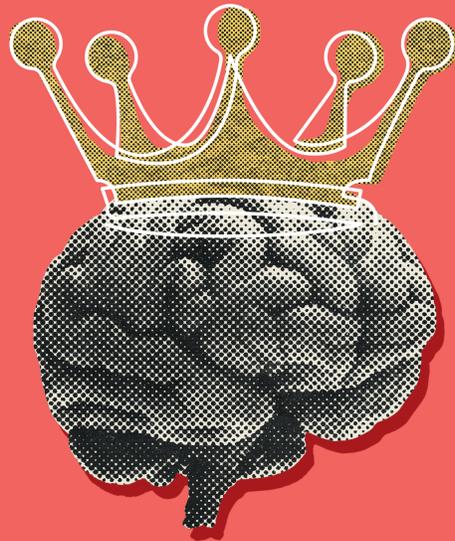


AUDIENCE GUIDE

30 SEASON
2022-23 *Renaissance*
RESILIENT THEATERWORKS
Theater by Women For Everyone



The How and

the Why

by Sarah Treem

Audience Guide

The How and the Why

About the Playwright: Sarah Treem

Sarah Treem's *The How and the Why* premiered at the McCarter Theatre starring Academy award winner, Mercedes Ruehl, (with Emily Mann directing) and went on to productions at Interact Theatre and Trinity Repertory, among others. Her play *A Feminine Ending* premiered at Playwrights Horizons and went on to productions at South Coast Repertory and Portland Center Stage, among others. Sarah's other plays include *Empty Sky*, *Orphan Island*, *Human Voices* and *Mirror Mirror*.

She has been commissioned by Playwrights Horizons, Southcoast Repertory and Manhattan Theatre Club and developed work at the Sundance Theatre Lab, Ojai Playwrights Festival, the Screenwriters Colony, Hedgebrook and Yaddo. In addition to her theater career, Sarah wrote and produced all three seasons of the acclaimed HBO series *In Treatment*, for which she won a Writers Guild of America award and was nominated for a Humanitas award.

She co-created, and was the showrunner, of the Showtime drama *The Affair*, which won the Golden Globe Award for Outstanding Drama Series. She was a writer and co-executive producer on the inaugural season of *House of Cards*, nominated for nine Golden Globes, including Outstanding Drama Series. She also wrote on all three seasons of the HBO series *In Treatment*. Sarah has taught playwriting at Yale University, where she earned her BA and MFA.

The Theories:

The Grandmother Hypothesis and Menses as Defense

The theories in the play are real although the characters in the play are fictional. In reality, there are often several people involved in the development of a theory.

The Grandmother Hypothesis holds that there was an evolutionary advantage for women who lived beyond menopause and cared for their grandchildren. Since these children were more likely to make it to adulthood and reproduce, the genes that select for long life were passed on, resulting in women living well after menopause.

Menses as Defense against pathogens introduced by sperm was proposed by Margie Profet (*see profile below*). She said that women menstruated in order to defend the uterus and the endometrial layer from infection that could be introduced by the male through pathogens accompanying sperm. Her theory was very controversial and was criticized in the same way Rachel is in the play. The “why” of menstruation is still debated.

Current Theories and scientific research are always a process of building on, revising or discarding earlier theories. Current theories suggest that human females menstruate because the body would require more energy to maintain the endometrium than to shed it on a cyclical basis. Current theories around menopause suggest it is advantageous for human females to stop ovulating because mortality risks increase with pregnancies in older females, as do problems with the egg. Ultimately, it is advantageous to invest more time in the success of existing offspring or in raising grandchildren.

A 2012 Yale study found that male scientists are more likely to be hired over females with equal qualifications. And, nationally, women hold less than 18% of science faculty positions. Science is gendered. The core of science as a systematic accumulation of knowledge gained through observation and experimentation reveals science as a uniquely human activity mediated through the lens of gender. As men have, historically, claimed a larger role in the development and perpetuation of the sciences, they have influenced the very patterns, languages, and methods used by scientists even today.

