

## BARBARA McCLINTOCK



1902 - 1992, USA



- Won the Nobel Prize in 1983 for the discovery of mobile genetic elements.
- It took 20 years for her major discovery to be accepted.
- Also studied ethnobotany by looking at the indigenous origins of Maize.

Image by Rachell Sumpter  
rachellsumpter.com

3pts

## HELEN SAWYER HOGG



1905 - 1993, USA/CANADA



- Performed pioneering research into globular clusters and variable stars.
- Wrote astronomy column in Toronto newspaper for 30 years.
- Traveled widely for her work (especially observing stars from the southern hemisphere).

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3pts

## ALICE HAMILTON



1869 - 1970, USA



- Established the field of industrial hygiene and occupational epidemiology.
- Work led to major legal, economic, and social change.
- First woman faculty member at Harvard University.

Image by Rachell Sumpter  
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5pts

## ELSIE MACGILL



1905 - 1980, CANADA



- World's first female aircraft designer.
- Designed and built the Hawker Hurricane fighter aircraft during World War II.
- She was a commissioner on the *Royal Commission on the Status of Women in Canada*, published in 1970

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3pts

## MARIE THARP



1920 - 2006, USA



- Created the 1st map of the entire ocean floor.
- Her work was an important part of the highly controversial theory of continental drift.
- Was once fired for "girl talk" and defending her science.

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minouette.etsy.com

3pts

## LISE MEITNER



1878 - 1968, SWEDEN/AUSTRIA



- Meitner helped lead the research group that went on to discover the nuclear fission of uranium.
- This work formed the basis for nuclear weapons.
- Meitner was unjustly snubbed for a Nobel Prize on this work (her research partner, Otto Hahn, did receive the prize).

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3pts

## INGE LEHMANN



1888 - 1993, DENMARK



- Discovered that the Earth has a solid inner core inside a molten outer core.
- She was the first head of the Department of Seismology at the Geodetical Institute of Denmark.

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2pts

## ADA LOVELACE



1815 - 1852, ENGLAND



- A countess, Lovelace wrote the world's first computer program for Charles Babbage's Analytical Machine.
- Was also interested in how individuals and society could use technology collaboratively.

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3pts

## URSULA FRANKLIN



1921 - 2016, GERMANY/CANADA



- A pioneer in archaeometry, where one uses modern material science in archeology.
- Her research on strontium 90 levels in teeth also led to the ending of atmospheric nuclear weapons testing.
- She was a fierce advocate of pacifism and feminism, and wrote extensively on these subjects.

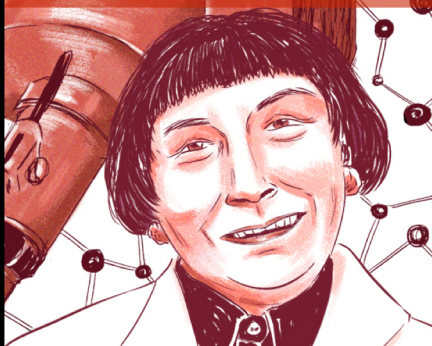
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3pts

SYLVIA OLGA  
FEDORUK



1927 - 2012, CANADA



- Helped develop the first cobalt-60 unit and one of the first nuclear medicine scanners.
- Was the Lieutenant Governor of Saskatchewan, Canada from 1988 to 1994.
- Her personal coat of arms has pictures of atoms.

Image by Shannon Wright  
shannon-wright.com

3pts

SALLY  
RIDE



1951 - 2012, USA



- She was the first American woman in space.
- Also the youngest astronaut, as well as the earliest known LGBT astronaut.
- Advocated for NASA to focus on problems directly facing humanity.

Image by Shannon Wright  
shannon-wright.com

4pts

EUPHEMIA  
HAYNES



1890 - 1980, USA



- First African-American woman to earn a PhD in math (she also had a Masters in Education).
- Taught elementary and high school.
- First woman chair of the Washington D.C. school board.

