women in Faculty Positions at Research I Institutions by Rank and Field (percent), 1995-2003

	ASSISTANT PROFESSOR					ASSOCIATE PROFESSOR					FULL PROFESSOR				
	1995	1997	1999	2001	2003	1995	1997	1999	2001	2003	1995	1997	1999	2001	2003
Agriculture	17.8	18.6	19.6	18.1	27.2	12.7	12.5	10.7	17.6	13.9	4.9	5.2	6.1	6.6	8.0
Biology	35.6	38.2	36.0	37.0	38.8	26.0	24.3	26.3	30.2	31.2	14.0	14.7	15.8	18.0	20.8
Engineering	14.2	12.7	12.8	14.8	16.6	4.8	6.4	9.6	9.3	11.7	1.8	1.4	2.3	2.7	3.8
Health Sciences	69.1	66.9	64.0	64.7	66.5	65.6	65.1	64.9	64.5	59.1	35.1	38.9	45.3	48.0	59.0
Mathematics	18.7	22.0	26.5	25.2	26.6	10.4	14.4	14.9	15.8	16.3	7.6	5.9	9.9	10.0	9.7
Physics	25.1	25.6	24.6	25.4	24.1	9.5	13.4	14.8	16.7	19.5	4.3	4.6	5.9	6.8	7.6

SOURCE: National Science Foundation, Survey of Doctorate Recipients, 1995-2003. Tabulated by the National Research Council.

ings below provide key insights on gender differences in Academic Hiring, Climate, Institutional Resources, Professional Activities, and Outcomes, and Tenure and Promotion. Complete findings in each of these areas can be found at the end of the relevant chapter and are summarized in the final chapter of the report.

As a foundation for understanding the survey findings, it is important to remember that although women represent an increasing share of science, mathematics, and engineering faculty, they continue to be underrepresented in many of those disciplines. While the percent of women among faculty in scientific and engineering overall increased significantly from 1995 through 2003, the degree of representation varied substantially by discipline, and there remained disciplines where the percentage of women was significantly lower than the percentage of men. Table S-1 shows the percent of women faculty in selected scientific and engineering disciplines during this time period at the assistant, associate, and full professor levels.

In 2003, women comprised 20 percent of the full-time employed S&E workforce and had slowly gained ground compared to men in the full-time academic workforce;

by 2003, they represented about 25 percent of academics. Women's representation in the academic workforce, of course, varied by discipline: in the health sciences, women were the majority of full-time, employed doctorates, while in engineering they were less than 10 percent. The greatest concentration of women among full-time academics was at medical schools; the lowest was at Research II institutions.

ACADEMIC HIRING

The findings on academic hiring suggest that many women fared well in the hiring process at Research I institutions, which contradicts some commonly held perceptions of research-intensive universities. If women applied for positions at Research I institutions, they had a better chance of being interviewed and receiving offers than male job candidates had. Many departments at Research I institutions, both public and private, have made an effort to increase the numbers and percentages of female faculty in science, engineering, and mathematics. Having women play a visible role in the hiring process, for example, has clearly made a difference. Un-

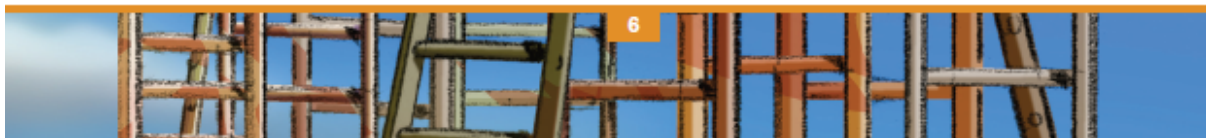




TABLE S-2 Transitions from Ph.D. to Tenure-Track Positions by Field at the Research I Institutions Surveyed (percent)

	DOCTORAL POOL	POOLS FOR TENURE-TRACK POSITIONS		
	Percent women Ph.D.s (1999-2003)	Mean percent of applicants who are women	Mean percent of applicants invited to interview who are women	Mean percent of first offers that go to women
Biology	45	26	28	34
Chemistry	32	18	25	29
Civil Engineering	18	16	30	32
Electrical Engineering	12	11	19	32
Mathematics	25	20	28	32
Physics	14	12	19	20

SOURCE: Survey of departments carried out by the Committee on Gender Differences in Careers of Science, Engineering, and Mathematics Faculty; Ph.D. data is from NSF, WebCASPAR.

fortunately, women continue to be underrepresented in the applicant pool, relative to their representation among the pool of recent Ph.D.s. Institutions may not have effective recruitment plans, as departmental efforts targeted at women were not strong predictors in these surveys of an increased percentage of women applicants.

