

Printable Rulebook for Astromania : The Astronomy Card Game

Welcome, researcher!

Congratulations on making it to astronomy graduate school! You have been presented with the opportunity to contribute to professional astronomy research. You'll be studying objects in space by collaborating with other astronomers, using cool new telescopes and tools, and get a chance to publish your work in the prestigious Astromania journal.

Game Components

This pdf file is the Print and Play version of Astromania : The Astronomy Card Game. This document has 27 pages split into two parts :

- The Rulebook (rulebook.pdf, pages 1 - 13)
- Printable version of all cards and tokens (pages 13 - 27)

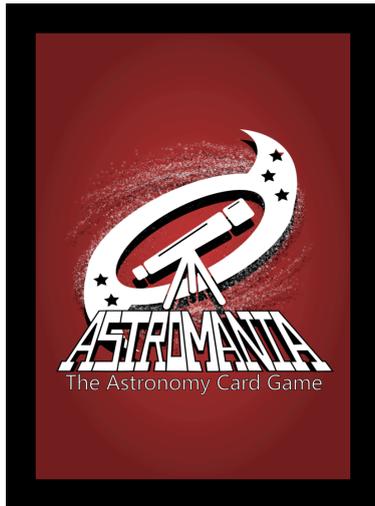
In addition to this file, you will need two six sided dice (2d6) to play the game.

See the end of this document for an index of the pdf file with cards and tokens and the number of copies you should print per page.

In addition to playable cards, the printable version also includes 3 printable reference cards with summary of allowed actions during a player's turn.

Card Types

Astromania has three types of cards :



Draw Deck:

Draw cards from this deck to add to your hand.



Sky Deck:

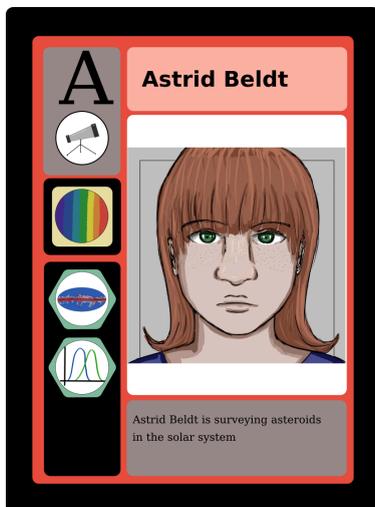
This deck has Objects for you to study. Add cards to Starboard from here.



Prompt Deck:

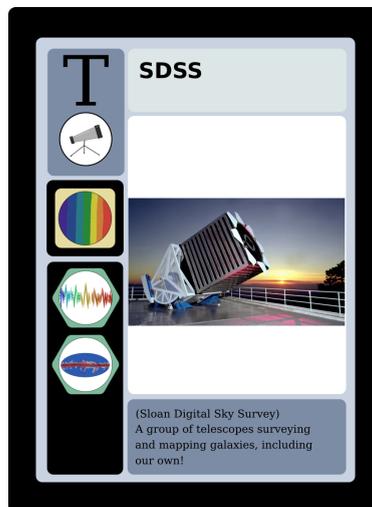
This deck has Prompts you work towards clearing. Draw one at the start of the game.

The **Draw Deck** has three types of cards:



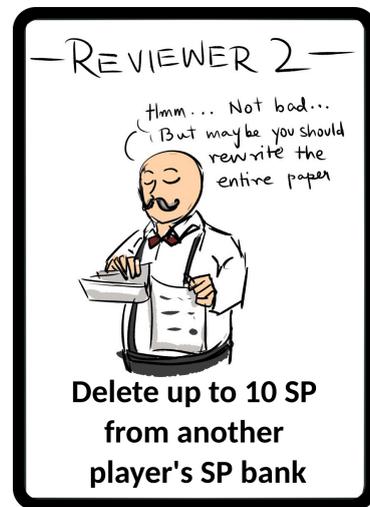
Astronomers

These are your colleagues and collaborators. They will help you operate Tools.



Tools

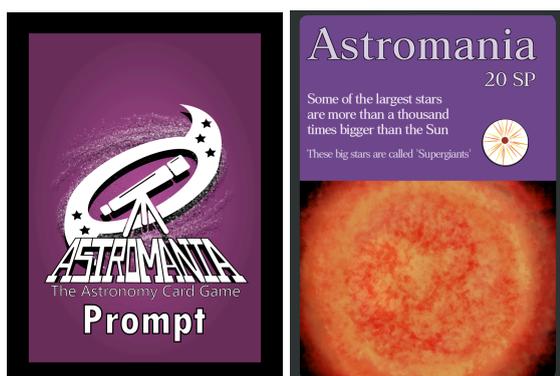
This is the equipment you use or codes you run.



