Professor Elizabeth Blackburn

The first Australian woman to win a Nobel Prize

Molecular biologist Professor Elizabeth Blackburn, whose pioneering work on telomeres - protective caps on the ends of chromosomes - has opened up new lines of inquiry into growth, ageing and disease, was awarded the 2009 Nobel Prize for Physiology or Medicine.

Elizabeth Blackburn

Jack W Szostak

Carole Greider

It was shared with Carole Greider, biology graduate working with Blackburn in the laboratory and Jack W. Szostak of Harvard Medical School,

Blackburn is only the ninth woman to be awarded the physiology or medicine prize since its inception in 1909, and only the 36th female Nobel laureate in any category since 1901 when the first prizes were awarded in chemistry, physics, medicine and peace. The first was Marie Curie, who won the prize in 1903 and whom Professor Blackburn says inspired her to become a scientist.

All seven Blackburn family siblings in the garden at their home, 3 Olive Street, Launceston, Tasmania. From left to right, back row: Andrew, Elizabeth, Katherine, John, Barbara; front row: Caroline, Margaret. Circa 1965.

Elizabeth Helen Blackburn was born in Hobart, Australia. Her interest in medicine and biology was influenced early on by her parents, Harold Blackburn and Marcia (née Jack) both of whom were physicians. “I just liked science,” she says “I liked animals. No one ever said ‘is she going to be a doctor.’ But because my parents and also so many members of my extended family -aunts, uncles - were doctors, there was this expectation that I’d probably be a physician. It never occurred to me that as a woman I wouldn’t have gone into science. I’m sure that’s just the example of having a mother who was doing some kind of career.”

According to her biographer Catherine Brady, the young Elizabeth's interest was further sparked by a likeable chemistry teacher at Launceston's Broadland school, where the young Elizabeth used the new chemistry lab to try to make touch powder fireworks, an early example of what the older Elizabeth called "curiosity-based science." She completed her schooling at Melbourne University High School, topping the state in three matriculation subjects. She went on to graduate from the University of Melbourne with a B.S. degree in 1970 and with an M.S. degree in 1971.

A colleague and friend, Melbourne University's Dean of Science, Rob Saint, says Professor Blackburn chose her career when women were starting to become more involved in the sciences.

"*I think she would be representative of a change in the gender balance in the study of maths and science," Saint said. "It's wonderful that here we're seeing the fruits of opening up the system. She is a very down-to-earth person, intelligent and wise."*

However Dr Blackburn's career path wasn't all that easy. Early in her tertiary education, she returned to her birthplace, Hobart, where according to her biographer a family friend said*: "What's a nice girl like you doing studying science?"*

In 1972 she entered Cambridge University, England, where she obtained a Ph.D. in molecular biology in 1975. The way she got into her field (micro biology) was, she says "... very straightforward. I decided I wanted to go to Cambridge, and then I got introduced to Fred Sanger. (English biochemist and a two-time Nobel laureate in chemistry.) I was very conscientious, and I asked him when I first got there if I should start reading up on things. But he said, 'No, I think you can just start these experiments,' so I plunged right in." The rest, as they say, is history.

Following her graduation from Cambridge with her Ph.D, Blackburn moved to the USA, drawn by both professional and personal reasons. While attending Cambridge, she met John Sedat, an American postdoctoral researcher in biology. They married in 1975, the same year she completed her Doctorate. They have one son, Benjamin.

Elizabeth and son, c. 1990

With husband John Serat 2008

She moved to the USA and pursued post-doctoral studies in molecular and cellular biology at Yale University in the laboratory of Dr. Joseph Gall, working with the single-celled organism, *Tetrahymena*, one of a class of simple organisms sometimes derisively referred to as "pond scum," Together with researcher Jack W. Szostak Blackburn uncovered the molecular structure of the telomere, the region at the end of the chromosome that prevents it from disintegrating as the cell reproduces. Telomeres drew her attention because of their crucial role in preventing the tips of chromosomes from fraying when a cell divides. Usually, when a cell makes a copy of itself, the telomeres shorten, which may explain why cells age and die.

Blackburn and her mentor, Joseph Gall, shared these findings in a landmark paper published in 1978.

