

The tenth anniversary of empowering women in science



SCIENCE EMPOWERS WOMEN



IT IS OUR RESPONSIBILITY TO PAVE A BETTER ROAD FOR THE FUTURE OF GIRLS AND WOMEN

- **ADNAN SHIHAB-ELDIN**
DIRECTOR GENERAL, KFAS

More than 200 outstanding women scientists, engineers and mathematicians—all under 50 and journeying from 25 countries across the globe—gathered in Kuwait last October for the International Conference on Women Leaders in Science, Technology and Engineering (WLSTE). With power and passion, they told tales of triumphs and adversity, and shared profound reflections on their personal experiences as women scaling the heights of the four fields of science, technology, engineering and mathematics—commonly known as STEM.

The conference, fostered by the Amir of Kuwait, Sheikh Sabah Al-Ahmad Al-Jaber Al-Sabah and the Kuwait Foundation for the Advancement of Sciences (KFAS), and in collaboration with the American Association for the Advancement of Science (AAAS) and the U.S. Department of State, was as at once a showcase of the challenges facing women in science and a celebration of their incredible feats of accomplishment and strength.

The resonating theme throughout the event was perseverance.

The three-day gathering served as an exercise in networking, helping young women connect with professionals who encouraged early engagement in STEM careers, and a more solid representation within this specific workforce.

The world's advancement and sustainability hinges on continuous development in science, technology and innovation (STI). Women will be a pivotal part of that drive, and should be encour-

aged and empowered through education and work opportunities, as well as the deliberate amendment of social constructs that restrain women in the workplace.

This translates into building platforms that celebrate accomplished women in science and engaging in open and collaborative dialogues on common woes and hurdles, on both a regional and international scale. Furthermore, we should continue to strive to inspire young girls to not only pursue science careers, but to become leaders and innovators in their own communities.

In a region where women currently make up 37% of scientists, scientific achievement in the Arab world would be unrecognizable without women. It is our responsibility to pave a better road for the future of girls and women, ensuring that meritocracy, hard work and perseverance, rather than gender, race or religion, are the driving forces in achieving success in scientific and engineering careers.

WLSTE+10 is one forward step in achieving this.

Adnan Shihab-Eldin
Director General, KFAS

Organizing committee

Fayzah Mohammad Al-Kharafi Chief Chairperson

Kuwait

Hayfaa Al-Mudhaf Chair
Ameenah Farhan Chair of Scientific Committee
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Shirley Malcolm Head of Education and Human Resources Programs, AAAS

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Leaders from many scientific disciplines, from different backgrounds and at various stages of their careers gathered in Kuwait in October 2017 to celebrate women who have chosen to study and work in science, technology, engineering and mathematics.

At the conference, women spoke of the challenges that they have faced and gave advice and recommendations on how to overcome them — all intended to enhance the role of women in science, technology, engineering and mathematics (STEM). Speakers also addressed policies that affect the advancement of women in science and, in turn, affect the world. In his opening presentation, Lawrence Silverman, ambassador of the United States of America to the State of Kuwait said, “The world cannot afford to miss out on what you and your colleagues have to offer”. He added, “We owe it to ourselves and to our children to encourage STEM education, and the government has a role in this.”

At the Arab Organizations Headquarters Building in Kuwait, women came together to share stories, collaborate on research, inspire younger generations and network. This event emerged from the founding conference in January 2007, which was aimed at building stronger networks of women scientists and engineers and developing their capacity to serve as leaders. The participants of the anniversary conference had similar goals: to create a space for inspiration and communication among women across disciplines and countries. The Kuwait Foundation of Advancement in Science

(KFAS) organized and sponsored the 10th Anniversary, in coordination with the Kuwait Institute for Scientific Research, the American Association for the Advancement of Science (AAAS), the United States State Department and the Arab Fund for Economic and Social Development, which took place from October 23–25, 2017.

In other opening remarks, Princess Sumaya bint El Hassan, president of the Jordan Royal Scientific Society, said, “As much of the population of our world sees little hope for a stable and prosperous future, it is inconceivable that the talent, drive and compassionate creativity of half of our population should not be utilized to the full. We graciously offer our services.”

MANY BENEFITS WERE GAINED FROM NETWORKING

The sessions and panel discussions explored several key themes, including success stories, scientific career avenues, early-career science, technology, engineering and mathematics (STEM), science ambassadors, science and leadership, innovation and leadership, science serving society and STEM improving society. Conversations extended beyond the panels and sessions, and women from different countries discussed issues during conference breaks, evening events, morning breakfasts and on the bus to and from the confer-

ence. The conversations brought together people of different disciplines, cultural backgrounds and ages, opening opportunities for future collaboration.

Samira Ibrahim Islam, who is head of the drug and monitoring unit at the King Fahd Medical Research Center in Saudi Arabia and the keynote speaker of the session ‘Innovation Needs Women’, emphasized the need for women to leave the conference with a plan of action that delineates a clear future for women in science. She said, “We should cooperate to be able to understand each other. Cooperation is very important.” She added, “Before leaving here, we should look at what we can cooperate in, everybody has something to contribute.”

At this gathering, women started networks to promote interdisciplinary work, found mentors and discussed different challenges that they might face in their careers. For instance, Nourtan Abdel-tawab – an associate professor of microbiology and immunology at Cairo University and a recipient of a 2015 rising-talent fellowship for the L’Oréal-UNESCO for Women in Science programme – said that she enjoyed and benefited most from “the spontaneous mentorship on all levels, even from your peers”. This mentorship emerged from conference panels and discussions, as well as informal networking outside of the conference. For example, a conversation with speaker Maha Al-Mozaini – an expert in infectious diseases and



Ms Hayfaa Al-Mudhaf Chair of Organizing Committee and Prof. Jolie Cizewski, Distinguished Professor of Physics, Rutgers University

head of the King Faisal Specialist Hospital and Research Center in Riyadh, Saudi Arabia – changed Abdeltawab's future research plans. As Abdeltawab explained: "While I was planning on working on a specific disease that is currently a hot topic, Maha's advice on another disease, which is not a hot topic but is going to be a rising concern in a few years, guided me to reorient my next funding plan."