“We live in a scientific age, yet we assume that knowledge of science is the prerogative of only a small number of human beings, isolated and priestlike in their laboratories. This is not true. The materials of science are the materials of life itself. Science is part of the reality of living; it is the way, THE HOW AND THE WHY for everything in our experience.”

—Rachel Carson in a 1952 speech



Rachel Carson (1907 – 1962) is best known for her 1962 book *Silent Spring*, which warned about the dangers of pesticides, especially DDT, in the environment. Although she was known to be an innovative and creative marine biologist, she is primarily known as a writer. After completion of her graduate studies at Johns Hopkins University, she joined the U.S. Bureau of Fisheries, writing about fishing and the sea for radio programs.

“The grandmother hypothesis highlights key differences in life history between people and our closest living relatives, chimpanzees, including the substantially greater longevity in humans—even though fertility ends at about the same time in both species.”

—Kristin Hawkes



Kristen Hawkes is an anthropologist at the University of Utah and a Collaborative Scientist at the **Yerkes** National Primate Research Center. Her work focuses on the history of evolution and is driven by the hypothesis that grandmothing is a fundamental shift in the human genus that differentiates us from other great apes. She has published on the grandmother hypothesis in many scientific journals and in *Grandmotherhood: The Evolutionary Significance of the Second Half of Life*. She has studied in hunter-gatherer populations, including the Ache of Eastern Paraguay and the Hadza of Northern Tanzania.

“I found myself torn between my work and an admittedly adorable but insatiably demanding human baby.”

— Sarah Hrdy in *Discover* magazine, March 2003



Sarah Blaffer Hrdy is an anthropologist who uses a lot of evolutionary biology in her work. She received the W.W. Howells Prize for outstanding contributions in biological anthropology in 2000 and 2012 and is the author of *Mother Nature: A History of Mothers, Infants and Natural selection* (written after receiving a Guggenheim Fellowship), *Mother Nature: Maternal Instincts and How They Shape the Human Species*, and *Natural Selection and Mothers and Others: The Evolutionary Origins of Mutual Understanding*.

Her work shocked people because she discussed the prevalence of infanticide and abortion across the animal kingdom. She also has theorized that female monkeys will copulate with many males to confuse parentage—so the male will not kill offspring—and that primates are designed for alloparenting because it is so costly and time consuming to raise a young primate. She has been accused of personalizing her work and has written about how her ideas were critiqued because she is both a scholar and a woman.



Margaret “Margie” Profet is an American evolutionary biologist. The daughter of two Berkeley-trained engineers, she has degrees in political philosophy and physics and also studied mathematics. With no formal training in evolutionary biology, Profet caused a stir in the scientific community when, in 1993, she published her findings on the evolutionary role of menstruation as a defense

against pathogens introduced by sperm, and other theories about allergies and morning sickness as ways of eliminating pathogens, toxins and carcinogens from the body. Also that year, she received a MacArthur “Genius” Award, which drew attention to her theories and led to profiles in major science and news outlets. Profet told a dream researcher, professor of psychology Deirdre Barrett, that the idea for her article about menstruation came in a dream about black triangles in a red field. Because of her lack of background in the field, Profet was ill-equipped to deal with the criticism lobbed against her ideas. In 1996, her theories were rebutted point by point by anthropologist Beverly Strassmann in the *Quarterly Review of Biology*. In 2005, Profet disappeared from the Boston area and was missing for seven years. In 2012, she was reunited with her family after having been sick and living in poverty.

Early Research

Early research revealed that human women generally ovulate mid-cycle and that estrogen regulates ovulation. Research on evolutionary biology in the human female did not begin until the late 19th Century. Initially, women were viewed as passive receptacles for semen from the male. In fact, even the role of the egg was not understood at first. Women exhibiting sexual behavior or desire were considered pathological.