That same year she joined faculty of the University of California at Berkeley, where she continued her work on telomeres. Her research suggested the existence of a unique enzyme that regulates the replication of the telomere, continuously rebuilding the ends of chromosomes to protect them in the cells of young organisms, and allowing them to decay in older ones. The identity of this hypothetical enzyme remained elusive. If its existence could be proved, and its mechanism understood, it would be **the first step toward a new understanding of the ageing process, of degenerative diseases in which healthy young cells suddenly die, and of cancer, where they multiply uncontrollably.**

In the mid-1980s, Blackburn and her graduate student, Carol Greider, discovered telomerase - an enzyme that repairs the telomeres - and demonstrated the role it plays in normal cells, cancer cells and ageing.. Blackburn has likened them to Dr. Jekyll and Mr. Hyde. Sometimes, she explains, telomerase is a 'good guy' because it helps produce immune cells and stops telomeres from shortening, but it can also make cells immortal, which prompts them to turn malignant (this is what happens with cancer)

Because of the enzyme's properties, its discovery was to be the first step toward a new understanding of the ageing process, of degenerative diseases in which healthy young cells suddenly die, and of cancer where cells multiply uncontrollably. In so unlocking the mystery the telomere's regulating enzyme (telomerase) they had opened a new field of discovery.

It was this that earned them, together with the Harvard-based Szostak, the 2009 Nobel Prize in Physiology or Medicine.

Receiving the Nobel Prize in Physiology or Medicine from Sweden's King Carl XVI Gustaf at a ceremony on Dec. 10 in Stockholm. Photo by Jonas Ekstromer / AP

Summing up her research the down-to-earth Blackburn says:

"The analogy that's made is that if you think of the chromosome as a shoelace, the ends need to be protected because they're always fraying away. It's a really interesting race in which the wearing down is happening, but it's being counteracted by the telomerase (the enzyme isolated by Blackburn & Greiger.) So it's the race between the wearing down and the counteracting... and the question is, who's going to win?"

Szostak is now Professor of Genetics at Harvard. Greider is now Professor of Genetics at Johns Hopkins University. Elizabeth Blackburn is now Professor of Biology and Physiology at the University of California, San Francisco, serving in both the Department of Microbiology and Immunology, and the Department of Biochemistry and Biophysics. She is also a Non-Resident Fellow of the Salk Institute. Her research team continues their work exploring telomerase (related to cancer) and telomeres (related to ageing) biology.

Carole Greider (left) and Elizabeth Blackburn today

Over the years, Blackburn and Greider have remained close friends, and both have raised families while carrying out their historic research. They continue their research and, just as others guided them, they have served as mentors to another generation of research scientists, men and women who will continue their work for years to come.

Professor Blackburn is also recognised for her contributions as an international adviser in bioethics. Most notably she was appointed, under the former Bush administration, to the USA President's Council on Bioethics in 2001. The role of the Council was to review the ethics involved in various areas of science and medicine.

The scientific community was outraged when, after two years, Professor Blackburn was dismissed from the Council for objecting to the way ideology, rather than science, was used to inform policy, particularly stem cell policy. (President Bush was known to be fervently opposed to such research.) "Just make sure you've got the science right," Professor Blackburn said at the time.

She has spoken openly about a number of issues, one of them being what is termed the "maths-science gender-gap" – the seeming hesitation of girls to enter the fields of science and mathematics. She says:

"It's socialization that changes girls. Girls find that to express these interests (in science and maths) is not so socially acceptable. A young person grows up and is uncertain, does not get positive reinforcement. The influence of peers is really different for girls. I see the consequences in my students and postdoctoral graduates. If doing science is perceived as an uncool thing for a girl - in high school during a very vulnerable time in her life -she won't perform as well and she won't do as well as teenage boys. I don't think female abilities are less than those of males; we've seen ample evidence around the world. If they're encouraged to do as well, they do. It becomes a self-fulfilling prophecy."

Another issue on which she speaks is that of achieving a work-life balance. She has this to say about being a mother and college professor, the sacrifices she and her family made, and her own guilt about working versus staying at home. (Blackburn was pregnant when she moved to Yale and began her major research.)

