SUFFRAGE SCIENCE
“A successful career in science is always demanding of intellect, hard work and resilience; only more so for most women.”

Professor Dame Sally C Davies
Dorothy Hodgkin remains the only British woman to have been awarded a Nobel Prize for science. She worked out the structure of penicillin, insulin and vitamin B12 and made an immeasurable contribution to human health as a result.

But when her award was announced in 1964, the Daily Mail reported it with the headline: “Oxford housewife wins Nobel”. Feminism has since done much to challenge such overt prejudice about women’s place in society, but does a subtle, subversive sexism still exist in science today?

While the discipline was formerly a gentleman’s pastime, over the last century many more women have been able to pursue scientific careers than before. So why is a man still six times more likely to work in a science, engineering, or technology profession than a woman, despite the fact that women make up just under half of the UK workforce?

We talked to a sample of leading female researchers in Life Science along with communicators that have helped to publicise the work of women scientists. This publication highlights the achievements of pioneering women over the past 100 years touching on some of the issues that they face in science today.

Brenda Maddox is author of The Dark Lady of DNA, which documents the story of Rosalind Franklin, whose expertise in the field of X-ray crystallography provided critical proof of the structure of the DNA double-helix, an achievement that led to a Nobel Prize for James Watson, Francis Crick and Maurice Wilkins in 1962.

Vivienne Parry is a broadcaster and prolific journalist, who has simultaneously written for the News of the World and the Journal of Molecular Cell Biology. She broadcasts regularly on BBC Radio 4 and writes for The Times and Guardian. She is a former presenter of Britain’s iconic science show ‘Tomorrow’s World’.

Perhaps men and women approach their careers differently. “I think women like to work with other people,” suggests Brenda. “The loneliness and the abstraction of science can be less appealing to women, whereas in medicine, they can use scientific abilities but do something to help people more directly, and be in contact with others. Science seems a bit impersonal.”

Vivienne agrees, but adds that, “Women are making a lot of progress in some areas of science, but not others. We don’t tend to do subjects like engineering and physics. And I think that’s partly a confidence issue. Though in biology, there’s a huge proportion of women, and in psychology, it’s all women.”
More women are doing science now than ever before, but they still make up less than a fifth of the scientific workforce. The discrepancy is most marked at the top, where less than a tenth of UK professors in science, technology, engineering and mathematics are women. Family life is the obvious reason for dropping out, but the problem is women are not returning to science.

However, it’s not all bad news. More young women are choosing science at secondary level, a few more are taking scientific degrees and there’s an increase in the number entering related research fields. Yet in an age dominated by celebrity culture, the changing values of fame and fortune take their toll on young women and their aspirations.

So, would young women today rather be sexy celebrities or change the world? “Both!” resound Brenda and Vivienne simultaneously. “Look at Latin America,” urges Brenda. “Half the presidents are female. Things are changing, and changing fast. In the next decade the figures will be quite different.”

—Women and men in science, engineering and technology: the UKRC Statistics Guide 2010

Commemorating women through the arts

Central Saint Martins College of Art and Design has pioneered a collection of jewellery and textiles to commemorate and promote women in science. Inspired by the suffrage movement, which fought for equal voting rights at the start of the last century, the collection echoes women’s struggle to get their voice heard.

Students taking BA Jewellery and Textile Design degrees at Central Saint Martins have created bespoke heirlooms for women scientists to wear. These are featured on pages 25–42. After a year, jewellery will be passed on to the next generation of female scientists. Track their progress on page 48.

Based on the students’ design work, leading ribbon manufacturer, VV Rouleaux, is producing a series of commemorative ribbons for women scientists. Referencing the suffrage movement – using green for hope, white for purity and purple for dignity – ribbons will unite women across scientific professions.

Ribbons will be available to purchase from:
www.vvrouleaux.com
LOVE & LIFE
Helen Fisher is an expert on love. She is a Research Professor in the Department of Anthropology at Rutgers University in New Jersey, and has published scientific articles on topics ranging from romantic behaviour and the neural mechanisms of mate choice, to functional brain imaging of people in love.

She lives on Manhattan’s Upper East Side and from her home office has written five books on subjects such as love, sex, relationships, and adultery. She is also the Chief Scientific Officer for the online dating company, Chemistry.com, a subsidiary of Match.com. It might at first seem ironic, then, that Fisher, who is 65, is not married and has no children. But she simply chose a different path, living with her long-term boyfriend for thirty years until he passed away last year. Regarding children, she says, “I certainly had the opportunity, but chose not to. I think because I was too obsessed with my work.”

Sarah-Jayne Blakemore is 36, married and has two young sons. She lives in the small, historic town of Berkhamsted in Hertfordshire, and each day she travels to her office at the Institute of Cognitive Neuroscience in Queen Square, London. There, she is a Royal Society University Research Fellow, a Professor in Cognitive Neuroscience, and leads the Developmental Cognitive Neuroscience Group.

Her group’s research focuses on social cognition – that is, how humans understand the actions, intentions and emotions of others – and she is particularly interested in how this works in adolescents, people with schizophrenia, and people with autism spectrum disorders. She has published over sixty scientific articles, and is co-author of the book, The Learning Brain: Lessons for Education.

These two women certainly have different backgrounds and lifestyles, but in a recent transatlantic interview – just after lunch for Fisher, and just after Blakemore had put her sons to bed – the pair discussed their shared views on how books have the power to stimulate a scientific career, and how babies shouldn’t (but sometimes do) have the power to cut such a career short.
Blakemore and Fisher both credit a particular book with kick-starting their careers. In Blakemore’s case, that book was *Autism: Explaining the Enigma*, by Uta Frith, given to her by developmental psychologist Peter Bryant.

Bryant was the father of one of Blakemore’s secondary school classmates and had come to the school to give a talk. Bryant’s talk had piqued Blakemore’s interest, but it was the book he gave her that turned interest into impetus. “It was a very inspirational book,” recounts Blakemore. So inspirational, in fact, that a year later when Blakemore had to do a week’s work experience, she wrote to Uta Frith. “I asked if I could do work experience with her. She agreed. So I went up to London for a week when I was 15 and I got a really amazing hands-on opportunity to observe and get involved in experiments with children in her developmental psychology lab,” says Blakemore. “That really set my heart on doing psychology.”