Interact

This helps you interact with your fellow graduate students (other players).

The **Sky Deck** has **Objects** you can study. These are all real celestial objects professional astronomers study!



And the **Prompt Deck** has suggestions for papers you can publish for a successful research career.

Gameplay

Game Setup

Follow these steps for setting up your game :

1. Split the cards into their appropriate decks by their back colour and shuffle all 3 decks.
2. Distribute a random **Prompt** card to each player.
3. Each player draws 5 cards from the **Draw Deck** as their starting hand.
4. Place 9 **Object** cards from the **Sky Deck** in a 3x3 grid. We'll call this the **Starboard**.
5. Determine who goes first. Turn order proceeds clockwise from the first player.

Turn Order can be decided in any way you choose. You may decide that whoever was the last person to see a shooting star or whoever has the next birthday goes first. We suggest each player take a turn rolling the dice and the player with the highest sum on the dice goes first.

OPTIONAL : You can remove all the Interact cards from the **Draw Deck** for solo play!

Game Layout

This is what your typical research space will look like in the the middle of a study (mid-game):



Game Mechanics

As an astronomer, your career's success relies on studying objects in the sky and publishing papers! In Astromania, you can do this by combining the Tool and Astronomer cards on your Player Field and studying an **Object** on the **Starboard** to gain **Science Points (SP)**.

To initiate an observation, you **MUST** have played an Astronomer AND a Tool in your Player Field – the space in front of you.

You may use the combination of one Astronomer and one Tool (both in your Field) to try 'studying' an **Object** by rolling dice. If you roll the number in the square on the **Object** card, or higher, you have successfully studied the **Object** and get Science Points (SP).

*****Once an astronomer is used for a 'study', you may NOT use it again in the same turn, regardless of the success or failure of the previous study attempt. *****

Every **Prompt** card requires 20 SP to become a published paper. Collect enough SP to 'publish' your **Prompt** card as a paper!

Icons on the **Object**, **Astronomer**, and **Tool** cards can be matched to get bonuses. For more information on the icons, see the Bonus section and the Icon Glossary!

Managing the Player Field

The maximum size of a Player Field depends on how many papers that player has published. A player begins with a field limit of 1 Astronomer + 1 Tool. For each paper that the player publishes, their field limit increases by 1 Astronomer and 1 Tool.

Using Interact Cards

Interact cards are part of the **Draw Deck** but they are different from the Tool and Astronomer cards. They don't go on a Player Field and do not directly help you study an Object. Instead, they have instructions written on them that benefit you in some way. When playing an Interact card, follow the instructions on the card.

Turn Actions

You should now know most of how the game works. So let's go over what a player does during their turn!

On their turn, a player can take up to 3 turn actions plus one free action. Once per turn, a player may do one of the following as a free action (does not count towards your 3 turn actions):

- Draw only one card from the **Draw Deck**
- Discard only one card in their hand or player field and gain +2 SP

At the cost of one turn action, a player may do any one of the following:

- Draw a card from the **Draw Deck**
- Play one **Astronomer** or **Tool** card on your field
- Use one **Astronomer** card and one **Tool** card in your field to attempt to study an **Object** on the **Starboard**
- Discard one card in their hand or field and gain +2 SP.

Publishing a Paper

When a player has the required SP to fulfil their **Prompt** (20 SP listed on the **Prompt** Card), they can publish a paper! A player must publish on their turn, but publishing does not require using an action.

To publish: **Object** cards in a player's SP cache are worth the amount of SP listed in the hexagon on the card. A player must trade in enough **Object** cards and SP tokens to fulfil the **Prompt**.

If an **Object** being traded in has the same class icon as the **Prompt**, then the **Object** is worth an additional 1 SP towards that **Prompt** (See Page 14 for info on SP bonuses). If the value of the SP being traded in is greater than the value required to publish, the player receives SP tokens representing the extra SP, which can be used as a rollover towards the player's next **Prompt**. The used **Objects** then go into the **Sky Deck** discard pile. The player then selects another random **Prompt** from the **Prompt** deck, unless it is their third publication... (See section Win Condition).