FOCUS ON THE YOUNGER GENERATION

Among the many goals of the conference, Faiza Al-Kharafi, professor of chemistry, conference chief chairperson, and Board member of KFAS, pointed out in her opening remarks that she hoped to engage "the full spectrum of the public in science, in particular women in early careers".

During one of the breaks, three participants – Shadia Rifa Habbal, professor at the institute of astronomy at the University of Hawaii; Nada El Masry, assistant professor of management information systems accounting at the Gulf University for Science and Technology in Kuwait; and El Masry's student Sumana Abbas – talked together. The three women from three different generations discussed the need for exposure to science among the younger generation. A second-year college student in management in-

formation systems, Abbas said that these types of events and exposure should take place when students are in high school. Although Abbas was not sure what track she wanted to take when she was in high school, she believes that by exposing those students to information and opportunities, they could be inspired by the world of science.

Others agreed. Habbal said, "You have to start as early as ninth

"I GREW UP THINKING THAT SCIENCE WAS A NATURAL THING FOR ME TO DO. I WAS A SCIENTIST BEFORE I WAS A WOMAN."

**EMILY LEVESQUE,
ASSISTANT
PROFESSOR OF
ASTRONOMY,
UNIVERSITY OF
WASHINGTON**

and tenth grade [age 14 to 16]. [Children] are at a impressionable age and need to be exposed to people who can inspire them and give them hope." Many students need that encouragement. As Abbas noted: "I never imagined that in college I would become one of the

best." She added, "I did not believe in my abilities before, but my college professors encouraged me."

A lack of belief in academic ability that some high school students develop poses a challenge in many countries around the world. "We have a real gap between teaching in schools and teaching in universities," El Masry said. El Masry explains that she was not a high achieving student in high school and she did not know what she would study in college. She says she was not given motivation and guidance when it was time to apply for college because she did not get good grades. Nonetheless, some high school teachers already develop opportunities to close that gap. Marie Aloia, engineering teacher at Bayonne High School in New Jersey, United States, spoke of her experience in creating a high school engineering class and starting an engineering day for girls. By creating this opportunity for young high school students, Aloia said, her work today is "a chance to give back from my career experience, a chance to say the word engineer to students before college, especially girls."

RETURNING TO SCIENCE FOLLOWING A CAREER BREAK

Speakers and participants discussed future prospects for women embarking on science careers and were inspired by success stories and comforted by mentoring opportunities. Many women discussed difficult choices that they face. One challenge mentioned by many of the women was that some decisions, such as having a family, can lead to a career break. Without a secure and promising future career in science, unfortunately some of those women end up leaving science altogether.

Fotouh Al-Ragom is a mechanical engineer and manager of the energy efficiency technologies programme and a research scientist at the Kuwait Institute for Scientific Research (KISR). She considers herself at the middle age of her career and spoke of a

problem that many women face when they choose to start a family then return to their scientific career. "When they decide they can go back, they find that they are in the middle-age period and have missed many opportunities," she said. "There are opportunities for young scientists and many for pioneers, but people forget the people in the middle."

Al-Ragom missed opportunities to win grants due to an age restriction. "After 11 years from my first masters, I went back to get my Ph.D., and I was in my forties," she explains. "I was frustrated because I was doing my Ph.D., and I considered myself at the top, but hitting the 40-barrier prevented me from applying to several programmes."

Al-Ragom was one of several women at the conference who had started a family before pursuing a career in science. Al-Ragom said that some women choose to take on these struggles, as she and many of her colleagues at the conference have. Conversely, some women choose to leave their chosen profession in science because they do not receive the encouragement and support they need to continue in their chosen science career. As Al-Ragom explains: "[Some] middle-aged women may feel there is nothing for them to do anymore, because their kids are grown up, but [the women scientists] are not young enough to pursue science and not advanced enough to work in the field, so they quit."

Manal Swairjo, an Associate Professor in the Department of Chemistry and Biochemistry at San Diego State University, always had a love for science. Her undergraduate studies were in physics and mathematics. However, due to marriage and maternity leave her career took a turn and needing to move with her husband and family her career turned towards biology, genetics and health sciences. Her family life caused her to take over 16 years to complete her post doctoral degrees. Through her career



Dr. Habiba Al Sarraf, UAE, Dr. Darin Al-Mojil, and Prof. Mariam Al-Maadeed

Opening Ceremony



Swairjo, specifically during her post doctoral years, made key discoveries in early evolution of the genetic code. The stage she was at in her life and her original background in a different specialization did not affect Swairjo or hinder her progress.

Rana Dajani, an associate professor in the department of biology and biotechnology at Hashemite University in Zarqa, Jordan, and Hauser fellow at Harvard University's Radcliffe Institute in the United States, was among the women who began her academic career in what is considered middle age. In her talk, she cited an MIT study that showed that while male productivity peaks at the age of 40 and might stop, the productivity of women keeps improving after the age of 40.

Al-Ragom, Swairjo and Dajani said that the opportunities and measurements of accomplishments in the fields of science should not be based on age, but rather on years of experience.