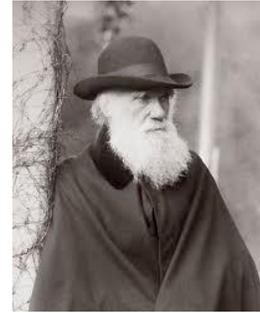
Charles Darwin's theory of sexual selection suggested that females of any species made choices in sex partners based on their desirable traits (such as plumage in birds)—a key component in inheritance. At a time when human species were not thought to have sexual feeling, the idea that females made choices so key to the inheritance of traits was revolutionary.

Researchers looked for estrus (heat) in human females and by the 1960s mixed results led many researchers to conclude that estrus had been lost in recent human evolution. Biologist Randy Thornhill and evolutionary psychologist Steven Gangestad have argued that estrus was not lost, but has been concealed, like human ovulation.

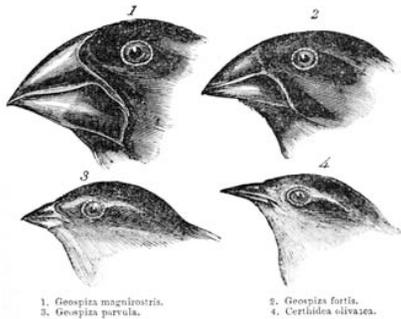
In short, there is an evolutionary arms race between human males and females. If a male wants offspring, it is advantageous to mate with as many females as possible. However, for females it is beneficial to conceal the time of heightened fertility. Doing so means a male cannot know if he has mated with the female while she was fertile—thus he has a vested interest in staying with her, to guarantee offspring. And given the amount of time and care human children require, offspring are more successful if they benefit from the contributions of both parents. Human women's physical appearance does not change with fertility (as opposed to many primate species), creating the appearance of continuous fertility.

Pioneers in Evolutionary Biology

Charles Darwin (February 12, 1809 – April 19, 1882) was a British scientist who laid the foundations for how we think about evolution.



In 1831 he joined a five-year scientific expedition on the HMS Beagle. During the voyage Darwin read Lyell's *Principles of Geology*, which suggested fossils in rocks were millions of years old. This was at a time when most Europeans believed God created the world in seven days, as described in the Bible. After he returned to England, he began to puzzle out his observations and gradually developed the theory of evolution occurring through a process of



natural selection. The theory is that animals or plants that are best suited to their environment are more likely to survive and reproduce—passing on those helpful characteristics to their offspring and changing a population over time (such as the variations he observed in the size and shape of beaks in the finches, which would be called Darwin's finches).

He worked on his theory for 20 years and after discovering another naturalist, Alfred Russel Wallace, had a similar idea, the two scientists made a joint announcement in 1858 and Darwin published *On the Origin of Species by Means of Natural Selection* in 1859. The book was extremely controversial because the logical extension of his ideas was that humans were just another species (*homo sapiens*) and could have evolved from similar species, which was seen to undermine the authority of the church.

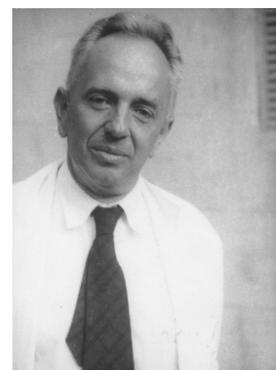
Almost as controversial was his theory of sexual selection, put forward in his book *The Descent of Man*, which argued that females selected mates for the most advantageous traits to pass on to offspring. The logical extension of this idea was that human females had interest in the desirability of male traits, which was at odds with the prevailing Victorian attitudes that females were passive receptacles rather than having an interest or volition in sex. At a time when human species were not thought to have sexual feeling, the idea that females made choices so key to the inheritance of traits was revolutionary.