What made Frith’s book so gripping, says Blakemore, was that, “it was the first book that had ever been written about the cognitive side of autism. It was really controversial because, back then, people just thought of [autism] as an emotional reaction to upbringing.” The idea that something neurocognitive could be dysfunctional was very new, Blakemore explains. “[Frith] was the pioneer of that, and now within the cognitive neuroscience community, it is absolutely not controversial at all, it is completely accepted.”

Blakemore says that it is not just the book and the science that she admires, but Frith’s whole approach. Blakemore and Frith now work at the same Institute. “You can’t go and have a conversation with Uta about anything without her insisting that you sit down and drink lots of tea and eat some amazing biscuits,” says Blakemore, “she has a very relaxed, friendly and chatty way of making you feel completely comfortable, but at the same time she is ruthlessly careful about the science she does, so you’ll be chatting away, having a real laugh about some funny thing that happened at a conference, and then she’ll interrogate you about the statistics that you’ve used in some study. She doesn’t let anything slip.”

The inspirational book, in Fisher’s case, was *In The Shadow of Man*, by Jane Goodall. Fisher had always been fascinated by people and behaviour, and at college, had studied a mixture of anthropology and psychology. After college, she was uncertain which direction to take and considered cultural anthropology after a project spent at a Navaho reservation observing Native American traditions. But then she read Goodall’s book, and that was the tipping point.
“In it [the book] she talked about chimpanzees being jealous, and petting and reassuring each other, and all kinds of things that I had regarded as totally human,” says Fisher, “I suddenly saw continuity between man and beast and the evolution of the emotions and that made me really interested in the biology of behaviour.” Fisher’s work focused on biological anthropology from then on. “It was a great moment when I read that book,” says Fisher. She describes Goodall’s work, like Frith’s, as “groundbreaking.”

Neither Blakemore nor Fisher is entirely comfortable with the idea that they too, like Frith and Goodall, might be role models. “I still feel like a young kid struggling to get the next paper out and constantly learning new things...so I don’t have that mind set of the role model,” says Fisher. Blakemore adds, “You don’t really think of yourself as a role model, but you can’t help it if other people do.” Despite their self-effacement, it is likely that both Blakemore’s and Fisher’s own publications will, if they have not already, inspire other young women to follow their scientific passion.

Inspiring young women to start scientific careers is all well and good, but as Blakemore and Fisher point out, the tricky bit is convincing women to stick with science.

“Women tend to leave science just after their PhD or first postdoc, where they look at their future and think ok, my biological clock is ticking, I would quite like to settle down and have a family and this career just doesn’t seem like the kind of career that would easily allow you to do that,” explains Blakemore, “you see other people around you and you think the people who have got really far are either men who have families or women who haven’t.”

So, with two young boys, how does Blakemore cope? “It’s a constant juggle,” she says, but adds, “My husband’s career is just as affected by our children as mine is, because we share the childcare.”

Fisher adds, “As Sarah-Jayne said, she has a husband who is very helpful, but a lot of women scientists do not, and at some point you’ve got to make a choice, so you ease back on the amount of time you spend in the lab, or on your academic papers, and that doesn’t lead you to the head of the class.” In her own case, she says, “I did feel that it would be very difficult for me to have children and also have the career I wanted. So I was glad that I was a person who never wanted to have children.”

Blakemore’s tactic when it came to deciding to have children was to not think too much, she says.
...as more women combine science and family, more will be encouraged to do the same...

“If I’d thought too hard about it, the rational decision would be: this is a crazy idea,” she says. “At the Institute of Cognitive Neuroscience there are about a hundred people, approximately half of whom are women, all of child-bearing age and when I was pregnant with my first son, there was not a single other woman who had ever had a child, apart from Uta Frith.”

But it is getting better, says Blakemore. Babies are on the rise – at the Institute of Cognitive Neuroscience, at least. Since Blakemore was first pregnant six years ago, she says, “there are now about seven or eight women who have small children at home, and I really do think that once you see someone similar to you, who can do it, who is able to manage, that does encourage you to think that maybe you could do it too. I think that is a really positive thing.”

Assuming Blakemore is right, it will be a self-perpetuating trend – as more women do decide to combine science and family, more will be encouraged to do the same. And as these women fill increasing numbers of senior academic posts, they will have greater influence over how young women scientists with children are catered for.

It will be a slow process, agree Fisher and Blakemore, but looking back over the last one hundred years, says Fisher, “It’s gotten progressively better.” Blakemore goes further: “It has changed beyond all recognition. One hundred years ago we didn’t even have the vote!”

"The Venus celebrates fertility and the human female form. I hope to be fertile with my ideas about love, gender and personality." Helen Fisher

"Discussing experiments (and of course a little bit of gossip) over tea is very productive and a nice way for the lab to bond." Sarah-Jayne Blakemore
Liz Robertson got a taste for research early on in life, helping her scientist dad in the lab at weekends. Later she did her PhD with Martin Evans, who won a Nobel Prize for his work on embryonic stem cells. She attributes her training in embryology to Matt Kaufman, but also met Rosa Beddington at a Cold Spring Harbor course, kick-starting a lifelong collaboration on embryonic patterning.

Sohaila Rastan – despite lacking formal education as a child in Iran – read Zoology at the University of Oxford. She had no particular desire to be a scientist, but was offered the chance to pursue a PhD in Mary Lyon’s lab when another student dropped out. The experience equipped her with expert technical skills, which she put to good use as a promising researcher. After a spell in a monastery, she left the lab to work for the Medical Research Council, SmithKline Beecham and, more recently, the Wellcome Trust and RNID.

Somewhere round the biological U-bend of a fallopian tube, life begins. One cell becomes two...then...four...eight...sixteen...a tiny cellular football...a lumpy miniature mermaid...then a recognisable human or animal form. All the while, genes switch on and off in tightly orchestrated patterns. Gradients of chemicals form a rugged molecular landscape, shaping limbs, digits and bones. Developing nerves and blood vessels wind down valleys away from the growing brain and beating heart.

The desire to unravel and trace this amazing journey from a single cell to a fully-formed being is shared by developmental geneticists across the globe. Compared to some other areas of science, the field seems well stocked with successful female researchers: Christiane Nüsslein-Volhard, Rosa Beddington, Brigid Hogan, Carol Greider and Elizabeth Blackburn to name a few. But there are notable heroines who, if not completely unsung, are praised with a fainter tune.