INTERDISCIPLINARY OPPORTUNITIES

A repeated topic of conversation among the speakers and participants was the need for interdisciplinary work among women. Interdisciplinary work has many benefits for science and women alike. When women work together across disciplines, their opportunities in science increase. Seema Nanda, an associate

professor in mathematics at Dartmouth University in New Hampshire, United States, said interdisciplinary work is important for science. "Before it was necessary to divide disciplines, but it became clear [there is a need] to go back [to interdisciplinary work]," she said. Nanda believes by connecting disciplines and working together, scientific advancement becomes more inclusive and is more beneficial to science.

The participants at the conference included astronauts, astronomers, biochemical engineers, biologists, chemists, engineers, nuclear physicists, parliamentarians, physicians and social entrepreneurs, but many of the conference participants work across more than one category.

In fact, interdisciplinary contributions make up most of the advances that the participants have made in the world. Recent advances in education have encouraged scientists to pursue an interdisciplinary career. As an example, Abdeltawab noted that the interdisciplinary track helped her to overcome a challenge early on in her career, after completing her bachelor's degree in pharmacy. "The stage when you are confused after graduating, I was wondering what I will join," she said. But she had believed since she was in school that she would pursue a Ph.D. whatever her choice of education. So, she was able to make a decision when she found an inter-

disciplinary programme that combined her many passions.

Nanda uses mathematics as the language to find solutions and her current work has opened a conversation between maths and biology. Using mathematical techniques, she is modelling the human immunodeficiency virus (HIV) in the hope of finding a cure for the virus. She described mathematics as "a backbone of

community issues. Susan Nasif, professor of biomedical sciences and founder of Cimaza Comics for Public Health Education used science and art to spread awareness on science information deficits and vaccine myths. Nasif's company used the scientific method to find the most effective form of comics and language to appeal to the different audiences. Combining her hobby with her passion Nasif's comics are fun and informative in many different languages. Cimaza Virology Comics have received global recognition winning the 2015 Science Hero Award and the Innovation in Science Literacy Award in 2017.

Beyond helping communities, interdisciplinary approaches benefit science. Nagwa El-Badri, director of the center of excellence for stem cells and regenerative medicine, Zewail City of Science and Technology in Giza, Egypt, said that interdisciplinary work helps scientists to "see a bird's eye view of the issue". Merging bioethics, social sciences, management and information systems, and technology, she said is the "normal evolution of science".

That evolution extends beyond the lab. Cristina Flesia — chair of the European Union–Gulf Cooperation Science, Technology and Innovation (EU–GCC–STI) Partnership — stressed the need for interdisciplinary work to create friendships as well as to assist scientific progress. "Human relations are more

"I ENJOYED THE SPONTANEOUS MENTORSHIP ON ALL LEVELS."

NOURTAN ABDELTAWAB, ASSOCIATE PROFESSOR OF MICROBIOLOGY AND IMMUNOLOGY, CAIRO UNIVERSITY

science, and it is the language in which the world is written." She added, "Math is a succinct way of describing language." Using her passion for mathematics, Nanda created a nonprofit organization, the Leora Trust, to empower girls and women in India through education. Her interdisciplinary work stems from her desire to help others by solving problems.

Many of the women at the conference have found solutions to

rich because of science," she said. As the chair of the EU-GCC-STI, which Flesia said was established as a nonprofit organization to "create a flexible environment hosting core research missions driven by

"LEADERSHIP IS A SELFLESS ACT WHERE YOU ARE GOING BEYOND YOURSELF."

HE UNDRAA AGVAANLUVSAN, MEMBER OF PARLIAMENT, MONGOLIA

common understanding of major research questions," she knows the importance of teamwork. To put together an interdisciplinary project, Flesia believes that it is best to start working with people she trusts from the different fields.

To work together successfully, however, scientists can sometimes face various obstacles, one of which is the lack of a common language between the disciplines. As an astrophysicist, Flesia said that when she was working with a molecular biologist, they found it took them at least three years to learn how to communicate effectively. To get certain messages across, Flesia said they needed to use examples to explain concepts to one another because exact

terminology sometimes does not exist in different disciplines. Flesia reiterated that it's important to work with someone you trust, because scientists need to be able to ask each other simple questions.

To enhance interdisciplinary communication, Nanda created a biology dictionary for her work, because, as she said, "You have to understand the basic vocabulary in order to work."

INITIATIVES TO ENCOURAGE WOMEN INTO SCIENCE

Different perspectives, terminology and career breaks from science are not the only challenges that women at the conference addressed. Annie Black, executive deputy director of the L'Oréal Corporate Foundation, oversees many initiatives to encourage young children to understand scientific professions. As part of her work, she has seen many children in schools across France reflect stereotypical ideas of science — such as scientists usually being men.

When women are portrayed in science, they are often shown through unflattering stereotypes as characters who have limited social lives or who are not physically appealing. Such caricatures can discourage some girls from pursuing studies in science. This might also contribute to what Black and many other participants called a 'leaky pipeline': The number of women in scientific



Prof. Faiza Al Kharafi and Prof. Samira Islam

fields in universities exceeds those in scientific careers, and even more women leak out of the system as

"WE HOPE TO ENGAGE THE FULL SPECTRUM OF THE PUBLIC IN SCIENCE, IN PARTICULAR WOMEN IN EARLY CAREERS."

