RULES

The GSA Starter Deck
You are a busy geneticist working on multiple research projects using model organisms. At the end of the day, you want to complete as many projects as possible. Projects can be completed by collaborating with other scientists or by working independently. Let the science and games begin!

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 Project Cards. In order to complete a Project Card the appropriate combination of Resource Cards must be collected. Points from any uncompleted Project Cards are 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 research DIY Project Cards and/or your own DIY Modifier Cards if you tweet or Instagram these DIY cards with hashtag #GSAdeck, see if they take a look in case there are future expansion ideas.

Project Cards:
Players obtain points upon completion of Project Cards. Each Project Card requires a specific combination of Resource Cards which must be assigned to the project in order to be completed. 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, uncompleted Project Cards result in negative points equal to the point value of the card.

The Deck
This deck contains a total of 74 cards which includes 16 Project Cards and 58 Resource Cards. This game is best for 2 to 5 players.

Note that at the bottom of the Species Cards, there is a cluster of symbols and numbers. This information is provided so that these Species cards can be used in the general PHYLO game system (see playphaire.org). For the GSA game, you can ignore this.

Modifier Cards:
These cards are played, the described effect is activated immediately unless stated otherwise.

Set Up
The Playing Field
There are 4 main card “piles” in the game.
2. Project Card Pile – contains the Project Cards face down.
3. Discard Pile – contains discarded cards face up.
4. Burn Pile – contains face down Resource Cards used to complete Project Cards and used Modifier Cards. Once the Resource Card Pile is completely used, the Burn Pile is shuffled and replenished the new Resource Card Pile.

To start the game, place all the Resource Cards and Project 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:

 Resource (face down) Project (face down) Discard (face up) Burn (face down)

Playing
Each player starts with a hand of two Resource Cards, and one Project Card. Decide who goes first! 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, the player draws two cards from the Project Card Pile, the Resource Card Pile or the Discard Pile and in any combination (ex: 2 cards from the Resource Card Pile or 1 card from the Project Card and Resource Card pile). 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. Cannot sort 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 project.
To start a project, place a Project Card face up in front of you. By doing this, you commit to finishing the project. 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. To work on a project, place resource cards from your hand beside the project card on the playing field that requires that resource.

ii) Complete a project.
A project is completed when you have acquired all the Resource Cards needed for the project and placed them beside the Project Card on the playing field. Take the completed Project 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 give you special abilities. They might help you complete your projects or disrupt another player's project.

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 projects you have in progress. For example, if you are working on one project independently and one collaborative project, you can hold two cards at the end of your turn.

Ending the Game
When the last Project Card is drawn from the Project Card Pile, the next player to complete a project ends the game. After this player finishes a project, all players get one more turn, then the game ends and players tally up all their points: positive points for completed Project Cards and negative points for unfinished Project Cards left on the field. The player with the most project points wins the game.

For example: Dave completed a 4-point Project, a 2-point Project, and has an unfinished 5-point Project. He gets 4 + 2 + (-3) = 3 point projects at the end of the game.

RULES

IV) Collaborate with another scientist.
Sometimes it may be in the player's best interest to collaborate on projects with other players. During a collaboration, one Project Card from each player is pushed together so the top of the cards are touching. Resource Cards are placed beside the Project Cards. If both projects in the collaboration require the same Resource Card, only one Resource Card of that type is needed for both projects.

Once the requirements for BOTH projects are completed, each player takes their own Project Card and can claim the associated points for THEIR project at the end of the game (ie. The players only receive the points for their project in the collaboration and do not share the points for both projects).

RULES

IMPORTANT RULES FOR COLLABORATIONS
- Both players must agree to the collaboration for a collaboration to happen.
- Collaborations can only be initiated if no more than ONE Resource Card is already attached under each of the projects. (ie. If you are working on a project and have already put two resource cards on it, you cannot start a collaboration on that project).
- You may collaborate with as many players as you want, with a maximum of ONE collaboration at a time with each player. For example, if there are 4 players, you may have a maximum of 1 collaboration with each player at a time, for a total of 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 projects you have in progress. For example, if you are working on one project independently and one collaborative project, you can hold two cards at the end of your turn.