“Mary Lyon was the ‘Grand Dame’ of X-inactivation,” remarks Sohaila. Females carry two X chromosomes in every cell, yet one whole chromosome is almost completely ‘switched off’. “She was just so clever and thought about things...
really hard. I’m still surprised she hasn’t had a Nobel, or even a big prize like a Lasker,” Rastan opines. “Even back in the 70s she was a historical figure to me like Napoleon or Nelson. Yet she’s still going strong, and it’s 50 years since X-inactivation was discovered.”

“And Dame Anne McLaren, the IVF pioneer,” adds Sohaila, “was still working at the age of 80 when she was killed in a car accident. She was a key figure and did absolutely fantastic stuff. At a scientific meeting she would invariably ask the question I was thinking of, so I’d know it was a good one!”

There are tragedies as well as success stories. Liz talks of Hilde Mangold, who co-discovered the ‘control centre’ of the developing embryo – the Spemann organiser. Hans Spemann got the glory and a Nobel Prize, while Mangold died in an accident aged 25, before her thesis was published. But in stark contrast, Salome Waelsch (originally from the same lab) was a German Jew who escaped to America, working as a research technician before becoming a lecturer. She worked on mutations in ‘master’ developmental genes, accumulating a great resource of strange and wonderful mice that she bred and kept herself. When the head of Waelsch’s department retired, she was catapulted from being a junior lecturer into his post, becoming Professor of Molecular Genetics at Albert Einstein College of Medicine. “After all those years working in the lab,” smiles Liz, “she became an extraordinary geneticist in the pre-genome era.”

Barbara McClintock – radical pioneer of maize genetics and transposons (so-called ‘jumping genes’) – is the only woman to receive the Nobel Prize as a sole winner. “Everybody knows her for transposons, which she discovered in the 40s but nobody actually believed it: a concept ahead of its time. She even stopped publishing on jumping genes in the 50s, realising that people just weren’t getting it,” reveals Sohaila. McClintock also described the organisation and function of centromeres (the ‘bit in the middle’ of chromosomes) and telomeres (the ‘bits at the ends’). And according to Rastan, “a lot of the work she did on gene controlling elements predated the Lac operon stuff [seminal research explaining how genes are controlled]. Everyone thinks of Jacob and Monod in 1961, but Barbara McClintock did all of this work before them.” And all this from someone whose mother believed higher education made women unmarriageable.

“Linda Buck also claimed her share of the Nobel Prize against the odds,” says Liz, “She was a long-term postdoc in Richard Axel’s lab. They didn’t always see eye to eye and she avoided working in the lab in the daytime. She worked all night every night, seven days a week for years. She drove
the entire project to clone the olfactory [scent] receptors literally single-handedly. When they got the prize, Richard was very complimentary, and explained it was Linda’s creativity that allowed them to succeed.”

However, on the matter of unsung heroines, both Robertson and Rastan agree there is one definite omission from the list of female Laureates: Gail Martin. Gail collaborated with Martin Evans, who won a joint 2007 Nobel Prize for his work on embryonic stem cells. According to Robertson, “They published some really nice work together based on experiments that Gail had done when she was on sabbatical. Gail’s lab – as well as Martin’s and Matt Kaufman – discovered ES cells in the same time interval. Yet Matt and Gail weren’t acknowledged with a share of the prize.”

It’s clear from our conversation that women have achieved great things in the field of developmental biology and genetics over the years. But are things getting any easier? And will we ever truly smash the glass ceiling that prevents women rising to senior faculty positions? Robertson ponders, “I think women have fewer obstacles now, and there’s a big effort to try and make it more equal. I notice that the majority of the presidents of the Ivy League schools in the States are now women.

“I’m sure that 25 years ago that wouldn’t have been the case. These women may have been brilliant at doing their own thing, but they wouldn’t have risen to that kind of prominence. It’s easier now if you’re a woman and you’re good at something. The glass ceiling is a problem, but if you manage to break through it, I think it’s easier for our generation than the generations before us, by a long way.”

“What about Rosa Beddington?” Rastan chips in. “She did the most amazing stuff, but died tragically when she was very young. She did what people thought were impossible experiments. She’s someone you just admire for her work regardless of gender.” Robertson adds, “Someone like Rosa probably still would have succeeded a hundred years ago, but I probably wouldn’t have. I’m not very good at standing up for myself. You had to have that extra edge, and the confidence to really push yourself.”

Despite this, Robertson has forged a highly successful career. But does she see herself as a role model for the next generation of female scientists? She is characteristically modest. “I don’t know if anybody has seen me as a role model per se, but I’ve certainly been very happy with the fact that the majority of my postdocs – including all the women...
have gone on to do what they wanted. They’ve become group leaders or faculty at different institutions around the world, or they’ve taken a step sideways and are working in biotech. I think the most important thing we can do is provide the encouragement and support to get people where they want to be.”

Although she’s no longer in the lab, Rastan’s view chimes with Robertson’s. “The thing I would always seek to foster in a young person doing science is to have confidence and believe that anyone can do anything if they’re good enough and think hard enough. And the other thing I would like to persuade people is to dare to be different. Don’t think you have to accept the received wisdom. Question everything and everyone. Think really hard about things. These are my words of wisdom to anyone – woman or man – starting off in science.”

“...dare to be different. Question everything and everyone. Think really hard about things.”

“My Dad was an insect virologist. As a child I helped him purify viral particles from infected caterpillars using a centrifuge.” Liz Robertson

“This fossil was given to me on my 50th birthday by a great female scientist friend at Oxford, where I studied Zoology.” Sohaila Rastan
STRUCTURE & STRIFE
Louise Johnson helped elucidate the way lysozyme works. The protein – present in our tears – was the first enzyme structure to be solved. She has worked on glycogen phosphorylase [helps release sugars from stored carbohydrate]. Additionally she researched the regulatory molecules that govern the life cycle of cells and developed an anti-cancer drug-design programme. Now retired as David Phillips Professor of Molecular Biophysics at the University of Oxford, and as Director of Life Sciences at Diamond Light Source [the UK’s synchrotron facility] she is still active in science.

Janet Thornton is one of the world’s leading researchers in structural bioinformatics, using computational methods to understand protein structure and function. She developed a classification system for proteins while Professor and Director of the Biomolecular Structure and Modelling Unit at University College London and later held the Bernal Chair in the Crystallography Department at Birkbeck College. She is now Director of the European Bioinformatics Institute near Cambridge.

These women are both distinguished scientists in the field of structural biology. And they sit among several other exceptional women in the field: Kathleen Lonsdale, Rosalind Franklin and Dorothy Hodgkin, the only British woman to win a Nobel Prize for science. So what attracts women to structural biology?