FAIZA AL-KHARAFI, CONFERENCE CHIEF CHAIRPERSON AND BOARD MEMBER, KFAS

they've been in the careers longer. Adnan Shihab-Eldin, director-general of KFAS, said that the latest figures from the United Nations Educational, Scientific and Cultural Organizations estimate that 53% of university graduates are women, but only 28% of those women go into research. Shihab-Eldin said that an even bigger problem is that even though there are 28% of women in research, the number in leadership positions within those universities is less than that. According to the 2007 WLSTE recommendations, Ameenah Farhan, head of the physics department in Kuwait University and

chair of the science committee of the WLSTE +10, acting Director of Research in KFAS, said, "we hoped to build stronger networks, develop women's capacity to serve in leadership and to increase regional collaboration." Farhan said, ten years later, "we are not networking enough, we did well in terms of leaders with women in STEM and we are still lacking in regional collaboration, we do not have a collaboration matrix."

"Kuwait and KFAS are committed to develop the initiative to transform the WLSTE+10 to a WLSTE Network," said Layla Al-Musawi, conference general coordinator. Despite the encouraging outcome of the 2007 WLSTE conference, much work remains to be done. Professor Jolie Cizewski, Department of Physics and Astronomy Rutgers said "it [the future of women in science] is likely to have challenges, but that does not mean giving up on dreams, science has no country, which is a wonderful opportunity to bring women from all over the globe together to share their accomplishments and be an inspiration for future generations, reaching for a star helps realize a dream." One unified sentiment was highlighted in Sheikhha Lubna Al Qasimi, president of Sheikh Zayed University's speech, "the world needs science and science needs women because women in science have the power to change the world."



Left to right: HE Sheikhha Aida Al-Sabah, HE Sheikhha Lubna Al-Qasimi, Dr. Nawal Al-Hamed, and Dr. Layla Al-Musawi Conference General Coordinator

Ameenah Farhan, head of the physics department at Kuwait University, acting director of research at KFAS and chair of the WLSTE +10 conference's scientific committee, said,

“

One of the main outcomes of this conference is to ensure that we integrate science into policy making, so that we start to see social impacts.”



Questions & Answers



Faiza Al-Kharafi

Faiza Al-Kharafi is chief chairperson of the International Conference on Women Leaders in Science, Technology and Engineers (WLSTE +10), KFAS board member, former president of Kuwait University and a pioneer in women's representation in science. Having been among the organizers of the first Women Leaders in Science, Technology and Engineering conference in 2007, and first woman to hold the position, Al-Kharafi said that the 2017 conference provided an opportunity for women to be represented, "especially those from a scientific background, because they can really lead the society." The first conference was comprised of 200 women mainly from Kuwait and the United States.

Prof. Al-Kharafi is known for her work on corrosion, which has been applied to commonly used systems, including crude-oil distillation and engine-cooling systems. Through her work she won a Kuwait prize in applied sciences in 2006 and in 2011 she won the L'Oreal-UNESCO award for women in science. In her opening remarks at the conference, she said, "It is hoped that this conference will provide a networking platform for women at all stages of their STEM career, to help them fulfill their potential, to build a diverse community of achievers, and to inspire career goals." Here, Prof. Al-Kharafi shared her journey to becoming a leading woman in science. Her thoughts and advice on success in the field of science are not gender-oriented but geared toward a positive work ethic.

Can you tell me about your early career in science?

'I graduated with a double major in chemistry and geology. I wanted to join Kuwait University as a teaching assistant. I was studying in Ain Shams University in Cairo, Egypt. I came to Kuwait University, which at the time had only been open for a year. When I joined I had to choose one specialization, so I chose chemistry.'

There weren't any interdisciplinary departments at the time?

'No. We had a chemistry depart-

ment and a geology department in the faculty of science. So, I preferred to join the chemistry department, because I did not want to go on field trips, and with geology I would need to go on many field trips. I found it difficult because I got married immediately after graduation. So, I chose to join the chemistry department.

'Then I became a lecturer. I took my master's degree and Ph.D. from Kuwait University. After that I went on sabbatical leave in Germany, and my master's degree and Ph.D. are joint

work between Kuwait University with referees from outside. I became a lecturer and then associate professor and then professor. In the administrative track, I was head of department of chemistry, then dean of the faculty of science, then I became the president of Kuwait University [from 1993 to 2002].'

What obstacles did you face at the time?

'To be a mother and while doing hard work like being a member in the chemistry department,

doing research to be promoted — it is not an easy job. But with time management and help from my family and my husband, I did it. I didn't call it an obstacle really, I like to call it a challenge, and I took that challenge. Thank God, I did it, and I achieved my goal.

'Of course, when my children were young I refused to take any leadership positions as head of the department. I took this position later, when they had grown. When I was president of Kuwait University,

they were already grown up and it was much easier for me.'

What about in the field itself? The university was new when you started working there. So, what was it like for a woman to start in an already new environment?

'I didn't find it especially difficult as a woman, because we had a research department, and they already provided me with everything. I was lucky to have very good professors supervising me. We bought new apparatus to work with. Nothing was really difficult at that time.'

There was no discrimination because you are a woman?

'Not at all. I didn't feel that, even when I was president I didn't feel it. I was the first female university president in the Middle East, and when I was appointed many people said: "How will she manage?" But I had a very good team of males and females that were helping me, and it had nothing to do with gender. I always say, it's not a matter of male and female, [but] what the male can do, the female can do. It depends on how you think, how you are planning what is your strategy — that's the most important thing.'

In your speech, you said women are still underrepresented. Why do you think this is so?

'I think we are in a much better position than before. We have to admit that, but still if you take the percentage of the various strata of the working force you can see that the most are male, especially the top levels. This has also been recognized on the global level, by the United Nations 2030 Sustainable De-

velopment Goals (SDGs), where gender equality and women's empowerment are noted to be intrinsic to the security of our common future. So, we really look for more females to enter the market. [If we look at] leading positions, many of the women who took leading positions — not only in Kuwait but all over, in the Gulf, in the Arab world even, in the world — are doing an excellent job. Of course, there are some that cannot succeed, but in general they try their best, because when any woman is appointed in a position, all focus is on her. People are usually waiting to see what she is going to do. So, I think if women prove themselves, why not give her leading positions? In Kuwait, we have many [female] engineers, many doctors, many physicians everywhere, but still we want them to be in leading positions.'

