

## How to play

Any number of people can play at once! Shuffle all the cards in the deck and deal all the cards equally between players, face down.

The player to the dealer's left starts by reading out an item from their top card, e.g. Badassery 7. The other players then read out their scores for the same characteristic. The player with the highest value (going from 1-10) wins and places all the top cards - including their own - to the bottom of their pile. They then choose an item from the next card at the top of their hand.

If two or more cards share the top value then all the cards are placed in the middle and the same player chooses again from the next card. The winner of the hand takes all the cards in the middle as well.

The person with all the cards at the end is the winner.

## About this deck

This deck contains the stories of some of the most awesome women to ever work in the fields of mathematics, biology, chemistry, physics and geology. Each field's cards are colour-coded and have a unique symbol in the top right.

We hope that you take inspiration from what these women have achieved, and maybe you will be a card yourself one day!



## Dorothy Hodgkin



English. 1904-1990. Biochemist.

Innovation 8  
Impact 8  
Obscurity 2  
Badassery 4

Winner of the 1964 Nobel prize for chemistry, Hodgkin advanced the technique of using X-ray crystallography to identify biological molecules. Her work on the structure of penicillin and vitamin B-12, and later insulin, was pioneering in the field. One of her research students was later Prime Minister Margaret Thatcher, who hung a portrait of her in 10 Downing Street.

Made by the Science Hour on XpressionFM at Exeter University

## Kathryn Sullivan



American. 1951-. Geologist.

Innovation 2  
Impact 2  
Obscurity 6  
Badassery 9

Trained as a geologist, and specialising in oceanography, Sullivan joined NASA's astronaut corp and has logged 532 hours in space over three space shuttle missions. She was the first American woman to walk in space. As well as working for the US government in both NASA and NOAA she was an oceanography officer in the US Naval reserve, retiring with the rank of Captain.

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## Lise Meitner



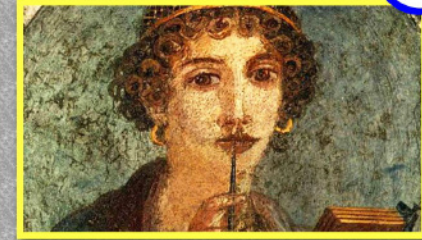
Austrian. 1878-1968. Physicist.

Innovation 9  
Impact 7  
Obscurity 8  
Badassery 6

The first woman in Germany to become a full professor in physics, and praised by Einstein as 'the German Marie Curie', Meitner was part of the team which discovered nuclear fission, the process by which atoms can be split apart, releasing huge amounts of energy. Extremely controversially she was not awarded the Nobel prize in physics for her work, while her male colleague Otto Hahn, was.

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## Hypatia



Greek. 370-415. Mathematician and Philosopher.

Innovation 4  
Impact 5  
Obscurity 4  
Badassery 5

Hypatia was a Greek philosopher, the head of the Neoplatonic school in Alexandria. While none of her original works survive, it is clear that she made contributions to mathematics - including commentary on Euclid and Diophantus - astronomy, and instrumental science. She was brutally murdered by a Christian mob, with her death signalling the end of Classical antiquity.

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## Emmy Noether



German. 1882-1935. Mathematician.

Innovation 8  
Impact 9  
Obscurity 7  
Badassery 3

Described by many, including Einstein, as the most important woman in the history of mathematics, Emmy Noether conducted world leading research at the University of Göttingen in rings, fields and algebra. Noether's theorem in physics elegantly draws a connection between symmetry and conservation laws, and has been described as one of the most powerful laws in mathematical physics.

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## Mary Somerville



Scottish. 1780-1872. Polymath.

Innovation 3  
Impact 5  
Obscurity 6  
Badassery 5

Somerville was a feminist, mathematician, and an astronomer who correctly predicted the existence of the planet Neptune, discovered four years later. She was a great scientific writer of textbooks and articles, with her work cited as influential on many great Victorian scientists. She has an Oxford college, Somerville College, named after her.

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## Marie Skłodowska



Polish. 1867-1934. Physicist and Chemist.