“The beauty of crystals and protein structures amazes me,” divulges Janet. “The internal symmetries within molecules create these huge symmetries. They are like wonderful flowers.” Both scientists share a great enthusiasm for the aesthetic aspects of their subject. “The detailed structures are so informative," Louise remarks, “and offer the experimentalist an objective measure of correctness.”
Her decision to become a scientist was gradual. “I had a wonderful headmistress,” recollects Louise, “and felt I should utilize what I’d been taught.” After reading Bertrand Russell’s *History of Western Philosophy*, “suddenly I realized you don’t have to take what people tell you at face value,” she asserts. “You can question things. It always puzzled me how they knew these scientific facts.”

Janet’s physics teacher was the worst in her school. Refusing to give up, she took to independent study. “I enjoyed trying to understand things like Newton’s law. It’s very simple, but my goodness it’s elegant!” Her mathematical flair led to a trip to the nuclear installation. “That was the big thing at the time,” she notes adding, “I never thought I was good enough to be a research scientist and expected I’d become a teacher.” After achieving a first class honours degree, she decided to try a PhD.

Louise moved to Oxford to join David Phillips, the newly appointed Professor of Molecular Biophysics in 1967. Phillips had been encouraged to come to Oxford by Dorothy Hodgkin. Dorothy Hodgkin was an exceptional structural biologist. Using X-ray crystallography, she determined the structure of several important biochemical substances, among them penicillin and vitamin B12. “She was a Royal Society Research Professor and Fellow of Somerville. Although we worked in separate groups I got to know her well.” Hodgkin was instrumental in getting Louise an association with Somerville, where she became the Janet Vaughan Lecturer in Biophysics. “Dorothy supported other women,” acknowledges Louise, “but always in an unfussy way, never in a pro-active way. She trained and encouraged many.”

After her PhD Janet also worked with David Phillips in Molecular Biophysics at the University of Oxford. “The whole atmosphere in the lab was family friendly,” she reports. “And it was never an issue being a woman. I never found that in the structural biology community. We were really blessed. Gender was completely irrelevant. I mean...several of the major figures in the field were women.”

David Phillips’s patronage was critical to both Louise and Janet. “David was very influential in my career,” concurs Johnson. “Mentors are so important. It doesn’t matter if it’s a man or a woman. It’s someone you respect, who is a very good scientist and is also interested in your career, your progression.”
Not only did he support their research, but as Janet remembers, was considerate of family life. "He cared very deeply," she alleges. "Although he could be tough, always demanding the highest scientific standards from all. When I had my first child he got me a parking slot in the basement of the Zoology Department."

Both women agree that these little things made all the difference. For many years they had time only for work and children. "But children definitely make people more rounded," maintains Janet, "... so in the end it’s good for your career. Science isn’t perfectly amenable to family life, but very few things are. However, you can arrange your own hours, and you’re your own boss."

"Society has changed a lot in the last 30 years and now men are participating much more in raising children," Louise certifies. "I think it’s time for the state to catch up. For example, when a baby is born the mother gets maternity leave up to a year. This shouldn’t be exclusive to the mother."

Our conversation proceeds to female pioneers and Louise recalls the role Kathleen Lonsdale played in establishing the science of crystallography. "She worked out the structure of hexachlorobenzene in the 20s, pioneering Fourier methods [locating the position of atoms in crystals] to resolve structure from X-ray diffraction patterns." And she was one of the first two women to be elected to the Royal Society in 1945. "Yet it’s not just her scientific achievements," reckons Louise. "She had an interesting life and personality: she was a Quaker and very austere. She had marvelous presence."

"Janet Vaughan impressed me." Louise reminisces; "She was Principal of Somerville from 1945 to 1967. Vaughan worked on the metabolism of radioactive fission products. "She ran the college at the same time: she would come in early, dictate her letters, rush off to the lab, dash back at 5pm, sign her letters and then off to college hall for dinner. She did extremely well with that routine."

“And of course we can’t forget Rosalind Franklin,” acknowledges Janet, “a true heroine in structural biology. Her contribution was overlooked for a long time, although her X-ray work was critical to the discovery of the structure of DNA. Unpublished drafts of her papers showed that she had determined the overall B-form of DNA. For Janet, "Franklin was an extremely good experimentalist, who fought a strong battle against the forces of the status quo."
Johnson and Thornton feel privileged that they didn’t have to fight this battle. Janet admits she often benefited from being the only woman on a conference programme; “I honestly have to say that for me it has been easier than for my male counterparts.”

Both scientists had teachers and mentors who encouraged them at critical moments in their lives and both had older sisters, which perhaps took the pressure off them in terms of parental expectation. “But it’s the sense of excitement,” says Louise, “the sense of joy in science that we should convey. There’s so much more to be discovered.”

Neither Janet nor Louise hesitate to admit the problems you’re likely to have as a female scientist, and they both think that there are not enough women in senior positions in science. For Louise this can only change if we “make learning science attractive and fun, and get men and women to appreciate the joy in a life of science; it’s a great life and should be warmly recommended.”

Janet concludes; “It’s a huge hill to climb, combining family life and a scientific career, but the view from the top is spectacular.”

“Model of a cell-cycle complex of molecules: Cdk2 (yellow), cyclin (purple) and a peptide substrate (green).” Louise Johnson

“Julian Adams gave me this fake myoglobin crystal. He worked for John Kendrew, who won a Nobel for elucidating myoglobin.” Janet Thornton
Fiona Watt is a cell biologist working on skin stem cells, leaders of a fascinating double life. They can both replenish themselves and mature into very different types of cell: hair follicles, sebaceous glands and epidermis. She is exploring signals that emerge from the cells’ microenvironment, which influence the fate of stem cells both in normal skin and diseases such as cancer.

Mary Collins is an immunologist and virologist who manipulates viruses to “carry genes for her own interest and delight.” Her work involves adapting viruses to deliver human genes to cells in which a defective copy is causing malfunction. Viruses can also be engineered to deliver molecules that can fight tumours. Such feats can be achieved with the HIV virus, transforming it from sinner to saint.

Cancer has manifold causes. The disorder can be triggered by viral attack, for example, Hepatitis B in cases of liver cancer or Human Papilloma Virus in cervical cancer. AIDS, on the other hand is caused exclusively by the Human Immunodeficiency Virus. Underlying these diseases is a battle waged by the sufferer’s immune system. When faced with a viral infection or with a developing tumour the body releases a protein called interferon, which precipitates a cascade of defence mechanisms in an effort to expel the alien(s).