1. **Women accounted for about 17 percent of applications for both tenure-track and tenured positions in the departments surveyed. In each of the six disciplines, the percentage of applications from women for tenure-track positions was lower than the percentage of Ph.D.s awarded to women.**

Table S-2 shows the percentage of women in the pool at each of several key transition points in academic careers: award of Ph.D., application for position, interview, and job offer. Although there was wide variation by field and department in the number and percentage of female applicants for faculty positions, the percentage of applications from women in each discipline was lower than the percentage of doctoral degrees awarded to women. This was particularly the case in chemistry and biology, the two disciplines in the study with the

highest percentage of female Ph.D.s. The mean percentage of female applicants for tenure-track positions in chemistry was 18 percent, but women earned 32 percent of the Ph.D.s in chemistry from Research I institutions from 1999-2003. Biology (26 percent in the tenure-track pool and 45 percent in the doctoral pool) also showed a significant difference.

The fields with lower percentages of women in the Ph.D. pool had a higher propensity for those women to apply. Electrical engineering (11 percent in the tenure-track pool and 12 percent in the doctoral pool), mathematics, and physics, for example, had modest decreases in the applicant pool.

The percentage of applicant pools that included at least one woman was substantially higher than would be expected by chance. However, there were no female applicants (only men applied) for 32 (6 percent) of the available tenure-track positions and 16 (16.5 percent) of the tenured positions.

2. **The percentage of women who were interviewed for tenure-track or tenured positions was higher than the percentage of women who applied.**





For each of the six disciplines in this study the mean percentage of females interviewed for tenure-track and tenured positions exceeded the mean percentage of female applicants. For example, the female applicant pool for tenure-track positions in electrical engineering was 11 percent, and the corresponding interview pool was 19 percent.

3. The percentage of women who received the first job offer was higher than the percentage who were invited to interview.

For all disciplines the percentage of tenure-track women who received the first job offer was greater than the percentage in the interview pool. For example, women were 19 percent of the interview pool for tenure-track electrical engineering positions and received 32 percent of the first offers. This finding was also true for tenured positions with the notable exception of biology, where the interview pool was 33 percent female and women received 22 percent of the first job offers.

4. Most institutional and departmental strategies for increasing the percentage of women in the applicant pool were not effective as they were not strong predictors of the percentage of women applying. The percentage of women on the search committee and whether a woman chaired the search, however, did have a significant effect on recruiting women.

Departments have not generally been aggressive in using special strategies to increase the gender diversity of the applicant pool. Most of the policy steps proposed to increase the percentage of women in the applicant pool (such as targeted advertising, recruiting at conferences, and contacting colleagues at other institutions) were done in isolation, with almost two-thirds of the departments in our sample reporting that they took either no steps or only one step to increase the gender diversity of the applicant pool.

It appears that women were more likely to apply for a position if a woman chaired the search committee. The percentage of females on the search committee and whether a woman chaired the committee were both significantly and positively associated with the proportion of women in the applicant pool.

PROFESSIONAL ACTIVITIES, CLIMATE, INSTITUTIONAL RESOURCES, AND OUTCOMES

The survey findings with regard to climate and resources demonstrate two critical points. First, discipline matters, as indicated by the difference in the amount of grant funding held by men and women faculty in biology, but not in other disciplines. Second, institutions have been doing well in addressing most of the aspects of climate that they can control, such as start-up packages and reduced teaching loads. Where the challenge may remain is in the climate at the departmental level. Interaction and collegial engagement with one's colleagues is an important part of scientific discovery and collaboration, and here women faculty were not as connected.

5. Male and female faculty appeared to have similar access to many kinds of institutional resources, although there were some resources for which male faculty seemed to have an advantage.