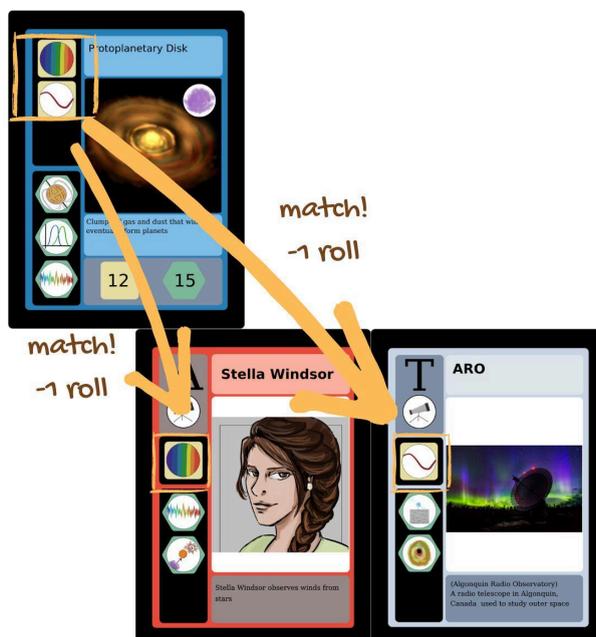
Bonuses

Some **Objects** are high risk, high reward. As in you need a high roll to study them, but they give you a lot of SP too! Meanwhile, some are literally impossible to study! For instance, the Dark Energy card requires a roll of 14 to be studied. How can one roll a 14 on two 6-sided dice?! Cards such as these *require* the use of in-game bonuses.

There are two kinds of in-game bonuses :

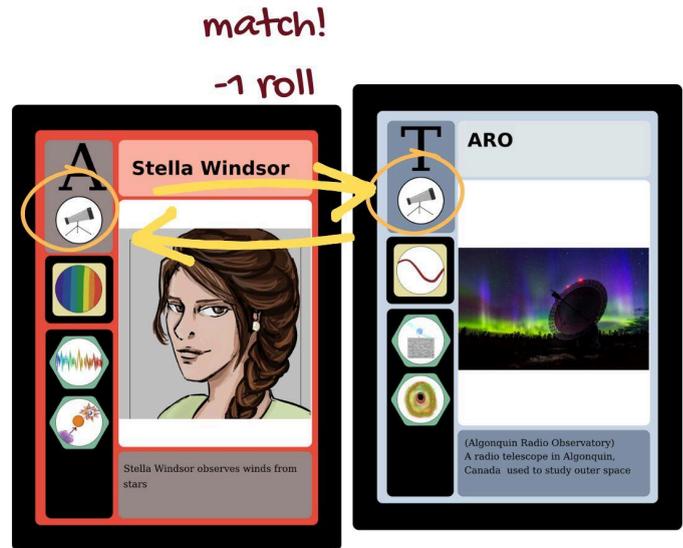
- **Dice Roll Bonus** : This lowers the dice roll you need to study an **Object** by -1 per bonus.
- **SP Bonus** : This increases the SP you get from studying an **Object** by +1 SP per bonus.

Dice Roll Bonus

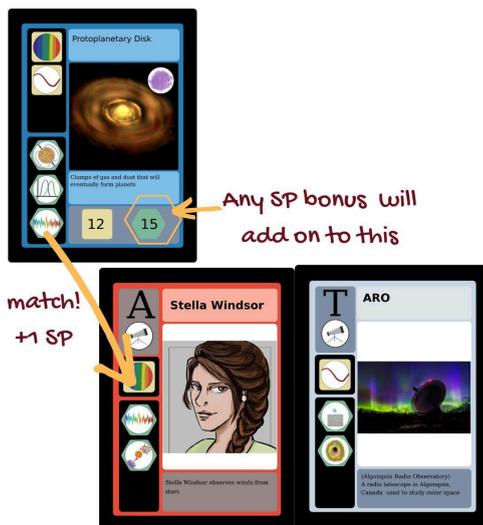


One way to get a **Dice Roll Bonus** is to match the symbol on the yellow square on the **Object** card you want to study to the squares on the **Astronomer** and/or **Tool** card you are using to study it. One match lowers the roll required by -1 and all bonuses stack. This is a *Wavelength bonus*. (See image on left)

Another way to get a **Dice Roll Bonus** is to match the icons in the circles of the **Astronomer** and **Tool** card. This bonus doesn't depend on the **Object** card! Any **Object** you try to study will have its required dice roll lowered by 1 if you get this match. (See image on the right).