Innovation 9  
Impact 8  
Obscurity 1  
Badassery 8

Better known as Marie Curie after her marriage to French physicist Pierre Curie, she was the first woman to win a Nobel prize, and the only woman to have won two Nobel prizes - for physics in 1903 and for chemistry in 1911. She pioneered a theory where radiation did not come from a chemical reaction but from atoms themselves, and discovered the elements Polonium and Radium.

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## Émilie du Châtelet



French. 1706-1749. Polymath.

Innovation 3  
Impact 4  
Obscurity 7  
Badassery 7

As interesting for her personal relationships as she is for her scientific work, du Châtelet had a wide range of talents including mathematics, linguistics, music, physics and gambling. Her greatest achievement was her translation of, and commentary on, Newton's Principia Mathematica, still considered the standard French translation. During her life she was romantically linked to French philosophers Voltaire and Pierre Louis Maupertuis.

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## Rachel Carson



American. 1907-1964. Biologist and Conservationist.

Innovation 5  
Impact 8  
Obscurity 3  
Badassery 3

Trained as a zoologist at John Hopkins university, Rachel Carson was recognised in her early career as an exceptional author - her trilogy of books on marine life were all bestsellers. She is most famous for her work *Silent Spring*, which raised awareness of environmental problems caused by artificial pesticides. She is credited as inspiring the global conservation movement.

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## Jocelyn Bell Burnell



Northern Irish. 1943-. Astrophysicist.

Innovation 7  
Impact 6  
Obscurity 4  
Badassery 4

As part of her doctoral studies at Cambridge, Bell Burnell worked as part of a team constructing a radio telescope to study quasars. As part of her research she noticed a signal which pulsed with amazing regularity. Originally dubbed 'Little Green Man 1' this signal was found to be the first discovered pulsar, a new astronomical phenomenon.

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## Sophie Germain



French. 1776-1831. Polymath.

Innovation 6  
Impact 4  
Obscurity 3  
Badassery 6

Despite massive opposition from every possible source - parents, academics, society - Sophie Germain worked on a broad range of mathematics through her life, and corresponded with famous mathematicians such as Carl Gauss. Her work on Fermat's Last Theorem provided a basis for centuries of subsequent work, and her work on elasticity won the Grand Prix from the Paris Academy of Sciences.

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## Rosalyn Sussman Yalow



American. 1921-2011. Biophysicist.

Innovation 7  
Impact 6  
Obscurity 7  
Badassery 7

Starting her career as a secretary to a leading biochemist, Rosalyn Sussman Yalow took advantage of university scholarships offered to women during the Second World War to study a doctorate in physics. After this she developed radioimmunoassay, a technique used to trace substances in the blood. For this she was awarded the Nobel prize in medicine in 1977.

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## Rosalind Franklin



English. 1920-1958. Chemist.

Innovation 7  
Impact 7  
Obscurity 4  
Badassery 5

Best known for her work on X-ray diffraction images used in the identification of DNA, she was educated at Cambridge before working at several research laboratories and then King's College, London. Her crucial contributions to the identification and understanding of DNA were only acknowledged after her premature death of ovarian cancer at the age of 37.

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## Maria Mitchell



American. 1818-1889. Astronomer.

Innovation 3  
Impact 2  
Obscurity 9  
Badassery 5

The first American woman to work as a professional astronomer, Mitchell discovered a comet in 1847, in so doing earning a gold medal prize from the Prince of Denmark. Following this acclaim she became a professor of astronomy, travelled globally for astronomical events such as solar eclipses, and campaigned passionately for the abolition of slavery.

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## Grace Hopper



American. 1906-1992. Computer Scientist.

Innovation 8  
Impact 9  
Obscurity 5  
Badassery 10

Nicknamed 'Amazing Grace', Hopper was a distinguished computer scientist and a rear admiral in the United States Navy. She invented the first compiler for a computer programming language, and popularised the idea of machine-independent computer languages - an important step towards scientific computing. She has both a supercomputer and a warship named after her.

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## Marie Tharp



American. 1920-2006. Oceanographer.