"*I bumbled through it like everybody does. I don't think we went to a movie or travelled on vacations. I spent minimal time at conferences and hurried home to be with my family. Of course it's going to be work and you do find yourself wishing you were in two places at once. Of course the kids do fine, the evidence doesn't bear out that they won't.*

You aren't a terrible parent if you aren't there after work every day baking cookies. I baked cookies – not such good ones but I baked. I was helped by the fact that I was a full professor so I attended those child related events that I wanted to be at. People will respect you if you take the time to make time for your children.

We'll always have guilt and stay-at-home mums have it too, although it's a different kind of guilt. We just have to realise we're not doing our children a disservice when we're engaged in our jobs if we are also engaged in them. The media does tend to stereotype women with a one-size-fits-all model, while real examples aren't well represented in the media."

Now I'd say that's a very practical, down to earth lady.

Professor Blackburn visits Australia regularly to teach, advise and mentor. (She holds dual Australian-American citizenship.)

Professor Blackburn In a laboratory in the new facility. A regular visitor to Monash she was looking forward to student lectures, mentoring and providing research advice in the new surrounds of the biosciences precinct.

On 24 February, 2010 Professor Blackburn opened Australia's largest biosciences precinct at Monash University's Clayton campus. During her time at Monash, she also presented the Dean's Lecture and was the keynote speaker at the forum *Women in research - Achieving it all.* More than 800 people attended, hearing from an expert panel of the challenges and opportunities for women juggling their personal life with a career in research.

Ph.D student Ms. Deanna Deveson-Lucas, Professor Elizabeth Blackburn, Dr Michele Davies and Ken Walker tour the new facilities at Monash.

Chatting with undergraduates at Monash University. Encouraging them to dream, perhaps?

On January 26, 2011, the Australian government appointed Professor Elizabeth Blackburn a Companion of the Order of Australia. (AC)

She was invested as a Companion in the General Division of the Order of Australia (AC) at Admiralty House in Sydney by the Governor-General

Her outstanding achievements have further been recognised through a new fellowship from the National Health and Medical Research Council (NHMRC) awarded to top female Research Fellows.

In announcing the Fellowship Minister for Health and Ageing Nicola Roxon said *"The NHMRC Elizabeth Blackburn Fellowships will foster the career development of female scientists excelling in biomedical, clinical and public health research,"*

The first Elizabeth Blackburn Fellowship winners (left to right) Professor Carola Vinuesa, Associate Professor Christine Roberts and Associate Professor Amanda Leach

Speaking recently to an audience of children at the national science and technology centre, *Questacon*, the first Australian-born woman to win a Nobel prize and named last year in *Time* magazine's '100 most influential people', revealed the secret to her success - daydreaming. However she conceded grown ups might not welcome her advice. "Your parents and your teachers are going to kill me if they hear you say 'she told us just to daydream,' " Professor Blackburn joked.

Then-Prime Minister, Kevin Rudd, and Professor Elizabeth Blackburn twist rope to demonstrate the make-up of DNA for the young *Questacon* audience. *Photo: Andrew Meares*

And Elizabeth Blackburn is as excited today about science as she was when she first set out on her voyage of discovery. When interviewed on a recent visit to Australia she said:

"The huge luck of being in academic research is that you can let yourself learn from the results you get. If you're on a freewheeling ride like I am, there are no dead ends, because there's always something new to investigate. I don't have dead ends. Isn't it wonderful?"

I'd suggest that's VERY good news for us all!

Australian Nobel Prize winners.

Lawrence Bragg & William Bragg in 1915 for work in x-ray crystallography.

Howard Florey in 1945 for work on the medicinal properties of penicillin.

Frank MacFarlane-Burnett in 1960 for work on immunology.

John Eccles in 1963 for work on nerve cells.

Bernard Katz - in 1970 for Physiology and Medicine.

Patrick White in 1973 for literature.

John Cornforth in 1975 for chemistry.

John Harsanyi in 1994 for mathematical contributions to economics.

Peter Doherty and Rolf M. Zinkernagel in 1996 for work in immunology.

Barry Marshall and Robin Warren in 2005 for discovery of the bacterium which causes stomach ulcers and gastritis.

Elizabeth Blackburn in 2009 for work in chemistry and genetics

Brian Schmidt in 2011 for work in physics which showed that the universe was expanding at an accelerating rate.