RULES

If you have no active projects, you must discard your entire hand. Project Cards can be held in your hand, but do not count towards the hand size limit. Additionally, only Project Cards in your hand may be discarded (ie. Active projects cannot be discarded).
**RULES**

**Credits**

Game Design Team: Sidney Ang, Genevieve Leduc-Robert, Lu Li and Sam McKinnon.


Special Thanks to David Ng, Phil Hieter, and the GSA Education Committee.

Support from the Genetics Society of America, the Canadian Institute for Advanced Research, the Canadian Institutes of Health Research, the Canadian Society for Molecular Biosciences, the Michael Smith Laboratories, and the Canadian Rare Disease: Models and Mechanisms Network.

For more information about the GSA, please visit [http://www.genetics-gsa.org/](http://www.genetics-gsa.org/)

For more information about the PHYLO card game, please visit [http://phylogame.org](http://phylogame.org)

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**YEAST**

Saccharomyces cerevisiae
Schizosaccharomyces pombe

The simple reproduction and powerful genetic tools of these unicellular eukaryotes make them ideal for genetic functional studies. The budding (S. cerevisiae) and fission (S. pombe) yeasts are premier model organisms to study the function of genes and pathways required for eukaryotic cell biology. APOYG!

Art by Claudia Stocker: [chandara](http://www.chandara.com)

- **Cool:** pt 2
- **Warm:** pt 1
- **Hot:** pt 1
- **Anywhere except ocean:** 2

---

**FROG**

Xenopus laevis, Xenopus tropicalis

Commonly known as the “clawed frog,” this amphibian’s large embryos and eggs are easy to obtain and manipulate for medical and developmental research.

Art by David Orr: [davidongenic.com](http://davidongenic.com)

- **Cool:** pt 5
- **Warm:** pt 3
- **Move of 2:** 3
- **False plankton:** 3

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**ZEBRAFISH**

Danio rerio

An ideal model organism for research in development, genetics, and stem cell research due to its large transparent embryos and regenerative abilities. Its shiny stripes and simple needs also make it a popular aquarium pet.

Art by Amy Dale: [aliasale](https://www.aliasale.com)

- **Cool:** pt 5
- **Warm:** pt 3
- **Move of 2:** 3
- **False plankton:** 3

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**CILIATES**

Tetrahymena (genus)

These unicellular protists use hair-like cilia for locomotion and feeding. They are important to biomedical research and have contributed to our understanding of many cellular and biochemical processes.

Art by David Orr: [davidongenic.com](http://davidongenic.com)

- **Cool:** pt 2
- **Warm:** pt 1
- **Move of 1:** 3
- **False plankton:** 3
**MOUSE**

*Mus (genus)*

The mouse is the most widely used mammalian model system. Its physiological and genetic similarity to humans makes it ideal for medical research.

**C. ELEGANS**

*Caenorhabditis elegans*

This transparent nematode (roundworm) is no more than 1mm in length, making it easy to examine for inherited traits during genetic studies. It has the distinction of being the first multicellular organism to have its genome sequenced.

**FRUIT FLY**

*Drosophila melanogaster*

This tiny fly has been a favorite model organism among geneticists for over 100 years, due to its short life cycle, prolific reproduction, ease of mutation, and ease of identifying inherited traits.

**ARABIDOPSIS**

*Arabidopsis thaliana*

This small flowering plant from the mustard family is an ideal model organism because of its short generation time, large yield, and small genome. It was the first plant to have its entire genome sequenced.
MOLECULAR GENETICS
Research Technique
Lab methods that manipulate tissue, DNA, and proteins to study the structure, function and interaction of genes.

Examples: Extraction, Cloning and Amplification of DNA and RNA, gene knockdown and mutagenesis.

Art by David Orr
davidorgenic.com

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Generation and propagation of organisms of the same genetic strain, allowing researchers to produce populations of organisms with defined mutations, to study traits and to understand biological systems.

Examples: Inbreeding, genetic crosses, cell culture, and mutagenesis.

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The visual representation of an organism’s exterior and interior at different magnifications.

Examples: Microscopy, radiography, fluorescent probes, and biomarkers.

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Research Technique

The use of computers to store, organize, and analyze biological data. The exponential growth of data produced with next generation sequencing has made bioinformatics essential to genetics research.