Survey data revealed a great deal of similarity between the professional lives of male and female faculty. In general, men and women spent similar proportions of their time on teaching, research, and service; male faculty spent 41.4 percent of their time on teaching, while female faculty spent 42.6 percent. Male and female faculty members reported comparable access to most institutional resources, including start-up packages, initial reduced teaching loads, travel funds, summer salary, and supervision of similar numbers of research assistants and postdocs.





Men appeared to have greater access to equipment needed for research and to clerical support. At first glance, men seemed to have more lab space than women, but this difference disappeared once other factors such as discipline and faculty rank were accounted for.

6. Female faculty reported that they were less likely to engage in conversation with their colleagues on a wide range of professional topics.

There were no differences between male and female faculty on two of our measures of inclusion: chairing committees (39 percent for men and 34 percent for women) and being part of a research team (62 percent for men and 65 percent for women). And although women reported that they were more likely to have mentors than men (57 percent for tenure-track female faculty compared to 49 percent for men), they were less likely to engage in conversation with their colleagues on a wide range of professional topics, including research, salary, and benefits (and, to some extent, interaction with other faculty members and departmental climate). This distance may prevent women from accessing important information and may make them feel less included and more marginalized in their professional lives. The male and female faculty surveyed did not differ in their reports of discussions with colleagues on teaching, funding, interaction with administration, and personal life.

7. There is little evidence across the six disciplines that men and women have exhibited different outcomes on most key measures (including publications, grant funding, nominations for international and national honors and awards, salary, and offers of positions in other institutions). The exception is publications, where men had published more than women in five of the six disciplines. On all measures, there were significant differences among disciplines.

Overall, male faculty published marginally more refereed articles and papers in the past 3 years than female faculty, except in electrical engineering, where the reverse was true. Men published significantly more papers than women in chemistry (men: 15.8; women: 9.4) and mathematics (men: 12.4; women: 10.4). In electrical engineering, women published marginally more papers than men (men: 5.8; women: 7.5). The differences in the number of publications between men and women were not significant in biology, civil engineering, and physics.

There were no significant gender differences in the probability that male or female faculty would have grant funding, i.e., be a principal investigator or co-principal investigator on a grant proposal. Male faculty had significantly more research funding than female faculty in biology; the differences were not significant in the other disciplines.

Female assistant professors who had a mentor had a higher probability of receiving grants than those who did not have a mentor. In chemistry, female assistant professors with mentors had a 95 percent probability of having grant funding compared to 77 percent for those women without mentors. Over all six fields surveyed female assistant professors with no mentors had a 68 percent probability of having grant funding compared to 93 percent of women with mentors. This contrasts with the pattern for male assistant professors; those with no mentor had an 86 percent probability of having grant funding compared to 83 percent for those with mentors.

Male and female faculty were equally likely to be nominated for international and national honors and awards, although the results varied significantly by discipline. Gender was a significant determinant of salary among full professors; male full professors made, on average, about 8 percent more than females, once we controlled for discipline. At the associate and assistant professor ranks, the differences in salaries of men and women faculty disappeared.





TENURE AND PROMOTION

The findings related to tenure and promotion indicate the importance of addressing the retention of women faculty in the early stages of their academy careers; not as many were considered for tenure as would be expected, based on the number of women assistant professors. Retention was particularly problematic given the increased duration of time in rank for all faculty. Both male and female faculty utilized stopping-the-tenure-clock policies—spending a longer time in the uncertainty of securing tenure—but women used these policies more. Women faculty who did come up for tenure were as successful or more successful than men, so one of the most important challenges may be in increasing the pool of women faculty who make it to that point.

- 8. In every field, women were underrepresented among candidates for tenure relative to the number of female assistant professors. Most strikingly, women were most likely to be underrepresented in the fields in which they accounted for the largest share of the faculty—biology and chemistry.**

In biology and chemistry, the differences were statistically significant. In biology, 27 percent of the faculty considered for tenure were women, while women represented 36 percent of the assistant professor pool. In chemistry those numbers were 15 percent and 22 percent, respectively. This difference may suggest that female assistant professors were more likely than men to leave before being considered for tenure. It might also reflect the increased hiring of female assistant professors in recent years (compared with hiring 6 to 8 years ago).