“The work of Joyce Taylor-Papadimitriou was key to understanding how interferons work,” reveals Fiona. “In the early 60s at the MRC National Institute for Medical Research, she worked in Alick Isaacs’s lab.” Isaacs had coined the term interferon to describe the molecule in 1957. According to Fiona, “Joyce was never fully acknowledged for her part in the interferon story.”

Shortly after the publication of her seminal work in the mid 60s, Taylor-Papadimitriou went on holiday to Greece and ended up meeting her husband and starting a family there. She wasn’t to return to the UK for a further eight years. Michael Stoker had been impressed by her earlier work on interferons and invited her to set up a research lab supported by the then Imperial Cancer Research Fund (ICRF). She focused on breast cancer and the tumour phenotype. In 1979, three years after the monoclonal antibody technique had been
developed, she made an antibody that detected the MUC1 glycoprotein on the breast cancer cells. This antibody became a groundbreaking research and therapeutic tool.

Fiona and Mary got to know Joyce in the 80s when both spent time at the ICRF London Institute in Lincoln’s Inn Fields. Fiona had set up her own lab to explore the life of skin cells, and Mary was doing her PhD on cell signalling. “Joyce made it seem easy for a woman to run a lab and have a life with kids,” remembers Mary. “She unabashedly recounted stories of her great Greek romance. I was twenty-one in the next-door lab thinking I could run off if I wanted to. None of this ‘don’t do that my girl or you won’t have a career’ business.”

In recognising the therapeutic potential of research accomplished in the lab, Taylor-Papadimitriou was pivotal in progressing the ‘translational’ agenda of cancer research, taking the ‘bench to the bedside’. This, Fiona and Mary say, was thanks to her not only being incredibly smart but also to her fearless character. As Fiona puts it, “she was ahead of her time”.

We now acknowledge that studying cancer in the context of the tumour microenvironment, as opposed to looking at cancer cells in isolation, is highly informative. However, this perspective was not formerly popular. The 70s saw a focus on the effects of carcinogens on genes. It was assumed that once gene mutations arose, cancer would necessarily follow, and many scientists concentrated efforts on individual cancer cell proteins.

Two scientists working in the USA – Mina Bissell and Zena Werb – pioneered a different approach. Thinking ‘outside the cell’ they considered how the extracellular matrix (cancer microenvironment) interacts with cancer cells. At first perceived as heresy, the two-way communication network between cells and the extracellular matrix is now conventional wisdom. “This has provided important insights into how cancer cells behave and metastasise, and there’s enormous potential for new therapeutic approaches that target the modes of communication between tumour cells and their environment,” explains Fiona. “Mina Bissell pioneered the concept that the extracellular matrix is more than an adhesive platform for cells, since it can also regulate their behaviour. She called this ‘dynamic reciprocity’ and decades later her ideas have gained widespread acceptance.”

Zena Werb was coming from a similar angle, albeit independently. She discovered that cells produce enzymes that can degrade the extracellular matrix. Many of Werb’s early findings prompted scientists to re-think how the microenvironment instructs development, differentiation, inflammation and cancer. She now develops new technologies that allow researchers to look directly into the cancer...
The microenvironment. Fiona sees Werb as “a superb and careful scientist, always at the cutting edge in terms of concepts and technology.”

Concurrent to this groundbreaking paradigm shift in cancer biology, the HTLV-1 virus (which can give rise to leukaemia by targeting immune CD4 cells) suddenly became a hot-topic. Clinicians had noted a steadily increasing number of people with swollen lymph glands, infections, certain cancers and a sharply reduced number of CD4s. They were suffering from AIDS.

HTLV-1 was being studied by Robert Gallo’s lab at the National Institute of Health in the USA. For a time they thought it might be the virus responsible for AIDS. In the 80s his team engaged in a race with Luc Montagnier’s lab at the Pasteur Institute in Paris to identify the correct virus. Then in 1984, after months of painstaking experiments culturing AIDS-affected human tissue, Françoise Barré-Sinoussi (in the French lab) discovered that HIV causes AIDS. This was less than two and a half years after the first disease reports in clinics.

Remembering Barré-Sinoussi’s quiet dedication, Mary wondered if she would ever get recognition for her work. “It was just so wonderful when she got the Nobel Prize,” she recalls. Back on the other side of the Atlantic, at the NIH, Beatrice Hahn was isolating and characterising (cloning) HIV’s genetic make-up, something that was particularly difficult in those days. “Hahn’s brilliant work empowered a lot of people to be able to work with other isolates of the virus,” Mary reveals.

Later, Beatrice moved to Alabama to set up in primate research and ultimately in primate conservation. She continued to work on HIV, concentrating on the genetic sequence divergence of the virus to trace its evolution from apes in Africa. “She had a very clear mind and direction,” remarks Mary, “combined with a real technical expertise. A credible story about how the virus evolved is critical both socially and medically. People need the right perception about science and the world.”

Unlike Hahn, Barré-Sinoussi stayed put, and today she challenges government and religious heads about how they are tackling HIV, contraception and the distribution of anti-retroviral drugs. Mary adds, “You have to be statesman-like to challenge these things properly, and she is.”

To Mary, both Françoise Barré-Sinoussi and Beatrice Hahn have been inspirational. “They carried out very important experiments early on,” she reveals, “and yet they continued to contribute to the field, while being very level-headed and modest. They epitomise the good side of research, and have maybe kept the whole field more on the rails than it might have been otherwise.”
Taylor-Papadimitriou, Bissell, Werb, Barré-Sinoussi and Hahn fearlessly tackled ‘difficult’ questions, highlighting the significance of pioneer women scientists. In the HIV field today, “there’s a cohort of very good young women scientists working directly with the virus,” says Mary, “but they do not seem to be in the big translational areas like vaccine and drug development. She observes “that kind of huge enterprise is more often done by clinician scientists, who tend to be men. The same is possibly true in cancer research with women more involved in the fundamental research, and less so in the big corporate enterprises.”

Female PhD students are relatively abundant today, but there are still more men in senior positions. Joyce Taylor-Papadimitriou’s lab of the early 80s is remembered as a particularly feminist haven. She cultivated an atmosphere in which the women team members (who were in the majority) could relax. “I really enjoy the company of women scientists,” adds Fiona. “The support I received early in my career from Joyce, Zena and Mina was so important. And we always have fun when we meet up these days. I’d like my postdocs to feel that way about their senior female colleagues.”