If you were to reflect, what's something that you might have wanted to fight for or to push for that you didn't at the time?

'Well, I think maybe I was lucky, but I worked really hard. I got the things that I wanted, which is the benefit of my university, my department and my country, and I hope I did a good job in that. During my heading of the university, we had many academic achievements.' [Among many achievements, Al-Kharafi founded the Corrosion and Electrochemistry Research Laboratory in Kuwait University, Kuwait]

What would you say is the biggest challenge for research now in Kuwait?

'The biggest challenge in Kuwait is we need to think of our priorities in research. We in Kuwait need research that helps the country and which solves some

problems in the country. This will only happen through applied science. This is very important, and we need to work on it. But again, we should not forget basic

IT'S MUCH EASIER NOW FOR WOMEN TO TAKE MANY LEADING POSITIONS.

research. The only home for basic research is in university; you cannot do it in other places. You have to balance in universities between basic research, where you can get theories, and try to apply these theories where your research will be of benefit to the country. We don't want theoretical research to be kept on the shelf that no one does anything with. We want something which benefits the country and which they can apply.'

One theme at this conference was that there is a move toward an interdisciplinary approach to science. What is your take on that?

'I agree 100% we should. The borders that used to be put between sciences have been removed. We all have interdisciplinary work: chemistry, physics, biology. Now, there are no boundaries. We should work on interdisciplinary research.

'Now, if you just work on pure physics or pure chemistry, this will not help in really getting new ideas or getting new theories or applying new methods. When you interact chemistry with biology, physics, you can get complete research, tackling many points from many aspects. So, it is very important. Even students now are studying in interdisciplinary departments

where they have many subjects to learn together.'

What inspired you to go into science?

'That's a very good question. When I was in secondary school, the system was that in the second year you had to choose between the science stream or humanities. I got top grades in all of them, both science and humanities. I liked journalism a lot. I like to read. I like the arts side a lot. But my science grades were very high in chemistry, maths and physics. I had to decide which stream to choose. My father left it to me. He said, "You choose. I am not going to interfere. Whatever you feel you can continue with you choose it."

'My teachers insisted that I go into science. My teachers said everybody can do humanities, but science, not everybody can do. I was the first female professor in chemistry in the Gulf area. I was the first female dean in the faculty of science in the Gulf area. That's when I thought maybe I made the right decision.'

If you were to give one final piece of advice to the coming generation of scientists, what would it be?

'I think the coming generation has better opportunities than those available to previous generations, and it's now open for women. It's much easier now for women to take many leading positions. I will always advise the new generation, male and female, that they should be honest in their work, do their work properly, try to manage between their domestic responsibilities and their work. When you do your work, you should do it as best as you can.'

MARRIAGE AND MOTHERHOOD

Women and men attending the conference discussed many reasons for the leaky pipeline. Continuing to work after marriage and/or motherhood is among the leading challenges that many women face in their careers. Manal Swairjo, associate professor of chemistry and biochemistry at San Diego State University in California, United States, said, "Marriage is considered the track of compromise." Swairjo moved with her family and many of the decisions she made early in her career were governed by her marriage and social circumstances. She took jobs that seemed less rewarding because she needed to move with her family.

Although several women attending the conference spoke of juggling family and work as a common challenge. The extent of each woman's perceived struggle differed, but the conference speakers and participants who discussed the issue all persevered and made compromises to pursue their chosen goal. Habbal, for example, studies the solar corona, which appears during a complete solar eclipse. Her work takes her on expeditions to remote areas. She said the challenges that she faced after she had children took "sacrifices and priorities", forcing her to make tough career decisions when she

couldn't find nurseries and child-care support when she needed it.

Motherhood can be a testing time for some women, so a strong support system at home and at the work place is very important. Samira Omar is director general of the Kuwait Institute for Scientific Research (KISR). When Omar had a child she wanted to resign from her job, but her boss encouraged her to take a break. The human resources department of the university she was working at accepted her request for maternity leave and she returned to her position after seven months.

Some skills learned in a science career can be useful when bringing up children. Susanne Wirwille head of strategy and policy at the North Atlantic Treaty Organization (NATO), said the ability to hypothesize, test and think critically are skills she teaches her two young daughters.

SUPPORT AMONG WOMEN

Some speakers addressed the lack of support among women. Selwa Al-Hazzaa, head of the ophthalmology department at King Faisal Specialist Hospital in Riyadh, Saudi Arabia, and one of the first women to be a part of the Saudi Parliament, is paving the way for women to take part in her country's government. Al-Hazzaa said one of the biggest mistakes made by women is the limited support they give to

one another. "We don't network; we always leave that to the men," she said. "And we are territorial as females, and while men help each other as men, we don't help each other." Al Hazzaa urged women

FAIZA AL-KHARAFI SAID, I HAVE A STRONG BELIEF IN WOMEN, AND I KNOW THEY CAN MAKE A BIG CHANGE ANYWHERE THEY ARE."

to support one another, she said, "There is always a place for a woman at the top but always work on taking other women with you."

Other attendees agree with Al-Hazzaa. "It has been ten years since the last conference, and we are still working individually as women," Samira Ibrahim Islam, said. "It is time to cooperate."

Through networking, many women not only find solutions for problems and identify interdisciplinary work opportunities, they also meet new mentors. Mentoring opportunities help early-career scientists to understand the extent of what they could accomplish.