- 9. Women were more likely than men to receive tenure when they came up for tenure review.**

In each of the six fields surveyed, women were tenured at the same or a higher rate than men (an overall aver-

age of 92 percent for women and 87 percent for men). It appears that women were more likely to be promoted when there was a smaller percentage of females among the tenure-track faculty. Discipline, stop-the-tenure-clock policies, and departmental size were not associated with the probability of a positive tenure decision for either male or female faculty members who were considered for tenure. Both male and female assistant professors were significantly more likely to receive tenure at public institutions (92 percent) than at private institutions (85 percent).

- 10. No significant gender disparity existed at the stage of promotion to full professor.**

For the six disciplines surveyed, 90 percent of the men and 88 percent of the women proposed for full professorship were promoted—a difference that was not statistically significant, after accounting for other potentially important factors such as disciplinary differences, departmental size, and use of stopping-the-tenure-clock policies. Women were proposed for promotion to full professor at approximately the same rates as they were represented among associate professors.

- 11. Women spent significantly longer time in rank as assistant professors than did men.**

Although time in rank as an assistant professor has increased over time for both men and women, women showed significantly longer durations than men. It is difficult to determine whether these apparent differences may be explained, at least in part, by individual and departmental characteristics such as length of post-doctoral experience and stopping-the-tenure-clock for family leave. Both male and female faculty spent more time in the assistant professor ranks at institutions of higher prestige.

- 12. Male and female faculty who stopped the tenure clock spent significantly more time as assistant professors than those who did not (an**





average of 74 months compared to 57 months). They had a lower chance of promotion to associate professor (about 80 percent) at any time (given that they had not been promoted until then) than those who did not stop the clock. Everything else being equal, however, stopping the tenure clock did not affect the probability of promotion and tenure; it just delayed it by about 1.5 years. It is unclear how that delay affected women faculty, who were more likely than men to avail themselves of this policy.

Although the effect of stopping the tenure clock on the probability of promotion and tenure is similar for both male and female faculty, 19.7 percent of female assistant professors in the survey sample availed themselves of this policy compared to 7.4 percent of male assistant professors. At the associate professor level, 10.2 percent of female faculty compared to 6.4 percent of male faculty stopped the tenure clock.

RECOMMENDATIONS

The survey data suggest that positive changes have happened and continue to occur. At the same time, the data should not be mistakenly interpreted as indicating that male and female faculty in math, science, and engineering have reached full equality and representation, and we caution against premature complacency. Much work remains to be done to accomplish full representation of men and women in academic departments.

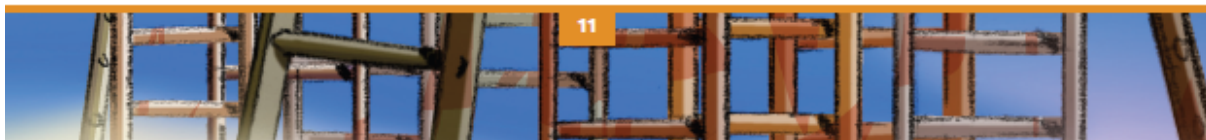
Many of the survey findings point out specific areas in which research institutions and professional societies can enhance the likelihood that more women will apply to faculty positions and persist in academia up to and beyond tenure and promotion. Changes in the faculty recruitment and search process, enhancement of mentoring programs, broader dissemination of tenure and stop-the-tenure-clock policies, and investigation of

the subtle effects of climate on career decisions can all help. Increased data collection, of course, is also necessary. Complete recommendations are delineated in the final chapter of the report.

RECOMMENDATIONS FOR INSTITUTIONS

Research I institutions should:

- 1. Design and implement new programs and policies to increase the number of women applying for tenure-track or tenured positions and evaluate existing programs for effectiveness.** This includes enhancing institutional efforts to encourage female graduates and postdocs to consider careers at RI institutions. In each of the six disciplines studied, women were underrepresented in the applicant pool relative to their representation in the pool of recent Ph.D.s. This critical gap must be narrowed to expand the number of female faculty in research-intensive institutions. Most departments reported using a very small arsenal of recruitment strategies (targeted advertising was the most cited), and 43 percent reported using only one strategy. Significant change in the applicant pool will not come from such minimal efforts.
- 2. Involve current female faculty in faculty searches, with appropriate release time.** The proportion of women on the search committee and whether a woman chaired the committee were both significantly and positively associated with the proportion of women in the applicant pool. Such engagement may signal to prospective hires that the institutional climate is supportive and inclusive.
- 3. Investigate why female faculty, compared to their male counterparts, appear to continue to experience some sense of isolation in subtle and intangible ways.** Finding six reports that female faculty are less likely to engage with other faculty in conversations about research or salary. Creating informal opportuni-





ties for faculty to engage within a department or across an institution might help to address this issue.