SP Bonus



SP Bonuses are calculated after a successful study of an **Object**. These add on to the inherent SP of the **Object**, the number in the green hexagon at the bottom of the card. One can match the symbols in the green hexagons on the left side of the **Object** card to the left side of the **Tool** and/or **Astronomer** cards to get more SP. Each match is worth +1 SP and bonuses stack up! This is a *Technique bonus*. (See image on the left)

Another way to get a SP Bonus is to match the icons in the circles of the **Object** and **Prompt** card. This bonus doesn't depend on the player field! (See image on the right)

Use the provided SP tokens to keep track of any bonus SP you acquire.



Win Condition

The first player to publish 3 (three) papers wins the game and successfully receives their PhD in Astronomy*! 🎉🎉🎉

(*!!! We do not have the authority to reward real PhDs !!!)

Keep in mind:

- If an **Object** being traded in has the same class icon as the **Prompt**, then the **Object** is worth an additional 1 SP towards that prompt (see Bonuses).
- If the value of the SP being traded in is greater than the value required to publish, the player receives SP tokens representing the difference.
- A player must publish on their turn, but publishing does not require using an action.

Icon Glossary

Astronomer - Tool Classes



Class of **Astronomers** that use telescopes to do their work. Symbol also on telescope **Tools**.



Class of **Astronomers** that use modelling or pen-paper math to do their work. Symbol also on code and software instrument **Tools**.



Class of **Astronomers** that build equipment to be used in telescopes. Symbol also used on **Tools** that are standalone instruments

Object - Prompt Classes



Class of **Objects** that are part of the space between stars or the Interstellar Medium (ISM). Symbol also on **Prompts** related to the ISM.



Class of **Objects** that are violent explosions of some sort. Symbol also on **Prompts** related to violent explosions.



Class of **Objects** that are galaxies. Symbol also on **Prompts** related to galaxies.



Class of **Objects** that are planets. Symbol also on **Prompts** related to planets.



Class of **Objects** that hold information about cosmology - study of the past, present, and future of our universe. Symbol also on **Prompts** related to cosmology.



Class of **Objects** that are stars. Symbol also on **Prompts** related to stars.

Wavelength



Denotes the light emitted by the highest energy events in the universe. Symbol on **Objects** as well as **Astronomers** who study it and **Tools** that can detect it.



Used for **Objects** that emit light humans can see. Symbol on **Objects** as well as **Astronomers** who study it and **Tools** that can detect it.



Denotes the light that has low energy but can travel very, very far. Symbol on **Objects** as well as **Astronomers** who study it and **Tools** that can detect it.



Used for objects that can be studied using things other than light. Symbol on **Objects** as well as **Astronomers** who study it and **Tools** that can detect it.

Technique



A technique called Spectroscopy. **Astronomers** use it to see what **Objects** in space are made of.



A technique called Astrometry. **Astronomers** use it to see how **Objects** in space move.



A technique called All Sky Map. **Astronomers** use it to see where in the universe an **Object** is.



A technique called Photometry. **Astronomers** use it to study the light an **Object** emits or reflects.



A technique called Population Study. **Astronomers** use it to learn how certain **Objects** behave when in large groups.



A technique called Polarimetry. **Astronomers** use it to learn how charged the light from an **Object** is.



A technique called Time Domain Astronomy. **Astronomers** use it to learn how an **Object** changes with time.



A technique called Hydrodynamics. **Astronomers** use it to learn how things flow in or around an **Object**.



A special technique just for the study of an exotic thing called Dark Energy



A technique called Scintillometry. **Astronomers** use it to study how light from far away **Objects** distorts as it travels through space.

About This Project

In June 2022, we made some trading cards to highlight the contributions of queer astronomers for a Toronto-based outreach program. But if you already have a deck of fancy cards, why not make a whole game out of it? Astromania is the card game equivalent of real-life astronomy research. With its assortment of cards, Astromania lets you strategize and combine techniques to solve the mysteries of the universe - just like a real astrophysicist! Our team is composed of graduate students who are all working towards a Ph.D. in astronomy and are actively involved in ongoing astronomy research.

Astronomy isn't always just taking pictures of black holes and distant galaxies. It's a field made of many people using different methods to study the past, present, and future of our universe. Sometimes we need to craft simulations to test our theories. Sometimes we need to write some code to calculate important statistics. Sometimes we're caught up in the political machine that is academia. It's not always pretty and an important part of success is luck. Things don't always work the way you expect so we hope we accurately convey the nuances of the scientific research process in our game.

Learn more about Astromania on our website: astromania-game.github.io

This game is neither affiliated with nor sponsored by any of the organisations featured on our Tool cards.

This project was made possible through the support of Carnegie Mellon University Physics and through the Seed Funding from The Dunlap Institute for Astronomy and Astrophysics (dunlap.utoronto.ca).