Image by Shannon Wright  
shannon-wright.com

5pts

ALICE  
BALL



1892 - 1916, USA



- First woman and African-American Masters graduate from the University of Hawaii.
- Developed a leprosy treatment that was still in use until the 1940s.
- However, after her death, the president of the university took credit for the treatment.

Image by Shannon Wright  
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3pts

MAUD  
MENTEN



1879 - 1960, CANADA



- Helped develop the Michaelis-Menten equation in biochemistry.
- Earned a medical degree (one of the first women in Canada) as well as a PhD.
- Had to move to Germany, as at the time, women were not allowed to do research in Canada.

Image by Ping Zhu  
www.pingszoo.com

3pts

ROSALIND  
FRANKLIN



1920 - 1958, ENGLAND



- Made key contributions (which were not acknowledged at the time) to the discovery of the structure of DNA.
- After her death, 2 Nobel Prizes were awarded to her collaborators.

Image by Ping Zhu  
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4pts

HEDY  
LAMARR



1914 - 2000, AUSTRIA/USA



- Co-invented spread spectrum and frequency hopping technology, which are now used in WiFi, GPS and more.
- Was a glamorous Hollywood film star, having starred in 30 films.

Image by Ping Zhu  
www.pingszoo.com

2pts

ANNIE  
EASLEY



1933 - 2011, USA



- Was a rocket scientist at NASA (Centaur rocket stage).
- Developed important computer code, that is used in alternative energy, solar, and wind projects.
- Was one of the first African-Americans in her field.

Image by Ping Zhu  
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5pts

MARIA SIBYLLA  
MERIAN



1647 - 1717, GERMANY



- First to observe and document the metamorphosis of a butterfly.
- One of the most significant contributors to entomology.
- Was an accomplished botanical artist.

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www.gurmillustration.com

2pts

CHIEN-SHIUNG  
WU



1912 - 1997, CHINA/USA



- The “Wu experiment” disproved conservation of parity, thought to be a law of nature.
- Worked on the Manhattan Project, and made significant contributions to radioactivity research.
- Was a fierce advocate of social justice in her later years.

Image by Simon Gurr  
www.gurnillustration.com



4pts

CAROLINE  
HERSCHEL



1750 - 1848, GERMANY



- She discovered 8 comets.
- First woman to be paid by a government for scientific contributions.
- An asteroid, a comet, and a moon crater all bear her name.

Image by Simon Gurr  
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3pts

SOPHIA  
KOWALEVSKI



1850 - 1891, RUSSIA



- Did 3 times as much work to become the first European woman to earn a mathematics PhD.
- Taught herself math from textbooks.
- Made important original contributions to differential equations and mechanics.

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4pts

MODIFIER

## Representation is everything.

Women are consistently underrepresented in science and engineering workplaces. This is especially so in senior management positions, where they face a high attrition rate.

*You can play immediately or keep in your hand. Place this card on **anybody's** active scientist card. Doing so, means that the affected player will need one extra discipline card (of the same type\*) to complete that scientist hand.*

\* Note: Players can choose which discipline for scientists with two discipline requirements. If there are no active scientist cards, you can discard this in the BURN pile.

MODIFIER

MODIFIER

## Girls don't see themselves as scientists.

Women are consistently underrepresented in science and engineering workplaces. This is especially so in senior management positions, where they face a high attrition rate.

*Immediately play this card when drawn. Place this card on **one of your** active scientist cards. Doing so, means that you will need one extra discipline card (of the same type\*) to complete that scientist hand.*

\* Note: You can choose which discipline for scientists with two discipline requirements. If you don't have any active scientist cards, you can discard this in the BURN pile.

MODIFIER

MODIFIER

## Mentors are awesome.

Women have blazed this trail before you, and many of them want to help others succeed.

*Immediately play this card when drawn. You may look through the BURN pile and remove one card of your choice to place in your hand. Discard this modifier card in the BURN pile.*

MODIFIER

MODIFIER

## Diversity makes better science.

Evidence has shown that mixed-gender teams produce research articles perceived to be of higher quality than single-gender teams.

