



Fermi Race

What is Fermi?

The Fermi Gamma ray Space Telescope is a space based gamma ray observatory that is observing black holes, active galaxies, and gamma ray bursts.

Its development took place around the globe. Components of the satellite and its instruments were developed in Italy, Germany, Sweden, France, Japan, and in the United States. The spacecraft has been designed by General Dynamics C4 Systems.

Integration of the components into the satellite occurred in 2007-2008. After rigorous testing of the satellite, it was integrated in its Delta II rocket. Liftoff occurred from Cape Canaveral on June 11 2008. Fermi then settled into an orbit at an altitude of 550 km and an inclination of 28.5 degrees. It is orbiting the Earth once every 90 minutes.

The Fermi observatory has a nominal orbital lifetime of five years, and an operating goal of ten years.

The Fermi Race

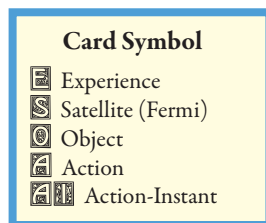
A Space and Astronomy Card Game

It's a space race! Assemble your high-energy satellite and observe cosmic objects before your opponents do! Along the way you can slow down their progress and speed up your own. Remember, they have the same goal and tools you do, and will do what they can to build their satellite before you do. Who will be the first to build their satellite and make successful observations of gamma-ray sources?

This game features NASA's Fermi Gamma-ray Space Telescope (see cover page).

Game Pieces:

- Game Boards: 2
- Combined Satellite/Objects cards: 24
- Action cards: 26
- Experience cards: 36
- Total cards: 86



Players: 2 or 4 (2 players or 2 teams of 2 players each)

Overview: The game consists of two stages.

Stage 1: Build the Fermi satellite by collecting and using *Satellite* and *Experience* cards. *Satellite* cards cannot be played until a sufficient amount and kind of *Experience* cards are collected.

Stage 2: Observe five astronomical objects by collecting and using *Object* and *Experience* cards. *Object* cards cannot be played until a sufficient amount of *Experience* card points are collected.

You can also play *Action* cards, which can slow down your opponent's progress or speed up your own.

The first player to successfully observe five objects wins the game!

Setup:

Each player unfolds their playing mat with the satellite side up for Stage 1 (the galaxy side is used in Stage 2). Note the designated spots for different cards.

Shuffle all the cards together well. Choose a dealer, and deal out 8 cards to each player. The cards can be freely arranged in front of each player—this is an “open-game”, where you can see your opponent's cards.

Place the remaining cards of the deck, called the Draw Deck, face down* between the player's mats. Leave room next to it for the Discard Pile. [*Note: some of the cards are double-sided, so they will be face up no matter what. See “Double-Sided Cards” section on p. 3.]

Game Play:

Each player takes turns at the game. A turn consists of the following actions in the order listed:

1st: Draw a card from the Draw Deck; or if you start your turn with no cards, draw 4 cards from the Draw Deck.

2nd: Play cards: You can play either *Experience+Satellite* cards (Stage 1) or *Experience+Object* cards (Stage 2). You can only play **one** *Satellite* or *Object* card during your turn (and as many *Experience* cards needed to play that *Satellite* or *Object* card).

You can also play **one** *Action* card during your turn, either before or after you have played a *Satellite* or *Object* card.

You do not have to play any cards if you do not wish to do so.

3rd: If you have run out of cards at this point, you draw 4 cards from the Draw Deck. You cannot play these new cards during this turn.

4th: If you have more than 8 cards in your hand, you must discard cards to the Discard Pile until you have 8 cards.

5th: Your turn ends and it is now your opponent's turn.

If the Draw Deck runs out of cards during your turn, your opponent should take the Discard Pile, shuffle, and place them face-down. This is now the new Draw Deck.

Double-Sided Cards:

The *Satellite* and *Object* cards are double sided. On one side is a *Satellite* card, and on the other is an *Object* card. If you are building the satellite (Stage 1), use the *Satellite* side; if you are observing objects (Stage 2) use the *Object* side.

This “open-game” play does not allow you to peek at the other side of a *Satellite* or *Object* card that is on the top of the deck or that has been put into play on your opponent's mat.

The Experience Cards:

Blue cards with an “E” in the upper right corner are *Experience* cards. Note how each “E” card is split in to two halves, the left half is for Stage 1 and the right half is for Stage 2.

In Stage 1, each Experience card is worth 1 experience point. There are three types of *Experience* cards: **Science Team** (flags icon), **Educators** (or ED), and **Wild Card** (Wild.) The type is shown by the icon in the upper region in the left half of the card.