4. Explore gender differences in the obligations outside of professional responsibilities (particularly family-related obligations) and how these differences may affect the professional outcomes of their faculty. Our findings focused only on the climate within academic institutions, but factors outside the institutional environment may be equally important.

5. Initiate mentoring programs for all newly hired faculty, especially at the assistant professor level. As described in finding seven, the mentoring of female faculty had a striking impact on their ability to secure grant funding. Institutional mentoring programs could help to ensure that female faculty acquire grant funding, which in turn should have a positive effect on their promotion rates.

6. Make tenure and promotion procedures as transparent as possible and ensure that policies are routinely and effectively communicated to all faculty. While 81 percent of male faculty know their institution's policies on promotion, only 75 percent of female faculty do. Departments in particular need to review their communication strategies, as only 49 percent of all faculty surveyed reported that their department had written procedures. And only 78 percent of departments reported that they had written tenure and promotion policies.

7. Monitor and evaluate stop-the-tenure-clock policies and their impact on faculty retention and advancement. Where such policies are not already in place, adopt them and ensure effective dissemination to faculty members. Only 78 percent of assistant professors reported that their department or university had a formal family or personal leave policy that allows stopping or extending the tenure clock. At those institutions that do, 19.7 percent of female and 7.4 percent of male assistant professors avail themselves of these policies, as well as 10.2 percent of female and 6.4 percent of male associate professors. As use of these policies will likely

grow, institutions need to review the careers of faculty who use these policies to understand their impact on career progress.

8. Collect data encompassed in this study (including applications, interviews, first offers, hires, time in rank, tenure award, and promotion) disaggregated by race, ethnicity, and gender. Many of the departments surveyed have made significant gains in their numbers of female faculty at many of these critical junctures, yet these results are not well known. The collection of data can allow departments and institutions to focus their scarce resources on transitions that need the most attention. Also, our findings do not address race and ethnicity, but this information is essential as institutions work to increase diversity.

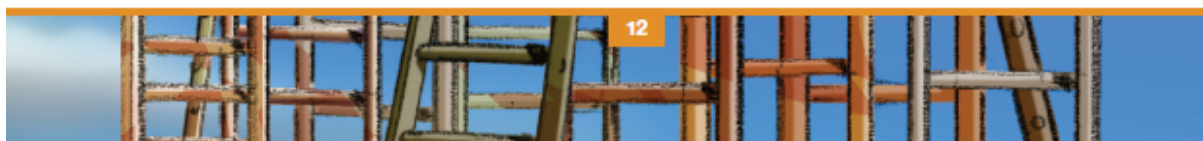
RECOMMENDATIONS FOR PROFESSIONAL SOCIETIES

Professional societies in science and engineering disciplines should:

9. Collect data on the career tracks of their members. This study identified many differences among disciplines that warrant investigation. Why, for example, do biology and chemistry have disproportionately smaller applicant pools of women for faculty positions? And why are women in electrical engineering and mathematics more likely than men to receive outside job offers, while the reverse is true for chemistry and physics?

10. Disseminate successful strategies to increase the gender diversity of the applicant pools for tenure-track and tenured faculty positions. Only 10 percent of departments reported relying on three or more strategies for recruitment.

11. Conduct in-depth surveys of their members at regular intervals on the climate for professional success and the role of mentoring in their discipline.