We also thank all our consultants, playtesters, and the larger astronomy community for the positive support and feedback we received, with a special shoutout to those who let us feature their tools on our cards!

Document Index for Card Printing

Page Number	Content	No. of copies to be printed
14	3 reference cards, 6 Astronomer cards	1
15	9 Astronomer cards	1
16	2 Astronomer cards, 7 Tool cards	1
17	8 Tool cards, 1 Interact card	1
18	6 Interact cards, 3 Object cards	1
19	9 Object cards	1
20	9 Object cards	1
21	9 Object cards	1
22	9 Prompt cards	1
23	9 Prompt cards	1
24	9 Draw Deck card backs	5
25	9 Sky Deck card backs	2
26	9 Prompt Deck card backs	2
27	SP tokens	1

✂️ Cut along the dotted line

1 Free Action
Draw one card
or
Discard one card for +2 SP

+

3 Turn Actions (choose)

1. Draw a card
2. Play an Astronomer or Tool
3. Attempt to study an object
4. Discard for +2 SP

+

For no action cost
(as many times as you want)

- Publish a paper
- Use an Interaction Card

1 Free Action
Draw one card
or
Discard one card for +2 SP

+

3 Turn Actions (choose)

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For no action cost
(as many times as you want)

- Publish a paper
- Use an Interaction Card

A Brad Spool



Brad Spool, still in grad school, studies gravitational waves

A Ash Turnomer



Ash Turnomer is trying to study how charged empty space can be

A Dirk Mattel



Dirk Mattel is using radio telescopes to understand Dark Matter

A Gal Acksees



Gal Acksees studies galaxies through computer models

A Garima Ray



Garima Ray is trying to map the sky in gamma rays

A Moe Sean



Moe Sean models the motion of stars in the Milky Way

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A **Luna Erklips**



Luna Erklips models exomoons — moons from outside our solar system

Icons: Telescope, Rainbow, Hexagon with star, Hexagon with planet, Hexagon with graph

A **Matteo Wright**



Matteo Wright studies meteorites

Icons: Telescope, Rainbow, Hexagon with star, Hexagon with graph, Hexagon with spectrum

A **Len Singh**



Len Singh builds instruments to measure gravitational lensing

Icons: Telescope, Rainbow, Hexagon with question mark, Hexagon with spectrum

A **Oz Cilatore**



Oz Cilatore studies explosions in the sky through radio telescopes

Icons: Telescope, Hexagon with wave, Hexagon with star, Hexagon with graph

A **Ray Diaz**



Ray Diaz surveys how radius of stars change in binary stars

Icons: Telescope, Hexagon with wave, Hexagon with spectrum, Hexagon with graph

A **Roe Tai Shen**



Roe Tai Shen is an observer who studies how stars rotate

Icons: Telescope, Hexagon with wave, Hexagon with star, Hexagon with graph

A **Shola Erklips**



Shola Erklips observes how stars like the Sun move through the Milky Way

Icons: Telescope, Rainbow, Hexagon with graph, Hexagon with star

A **Stella Windsor**



Stella Windsor observes winds from stars

Icons: Telescope, Rainbow, Hexagon with spectrum, Hexagon with star

A **Theo Raman**



Theo Raman is a theory man, studying how galaxies come to be

Icons: Telescope, Hexagon with star, Hexagon with planet, Hexagon with graph

✂️ Cut along the dotted line

A **Yew Auftee**




Yew Auftee is building a telescope to make X-ray images of stars

A **Neo Trinos**




Neo trinos observes the universe in neutrinos

T **ACT**




(Atacama Cosmology Telescope)
A radio telescope in Chile that helped us understand the history of our universe

T **ARO**




(Algonquin Radio Observatory)
A radio telescope in Algonquin, Canada used to study outer space

T **BOOMERanG**



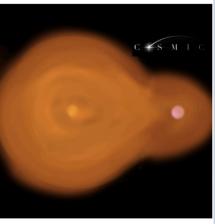

A balloon telescope that flew over Antarctica and sent back first measurements of the early universe

T **CHIME**




(Canadian Hydrogen Intensity Mapping Experiment)
A radio telescope in Canada that's always looking at most of the sky

T **COSMIC**

A software suite to make populations of binary stars

T **DECam**




(Dark Energy Camera)
An instrument atop a telescope in Chile that helps us study Dark Energy

T **Dragonfly**




An optical telescope in New Mexico that looks at faint objects in the sky (Logo by C. Abraham)

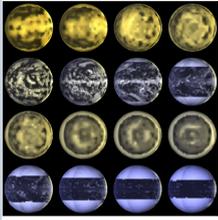
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T **eRosita**