Science Team

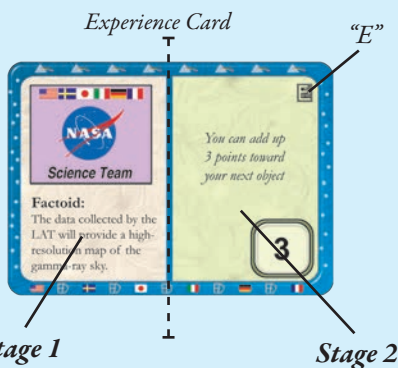


Educators



Wild Card

In Stage 2, each card has its listed value in the lower right corner.



All three cards have a **factoid** about Fermi on them. Although they are not part of the game play, it is an interesting thing to know about Fermi and the objects it studies.

Stage 1: Building the Fermi Satellite

The first part of the game consists of building the Fermi satellite. It is built by collecting and playing 6 *Satellite* cards (red framed cards labeled with an “S” in the upper right corner) corresponding to the different components of Fermi. To play a “S” card, you must accumulate the “experience points” necessary to satisfy each “S” card requirement. This is done by collecting *Experience* cards.

Each “S” card requires a combination of “Science Team” and “Educators” cards. The card requirement is shown by the icon in the lower right corner (see example on p. 5). An *Experience* card “Wild Card” can be used as either a “Science Team” or an “Educators” card.

How to read the “S” card requirement:



i.e.: 1 Science Team **and** 2 EDs cards

The *beige background color* indicates that **both** requirements shown are needed.



i.e.: 1 Science Team **or** 2 EDs cards

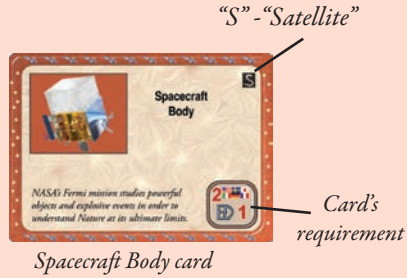
The *beige and blue colors* indicate that meeting **either** requirement is sufficient.

Example:

Let's say you want to play the "Spacecraft Body" *Satellite* card— you need to have 1 *ED* card and 2 *Science Team Experience* cards.



2 *Science Team* and 1 *ED* "E" cards



Place the "S" card on the mat and discard the *Experience* cards used after showing them to your opponent.

Once a player sets down all six *Satellite* cards, he or she moves on to Stage 2. A player can move on to Stage 2 while the other player is still in Stage 1. After setting down your last "S" card to complete your satellite, you recycle your played *Satellite* cards by placing them in the Discard Pile. Your opponent then shuffles the Discard Pile and the Draw Pile together creating a new Draw Pile.

You now turn your mat over to the galaxy side.

Stage 2: Observing Astronomical Objects

Once you've built Fermi, you can start observing the sky with it! You need to observe 5 different astronomical objects to win the game.

There are 8 kinds of astronomical objects to choose from, represented by the *Object* cards (green frame card with an "O" in the upper right corner). Each *Object* card has the number of *Experience* points needed listed in the lower right corner. You must have the exact total of "E" points to play an "O" card. In this stage, the number of points each "E" card is worth is listed in the lower right hand corner (see example on p. 6).

Example:



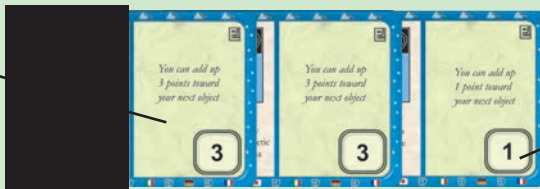
“O” - Object

Object points requirement

Playing an *Object* card is similar to playing a *Satellite* card.

For example, to play the “Unidentified Sources” card, you need to have exactly 7 *Experience* points. You could play three cards, with 3+3+1 points, or two cards with 4+3, or 7 cards at 1 point each, but you must have exactly 7 points to play that *Object* card.

Stage 2



Experience points

$$3 + 3 + 1 = 7$$

When you have the correct amount of experience point, you can place the *Object* card on the playing mat in a Space Object box and discard the “E” cards after showing them to your opponent.

Note: the player must display 5 *different* objects on the play mat at the same time to win the game!

Action Cards:

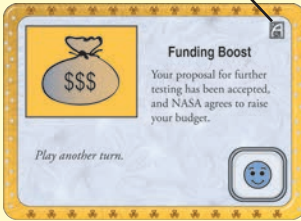
Besides being able to play *Satellite* and *Object* cards, there are also *Action* cards (labeled with an “A” in the upper right corner, see images on p. 7). These cards either help your progress or slow down your opponent.

You can play a regular *Action* card only on your turn unless otherwise noted. When you play it, tell your opponent what it does, show it to him or her, follow the instructions on the card, then discard it.

There are also *Instant Action* Cards, labeled “AI” in the upper right corner. These are defensive cards, and can be played instantly to counteract an *Action* card played on you by your opponent. When used, both cards are discarded and play continues as normal.