“I inherited these after a murder-mystery themed lab retreat. I like their ambiguity. Am I going to handcuff someone or have I escaped?” Fiona Watt

“Winifred Cullis (pictured) was the Sophia Jex-Blake Chair at the Royal Free Hospital, an early hot bed of feminism.” Mary Collins
SUFFRAGE
HEIRLOOM
JEWELLERY
'Suffrage' comes from the French word meaning ‘vote’. A hundred years have not yet passed since women were granted the right to vote. Emmeline Pankhurst and Louise Eates spent the late 19th and early 20th centuries protesting for equal rights. These famous suffragettes were presented with specially commissioned pieces of jewellery by the Women’s Social and Political Union to acknowledge their important contribution in the fight for equal voting rights in the UK, granted finally by 1928.
First-year students taking the BA in Jewellery Design at Central Saint Martins College of Art and Design participated in a competition to have their designs made for leading women life scientists. Two winning designs – by Anya Malhotra and Benita Gikaite – were selected by a panel of judges for production. Pendants and brooches were crafted courtesy of Martin Baker for the scientists featured in this publication. Jewellery will be passed on – as science heirlooms – to encourage young female researchers. A selection of student designs – that reference the suffrage movement using green (hope), white (purity) and purple (dignity) – is featured on the following pages.

Course Tutor: Giles Last, Course Director: Caroline Broadhead
I have taken this Masonic charm as a symbol of men power and I have given it to women.

Engraved the dates when 1897 in NUWSS was founded by M. Fawcett, 1903 first female Nobel prize winner - Marie Curie, 1918 British women obtained the right to vote. The rest left blank for future dates or names.

This charm should be made of brass with three different stones: amethyst, peridot (or any other green stone) and a white freshwater pearl.

Benita Gikaite
A basic unit of matter
Central nucleus surrounded
by a cloud of negatively
charged electrons.

The women who
have contributed to science
are like the nucleus surrounded
by negativity but they still
break through these barriers.

Amethyst
Jade?
Moonstones?

Invention
Discovery
Power
Creative
Innovation
Word placement
Power

Invention Discovery
Power

Brooch

Slots so that
the words
slip out

Any Malhotra
SUFFRAGE HEIRLOOM JEWELLERY: RUNNER UP

A WOMAN’S PLACE IS EVERYWHERE

Go Un Lee
SUFFRAGE HEIRLOOM JEWELLERY: RUNNER UP

Votes for Women

Woman begins to have the power

Lin Huang
SUFFRAGE HEIRLOOM JEWELLERY: RUNNER UP

Yuri Lee
SUFFRAGE HEIRLOOM JEWELLERY: RUNNER UP

Sarah Narici
SUFFRAGE HEIRLOOM JEWELLERY

Equality and celebrating women's past, present, and future achievements.

Naomi Brown
SUFFRAGE
TEXTILES
'A History of the World in 100 Objects' (BBC Radio 4) recently featured a penny coin from 1903, with the image of Edward VII defaced by the words ‘Votes for women’. Suffrage artefacts like this and the banner pictured above echo the historical campaign for gender equality. Using green for hope, white for purity and purple for dignity, contemporary designers reference the suffrage legacy and commemorate women in science today with a collection of bespoke textiles.
Second-year degree students taking the BA in Textile Design at Central Saint Martins College of Art and Design participated in a competition to have their designs produced by ribbon specialists, VV Rouleaux. Students spent three weeks researching suffragists and scientists, before weaving six ribbons designed for women scientists to wear. Work by winner, Kyung Young Jeon, was inspired by Dorothy Hodgkin, the only British woman to win a Nobel Prize for science. Kyung’s ribbons (p36–37) will be awarded to leading female researchers. Kyung, Alix Massieux and Holly Walker will design three commemorative ribbons, for sale through www.vvrouleaux.com. A selection of textile designs is featured on the following pages.

Course Tutor: Philippa Brock, Course Director: Anne Marr
SUFFRAGE TEXTILES: WINNING DESIGNS

Kyung Young Jeon
SUFFRAGE TEXTILES: WINNING DESIGNS

Suffrage ribbons by Kyung Young Jeon
Suffrage textiles: inspired by scientists

Dominique Caplan responds to Fiona Watt

Yangzi Wang responds to the research of Rosalind Franklin
SUFFRAGE TEXTILES: DESIGNED TO WEAR

Heloise Ringner
SUFFRAGE TEXTILES: GREEN, WHITE & PURPLE

Azza Alsharif

Chloe Liu

Alix Massieux
SUFFRAGE TEXTILES: GREEN, WHITE & PURPLE

Kate Richardson

Jane Brooke

Jane Harper
SUFFRAGE TEXTILES: DESIGNED FOR WOMEN

Sian O’Flaherty responds to Vivienne Parry

Suffrage ribbons designed for garment, Holly Walker
BARRÉ-SINOUSSI, Françoise
Virologist; PhD (1974); Director, Unité de Régulation des Infections Rétrovirales (Institut Pasteur, Paris); Nobel Prize in Physiology or Medicine (2008)

Took Natural Sciences at the University of Paris (1966). While volunteering at Institut Pasteur, supervisor Jean-Claude Chermann proposed a PhD. After a short time in the US, returned to the Pasteur Institute under Luc Montagnier, who was working on the role of retroviruses in cancer. Identified HIV as being the cause of AIDS (1982), for which she was awarded a Nobel Prize. Challenged Pope Benedict XVI (2009) over his assertion that condoms are ineffective in tackling AIDS. Pending Presidency of the International AIDS Society (2012).

BEDDINGTON, Rosa
Developmental Biologist (1956–2001); PhD (1981); Head of Division of Mammalian Development at NIMR (1993–2001); Revolutionised understanding of mammalian embryonic patterning; FRS

Read Medicine at Brasenose College, Oxford. First class BA (1977). DPhil and Postdoc in Richard Gardner’s lab focusing on early mouse embryo; conducted renowned microsurgical experiments; noted also for artistic drafting skills. Moved to Edinburgh (1991) and NIMR (1993). Provided significant revisions to Spemann’s 1920s work on embryonic development: showed patterning in anterior-posterior axis formation depended on two sets of organisers, now called ‘head’ and ‘trunk’. Died from cancer (2001) aged 45.