A space telescope helping us understand dark energy through X-rays

T **ExoPlaSim**



(Exoplanet Planet Simulator)
A software module that lets you make models of planets

T **Las Campanas Observatory**



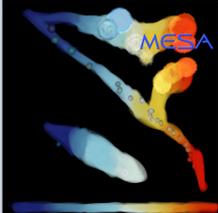
A group of telescopes in Chile looking at the universe since 1969

T **LIGO-Virgo-KAGRA Collaboration**



A group of instruments searching for objects that produce gravitational waves

T **MESA**



(Modules for Experiments in Stellar Astrophysics)
A software instrument to simulate the stars

T **SDSS**



(Sloan Digital Sky Survey)
A group of telescopes surveying and mapping galaxies, including our own!

T **SNO+**



(Sudbury Neutrino Observatory)
An underground detector in a nickel mine looking at neutrinos

T **Vera C. Rubin Observatory**



An observatory in Chile surveying and mapping the entire visible Southern sky (Image Credit Rubin Observatory/NSF/AURA)

— CO-WORK —



Swap hands with another player

✂️ Cut along the dotted line

— GRAD SCHOOL —

Use an Astronomer (on your field) that has already been used and a tool (on your field) to attempt to study an object

— JOURNAL CLUB —

Choose a player and pick a random Tool Card from their hand. (If they do not have any, you may choose another player instead)

— MALFUNCTION —

Use an action to discard a tool from your field (+2 SP) and take a tool from another player's field to replace it

— OUTREACH —

Choose a player and pick a random Astronomer Card from their hand. (If they do not have any, you may choose another player instead)

— REVIEWER 2 —

Delete up to 10 SP from another player's SP bank

— SEMINAR —

Use an astronomer from your hand and tool on another player's field to attempt to study an object

Asteroid

Irregular sized debris just floating around in planetary systems

08 05

Asymptotic Giant Branch

Some low mass stars expand and form an AGB star after they finish burning hydrogen

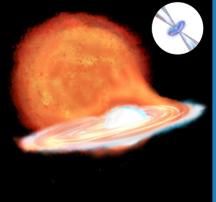
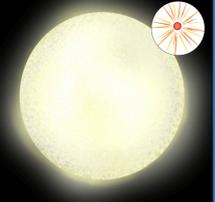
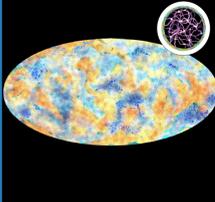
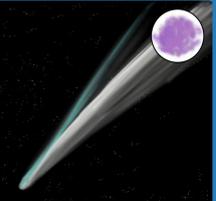
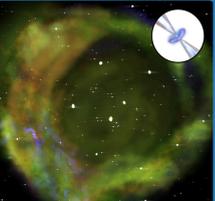
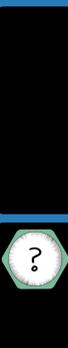
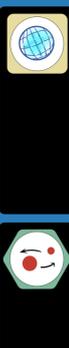
10 10

Black Hole

Dead remains of a massive star that has collapsed in on itself

10 10

✂️ Cut along the dotted line

<p>Cataclysmic Variable</p>   <p>When a white dwarf swallows its younger companion star</p> <p>10 10</p>	<p>Cepheid Variable</p>   <p>Stars that periodically change their radius</p> <p>10 10</p>	<p>Cosmic Microwave Background</p>   <p>The earliest image we have of the universe - its how it used to be before stars formed!</p> <p>08 05</p>
<p>Comet</p>   <p>Balls of ice and dust that heat up and form a tail if they get too close to the host star</p> <p>08 05</p>	<p>Core Collapse Supernova</p>   <p>Fancy explosion that marks the death of a massive star</p> <p>10 10</p>	<p>Cosmic Rays</p>   <p>A bunch of high energy particles that are colliding against our atmosphere all the time</p> <p>08 05</p>
<p>Dark Energy</p>   <p>A mysterious little something</p> <p>14 30</p>	<p>Dark Matter</p>   <p>It's invisible, it's abundant, it can bind a galaxy!</p> <p>10 10</p>	<p>Dust</p>   <p>Chunks of rocks to grains - space dust comes in all shapes and sizes!</p> <p>08 05</p>

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Fast Radio Burst



This emits fast pulses! And radio waves! But that's all we know about it . . .