“We admit that we are like apes, but we seldom realise that we are apes.” — Richard Dawkins

Richard Dawkins (born March 26, 1941) was born in Nairobi and educated at Balliol College at Oxford University, where he is an emeritus fellow of New College. He is an evolutionary biologist, atheist and writer who is gifted at bringing scientific ideas into the public discourse. His books include *The Selfish Gene*, *The Extended Phenotype*, *River Out of Eden*, *The Blind Watchmaker* and *The God Delusion*. He created the Richard Dawkins Foundation for Reason and Science. He is a proponent of the gene-centered view of evolution, which posits that the gene is the principle unit of selection in evolution. He is known for a somewhat cantankerous personality and has clashed with other scientists and thinkers such as Stephen Jay Gould. He is an ardent critic of creationism.



Theodosius Grygorovych Dobzhansky (January 24, 1900 – December 18, 1975) was a prominent geneticist and evolutionary biologist. He was born in Imperial Russia in the region now known as Ukraine and immigrated to the United States in 1927. His most well-known work is *Genetics and the Origin of Species*, published in 1937, which is a cornerstone of modern synthesis of evolutionary theory and lab work. He provided laboratory evidence for natural selection when there previously had been only field observation. He worked with fruit flies *Drosophila*. One key discovery was that naturally occurring mutations provided the raw material for natural selection to act upon. Since 1981, the Theodosius Dobzhansky Prize has been awarded annually by the Society for the Study of Evolution “to recognize accomplishments and the future promise of an outstanding young evolutionary biologist. The prize was established in memory of Professor Dobzhansky by his friends and colleagues, and reflects his lifelong commitment to fostering the research careers of young scientists.”



“The searching human mind is not satisfied merely to discover facts. We also want to know how things happen and why.”

— Ernst W. Mayr, from his book, *What Evolution Is*

Ernst Mayr, Evolutionary Biologist (1904-2005) was perhaps the greatest evolutionary scientist of the twentieth century. Along with Theodosius Dobzhansky, George Gaylord Simpson, and others, Mayr achieved the "modern synthesis" in the 1930s and 1940s that integrated Mendel's theory of heredity with Darwin's theory of evolution and natural selection. Ironically, one great unsolved problem in Darwin's master work, *On the Origin of Species*, was just that: How and why do species originate? Darwin and his later followers were faced with a seeming paradox. They described evolution as a continuous, gradual change over time, but species are distinct from each other, suggesting that some process has created a discontinuity, or gap, between them. Credit for doing the most to crack this puzzle goes to Ernst Mayr.

The 'How' and the 'Why'
Alfred Lord Tennyson (1809-1892)
United Kingdom Poet Laureate

*I am any man's suitor,
If any will be my tutor:
Some say this life is pleasant,
Some think it speedeth fast:
In time there is no present,
In eternity no future,
In eternity no past.
We laugh, we cry, we are born, we die,
Who will riddle me the how and the why?*

*The bulrush nods unto his brother
The wheatears whisper to each other:
What is it they say? What do they there?
Why two and two make four? Why round is not square?
Why the rocks stand still, and the light clouds fly?
Why the heavy oak groans, and the white willows sigh?
Why deep is not high, and high is not deep?
Whether we wake or whether we sleep?
Whether we sleep or whether we die?
How you are you? Why I am I?*

*Who will riddle me the how and the why?
The world is somewhat; it goes on somehow;*

*But what is the meaning of then and now!
I feel there is something; but how and what?
I know there is somewhat; but what and why!
I cannot tell if that somewhat be I.*

*The little bird pipeth 'why! why!'
In the summerwoods when the sun falls low,
And the great bird sits on the opposite bough,
And stares in his face and shouts 'how? how?'
And the black owl scuds down the mellow twilight,
And chaunts 'how? how?' the whole of the night.*

*Why the life goes when the blood is spilt?
What the life is? where the soul may lie?
Why a church is with a steeple built;
And a house with a chimney-pot?
Who will riddle me the how and the what?
Who will riddle me the what and the why?*

Edna St. Vincent Millay (1892 – 1950) was a Pulitzer Prize winning poet and playwright. Known for her brilliance as a writer she became equally known for her feminist activism and numerous love affairs.