*Immediately play this card when drawn. All players draw a card from the resource pile. MODIFIER cards must be discarded in BURN pile. All other cards can be kept in the player's hand.*

MODIFIER

MODIFIER

## Sexism delays science.

Charles Darwin delays publishing the *Origin of Species* by 20 years in part because mentor Adam Sedgwick writes that evolution is an idea that “could have been written by a woman.”

*You can play this card immediately or keep in your hand. Give this card to any player. If that player has a GROUNDBREAKER resource card(s) in their hand or in active play, they must discard one into the BURN pile.*

MODIFIER

MODIFIER

## The leaky pipeline.

Women are half the population but hold only about a quarter of the science and engineering jobs in the US. As well, despite women receiving roughly half of the PhDs, they only hold less than a quarter of professorships.

*Play this card immediately and then place in the BURN pile. You must discard a scientist in progress; however the resource cards can be returned to your hand.*

MODIFIER

MODIFIER

## Stupid patriarchy.

"The main stumbling block in the way of any progress is and always has been unimpeachable tradition."

~ Chien-Shiung Wu

*Play this card immediately and then place in the BURN pile. Choose one RESOURCE card from another player's Scientist hand and BURN it.*

MODIFIER

MODIFIER

## Stupid patriarchy.

"I didn't succumb to the stereotype that science wasn't for girls."

~ Sally Ride

*Play this card immediately and then place in the BURN pile. Choose one RESOURCE card from another player's Scientist hand and BURN it.*

MODIFIER

MODIFIER

## Biased family leave.

STEM women's careers suffer disproportionately from taking family leave. Many fathers do not take paternal leave even where it is available.

*Play this card immediately and then place in the BURN pile. When given to another player, that player must skip their next two turns.*

MODIFIER

MODIFIER

## Ways of the Queen Bee

This phenomenon is complex and involves a variety of unconscious biases, but the general idea is that this describes situations where a successful woman will undermine her female colleagues.

*Play this card immediately and then place in the BURN pile. Take an achievement card from another player and play it on one of your own Scientists.*

MODIFIER

MODIFIER

## FTW!

Congratulations! Your achievements and contributions to science and humankind are being recognized.

*You may use this MODIFIER card as a resource (achievement or discipline) wildcard.*

MODIFIER

MODIFIER

## Trailblazer!

Although there is still much work to be done, things are better than they used to be. For this, we owe a huge thanks to the trailblazing efforts of many women in STEM.

*Play this card immediately and then place in the BURN pile. Pick up two extra cards from the resource pile and place in your hand for play. Note that negative MODIFIER cards (for either you or other players) are ignored and immediately placed in the BURN pile.*

MODIFIER

MODIFIER

## Tokenism and Marie Curie.

Why it is that Marie Curie is almost always the one person that is brought up over and over when talking about women in STEM?

*Play this card immediately and then place in the BURN pile. If you have more than one Scientist in progress, you must DISCARD all of them - and their cards - except for one.*

MODIFIER

MODIFIER

## Tokenism is not inclusion.

The Oxford Dictionary defines this as: The practice of making only a perfunctory or symbolic effort to do a particular thing, especially by recruiting a small number of people from under-represented groups in order to give the appearance of gender or racial equality within a workforce.

*Play this card immediately and then place in the BURN pile. If you have more than one Scientist in progress, you must DISCARD all of them - and their cards - except for one.*

MODIFIER

MODIFIER

## I'm with her.

Allies, the ones who are actively engaged, are so important.

*You can keep this card in your hand. Playable at any time - blocks the negative effects of one MODIFIER CARD. Burn after use.*

MODIFIER

MODIFIER



## We got your back.

Many successful women scientists have been supported by great organizations. For example, check out WWest (Westcoast Women in Engineering, Science and Technology - [www.wwest.ca](http://www.wwest.ca))

You can keep this card in your hand and burn after use. The next scientist you complete can give their resources to any of your other scientists. Resources not needed by your current Scientists are burned.