Innovation 6  
Impact 10  
Obscurity 8  
Badassery 2

Trained as a geologist and mathematician, Tharp worked with Bruce Heezen to create the first scientific map of the entire ocean floor. Her work revealed the presence of the mid-Atlantic ridge, which caused a paradigm shift in how scientists perceived the Earth; bringing acceptance to ideas such as plate tectonics and continental drift.

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## Linda B. Buck



American. 1946-. Biologist.

Innovation 9  
Impact 5  
Obscurity 5  
Badassery 2

Until 1991, science could not explain how the sense of smell worked. This was changed by Linda B. Buck, who worked with Richard Axel to identify the parts of the mammalian genome which corresponded to olfactory receptors. For this work she received the Nobel prize for physiology in 2004. She is a member of the National Academy of Sciences and a fellow of the American Academy of Arts and Sciences.

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## Gerty Cori



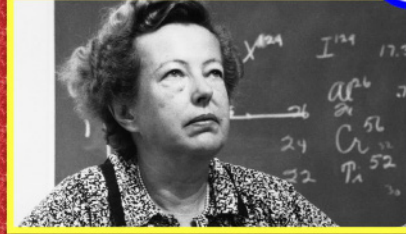
American. 1896-1957. Biochemist.

Innovation 6  
Impact 4  
Obscurity 10  
Badassery 5

Born in Prague in 1896, Gerty Cori and her husband moved to the US and became citizens in 1928. Working with her husband she was the first American woman to win the Nobel Prize in science and the first in physiology or medicine. Their work looked at how energy is produced and transmitted in the human body, following the "Cori Cycle", from muscle to liver and back to muscle.

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## Maria Goeppert-Mayer



German/American. 1906-1972. Physicist.

Innovation 9  
Impact 8  
Obscurity 9  
Badassery 8

Born in Germany but later taking American citizenship, Goeppert-Mayer became only the second woman in history to win the Nobel Prize in physics, in 1963. In addition to proposing the nuclear shell model of the nucleus, for which she won the Nobel Prize, she also pioneered work on two-photon absorption by atoms, and worked on nuclear weapons during the Manhattan Project in WW2.

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## Margaret Thatcher



English. 1925-2013. Chemist then Politician.

Innovation 2  
Impact 2  
Obscurity 2  
Badassery 9

One of the most divisive politicians in history, Thatcher was originally trained as a chemist at the University of Oxford. Before her political career she worked as a research chemist on projects including cake fillings and ice cream. As well as being the first and only female prime minister of the UK, she was also the first and only prime minister to hold a science degree, a fact of which she was very proud.

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## Mary Anning



English. 1799-1847. Palaeontologist.

Innovation 5  
Impact 7  
Obscurity 4  
Badassery 7

Described as the greatest fossil hunter ever known, Anning was a palaeontologist whose work on Jurassic fossils on the south coast of England changed global thinking of prehistoric life and the history of the Earth. Despite being poor all her life and struggling to be accepted into the full scientific community, she became famous around the world for her work.

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## Caroline Herschel



German/British. 1750-1848. Astronomer.

Innovation 4  
Impact 6  
Obscurity 6  
Badassery 6

When Caroline was 22 her brother William took her to Bath to work as his housekeeper. William trained her to become a music teacher and taught her mathematics as well as sharing his love of astronomy. Caroline worked with William on all of his astronomy projects, sometimes taking the lead in the calculations to catalogue the position of the stars. She was awarded The Royal Astronomical Society Gold Medal in 1828 for her work cataloguing nebulae, and was the first woman ever to discover a comet.

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## Ada Lovelace



English. 1815-1852. Computer Scientist.

Innovation 10  
Impact 9  
Obscurity 3  
Badassery 2

The world's first computer programmer and daughter of poet Lord Byron, Ada Lovelace was a mathematician who worked under Charles Babbage, himself a pioneer of computer science. Her annotations to translated mathematical notes opened the door to a future where not only did computer programs exist, but they did much more than simply crunch numbers.

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## Barbara McClintock



American. 1902-1992. Geneticist.