Support among women is one needed on a policy level. Undraa Agvaanlvsan, Member of Parliament of Mongolia said in her talk, "leadership is a selfless act where you are going beyond yourself." Agvaanlvsan is part of several initiatives to improve educational and research opportunities in Mongolia to help improve the quality of education and opportunities among women.

Among the many community efforts discussed at the conference, Rana Dajani talked about her project, The Three Circles of Alemat, which aims to create a forum for women in academia around the world. In Arabic, alemat means 'women of knowledge'. Through the forum, Dajani aims to

encourage women from all scientific disciplines to find support and mentoring opportunities from other women around the world. "You do the work, but you don't have enough time to network," she said. To solve that problem, Dajani explained, The Three Circles of Alemat pairs mentors with mentees, which starts a cycle of mentoring.

The Three Circles of Alemat also encourages interdisciplinary work. "When we look across boundaries, we discover new solutions," Dajani said.

The Three Circles of Alemat works on a professional and a personal level and creates the space that so many of the WLSTE +10 conference attendees said they needed. Dajani also suggested that scientists today should tell their stories through writing. By sharing their own personal journeys, more experienced scientists can give the early-career women the necessary support.

Vidita Vaidya, professor of neuroscience from the Tata Institute of Fundamental Research in Mumbai, India, also spoke of several ways to solve the leaky pipeline. She sees the bigger picture as "the entire hose". Vaidya said that creating mentoring opportunities for women scientists, as well as exposing young men and women to the many successful women in the field of science, is important. She referred to an ebook, 'A Girl's Guide to a Life in Science', as a good start for young girls, because it includes the stories of 25 women scientists from India.

IMPOSTER SYNDROME

Jacquelyn Gill, assistant professor of paleoecology at the climate change institute and the school of biology and ecology at the University of Maine, Orono, United States, spoke of imposter syndrome. The phenomenon sees professionals question the legitimacy of their abilities. Gill also mentioned her self-doubt when she was asked to speak at the conference: "After being invited, I started doubting myself instead



Left to right: Mr. Tom Rudin, Director of Education and Human Resources programme, AAAS, Dr. Annie Black, Executive Deputy Director, L'Oreal Corporate Foundation

CLOSING REMARKS

THE CLOSING REMARKS ended with recommendations collected from conversations across the three days by speakers and participants of all disciplines, ages and expertise. The recommendations were:

MOVE TOWARD a more dynamic arrangement of joint research and development and address regional challenges through international collaboration and recognition.

ESTABLISH AN ADEQUATE environment of mentoring and leadership through partnership programmes.

INTEGRATE SCIENCE, technology and innovation indicators into policy making to have an impact on society.

DEVELOPING SCIENCE, technology, engineering and mathematics programmes for girls.

MOBILIZE REGIONAL and international networking.

SHOW THE GENERAL PUBLIC the work done by women in science, especially women in their early careers.

BRING TOGETHER PEOPLE from different disciplines to increase productivity around the world.

FOSTER GLOBAL partnerships and data sharing.

of celebrating.” Gill also outlined traits of imposter syndrome. According to Gill, imposter syndrome is more common in women from families with high expectations, high achievers, underrepresented minorities and people embarking on new endeavours. By understanding imposter syndrome, Gill noted, women can notice the signs and circumvent it.

“WE CANNOT AFFORD TO LOSE ANY MORE TIME OR TALENT.”
– PRINCESS SUMAYA BINT EL HASSAN

“The signs include perfectionism and overworking, difficulty accepting praise, undermining achievements, anxiety and self-doubt, comparing oneself to others,” Gill explained. The problem with imposter syndrome is that “it prevents us women from seeking opportunities, undermines our health and well-being, affects our work and contributes to the lack of diversity in STEM.” She added, “Perfect is the enemy of good.”

Gill further gave recommendations to help stop imposter syndrome, which she says is something that returns even after it has been dealt with in previous situations. She said that cultivating strong networks, celebrating

achievements, mentoring and teaching, as well as therapy and self-care can be helpful tools to treat imposter syndrome.

HARASSMENT AND DISCRIMINATION

Tom Rudin, director of the board on higher education and workforce at the United States National Academy of Sciences, Engineering and Medicine, discussed sexual harassment. Rudin said that it is important to clarify to men how sexual harassment is defined and explained its prevalence in the workplace. Rudin stressed that it is important to provide good quality training to men to help them recognize behaviours that are not acceptable. Poorly delivered training, he said, gives the impression that the topic is not important.

Emily Levesque, assistant professor of astronomy at the University of Washington in Seattle, United States, said the media is reporting a high prevalence of sexual harassment in her field, and the awareness that this is happening is a sign of opening the conversation.

Levesque, whose research focuses on improving the overall understanding of massive stars, said that, although she has not been subjected to blatant gender discrimination, she has been affected by a subtle kind of discrimination, including a rejected paper with a comment questioning whether she “pointed her telescope in the right direction”. She said, “I

grew up thinking that science was a natural thing for me to do. I was a scientist before I was a woman.” Facing these kinds of “hidden discrimination” is something she was not used to when she began her pursuit of science as young as 6 years old.

As Rudin said, “We do need to address the culture of unconscious bias in STEM and change the culture — don’t fix the women.”

OPENING COMMUNICATION WITH MEN

After the three-day conference, which spawned various discussions and ideas, some of the attendees noted the limited presence of men.

Nadia Zakhary, former minister of scientific research in Egypt, said, “We are all hearing ourselves talk.” She noted that it is important that many more people are present to hear what women have to say.