12 15

Gamma Ray Burst



A burst of very high energy light gets emitted when neutron stars collide or stars collapse

12 15

Hot Jupiter



Jupiter type planets that are too close to their host stars

10 10

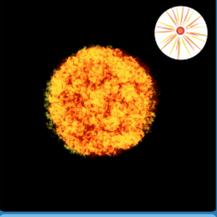
Irregular Galaxy



A misshapen blob like galaxy

08 05

Main Sequence Star



Stars close to or around the mass of our own Sun that are still burning hydrogen

08 05

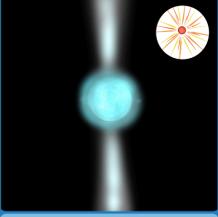
Nebula



An area with a lot of gas and dust that will all go into making new stars

08 05

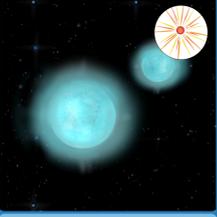
Neutron Star



Dead remains of a massive star that has almost collapsed in on itself but is being held by neutrons

10 10

Neutron Star Binary



Oh look! This system has not one but two neutron stars! That's pretty rare . . .

10 10

Protoplanetary Disk

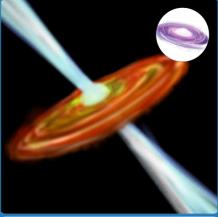


Clumps of gas and dust that will eventually form planets

12 15

✂️ Cut along the dotted line

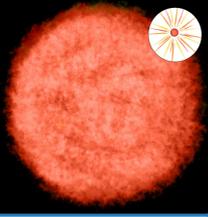
Quasar



A galaxy from the early universe

08 05

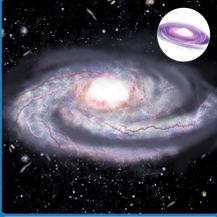
Red Supergiant



A massive star burned all its hydrogen and evolved off the main sequence

12 15

Spiral Galaxy



A galaxy that looks like a fidget spinner

08 05

Star Cluster



Big group of stars with very little dark matter holding them together

08 05

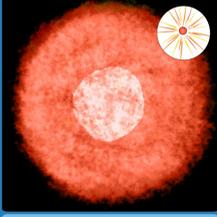
Super Earth



Planets about the mass of the Earth but bigger in size

08 05

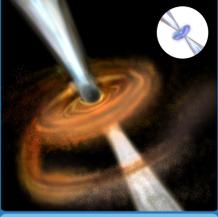
Thorne-Zytkow Object



These are the Matryoshka dolls of stars, there is a neutron star inside a massive star!

14 30

Tidal Disruption Event



When stars venture too close to a Supermassive Black Hole . . .

12 15

Ultra Diffuse Galaxy



A dim and spread out galaxy

10 10

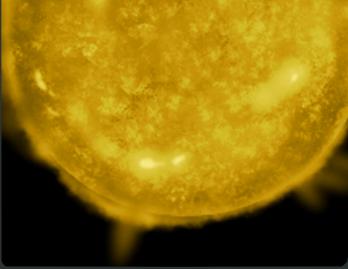
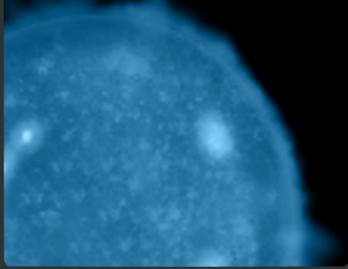
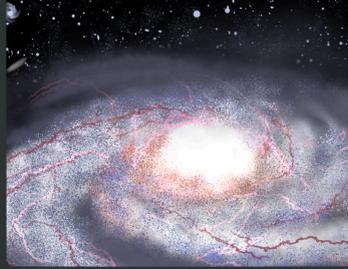
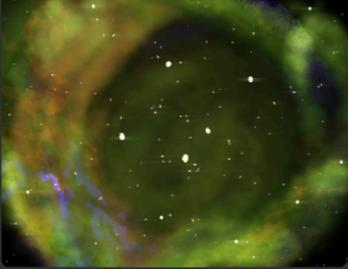
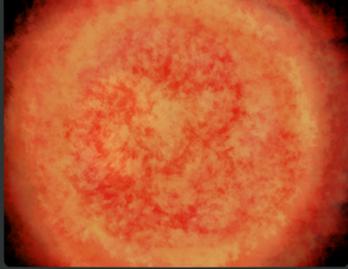
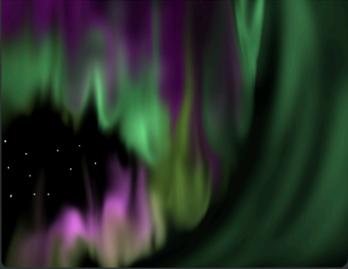
White Dwarf