MODIFIER

MODIFIER

## Back handed compliment.

Unfortunately, this happens a lot. Said Voltaire of Emilie du Chatelet (physicist and mathematician), "She was a great man whose only fault was being a woman."

Play this card immediately and then place in the BURN pile. Discard all your cards from your hand this round.

MODIFIER

MODIFIER

## Credit where credit is due.

Congrats! You've made a major breakthrough! However, credit is disproportionately given to a male colleague or advisor.

Play this card immediately and then place in the BURN pile. Discard a resource card from one of your scientists.

MODIFIER

WoC MODIFIER

## Prove it again and again...

Women in STEM, particularly women of colour, often have to provide more evidence of being competent to be treated as equally capable as men.

Play this card immediately. Add this card to any active scientist who is a woman of colour (if yours is the only one, you have to play on your own). This scientist now requires an extra resource card to complete (it can be any of the ones required). If there are no active women of colour scientists, you may BURN this card.

WoC MODIFIER

WoC MODIFIER

## Mistaken for a janitor.

Almost half of black and latina women in STEM fields have been mistaken for a janitor or admin staff in their own offices.

Play this card immediately and then place in the BURN pile. Play on any active scientist who is a woman of colour (if yours is the only one, you have to play on your own). This scientist must discard one of their resource cards. If there are no active women of colour scientists, you may BURN this card.

WoC MODIFIER

WoC MODIFIER

## Good girls play nice.

Women in STEM report pressure to fill traditionally feminine roles. Asian-Americans report the most backlash for assertive, self promoting behaviours.

Play this card immediately and then place in the BURN pile. Play on any active scientist who is a woman of colour (if yours is the only one, you have to play on your own). This scientist must discard one of their resource cards. If there are no active women of colour scientists, you may BURN this card.

WoC MODIFIER

PHYSICS



discipline card



discipline card

PHYSICS

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CHEMISTRY



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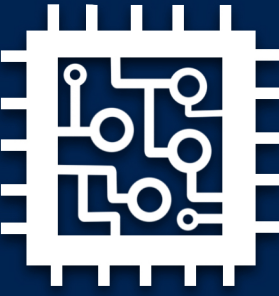
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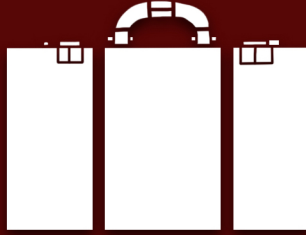
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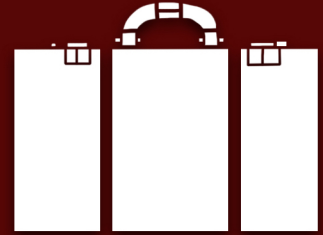
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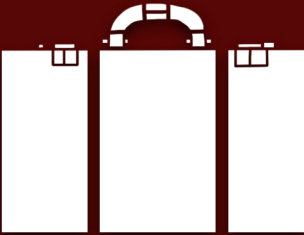
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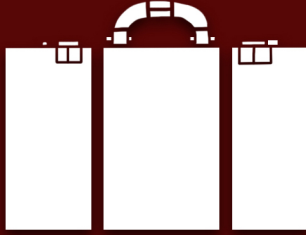
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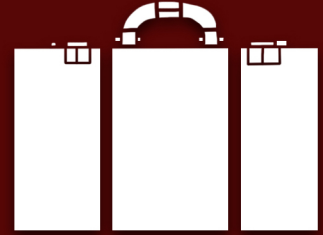
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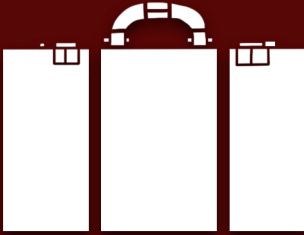
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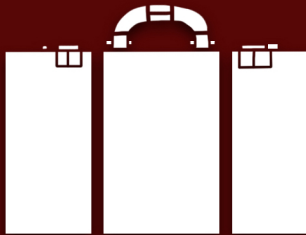
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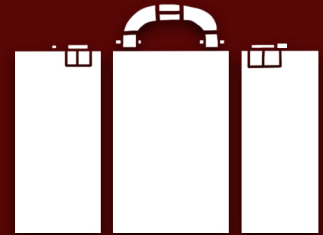
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DOCTORATE