BISSELL, Mina
Breast Cancer Biologist; PhD (1969); Life Sciences Division, University of California, Berkeley

Left Iran aged 18 to study English Literature at Bryn Mawr College, Pennsylvania; switched to Chemistry, then transferred to Harvard. Remained there for Master’s and doctoral degrees in microbiology. Joined Laurence Berkeley Laboratory (1972); focused on tissue architecture and microenvironment of breast cancer; fostered the notion that extracellular matrix and the arrangement of normal cells around cancers can be as important as genetic causes to the development of the disorder. Fellow of the American Academy for the Advancement of Sciences (1994).

BLACKBURN, Elizabeth
Molecular Biologist; PhD (1975); Morris Herzstein Professor of Biology and Physiology (University of California, San Francisco); AC, FRS

BUCK, Linda
Immunologist; PhD (1980); Full Member of Basic Sciences Division at Fred Hutchinson Cancer Research Center; Affiliate Professor of Physiology and Biophysics at the University of Washington; Nobel Prize in Physiology or Medicine (2004)

Studied chemistry at Newnham College, Cambridge. Awarded an honours degree in 1941 (BAs were not awarded to women at the time). Work towards her PhD carried out at the British Coal Utilisation Research Association located at Kingston-upon-Thames. Awarded doctorate from Cambridge before going to Centre National de la Recherche Scientifique in Paris. Carried out X-ray diffraction studies on amorphous material. Worked as Research Associate (1951) in the MRC Biophysics Unit at Kings College London under John Randall, on DNA. Her X-ray crystallography provided critical proof of the DNA double-helical structure proposed by James Watson and Francis Crick, which won them the Nobel Prize (1962) along with Maurice Wilkins.

GOODALL, Jane
Primatologist; PhD (1965); Ethologist, UN Messenger of Peace

Worked in Kenya as secretary for archaeologist and paleontologist Louis Leakey. Leakey sent Goodall to London to study primate behaviour and anatomy and funded her research at Gombe Stream National Park, Tanzania from 1960. Doctoral thesis Behaviour of the Free-Ranging Chimpanzee completed under Robert Hinde, St John’s Cambridge. Married twice: Hugo van Lawick, wildlife photographer; Derek Bryceson, director of National Parks Tanzania. Bryceson protected Goodall’s research at Gombe, implementing an embargo on tourism.

HODGKIN, Dorothy
Chemist and Crystallographer; (1910–1994); PhD (1937); Order of Merit, FRS; Nobel Prize in Chemistry (1964)

Attended University of California-Santa Barbara’s College for Creative Studies, receiving a BA (biology) in 1983. Doctoral research at UC Berkeley supervised by Elizabeth Blackburn. Together they discovered telomerase, a key enzyme that protects against progressive shortening of telomeres – the ends of chromosomes – which can lead to anaemia and some cancers. Awarded Nobel in 2009 with Jack W Szostak. Showed that telomerase not indispensable to life in mice; however, absence leads to various deleterious phenotypes, causing premature ageing.

FRITH, Uta
Developmental Psychologist; PhD (1968); Emeritus Professor of Cognitive Development (UCL); Foundation Professor, Faculty of Humanities and Health Sciences (Aarhus); FBA, FMedSci, FRS

Undergraduate degree in History of Art (Universität des Saarlandes, Saarbrücken). Switched to clinical psychology, completed PhD on autism at the Institute of Psychiatry (King’s College London) in 1968. Focused on autism spectrum disorders, pioneering the hypothesis that incomplete Theory of Mind leads to poorly developed empathy. Seminal paper published with Simon Baron-Cohen, her former PhD student. Book entitled Autism: Explaining the Enigma (1989) translated into numerous languages. Work on Asperger’s and dyslexia very well regarded.

HANNAH, Beatrice
Virologist; MD (1981); Professor and Co-Director of the Center for AIDS Research, University of Alabama, Birmingham

MD from Munich Medical School. Postdoctoral research in Robert C. Gallo’s lab at the American National Cancer Institute, Bethesda, Maryland. Moved to the University of Alabama at Birmingham (1985), joining the departments of Medicine and Microbiology. Senior Scientist at the UAB Comprehensive Cancer Center and Associate Director for Program in Development and Resources, Center for AIDS Research. Her work has focused on the co-evolution of HIV and its chimpanzee equivalent, SIV.

HODGKIN, Dorothy
Chemist and Crystallographer; (1910–1994); PhD (1937); Order of Merit, FRS; Nobel Prize in Chemistry (1964)

Read Chemistry at Somerville College, Oxford. Studied under John D Bernal at Cambridge. Discovered potential of X-ray crystallography to unravel biomolecular structure. Returned to Oxford (1934); became
Research Fellow at Somerville (tutored Margaret Thatcher). Early work described the structures of penicillin and vitamin B12; later elucidated the structure of insulin, revolutionising the treatment of diabetes. Chancellor of Bristol University (1970–1988). Remains the only British woman to have won a Nobel Prize for science.

HOGAN, Brigid
Developmental Biologist; PhD (1968); George Barth Geller Professor of Research in Molecular Biology; Chair, Department of Cell Biology, Duke University, NC USA; FRS

PhD in Biochemistry at Cambridge; Postdoc at MIT. Head of the Laboratory for Molecular Embryology at NIMR; later founding Director of Stem Cell & Organogenesis Program at Vanderbilt University (USA). Seminal publication: Manipulating the Mouse Embryo. Taught a related course at Cold Spring Harbor Laboratory. Served as President of the American Society for Developmental Biology and the American Society of Cell Biology and has sat on several advisory councils relating to transgenics, cloning and child development. Awarded 2008 International Society for Transgenic Technologies Prize.

LONSDALE, Kathleen
Chemist and Crystallographer; (1903–1971); DSc (1936); UCL Professor, President of BA, FRS

Attended Ilford School for Boys (girl's school did not offer science or mathematics). Studied physics at Bedford College, University of London's women's college, earning a BSc (1922). MSc at UCL (1924). Joined WH Bragg's team at the Royal Institution (RI). Determined structures of benzene and hexachlorobenzene by X-ray diffraction. Married Thomas Lonsdale (1927); career break to raise three children. Returned to the RI (1934). Awarded a DSc, UCL (1936). Professor (first female) at UCL (1949). Dame Commander of the British Empire (1956), and President (first female) of the British Association (1967). First female FRS.

