RULES 01

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 the hashtag **#GSAdeck**, we'll take a look in case there are future expansion decks!

RULES 02

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 also used in the general PHYLO game system (see phylogame.org). For the GSA game, you can ignore this.

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.

RULES 03

Symbols for resources required for project completion (species and research techniques)

Project title and brief description.

Number of points won if the project is completed.

Note that there are some *mandatory project cards*. These are not worth points, but if not completed will result in negative points!

Resource Cards:
Resource Cards include *Species cards*, *Research Technique Cards*, and *Modifier Cards* and contribute to completing *Project Cards* or impeding other players.

Species Cards: An organism needed to complete a project.
Research Techniques Cards: Research techniques needed to complete a project.

RULES 04

Modifier Cards: When 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.

1. **Resource Card Pile** – contains the *Resource Cards* face down.
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 replenishes 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

RULES 05

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).

RULES 06

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.

RULES 07

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 08

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.

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 09

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).

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 3-point Project. He gets 4 + 2 - 3 = 3 project points at the end of the game.

RULES 10
Credits

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

Art by Amy Dale, Maki Naro, David Orr, Claudia Stocker, and Joe Wierenga. Card back design by Suzanne Norris, Phylo logo by Haley Fiege.

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

FROG
Xenopus laevis, Xenopus tropicalis

Animalia, Chordata, Amphibia

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
davidorogenic.com

PHYLO 5 3*3pts
COOL WARM | MOVE OF 2 | *also plankton

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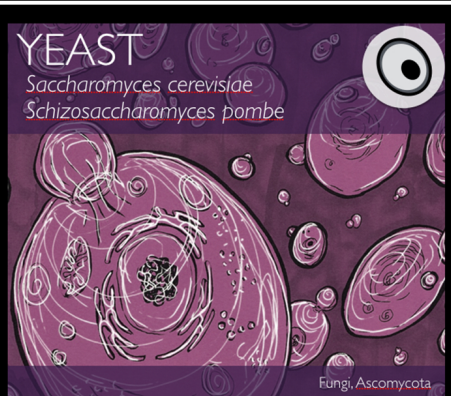
YEAST
Saccharomyces cerevisiae
Schizosaccharomyces pombe



Fungi, Ascomycota

The simple reproduction and powerful genetic tools of these unicellular eukaryotes make them ideal for gene 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
vividbiology.com

PHYLO * 2 | 1 pt
COOL WARM HOT | *anywhere except ocean

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Danio rerio

Animalia, Chordata, Actinopterygii

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
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CILIATES
Tetrahymena (genus)

Chromalveolata, Ciliophora

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.

PHYLO 2 | 3pts
COOL WARM | MOVE OF 1

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MOUSE
Mus (genus)

Animalia, Chordata, Mammalia

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

PHYLO 5 3 2pts
COOL WARM | MOVE OF 2
Art by Joe Wierenga joewierenga.com/

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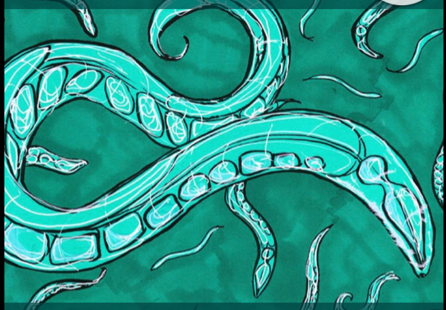
Caenorhabditis elegans



Animalia, Nematoda, Chromadorea

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.

PHYLO 3 2* 5pts
COOL WARM | MOVE OF 1 | *bacteria + rotting plants
Art by Claudia Stocker vividbiology.com

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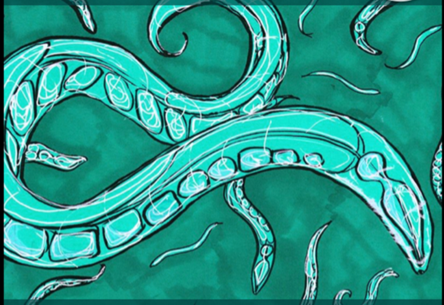

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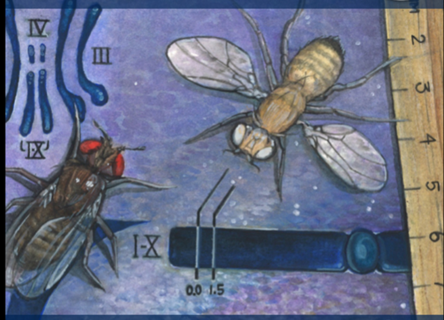
FRUIT FLY
Drosophila melanogaster



Animalia, Anthropoda, Insecta

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.