*My candle burns at both
ends; It will not last the
night;
But ah, my foes, and oh, my
friends — It gives a lovely light!"*



— “First Fig,” from the 1922 book *A Few Figs from Thistles*

“I should say that the majority of women (happily for them) are not very much troubled with sexual feeling of any kind.”

— William Acton, physician and sexologist, 1857

“It must be distinctly recognized that the assertion that sexual passion commands more of the vital force of men than of women is a false assertion, based on a perverted or superficial view of the facts of human nature.”

— Elizabeth Blackwell, one of the first women in the United States to obtain a medical degree, 1902

Scientific and Medical Terminology

Abstract — When proposing an academic or scientific article for publication or to present at a conference, it is traditional to submit an abstract or summary of the article, paper or presentation.

Amenorrheic — The suppression of menstruation by any means other than pregnancy. For example, famine could make females in a population amenorrheic.

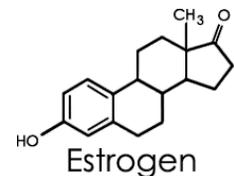


Bonobo Monkeys — Are a great ape and one of two species in the pan genus, the other being chimpanzees. They are found primarily in the Congo in Africa. They are one of the closest primate relatives to humans.

Concealed Ovulation — Human women do not have external physical changes that allow males to know when they are fertile (in some apes there are visible changes in the genitalia).

Endometrium — The mucous membrane that lines the interior of the mammalian uterus.

Estrogen — One of the primary female sex hormones, which helps regulate both the menstrual and estrus cycles. Estrogen levels decline at menopause and synthetic estrogen is commonly used in Hormone Replacement Therapy. *(Pictured at right: Diagram of the molecular structure of estrogen)*



Estrus — A regularly current state of sexual excitability in which a female is most receptive to the male and capable of conceiving. In many animals this is called being in “heat.” Because female humans can have sex throughout their cycle and do not have changes in appearance, there has been discussion about whether or not estrus around ovulation exists. In many animals this is manifested by physical and pheromonal as well as behavioral signals.

Hormone Replacement Therapy (HRT) — The replacement of hormones such as estrogen with synthetic versions after menopause. Because hormone levels fluctuate during and after menopause, replacing hormones can relieve symptoms such as hot flashes and vaginal dryness and may help protect against osteoporosis. However, it can also increase the risk of breast cancer, heart disease and stroke, so HRT is controversial. For some women it is part of the pathologizing of women's health issues, and they do not want HRT.

The Hadza — An ethnic group living in north-central Tanzania who are still full-time hunter-gathers. A tribe of about 1,000, their language includes clicks. They were the subject of a recent PBS documentary and have been a group popular with scientists because their means of living has not undergone the changes that it has in other populations.

Hypothesis — A hypothesis in science is the first step in the scientific method. It is an educated guess based on knowledge and observation to explain a particular phenomenon. There should be no predetermined outcome in a hypothesis and it should be testable—able to be supported or refuted through scientific experiments or observation. As a hypothesis receives sufficient data through various independent scientific studies, it becomes a theory.

Hysteria — The word is actually derived from the Greek word for “womb.” In ancient Greece (as well as Egypt and Rome) it was believed that a woman's womb wandered through the body because it was seeking children, causing behavioral changes and illnesses.

Macrophage — A tissue cell of the immune system that is involved in the destruction of antigens such as bacteria and viruses.

Menstruation — The periodic discharge of blood and mucous tissue from the uterus or uterine lining (endometrium) and vagina in sexually reproductive humans (and some simians, bats and shrews).

Nature vs. Nurture — The modern sense of the phrase coined by the Victorian Francis Galton to refer to the ongoing efforts to understand the influence of heredity or genetics (nature) vs. the influence of environment (nurture).

NOORB — National Organization of Research Biologists — A fictional scientific professional organization, perhaps as a stand in

for the Society for the Study of Evolution, which is the organization that awards the Dobzhansky Prize.

Pathogen — Any agent that causes disease, usually a bacterium, fungus or other microorganism.