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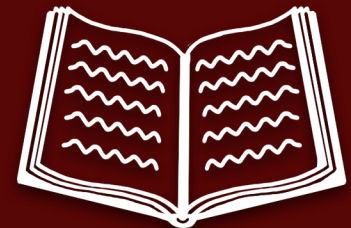
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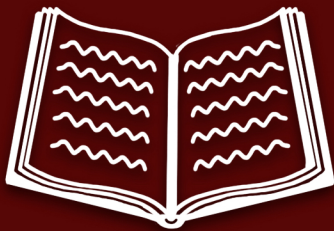
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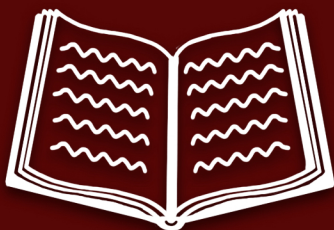
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TALENT



achievement card



achievement card



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GROUND BREAKER

achievement card

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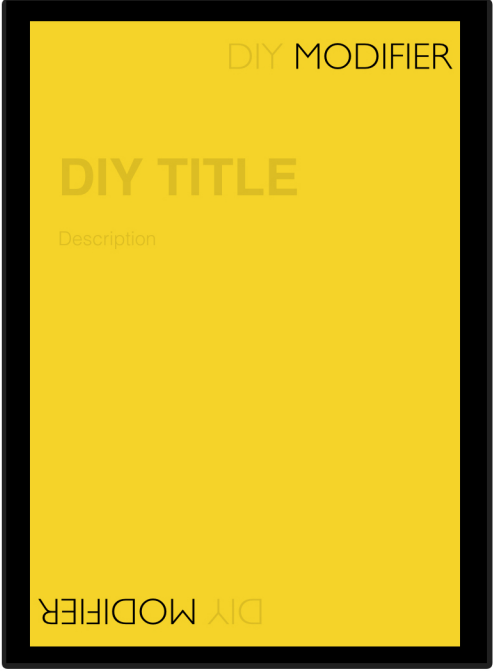
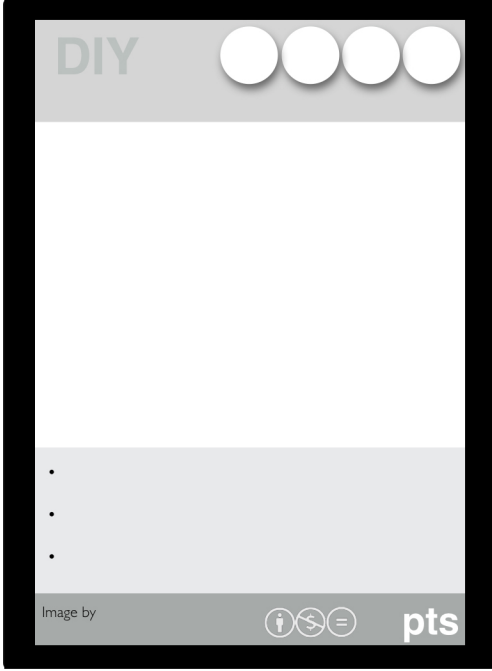
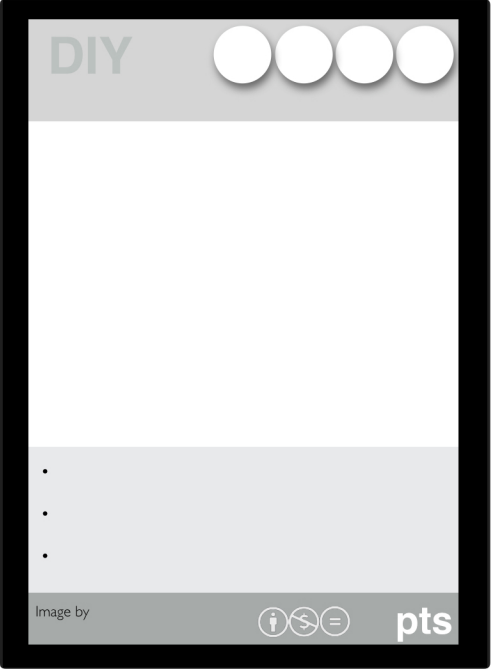
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## RULES