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Art by Amy Dale alsdale.deviantart.com

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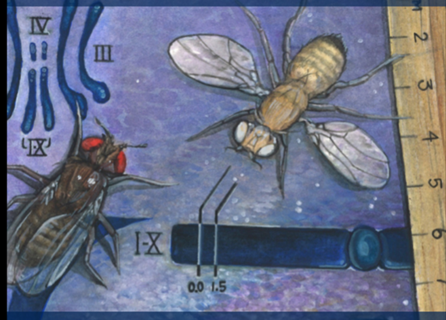

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ARABIDOPSIS
Arabidopsis thaliana

Plantae, Angiosperms, Eudicots

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.

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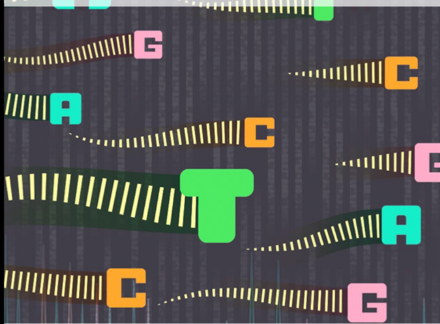
SEQUENCING

S

Research Technique



Determining the order of nucleotides of a DNA or RNA fragment. Sequencing may be applied to small and large amounts of nucleic acids from a single gene to a whole genome.

Examples: Sanger sequencing, Sequencing by Synthesis, Next-Generation Sequencing techniques.

Art by David Orr
davidorogenic.com

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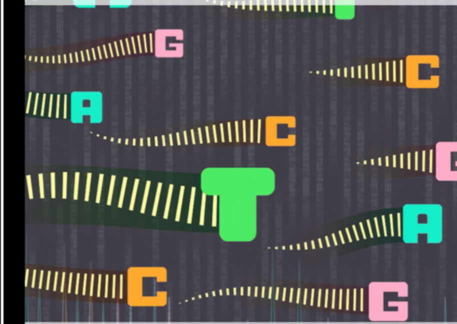

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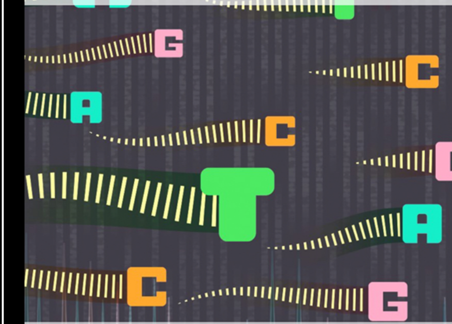

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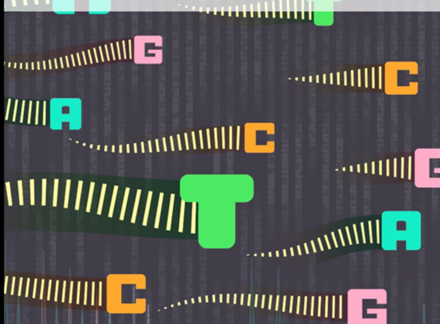

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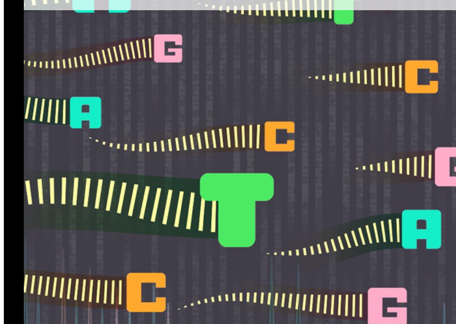

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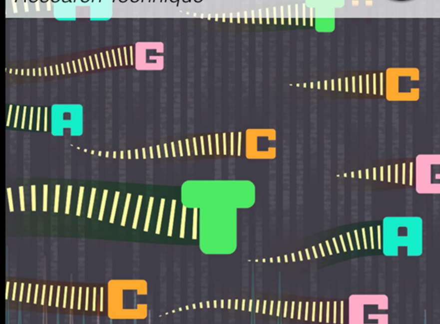

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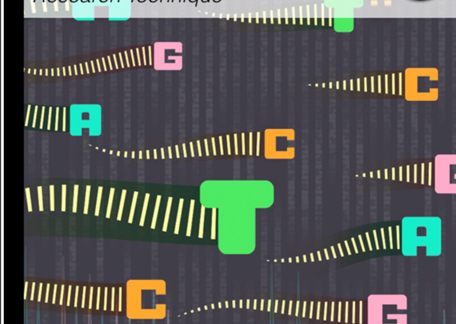

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MOLECULAR GENETICS

M

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.