Sexual Selection — Scientist Charles Darwin first postulated a theory of sexual selection, that female choice is a key component in evolution, resulting in such male adaptations as gaudy plumage in male birds.

Simian — Any of the suborder Anthroidea of primates, which includes monkeys, apes and humans.

Stockholm Syndrome — Named for a 1973 bank robbery in which the bank employees — after being held hostage for 131 hours — seemed to have formed an emotional bond with their captor. It is now used to describe any case in which a prisoner seems to identify with a captor and perhaps responds in ways that seem against his or her interest.

Taboo – (also written tapu and tabu), the Polynesian name given to a place where menstruating females were prohibited from entering, enforced by religious or magical sanctions. As a verb it means to "prohibit," as an adjective, "prohibited, sacred, dangerous, unclean."

Yerkes Primate Research Center — A real center of scientific study at Emory University. "The Yerkes National Primate Research Center conducts essential basic science and translational research to advance scientific understanding and to improve the health and well-being of humans and nonhuman primates."

Trailblazing Women in Science



Elizabeth Blackwell (1821 – 1910)

Physician

Elizabeth Blackwell was the first woman to receive an M.D. from an American medical school. She co-founded the New York Infirmary for Women and Children and was an early advocate for women's education in medicine and other fields.



Isabella Bird (1831 – 1904)

Explorer, Writer, Natural Historian

Bird was a 19th Century writer and naturalist. She traveled the world and supported herself by writing about the nature and people she saw in her travels. Her most famous book is *A Lady's Life in the Rocky Mountains*. She also traveled in Japan, China, Malaysia, Singapore and Vietnam. At age 60 she trained in medicine and traveled to India. She was the first woman inducted into the Royal Geographical Society.



Margaret Lucas Cavendish (1623 – 1673)

Philosopher, Writer, Naturalist

Cavendish was a 17th Century British naturalist, philosopher and writer. Also the Duchess of Newcastle upon Tyne, she published *Observations Upon Experimental Philosophy* and *Grounds of Natural Philosophy* as well as plays and an early work of science fiction, *The Blazing World*. In 1667 she was invited to participate in a meeting of the Royal Society, but was regarded as a spectacle by many of her male peers. She was an early opponent of animal testing.



Jewel Plummer Cobb (1924 – Present)

Cell Biologist

Cobb's research at both the National Cancer Institute and at New York University involved comparing the effects of chemotherapy with research on normal and malignant pigment cells. She also works to promote programs that increase girls', women's and minority students' interest in scientific careers.



Dian Fossey (1932 – 1985)

Anthropologist and Primatologist

Fossey received her Ph.D. from Darwin College, Cambridge, writing a thesis entitled "The Behaviour of the Mountain Gorilla" in 1976. After attending a lecture by Dr. Louis Leakey (a Kenyan paleoanthropologist), Fossey became interested in the mountain gorillas of the Virunga Volcano region of Rwanda and began to study them. Her work provided the basis for our understanding of the behavior and social life of gorillas. Her struggle to protect gorillas against poachers and government officials led to her tragic murder.



Rosalind Franklin (1920 – 1958)

***Biophysicist* — subject of *Photograph 51* written by Anna Ziegler. Produced by RTW January 2019**

Franklin went to Newnham College, Cambridge, and graduated in 1941, but was only awarded a degree titular, as women were not entitled to degrees from Cambridge at the time. She received her Ph.D. from Cambridge University in 1945. Franklin's x-ray diffraction photographs led to the understanding of the structure of deoxyribonucleic acid (DNA). Her colleague, Maurice Wilkins, without obtaining her permission, made her then-unpublished x-ray diffraction pattern of the B form of DNA available to James Watson and Francis Crick, which was crucial evidence for the helical structure of DNA.