QUESTIONS FOR FUTURE RESEARCH

This study raises many unanswered questions about the status of women in academia. As noted at the onset of this report, the surveys did not capture the experiences of Ph.D.s who have never applied for academic positions, nor of female faculty who have left at various points in their academic careers. We also recognize that there are important, nonacademic issues affecting men and women differentially that impact career choices at critical junctures. Fuller examination of these issues (for example, topics relating to family, children, home life, care of elderly parents) will shed greater light on career choices by women and men and should yield suggestions on the types of support needed to encourage retention of women in academic careers. Below are suggestions for future research:

A DEEPER UNDERSTANDING OF CAREER PATHS

1. Using longitudinal data, what are the academic career paths of women in different science and engineering disciplines from receipt of their Ph.D. to retirement?
2. Why are women underrepresented in the applicant pools and among those who are considered for tenure?
3. Why aren't more women in fields such as biology and chemistry applying to Research I tenure-track positions, as discussed in Finding 1?
4. Why do female faculty, compared to their male counterparts, appear to continue to experience some sense of isolation in more subtle and intangible areas?
5. What is the impact of stop-the-tenure-clock policies on faculty careers?
6. What are the causes for the attrition of women and men prior to tenure decisions, if indeed attrition does take place?
7. To what extent are women faculty rewarded beyond promotion to full professor?
8. What important, nonacademic issues affect men and women differentially that impact their career choices at critical junctures?

EXPANDING THE SCOPE

9. How important are differences among fields?
10. What are the experiences of faculty at Research II institutions?
11. What are the experiences of part-time and non-tenure track faculty?





FOR MORE INFORMATION

This report was developed under the aegis of the National Research Council's Committee on Gender Differences in Careers of Science, Engineering, and Mathematics Faculty with the support of the Committee on Women in Science, Engineering, and Medicine (CWSEM) and the Committee on National Statistics (CNSTAT) of the National Research Council. The mandate of CWSEM is to coordinate, monitor, and advocate action to increase the participation of women in science, engineering, and medicine. More information on CWSEM can be found at www.nas.edu/cwsem.

The mission of CNSTAT is to improve the statistical methods and information on which public policy decisions are based. More information on CNSTAT can be found at <http://www7.nationalacademies.org/cnstat/>.

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More information, including the body of the full report, is available from the National Academies Press at www.nap.edu or 1-800-624-6242.

NOTE:

This report was reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with the procedures approved by the National Academies' Report Review Committee. For a list of those reviewers, refer to the full report.