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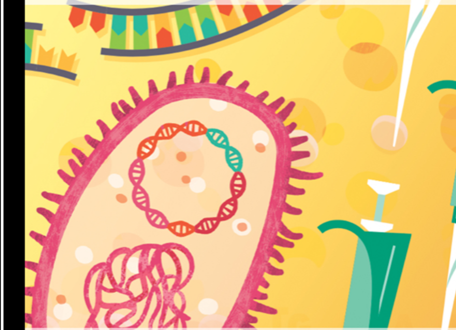

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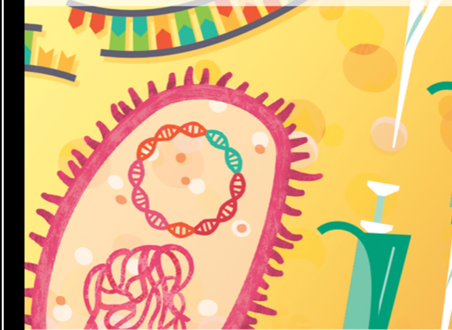

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GENETIC ANALYSIS G
Research Technique

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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Research Technique

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

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

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BIOINFORMATICS
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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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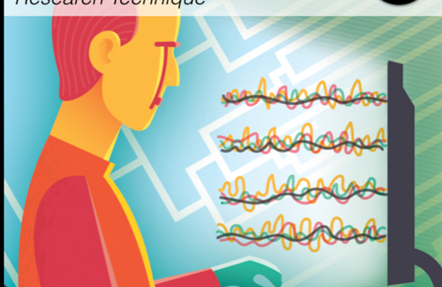

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S M I

CHOOSE 1 SPECIES

Cancer Research

Project Card, Genetics Society of America

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

https://commons.wikimedia.org/wiki/File:HeLa-V.jpg

www.genetics-gsa.org/education

4pts

S S

CHOOSE 1 SPECIES

Whole Genome Sequencing

Project Card, Genetics Society of America

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

https://commons.wikimedia.org/wiki/File:RPL-P0_90_ClustalW_aln.gif (by Miguel Andrade)

www.genetics-gsa.org/education

3pts

B B

CHOOSE 1 SPECIES

Software Development

Project Card, Genetics Society of America

Task: Design a computer program for analyzing genetic data.

https://commons.wikimedia.org/wiki/File:The_protein_interaction_network_of_Treponema_pallidum.png (by Häuser et al. doi:10.1371/journal.pone.0002292)

www.genetics-gsa.org/education

3pts

I

Invertebrate Cytogenetic Analysis

Project Card, Genetics Society of America

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

https://commons.wikimedia.org/wiki/File:Chr2_orang_human.jpg (by Stefan Müller)

www.genetics-gsa.org/education

2pts

I

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.

https://commons.wikimedia.org/wiki/File:Telomere_caps.gif

www.genetics-gsa.org/education

2pts

S G I

Invertebrate Gene Knockout

Project Card, Genetics Society of America

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

https://commons.wikimedia.org/wiki/File:EyeColors.jpg

www.genetics-gsa.org/education

4pts

S B

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.

https://commons.wikimedia.org/wiki/File:PDB_1muh_EBI.jpg

www.genetics-gsa.org/education

3pts

S M B

CHOOSE 1 SPECIES

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.

www.genetics-gsa.org/education

4pts

https://commons.wikimedia.org/wiki/File:DNA_Structure%2BKey%2BLabelled.pn_NoBB.png

I M

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.

www.genetics-gsa.org/education

3pts

https://commons.wikimedia.org/wiki/File:A_fly%27s_first_breath_2.png (by Yosoyden)

B M

Vertebrate SNP Analysis

Project Card, Genetics Society of America

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

www.genetics-gsa.org/education

3pts

https://commons.wikimedia.org/wiki/File:DNA_microarray.svg (by Guillaume Paumier)

S B

CHOOSE 2 SPECIES

Phylogenetic Analysis

Project Card, Genetics Society of America

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

www.genetics-gsa.org/education

4pts

https://commons.wikimedia.org/wiki/File:Simplified_tree.png

M

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.

www.genetics-gsa.org/education

2pts

https://commons.wikimedia.org/wiki/File:181-CascadeAndCRISPR_1vy8.tiff (by David Goodsell)

S G

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.

www.genetics-gsa.org/education

3pts

https://commons.wikimedia.org/wiki/File:Arabidopsis_Thaliana_planted_in_Laboratory.JPG (by Jucember)

S M B

Plant Transcriptomics

Project Card, Genetics Society of America

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

www.genetics-gsa.org/education

4pts

https://commons.wikimedia.org/wiki/File:Heatmap.png

S B I

Unicellular Genomic Stability Study

Project Card, Genetics Society of America

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

www.genetics-gsa.org/education

4pts

https://en.wikipedia.org/wiki/File:Spectralkaryotype96-300.jpg

S G

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.

www.genetics-gsa.org/education

3pts

https://commons.wikimedia.org/wiki/File:Drosophila_in_the_lab.jpg (by cudmore)

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 use on collaborative or mandatory projects.