LYON, Mary
Geneticist; Retired (1990); ScD (1948); FRS

Graduated from Girton College, Cambridge (1946). Studied the genetic hazards of radiation at Edinburgh. Moved to the MRC Radiobiology Unit Harwell (1955); discovered X-chromosome inactivation (1961). Headed the Genetics Section at Harwell (1962–1986). Research shed light on X-linked diseases, such as Duchenne’s Muscular Dystrophy. Numerous contributions to mammalian genetics; service on the Committee for Standardized Genetic Nomenclature for Mice. Treasurer and Vice-President of Genetic Society. Foreign Associate of the US National Academy of Sciences and a Foreign Honorary Member of the American Academy of Arts and Sciences.

MANGOLD, Hilde
Embryologist; (1898–1924)

Attended University of Jena, transferring to University of Frankfurt after two semesters. Entered Spemann’s group at the Zoological Institute, Freiburg to do research towards PhD. Met and married Otto Mangold. Thesis Induction of Embryonic Primordia by Implantation of Organizers from a Different Species the foundation for her supervisor's Nobel Prize in 1935. Died aged 26 following a gas explosion in her Berlin flat prior to publication of thesis results.

MARTIN, Gail
Developmental Biologist; PhD (1971); Head of Developmental Biology at University of California, San Francisco

Isolated embryonic stem cells, a term she coined (concurrently Martin Evans and Matthew Kaufman at Cambridge achieved the same) while working at UCSF (1981). Demonstrated their potential to become any cell type in the body. Now focuses on control of embryonic development, with particular interest in signalling. Member of the American Academy of Arts & Sciences, the National Academy of Sciences (Cellular and Developmental biology) and President of the Society for Developmental Biology.

McLAREN, Anne
Developmental Biologist; (1927–2007); PhD (1952); DBE, FRS, FRCOG


McCINTOCK, Barbara
Cytogenetecist; (1902–1992); PhD (1927); Nobel Prize in Physiology or Medicine (1983)

BSc (1923) from Cornell’s College of Agriculture. Graduate research on maize cytogenetics led to PhD (1927). Demonstrated numerous fundamental concepts during early postdoc, such as genetic recombination by meiosis, and roles of centromere and telomeres. Demonstrated transposition (1940–1950s) as a mechanism of turning genes on or off, which led to Nobel Prize (sole female winner).
NÜSSLIEIN-VOLHARD, Christiane (Janni)
Fruit Fly Biologist; PhD (1974); Director, Max Planck Institute for Developmental Biology, Tübingen; Nobel Prize in Physiology or Medicine (1995)


TAYLOR-PAPADIMITRIOU, Joyce
Breast Cancer Biologist; PhD (1962); Head of CRUK Breast Cancer Biology Group at Guy’s Hospital (1997)

Studied Biochemistry at Cambridge. Moved to Lou Siminovitch’s group in Toronto for PhD. Postdoctoral work at NIMR (UK) was self-directed; supervisor Alick Isaacs being ill. Published two seminal papers showing that interferon required mRNA and proteins to activate. Offered assistant Professorship at Toronto; delayed while on holiday in Greece by Spyros Papadimitriou, whom she met and married within three days. Civil unrest in Greece later meant her husband was unable to leave the country until the dictatorship was overthrown in 1974. Identified antigen MUC1 in breast cancer and developed antibody therapy, now undergoing clinical trials.

VAUGHAN, Janet
Physiologist; (1899 –1993); DM (1931); Dame Commander of the British Empire, FRS


WAELSCH, Salome
Developmental Geneticist; (1907–2007); PhD (1932); ForMemRS

Attended University of Freiburg. Studied Classics before switching to Biology. PhD under Hans Spemann; antisemitism prompted flee to America. Worked as a laboratory assistant for 17 years, marrying Heinrich Waelsch in 1943. Obtained a position at the Albert Einstein College of Medicine (1955); made Full Professor (1958) and Chair of Genetics (1963). Offered a gold diploma from Freiburg (1982), an honour she declined. Elected Foreign Member of the Royal Society (1995).

WERB, Zena
Cell Biologist; PhD (1971); Professor and Vice-Chair of Anatomy, University of California, San Francisco

Left Wroclaw in 1948 for Canada. Entered the University of Toronto (1962) to study geology. As the only female student, she was denied a place on a summer field trip. Switched to biology, graduating (1966) in biochemistry and physiology. Researched lipid membranes at Rockefeller University. Postdoc at Strangeways Research Laboratory, Cambridge (UK) focused on tissue physiology. Returned to the US; Dartmouth Medical (1976) until present at UCSF; made full professor (1983). Research in the past two decades has focused on the role of the extracellular matrix in cancer.
In addition to all of the women scientists who contributed to this publication, we would like to thank: Professor Amanda Fisher (Director, MRC Clinical Sciences Centre), who inspired all aspects of this project to commemorate women in science; Vivienne Parry for conceiving of science heirlooms (jewellery) and for chairing the associated ICA debate; Professor Uta Frith (UCL), Dr Mariann Bienz (University of Cambridge), Dr Daniela Rhodes (MRC Laboratory of Molecular Biology) and Andree Molyneux (Producer) for all their help with editorial direction; the UKRC for their support in marketing the project; Philippa Brock, Caroline Broadhead, Giles Last and BA design students from Central Saint Martins College of Art and Design for creating Jewellery and Textile designs to commemorate 100 years of women in life science; Jenny Higham (Imperial College London), Kiki von Glasow (Palladio Films) and Fiona MacLeod (MRC Clinical Sciences Centre) for helping to judge designs; Martin Baker for making jewellery; Carole Collet (Central Saint Martins) and Caroline Till (Central Saint Martins) for design advice; Annabel Lewis (VV Rouleaux) for producing commemorative ribbons; David Nelson (Photographer); for images: L’Oreal (Janni Nüsslein-Volhard), Holger Motzkau (Elizabeth Blackburn), The Nobel Foundation (Françoise Barre-Sinoussi), LBNL (Mina Bissell), The Gurdon Institute (Anne McClaren), ECHO Magazine (Mary Lyon), Heritage Images (Rosalind Franklin); Mary Collins (UCL), Carole Robinson (University of Oxford), Sally C Davies (NHS) and Liliane Lijn (Artist) for participating in the ICA debate: Are women changing science? on March 9th 2011, which launches this limited-edition print edition of Suffrage Science.
TRACING SUFFRAGE HEIRLOOMS

Follow the provenance of 13 pieces of **Suffrage Heirloom Jewellery** as they are handed down from leading women in Life Sciences to their protégés

**Awarded to:**

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TO COMMEMORATE
THE CENTENARY OF
INTERNATIONAL WOMENS DAY
1911 - 2011