Examples: Genome assembly, genetic variant detection, sequence alignment, network analysis, and text mining.

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Art by David On

davidong.com

Cancer Research

Project Card, Genetics Society of America

Task: Study the genetics of cancer using a model organism.

www.genetics-gsa.org/education

4pts

Whole Genome Sequencing

Project Card, Genetics Society of America

Task: Sequence the entire genome of an organism of your choosing.

www.genetics-gsa.org/education

3pts

Software Development

Project Card, Genetics Society of America

Task: Design a computer program for analyzing genetic data.

www.genetics-gsa.org/education

3pts

Invertebrate Cytogenetic Analysis

Project Card, Genetics Society of America

Task: Investigate chromosome arrangements, forms, and behaviors in an invertebrate model organism.

www.genetics-gsa.org/education

2pts

Telomere Study

Project Card, Genetics Society of America

Task: Study the maintenance, structure, and localization of telomeres (a genetic component in aging) in a single celled model organism.

www.genetics-gsa.org/education

2pts

Invertebrate Gene Knockout

Project Card, Genetics Society of America

Task: Study the biological effects of disrupting specific genes in a multicellular model organism.

www.genetics-gsa.org/education

4pts

Unicellular Transposon Study

Project Card, Genetics Society of America

Task: Identify the structure and location of transposable elements in the genome, as well as their possible role in epigenetic control.

www.genetics-gsa.org/education

3pts
**Rare Disease Gene Study**
*Project Card, Genetics Society of America*

**Task:** Identify a new rare disease gene and study its function in a model system.

4pts

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**Vertebrate Embryonic Development Study**
*Project Card, Genetics Society of America*

**Task:** Determine the role of chromatin structure in embryonic development and its contribution to stem cell properties.

3pts

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**Vertebrate SNP Analysis**
*Project Card, Genetics Society of America*

**Task:** Identify genetic variation associated with psychiatric disorders using a single-nucleotide polymorphism (SNP) array.

3pts

---

**Phylogenetic Analysis**
*Project Card, Genetics Society of America*

**Task:** Infer the evolutionary relationships of different species by comparing their genetic sequences.

4pts

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**Vertebrate CRISPR / Cas Genome Editing**
*Project Card, Genetics Society of America*

**Task:** Use modified bacterial DNA segments (CRISPRs) to silence, enhance, or otherwise alter genes of a vertebrate organism.

2pts

---

**Common Garden Experiment**
*Project Card, Genetics Society of America*

**Task:** Differentiate between genetic and environmental effects on plant traits such as growth and flowering time.

3pts

---

**Plant Transcriptomics**
*Project Card, Genetics Society of America*

**Task:** Study changes in gene expression that occur when plants defend themselves from pests and pathogens.

4pts

---

**Unicellular Genomic Stability Study**
*Project Card, Genetics Society of America*

**Task:** Study the genes responsible for the maintenance of chromosome structure and genome stability.

4pts

---

**Invertebrate Hybrid Study**
*Project Card, Genetics Society of America*

**Task:** Study the genetics of reproductive isolation by mating two different genetic lines to produce hybrid organisms.

3pts
SWAP PROJECTS
Modifier Card

You have the opportunity to exchange ideas and expertise with another scientist.

Play: Choose a player and take one of their projects and associated resources. Give them one of your projects and associated resources.

May not be used on collaborative or mandatory projects.

Art by Mali Naro
www.popsci.com/blog/network/boxplot

LOSE FUNDING!
Modifier Card

Budget cuts create project setbacks. Noooo!

Play: Place on top of another player's RESEARCH TECHNIQUE card. The card affected is immediately removed and placed in the burn pile along with this card.

Art by Mali Naro
www.popsci.com/blog/network/boxplot

HUMAN ERROR!
Modifier Card

Something isn't working! Perhaps your samples are contaminated, you lost your data, or forgot to feed your organism.

Play: Place face up on another player's species card. The covered species card is immediately placed in the burn pile along with this card.

Art by Mali Naro
www.popsci.com/blog/network/boxplot

GRANT APPROVED
Modifier Card

You just got funded!