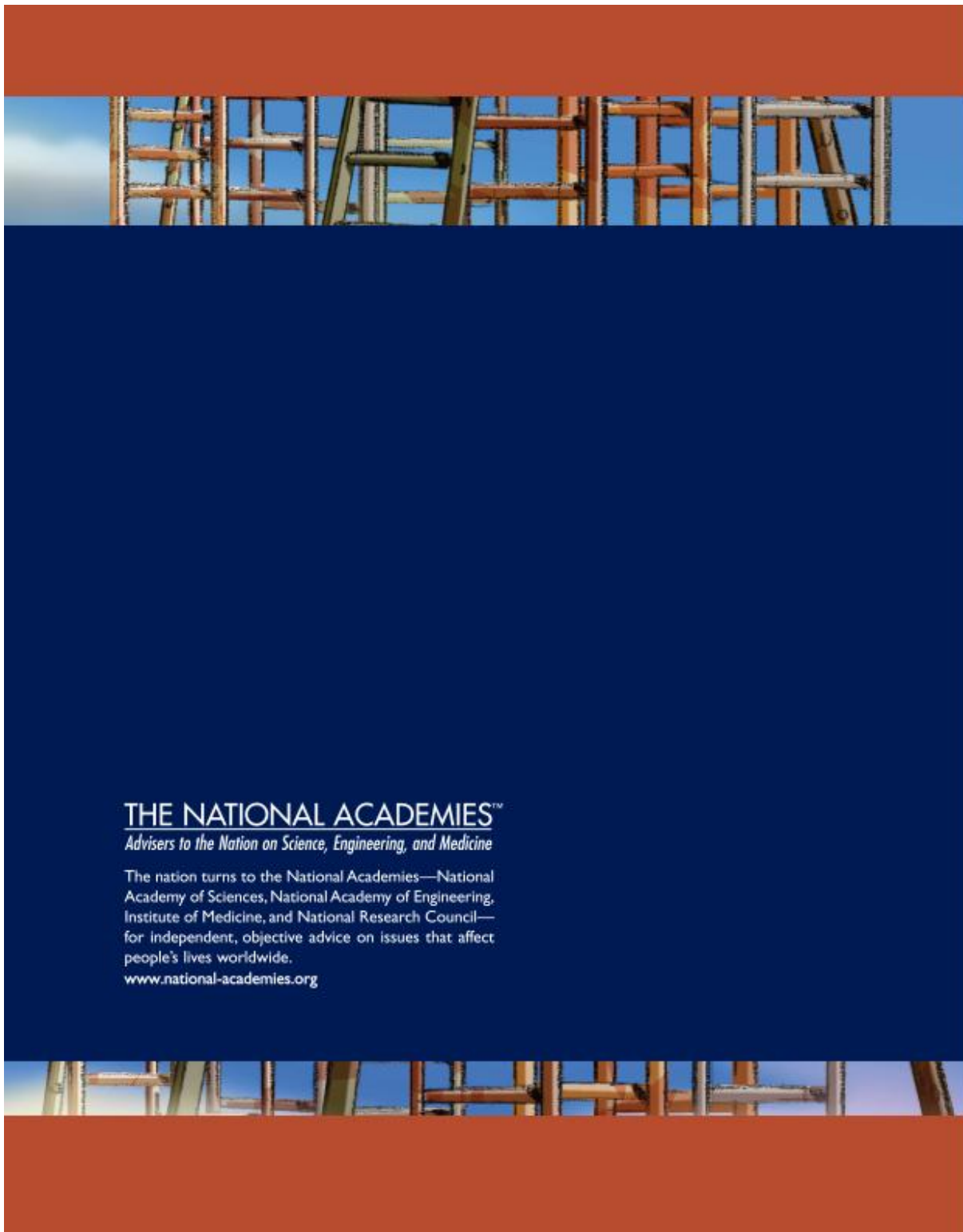
RELATED PUBLICATIONS

Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering (2007)

To Recruit and Advance: Women Students and Faculty in Science and Engineering (2006)

From Scarcity to Visibility: Gender Differences in the Careers of Doctoral Scientists and Engineers (2001)

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Links & Other Resources

1. Women in Science (an Indian Academy of Science Initiative):
<http://www.ias.ac.in/womeninscience/>
2. Website for Indian women in science: www.indianwomenscientists.in
3. The study conducted by WiS Panel of Indian Academy of Sciences Report, April 2010: "Trained Scientific Women Power: How Much are we Losing and Why?"
http://www.ias.ac.in/womeninscience/surveyreport_web.pdf
4. Task force on Indian Women in Science Recommendations:
<http://indianwomenscientists.in/Recommendations.html>
5. Scholarships available for women from the Department of Science and Technology:
<http://www.dst.gov.in/scientific-programme/women-scientists.htm>
6. Training Programmes available for scientists in Government of India institutions:
http://www.dst.gov.in/admin_finance/training-prog.htm
7. The book *LILAVATI'S DAUGHTERS: The Women Scientists of India*. Edited by Rohini Godbole and Ram Ramaswamy, Indian Academy of Sciences, Bangalore
<http://www.ias.ac.in/womeninscience/LDCover.html>
8. The book *VENTURE CAPITAL DECISION-MAKING: GENDERED ASSUMPTIONS ABOUT TECHNICAL KNOWLEDGE AND SOCIAL NETWORKS (2009)* by Manwai C. Ku, Stanford University
9. The book *Women Scientists and Engineers Employed in Industry, Why so Few?* National Academy Press
10. An examination of Indian women's access to and retention in scientific careers: SCIENCE CAREER FOR INDIAN WOMEN, October 2004, **Indian National Science Academy, New Delhi**
<http://insaindia.org/science.htm>
11. "Engineer Your Life" is a website created to bring awareness of science and technology for women: <http://engineeryourlife.org/>
12. Gender and science bias association test results: www.implicit.harvard.edu
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“Change will not come if we wait for some other person or some other time. We are the ones we’ve been waiting for. We are the change that we seek.”

- President Barack Obama

“Making your mark on the world is hard. If it were easy, everybody would do it. But it’s not. It takes patience, it takes commitment, and it comes with plenty of failure along the way. The real test is not whether you avoid this failure, because you won’t. It’s whether you let it harden or shame you into inaction, or whether you learn from it; whether you choose to persevere.”

- Secretary of State Hillary Rodham Clinton

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