01

### The Women in Science and Engineering Starter Deck

Although patriarchy's stranglehold on science and engineering is ever-weakening, it still causes significant hurdles for scientists and engineers worldwide. You have the chance to support groundbreaking women in science and technology by securing resources for their careers. Advance science by completing as many careers as possible!

### Objective

The objective of the game is to obtain as many points as possible. The player with the most points at the end of the game is the winner. Points are gained by completing *Scientist/Engineer Cards*. In order to complete a *Scientist/Engineer Card* the appropriate combination of *Resource Cards* must be collected. Points from any incomplete *Scientist/Engineer Card* is subtracted from your total score at the end of the game.

Note that this deck also has a few blank cards for you to create and add your own DIY *Scientist Card* and/or your own DIY *Modifier Card*. If you tweet or Instagram these DIY cards with the hashtag #WISEdeck, we'll take a look in case there are future expansion decks!

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### The Deck

This deck contains a total of 74 cards which includes 21 *Scientist/Engineer Cards*, 77 *Resource Cards*, and 22 *Modifier cards*. This game is best played with 3 to 5 players, but can be played with 2.

Length of playing time is approximately 30 to 45 minutes but this can be easily adjusted by lowering the number of *Scientist/Engineer cards* used (see below).

#### Scientist/Engineer Cards:

Players obtain points upon completion of *Scientist/Engineer Cards*. Each of these cards requires a specific combination of *Resource Cards* which must be assigned to the scientist/engineer in order to be completed. Usually, the number of *Resource Cards* required to complete a project is the number of points collected by the player upon completion. At the end of the game, incomplete *Scientist/Engineer Cards* result in negative points equal to the point value of the card.

Note that some of the scientists/engineers are women of colour (WoC), and therefore may have additional obstacles in game. Because of this, their cards may be more difficult to complete and are consequently worth an extra point.

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Symbols for resources required for project completion (discipline and achievements)\*

Name and some interesting biographical notes.

Number of points won if the project is completed. Points lost if incomplete.

\*Note that women of colour are not specifically labeled as such.

#### Resource Cards:

*Resource Cards* include *Discipline cards*, and *Achievement Cards* which contribute towards completing *Scientist/Engineer Cards*. They also include *Modifier Cards*, which can affect gameplay in special ways.

**Discipline Cards:** The field(s) of research that the woman was involved in.

**Achievement Cards:** These cards reflect additional activities that the woman may have been involved in.

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#### Modifier Cards:

These cards generally reflect issues related to gender equity and have effects (explained in the card text) that can impede or help a player complete their *Scientist/Engineer cards*. Note that some *Modifier Cards* are specifically aimed at women of colour scientists/engineers (WoC).

### Set Up

#### The Playing Field

There are 4 main card "piles" in the game.

- Resource Card pile** – contains the shuffled up *Resource Cards* face down.
- Scientist/Engineer Card pile** – contains the *Scientist/Engineer Cards* face down.
- Discard pile** – contains discarded cards face up (at the beginning, this will be empty).
- Burn pile** – (also empty at the beginning) contains face down *Discipline* and *Achievement Cards* that were used to complete *Scientist/Engineer Cards* as well as used *Modifier Cards*.