Habbal said that it is important to have a similar platform with men involved: “We need to showcase our capabilities in front of more men.”

Of the three-day conference, Rudin said, “I have not heard any man bashing.” He described this event as a chance to inspire women and men to love science because “every problem we face has a significant scientific component in it.”

As Al-Kharafi said, “People look at women and see all the obstacles, but I don’t call them obstacles, I call them challenges.”

END OF CONFERENCE RECOMMENDATIONS

Wrapping up the conference, Ameenah Farhan, head of the physics department at Kuwait University, acting director of research at KFAS and chair of the WLSTE +10 conference’s scientific committee, said, “One of the main outcomes of this conference is to ensure that we integrate science into policy making, so that we start to see social impacts.” She added, “We must have discussions and make recommendations based on the findings of the conference as to the policies that are needed to make an impact and change the current situation for women in science.” Ms Al-Mudhaf the Chairperson of the conference remarked that “the event provided the much-needed forum for engagement and discussion, where pertinent issues surrounding the role and development of women in science were highlighted and collaborative solutions were discussed.”

The conference organizers hope that the WLSTE initiative becomes an official WLSTE network that functions continuously rather than just a conference that takes place over three days. “Science makes personalities stronger,” Al-Kharafi said. “I have a strong belief in women, and I know they can make a big change anywhere they are.”

Emily Levesque

Emily Levesque, assistant professor of astronomy at the University of Washington in Seattle, United States, shared her history, her childhood love for science and some subtle challenges she has faced.



As you started your education, what challenges did you face as a woman?

'My biggest challenge was in high school. Finding people in my school who could appreciate the love I had for science was hard.

'Going into college at Massachusetts Institute of Technology in Cambridge, Massachusetts in the United States was amazing. I found people who had the same interests. The types of challenges that are apparent when women begin their academic careers are subtle barriers. For example, in the standardized physics GRE [graduate record examination, a standardized test often required to enter post-graduate programmes in the United States], women scores are worse than men. As a result, the test is, from the start, eliminating good women who could be beneficial to the field. It was

an exhausting journey.'

What do you think is a supporting factor to your own success?

'My family has always been supportive of my love of science and my school choices. I think I have been lucky in my life. I have been in programmes that are progressive and supportive of me as a scientist. Where I work, one-third of the faculty are women, there are two emerita department chairs and my current department chair is a woman.

Seeing women in leadership positions means a lot to me. I was lucky to have mentors and role models in my field and the places I worked.'

What were the most challenging issues during your career?

'Like I said, it is the subtle barriers like the GREs. Sometimes, there are places that a person works where the work community is male dominated. Sometimes, there are systems in place that make bad experiences. As you go up in your career, the encouragement gets a lot quieter.'



Nourtan Abdeltawab

Nourtan Abdeltawab is associate professor of microbiology and immunology at Cairo University in Egypt. Her postdoctoral work focused on systems-biology approaches to infectious diseases at the University of Tennessee Health Science Center in Memphis, United States. Here, she talked about the challenges she has faced in her career and her experience at this conference. Abdeltawab grew up and completed her education to her bachelor's degree in Egypt. She pursued her postgraduate studies in the United States and then returned to Egypt to continue her career.

Why did you choose science?

'What I liked most about science was colours and pictures. I am very visual. I am the youngest person in my parent's home. When I was making my school choices, everyone around me was studying. I knew that whatever field I would go into, I would continue working through to a Ph.D.

'Colours and shapes always attracted me, and although I did not draw well, I loved combining things to create something new. It seemed like I would go into the art track. I didn't get into science until early high school when we started taking chemistry. I fell in love with chemistry. It became clear that this was what I wanted to study. I decided to study pharmacy in college. 'My parents used to take us during the summer to spend our time in the US while they worked as visiting professors. Ever since middle school I knew that I would pursue my post-grad in the United States.'

What challenges do you face in your career?

'At every stage there are specific challenges. At the beginning, the stages when you are confused and need to make choices, it is challenging to make a decision. During high school you make decisions with what track you will study - science or humanities. I chose science because I liked chemistry. That took me to study pharmacy. When I finished my bachelor's in science in pharmacy, I was wondering what programme I would join for my postgraduate stud-

ies, and it was challenging until the answer came in the form of an interdisciplinary programme.

'I chose an interdisciplinary Ph.D. programme. The programme was biomedical sciences, and you choose what is best for you. They were seven tracks, you had two years to go through all the tracks, and then you chose the best track for you. They also gave us an option that you could have more than one track. When I was starting, it wasn't that common. Now, it is even more common, and mono discipline is not very common. During the Ph.D., it was very challenging — starting life in a new country with a new job, but the challenges were all resolved at the different stages. Right now, working, I face challenges with time and funding management.'

What are some of the benefits and opportunities from this conference?

'The benefit I got from this conference was listening to different points of view, from people of different disciplines, seeing the different people have different conversations with people out of the conference. Seema Nanda was very inspiring. Rana Dajani was automatically mentor-like.

'The whole conference was very friendly. Dr. Nagwa El Badri, from my own country, gave me specific advice and a helping hand despite her busy schedule and high position.

I felt I was with a group of friends who are easy to talk to and not standoffish. Everyone is willing to help each other.'

Questions & Answers

Seema Nanda



Seema Nanda — associate professor in mathematics at Dartmouth University in New Hampshire, United States — is an example of how interdisciplinary work breeds practical solutions and community development. She began her career by studying business. Her work took her to a job on Wall Street. However, Nanda's passion for learning encouraged her to return to education, leading her to a doctoral degree in mathematics, working on probability theory. Currently, she is working on an interdisciplinary project merging mathematics with biology. Nanda's passion is solving problems, and mathematics provides a practical approach. Her belief that a strong educational foundation, as well as her passion to solve problems, led her to start the Leora Trust to help bring STEM education to poor girls in her homeland, India.