Art by Maki Naro
www.popsci.com/blog-network/boxplot

LOSE FUNDING!

Modifier Card

CAN BE PLAYED ON **M S G I B**

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 Maki Naro
www.popsci.com/blog-network/boxplot

HUMAN ERROR!

Modifier Card

CAN BE PLAYED ON

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 players species card. The covered species card is immediately placed in the burn pile along with this card.

Art by Maki Naro
www.popsci.com/blog-network/boxplot

GRANT APPROVED

Modifier Card

M S G I B

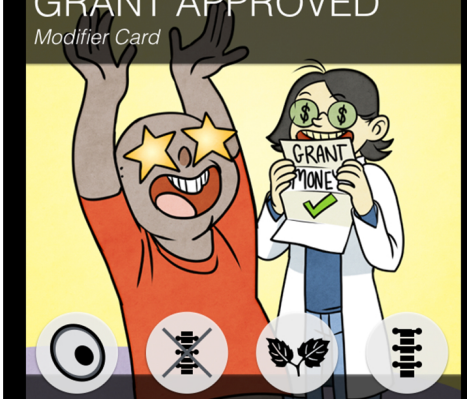
You just got funded!

Play: You may use 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 Maki Naro
www.popsci.com/blog-network/boxplot

GRANT APPROVED

Modifier Card



You just got funded!

Play: You may use 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 Maki 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 Maki Naro
www.popsci.com/blog-network/boxplot

M S

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

COLLECT 2 OF SAME

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

GSA®
Genetics Society of America

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.

CONNECTION MADE!

Modifier Card

RARE DISEASES MODELS and MECHANISMS NETWORK

The Canadian Rare Diseases: 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

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

Modifier Card

CSMB SCBM

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-scbm.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

Modifier Card

UBC MICHAEL SMITH LABORATORIES

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: www.msl.ubc.ca | bioteach.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

Modifier Card

CIFAR
CANADIAN INSTITUTE FOR ADVANCED RESEARCH

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

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

Modifier Card

CIHR IRSC
Canadian Institutes of Health Research | Instituts de recherche en santé du Canada

The Canadian Institutes of Health Research (CIHR) is Canada's federal funding agency for health research. Composed of 13 Institutes, CIHR provides leadership and support to more than 13,000 health researchers and trainees across Canada.

web: www.cihr-irsc.gc.ca

Play: During your turn, you may use this card to pick up two extra cards from any pile except for the burn pile.

DIY MODIFIER (TITLE HERE)

Modifier Card

Doodle picture here

Description:

Play:

www.genetics-gsa.org/education **#GSAdeck** By:

DIY MODIFIER (TITLE HERE)

Modifier Card

Doodle picture here

Description:

Play:

www.genetics-gsa.org/education **#GSAdeck** By:

DIY MODIFIER (TITLE HERE)

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Doodle picture here

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Play:

www.genetics-gsa.org/education **#GSAdeck** By:

DIY MODIFIER (TITLE HERE)

Modifier Card

Doodle picture here

Description:

Play:

www.genetics-gsa.org/education **#GSAdeck** By:

DIY ORGANISM CARD

scientific name

Kingdom, Phylum, Class

Description:

PHYLO

By:

www.genetics-gsa.org/education **#GSAdeck**

DIY ORGANISM CARD

scientific name

Kingdom, Phylum, Class

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DIY MODIFIER (TITLE HERE)

Modifier Card

Doodle picture here

Description:

Play:

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DIY MODIFIER (TITLE HERE)

Modifier Card

Doodle picture here

Description:

Play:

www.genetics-gsa.org/education **#GSAdeck** By:

Choose organism Write down techniques

Title here. DIY Project Card

Project Card, Your Name & Group

Task:

www.genetics-gsa.org/education **#GSAdeck**

pts

Choose organism Write down techniques

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Project Card, Your Name & Group

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pts


Phylo
CIHR IRSC
Canadian Institutes of Health Research
Instituts de recherche en santé du Canada
CIFAR
CANADIAN INSTITUTE FOR ADVANCED RESEARCH
GSA
Genetics Society of America
CSMB SCBM
UBC Michael Smith Laboratories
RARE DISEASES MODELS and MECHANISMS NETWORK