Play: You may play this card in place of a RESEARCH TECHNIQUE card for one project. You do not have to specify which technique it is being used for until the project is complete.

Art by Mali Naro
www.popsci.com/blog/network/boxplot

GRANT APPROVED
Modifier Card

You just got funded!

Play: You may play this card in place of a SPECIES card for one project. You do not have to specify which species it is being used for until the project is complete.

Art by Mali Naro
www.popsci.com/blog/network/boxplot

RESOURCE DONATION
Modifier Card

A neighboring lab has a resource you want and generously offers it to you.

Play: Take a resource from another player's project and place it in your hand. Place this card in the burn pile after use.

Art by Mali Naro
www.popsci.com/blog/network/boxplot

Lab Preparations
Mandatory Project, Genetics Society of America

Before starting a molecular genetics project, you must prepare your reagents and optimize your protocol.

Play: Give to another player. No points for completing. Minus 2 points for NOT being completed. Cannot be involved in collaborations.

www.genetics-gsa.org/education

-2pts

Increase Sample Size
Mandatory Project, Genetics Society of America

Your reviewers are not convinced by your results and want you to increase your sample size. Collect 2 species cards in the same category.

Play: Give to another player. No points for completing. Minus 2 points for NOT being completed. Cannot be involved in collaborations.

www.genetics-gsa.org/education

-2pts

JOIN A SOCIETY
Modifier Card

Founded in 1931, the Genetics Society of America is the professional scientific society for genetics researchers and educators. The Society's more than 5,500 members worldwide work to deepen our understanding of the living world by advancing the field of genetics, from the molecular to the population level.

web: www.genetics-gsa.org

Play: During your turn, you may use this card to look at the top three cards from the resource pile. From these, you may take one, and return the other two to the top of the pile.
<table>
<thead>
<tr>
<th>Card</th>
<th>Modifier Card</th>
</tr>
</thead>
</table>
| **CONNECTION MADE!** | Models & Mechanisms Network has been established to catalyze connections between clinician scientists discovering new disease gene mutations in patients with rare diseases, and basic scientists who can analyze equivalent genes and pathways in model organisms.  
web: [www.rare-diseases-catalyst-network.ca](http://www.rare-diseases-catalyst-network.ca)  
Play: During your turn, you may use this card to pick up two extra cards from any pile except for the burn pile. |
| **JOIN A SOCIETY** | The Canadian Society for Molecular Biosciences fosters interaction, communication and collaboration among discovery scientists and trainees in Canada and abroad, to advance the molecular understanding of biology, and to play a strong advocacy role for promoting the value of basic science in society.  
web: [csmb-scmb.ca](http://csmb-scmb.ca)  
Play: During your turn, you may use this card to look at the top three cards from the resource pile. From these, you may take one, and return the other two to the top of the pile. |
| **OUTREACH** | Home to more than 300 researchers, the Michael Smith Laboratories at the University of British Columbia, is home to internationally renowned programs of research, training, and outreach including the team that brought you this card game.  
web: [msh.ubc.ca](http://msh.ubc.ca)  
Play: During your turn, you may use this card to look at the top two cards from the project pile. From these, you may take one, and return the other one to the top of the pile. |
| **CATALYZE IDEAS** | CIFAR has been successfully taking on complex challenges for more than three decades. Our global research programs connect many of the world’s best minds – across borders and disciplines – to shape new perspectives and spark groundbreaking ideas.  
web: [www.cifar.ca](http://www.cifar.ca)  
Play: During your turn, you may use this card to look at the top two cards from the project pile. From these, you may take one, and return the other one to the top of the pile. |
| **FUND RESEARCH** | The Canadian Institutes of Health Research (CIHR) is Canada’s federal funding agency for health research. Composed of 19 Institutes, CIHR provides leadership and support to more than 13,000 health researchers and trainees across Canada.  
web: [www.cihr-irsc.gc.ca](http://www.cihr-irsc.gc.ca)  
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| **DIY MODIFIER (TITLE HERE)** | Description:  
web: [www.genetics-gsa.org/education #GSAdeck](http://www.genetics-gsa.org/education #GSAdeck)  
By: |
Title here.
DIY Project Card

Task:

Project Card, Your Name & Group