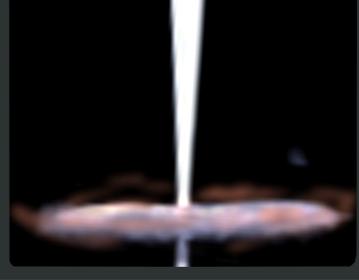
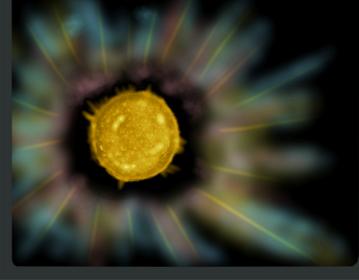
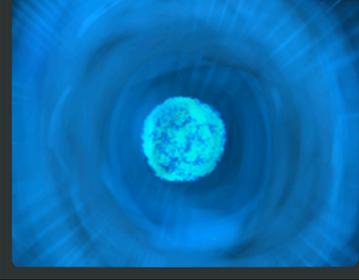
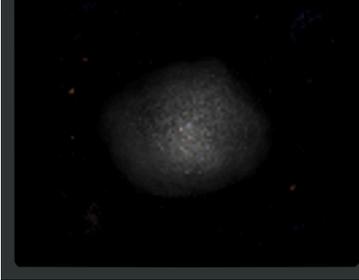
Dead remains of a low mass star that has almost collapsed in on itself but is being held by electrons

08 05

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<p>Astromania 20 SP</p> <p>Stars like the Sun smash hydrogen to create helium and light</p> <p>Different stars might be smashing different elements</p>  	<p>Astromania 20 SP</p> <p>Stars are balls of extremely hot and charged gas</p> <p>Young stars are made of mostly hydrogen</p>  	<p>Astromania 20 SP</p> <p>Scientists find a Supermassive Black Hole at the Center of our Galaxy</p> <p>Astronomers say we are no exception, nearly every galaxy has one</p>  
<p>Astromania 20 SP</p> <p>Massive stars die in dramatic explosions called a 'Supernova'</p> <p>These explosions can outshine a whole galaxy!</p>  	<p>Astromania 20 SP</p> <p>Some of the largest stars are more than a thousand times bigger than the Sun</p> <p>These big stars are called 'Supergiants'</p>  	<p>Astromania 20 SP</p> <p>Hydrogen is the most abundant material in the universe, followed by Helium</p> <p>The rest is just 'metals'</p>  
<p>Astromania 20 SP</p> <p>Astronomers say magnetic field important for protecting a planet from the host star's 'winds'</p> <p>Display of beautiful lights near poles indicative of Earth's magnetic field</p>  	<p>Astromania 20 SP</p> <p>We expect every galaxy to have a dark matter halo around it</p> <p>However, ongoing research finds some rare exceptions</p>  	<p>Astromania 20 SP</p> <p>Many astronomical events emit neutrinos — the elusive 'ghost' particle that passes through everything</p> <p>Neutrino detections may help us solve many mysteries of the universe</p>  

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<p>Astromania 20 SP</p> <p>Many explosive events have jets coming out of them</p> <p>We are yet to understand the complete physics of these jets</p>  	<p>Astromania 20 SP</p> <p>We thought we weren't counting neutrinos from the Sun correctly</p> <p>Turns out, we simply had to account for how much neutrinos change their identity</p>  	<p>Astromania 20 SP</p> <p>Astronomers spot black holes using the light that shines before it eats up stars</p> <p>The Black Hole then proceeds to eat up the light</p>  
<p>Astromania 20 SP</p> <p>We can only see about 5% of the things in the universe</p> <p>The rest is the invisible and elusive Dark Matter and Dark Energy</p>  	<p>Astromania 20 SP</p> <p>Stars chuck out gas in space — astronomers call them 'stellar winds'</p> <p>Stellar winds of some stars remain an enigma</p>  	<p>Astromania 20 SP</p> <p>Scientists ponder the true nature of Dark Matter, come up with multiple possibilities</p> <p>A comprehensive theory yet to be confirmed</p>  
<p>Astromania 20 SP</p> <p>The universe will end in a 'Heat Death' but it won't be hot</p> <p>Everything will simply stop moving</p>  	<p>Astromania 20 SP</p> <p>We keep finding planets outside the solar system</p> <p>Research ongoing on whether any of them could host life</p>  	<p>Astromania 20 SP</p> <p>Most stars have companions</p> <p>Sometimes more than one!</p>  

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