Innovation 7  
Impact 7  
Obscurity 8  
Badassery 8

The only woman to receive an unshared Nobel prize for medicine or physiology, McClintock studied maize and discovered jumping genes, the ability for genes to change position on the chromosome. She described her love of research when accepting the Nobel: "It might seem unfair to reward a person for having so much pleasure, over the years, asking the maize plant to solve specific problems and then watching its responses."

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## Jane Goodall



English. 1934- . Primatologist.

Innovation 5  
Impact 3  
Obscurity 4  
Badassery 7

Considered to be the world's leading expert on chimpanzees, Jane Goodall is most famous for her groundbreaking study of social and family interactions of chimpanzees in Tanzania. She was, uniquely among researchers, accepted into a chimpanzee society for 22 months. She is also a passionate advocate of conservation and animal welfare issues.

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## Helen Sharman



English. 1963- . Chemist.

Innovation 2  
Impact 1  
Obscurity 5  
Badassery 9

A chemist who received her doctorate from Birkbeck, University of London, Sharman was the first Briton to go into space, and the first woman to visit the Mir space station, after responding to a radio advert 'Astronaut wanted - no experience required'. Before going into space, she worked on the chemical properties of chocolate, because she liked to 'eat it'.

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## Florence Bascom



American. 1862-1945. Geologist.

Innovation 4  
Impact 4  
Obscurity 9  
Badassery 1

The first woman to graduate with a PhD at Johns Hopkins University; the first woman to be hired by the US Geological Survey; the first woman to present a scientific paper at the Geological Society of Washington; and the first woman officer of the Geological Society of America. Bascom was an authority on rocks of the Piedmont region and was given 4 stars in the first edition of American Men and Women of Science (called American Men of Science at the time), a very high honour for a scientist of any gender.

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## Marie Maynard Daly



American. 1921-2003. Biochemist.

Innovation 6  
Impact 5  
Obscurity 9  
Badassery 9

Trained as a chemist, Daly became the first African American woman in the United States to receive a PhD in chemistry, from Columbia University in 1947. In her long research career she pioneered work on the effect of cholesterol on heart attacks, the effect of sugar on arteries, and the effect of cigarette smoking on the lungs.

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## Maryam Mirzakhani



Iranian. 1977- . Mathematician.

Innovation 5  
Impact 3  
Obscurity 6  
Badassery 4

Both the first woman and the first Iranian to win the Fields Medal - the most prestigious award in mathematics - in 2014. Mirzakhani is currently a professor at Stanford University, and received her PhD from Harvard. Her work on the symmetry of curved surfaces was described as having "superb problem-solving ability, ambitious mathematical vision and fluency in many disciplines".

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## Dorothy Hill



Australian. 1907-1998. Geologist.

Innovation 4  
Impact 7  
Obscurity 7  
Badassery 8

Educated at the University of Queensland, AUS, and the University of Cambridge, UK, Hill completed research on the coral reefs of Australia which became the global standard for the field. During WW2 she enlisted in the Women's Royal Australian Naval Service and worked on ciphers and coding. After the war she became the first female professor in Australia.

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## Claudia Alexander



American. 1964- . Planetary Scientist.

Innovation 1  
Impact 3  
Obscurity 8  
Badassery 6

Named Women of the Year by the University of Michigan when she graduated with her PhD in 1993, Alexander went on to work for NASA as a planetary scientist at the Jet Propulsion Laboratory. In 2003 she was awarded Emerald Honor for Women of Color in Research & Engineering for her work at JPL. Alexander is now the project manager of NASA's contribution to the ESA Rosetta mission to study the comet 67P.

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## May-Britt Moser



Norwegian. 1963- . Neuroscientist.

Innovation 8  
Impact 6  
Obscurity 5  
Badassery 4

May-Britt Moser and her husband Edvard shared the 2014 Nobel Prize for physiology for their pioneering work on how the brain represents space. Both were appointed associate professors of the Norwegian University of Science and Technology just one year after completing their PhD theses. She is noted for her superb leadership qualities and has established multiple research institutes.

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