Birute Mary Galdikas (1946 – Present)

Anthropologist

Galdikas holds bachelor's degrees in psychology and zoology, a master's degree in anthropology and a doctorate in anthropology. Similar to Jane Goodall's work with chimpanzees and Dian Fossey's study of gorillas, Galdikas has studied the orangutans of Indonesian Borneo since 1971 and is a world authority. Galdikas has campaigned tirelessly to save the orangutans from extinction and preserve their habitat from illegal logging.



Jane Goodall (1934 – Present)

Primatologist

Goodall, a protégé of Louis Leaky, earned a doctorate in ethology from the University of Cambridge in 1964. She is one of the world's foremost primatologists and has spent decades closely observing and studying the behavior of the Gombe chimpanzees in Tanzania. Her numerous awards and honorary degrees include the UNESCO Gold Medal and the Medal of Tanzania. In 2002, Goodall was named a United Nations "Messenger of Peace."



Shirley Ann Jackson (1946 – Present)

Theoretical Physicist

In 1973, Jackson was the first African American woman to receive a Ph.D. in physics, from the Massachusetts Institute of Technology (MIT). She has conducted research in subatomic particles, including studying hadrons at the Fermi National Laboratory and strongly interacting elementary particles at the European Center for Nuclear Research (CERN). She was appointed chair of the Nuclear Regulatory Commission (NRC) in 1995 and inducted into the National Women's Hall of Fame in 1998 for her contributions as a distinguished scientist and advocate for science education.



Mae Carol Jemison (1956 – Present)

Chemical Engineer, Physician, Astronaut

Jemison received a B.S. degree in chemical engineering from Stanford University in 1977 and a medical degree from Cornell University Medical School in 1981. She joined NASA's astronaut training program in 1986 and on September 12, 1992 became the first African American woman to travel to space, on the space shuttle Endeavor.



Augusta Ada Byron Lovelace (1815 – 1852)

Computer Scientist

The child of the poet Lord Byron Lovelace was privately home schooled in mathematics and science by her mother, Anne Isabella Byron. Lovelace's work laid the foundation for computer programming. The programming language "Ada" was named in her honor. In 1834 she became interested in the plans for Charles Babbage's proposed calculating machines and her article on Babbage's "analytical engine," including detailed instructions on how such a machine might be programmed, is now recognized as an early model for a computer and as a description of a computer and software.



Barbara McClintock (1902 – 1992)

Geneticist

McClintock earned her Ph.D. in botany from Cornell University despite her mother's disapproval of spending money to send a "girl" to college. Prior to the discovery of the structure of DNA, McClintock focused on the 10 chromosomes in maize plants and the genes they carry. She became the first woman to receive the Nobel Prize in physiology or medicine "for her discovery of mobile genetic elements."



Margaret Mead (1901 – 1978)

Anthropologist

Margaret Mead received her Ph.D. in anthropology from Columbia University in 1929 and became one of the most famous anthropologists of the 20th century. She did fieldwork in Samoa, Bali and New Guinea, as well as among the Omaha Indians of Nebraska, studying human development from a cross-cultural perspective. Mead's provocative findings profoundly influenced anthropology and ideas about sex and gender.



Beatrix Potter (1866 – 1943)

Naturalist, Mycologist

Perhaps best known for her children's books and illustrations, Beatrix Potter was also a naturalist. While she had no formal scientific training, she was a careful observer and illustrator of the natural world. She was particularly devoted to the study of fungus and illustrated more than 350 varieties of mushrooms, mosses and spores. She was also the first person to speculate that lichens are a symbiotic life form. She submitted a paper to the Linnean Society of London, but since women were not permitted to attend meetings, the paper was presented by George Masee of the Kew Gardens.



Julie Robinson (1967 – Present)

Evolutionary and Conservation Biologist

Robinson earned a B.S. degree in Chemistry and a B.S. degree in Biology from Utah State University in 1989.

She earned a Doctor of Philosophy in Ecology, Evolution and Conservation Biology from the University of Nevada - Reno in 1996. She is the Chief Scientist for the International Space Station Program, where she oversees hundreds of active investigations and represents scientists using the space station as a national laboratory.