Tell me about the Leora Trust.

'Leora Trust partners public schools with private schools to help children from slum areas to get an education. To ensure that these children, who mostly have to work to live, come to school, we needed to ensure that they would be guaranteed meals. In mentoring the girls, our number-one goal was to keep them in school. We gave them the support to do so. We started with 12 girls who came to school on Saturdays and learned the basics of maths. Out of the 12 girls, 11 passed their exams. We worked hard with them, although it was hard to fill the gap. These girls were malnourished, which affected their memory.

'In many cases, by the time the girls begin work the gap between their age and the education is too wide, but Leora works hard to fill the gap as much as possible.'

Were you always interested in mathematics?

'I like solving problems that are useful. I choose jobs that allow me to use maths to solve these problems that will make a difference.

'I used to work for an aviation company to find algorithms that the company can use in their technology. I like work that is practical in nature and has longevity. Maths has had an impact

IN MENTORING THE GIRLS, OUR NUMBER-ONE GOAL WAS TO KEEP THEM IN SCHOOL.

on all sciences. I like the application process, and mathematics starts with the application. With any subject, maths can be the start to a conversation. Maths

is driven by the science of the century. Currently, that science is biology. Before it was physics. With mathematics, for example, we can look at phylogenetic trees. Merging geometry and topology, we can get a deeper understanding. All medical schools have mathematics. Maths is a backbone, the queen of science. It is the language in which the world is written. It has a succinct way of describing the world.'

How is your current work with biology informed by mathematics?

'Human immunodeficiency virus (HIV) formal care and current therapy has been informed by maths models. Understanding why the therapy does not work can be understood using mathematics to see the mutation rates of the virus. HIV mutates too fast, and using mathematics we can

understand the virus.

'Currently, using CRISPR-Cas [Clustered Regularly Interspaced Short Palindromic Repeats] technology, I am beginning to understand the modeling of HIV, and it is giving us an idea of how

I AM BEGINNING TO UNDERSTAND THE MODELING OF HIV, AND IT IS GIVING US AN IDEA OF HOW WE CAN POSSIBLY CURE HIV.

we can possibly cure HIV. With maths modeling, we can speed up the understanding of the kind of threshold the cell needs to fight the virus. Mathematics is a back and forth conversation, and understanding this conversation gives us answers.'

Rayan Al-Kalbani

Nourtan Abdeltawab 'Rayan Al-Kalbani — co-founder and executive director of Mazoon Environmental and Technological Services in Oman — uses her passion and circumstances to drive her choices, and the results benefit her personal life and her community. Al-Kalbani's company specializes in environmental monitoring and bioremediation, as well as offering research opportunities for young scientists. Her company also offers collaborative work with universities in Germany, which lets students from that country conduct research in Oman.

'Al-Kalbani did not always see herself starting a business, but she did dream of herself in a lab coat. As the only girl among six children — all of the boys ending up as engineers — she said, "I saw myself studying something I like." Her love and passion for science led her to seek a degree in chemistry. Upon completing her bachelor's of science in chemistry at the Sultan Qaboos University in Oman, and a master's of science in chemistry from Freie Universitate (Berlin, Germany), she knew that she wanted people to enjoy science. So, she thought of going into teaching and working in a research lab. 'During this time, Al-Kalbani became a mother, and she struggled to continue working outside her home. Her thoughts took her to the business track, and she began seeking classes in business. By then, her motivation was to create her own job in science. That is when her journey as an Omani entrepreneur began to take form. "I am a proud woman who decided to be a scientist because of my passion," Al-Kalbani said. "Science gave me the tools to understand."

'In her journey, Al-Kalbani faced many challenges, including financial, logistical and emotional ones. "I went to get my government papers done and when the personnel asked about my occupation and I said science she said, 'That is not a very feminine job.'" Despite the challenges, Al-Kalbani perseveres and makes time to speak with young women and men who are making their career choices.'



What advice would you give to young men and women?

'I would say just try [new opportunities, ventures and subjects]. We are always terrified of trying. Everyone thinks your college degree will restrict your future. Science is science, and you can use it in many other ways. You can be whoever you want to be, and if it doesn't work then find another solution. We as a culture are scared to try.

'It is also important to take a break. It is normal to be confused and to question your decisions.'

Please tell us about your journey with your business.

'It has been nine years since the business was established. We are trying to progress and continue to do so.

'Oman has a job-shadowing problem. Many young people wait for opportunities to come to them and take things for granted. I did not do that. I didn't find a job. So, I decided to create it.

'I knew the first step I needed was to get a big-name client, which I did. Then I searched for an initial fund, which I got from [winning the "Big Business Idea Competition" by TKM and Ernst & Young in Oman in 2008.] I also had the use of a free office, which helped,

and the rest is self-funded.'

What are the benefits of starting your own business?

'I am the boss of my own life. I can schedule my work. I have control over when I go out on field work. It is not about being lazy, it is about taking control and being able to schedule my life.

'Of course, I need to work and the business must be profitable, but being able to manage my time allows me to do what I am convinced to do and be the CEO of my own life.

'I am bossy by nature. So, having my own small company is fitting for me.'

What is the structure of your business?

'It is a small company. We have four permanent employees. The business gives fresh Omani graduates opportunities to work on a temporary basis, based on projects. This creates a win-win situation for the company. Among the four permanent employees are two owners – myself and my partner – and two other employees who work full time.

Research depends on capabilities. Anyone can approach us, and we help with their research. You can do a lot within your limitations.'



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