Once the *Resource Card* pile is completely used up, the *Burn pile* and *Discard pile* (minus the top card) are combined, shuffled and used to replenish the new *Resource Card* pile.

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To start the game, place all the *Resource Cards* and *Scientist/Engineer Cards* face down in two separate piles between the players. As the game progresses, a *Discard* pile and a *Burn* pile will be generated. Position the piles as below:



### Playing

Each player starts with a hand of two *Resource Cards*, and one *Scientist/Engineer Card*. If you pick up a *Modifier Card* at the beginning, return it to the middle of the *Resource* pile – unfortunately, this also means you will be starting with a smaller hand. Every turn consists of three basic phases: A draw phase, an action phase and a discard phase.

- 1. Draw:** At the start of their turn (youngest player goes first), the player draws two cards, in any combination, from the *Scientist/Engineer Card* pile, the *Resource Card* pile or the *Discard* pile (ie. 2 cards from the *Resource Card* pile or 1 card each

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from the *Scientist/Engineer Card* and *Resource Card* pile, etc). The player must pick up both cards before looking at either of them. Only the top cards in the *Discard* pile can be drawn (ie. you cannot look through *Discard* pile).

**2. Action:** The player can now choose to do as many of the following actions during their turn.

#### i) Start and/or work on a scientist/engineer.

To start a scientist/engineer, place a *Scientist/Engineer Card* face up in front of you. By doing this, you commit to finishing the card. If you do not finish it, you will be deducted the point value of the project at the end of the game. There is no limit to the number of projects you can work on at the same time. Finishing a scientist/engineer card, involves placing required *resource cards* from your hand beside the *scientist/engineer card* on the playing field.

#### ii) Complete a scientist/engineer.

A scientist/engineer is completed when you have acquired all the *Resource Cards* needed for the project and placed them beside the *Scientist/*

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*Engineer Card* on the playing field. Take the completed *Scientist/Engineer Card* and set it aside. Place the associated *Resource Cards* face down in the *Burn* pile.

#### iii) Use a Modifier Card.

*Modifier Cards* are *Resource Cards* that result in special actions. They might help complete or disrupt a player's progression. Read these cards carefully. Many require you to use them immediately, but there are a few that let you keep in your hand. As well, there are a few *WoC Modifier Cards* which can only be used on women of colour.

- 3. Discard.** At the end of your turn, you must discard cards from your hand into the *Discard* pile face up if your hand size is LARGER than the number of *Scientist/Engineer Cards* you have in progress. For example, if you are working on one *Scientist/Engineer Card*, you can only hold one card at the end of your turn. If you have no active *Scientist/Engineer Cards* (completed *Scientist/Engineer Cards* do not count), you must discard your entire hand. Note that *Scientist/Engineer*

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*Cards* can only be discarded if they are in your hand (ie. Active ones on the table cannot be discarded).

### Ending the Game

When the last *Scientist/Engineer Card*\* is drawn from the *Scientist/Engineer* pile, the next player to complete a *Scientist/Engineer Card* ends the game. After this player finishes a *Scientist/Engineer Card*, all players get one more turn before the game ends. Then, players tally up all their points: positive points for completed *Scientist/Engineer Cards* and negative points for unfinished *Scientist/Engineer Cards* left on the field. The player with the most points wins the game.

For example: Dave completed a 4-point card, a 2-point card, and has an unfinished 3-point card. He gets 4 + 2 - 3 = 3 points at the end of the game.

\* Note that you can play with fewer *Scientist/Engineer Cards* to start. This can be done to adjust the total playing time.

## CREDITS

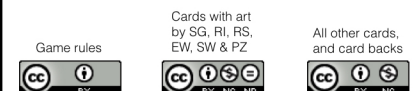
### Credits

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For more information about the WWEST, please visit <http://www.wwest.ca>

For more information about the PHYLO card game, please visit <http://phylogame.org>