Action cards used defensively are colored blue and have a smiling face in the corner.

"A" - Action



Defensive - blue background and happy face

"A" Action - "I" Instant



Can be used at any time during the game.

Action cards used offensively are colored yellow and have a mischievous face in the lower right corner.



Offensive - yellow background and mischievous face

Ending the Game: Whoever observes 5 different objects first wins the game.

Glossary:

Science Terms

Astronomical Objects: Objects such as galaxies, pulsars, and supernovae observed by Fermi.

Communication Antenna: Sends the data from the spacecraft to ground control computers.

Educators: 10 educators chosen to teach about Fermi science throughout the country.

Field of View: A telescope camera viewing angle.

Gamma-ray Burst: A brief but intense flash of gamma rays that comes from space. GRBs may release more energy in a second than the Sun does over its lifetime.

GBM: (Gamma-ray Burst Monitor) Fermi detectors that capture the energy from gamma-ray bursts.

Electromagnetic Spectrum: Entire range of wavelengths of electromagnetic radiation (from gamma rays to the longest radio waves and including visible light).

High-Energy: In the electromagnetic spectrum, high energy refers to X-rays and Gamma-rays.

Instrument: The telescopes used by Fermi.

LAT: (Large Area Telescope) An imaging, wide field-of-view telescope. Measurements enable scientists to determine the energy and location in the sky of detected gamma rays.

Science Team: Fermi is a multi-national multi-agency space mission including teams from the United States, Sweden, Japan, Italy, Germany and France.

Solar Panels: Power the spacecraft by converting sunlight into electricity, then used by the computers onboard.

Game Terms

A or Action: Cards that either help your progress or slow down your Opponent's (p.6).

A-I or Action-Instant: An *Action* card that can be played at any time during any player's turn (p.6-7).

Building (see Stage 1).

Category: There are 4 card Categories in the game; *Action, Experience, Satellite, and Object.*

Discard: To place a card in the Discard Pile.

Discard Pile: Where cards that have been played and discarded are placed.

Draw Deck: After dealing, the remaining cards from which you draw.

ED: "Educators", a type of *Experience* card used in Stage 1 (p.4).

Educators (see ED).

Experience or E cards: Cards ("Educators, Science Team, Wild") that provide the necessary requirements to place a *Satellite* or *Object* card on the Board (p.4).

Factoid: A fact about Fermi written on each *Experience* card.

Hand: The cards the player has in his/her hand or in front of him/her, but not played yet.

Object or O card: Cards with observable astronomical objects – used in Stage 2 to win the game (p.5-6).

Observing (see Stage 2).

Opponent (see Players).

Open-Game: A card game where all players can see the cards in each player's hand.

Played: Cards that have been placed on the play mat or in the discard pile.

Player: A person engaged in playing Fermi Space Race card game.

- **Dealer:** The person designated to deal 8 cards to each side at the beginning of the game.

- **Opponent:** The person playing against you.

- **You:** The person who is playing the card.

Playing Mat: This is where the played cards are displayed.

Satellite or S card: Cards with the Fermi satellite parts – used to build the satellite in Stage 1 (p.4-5).

Science Team: A type of *Experience* card used in Stage 1 (p.4).

Stage 1: The process of building the Fermi satellite by accumulating the appropriate *Experience* cards, and displaying a *Satellite* card on the play mat.

Stage 2: The process of observing space objects by accumulating *Experience* points, and displaying an *Object* card on the play mat.

Turn: When a Player is allowed to play cards. A Player may only play cards on his or her turn, except for *Action-Instant* cards, which a Player may play at any time during the game (p. 3).

Wild Card: A type of *Experience* card used in Stage 1. You choose whether this card represents a "Science Team" or an "Educators" *E* card.

You (see *Player*).

Resources

Official Fermi Website: <http://www.nasa.gov/fermi> and NASA Goddard Fermi Website: <http://fermi.gsfc.nasa.gov/>
Download the game, and other materials, here: <http://fermi.sonoma.edu/teachers/race.html>

Fermi LAT Website: <http://www-glast.stanford.edu/>

Fermi GBM Website: <http://gammaray.msfc.nasa.gov/gbm/>

Introduction to gamma-ray bursts: http://imagine.gsfc.nasa.gov/docs/science/know_11/bursts.html

Enrico Fermi's Biography at Nobleprize.org: http://nobelprize.org/nobel_prizes/physics/laureates/1938/fermi-bio.html

Game Credit:

This game was developed by the NASA Education and Public Outreach group at Sonoma State University, CA. Concept, design and layout by Aurore Simonnet, edited by Phil Plait, reviewed by Dr. Lynn Cominsky, Sarah Silva, Logan Hill, Sean Greenwalt, Dakota Decker, Steve Ritz, Erik Andrews, Patrick Hascall, Sharla Dowding, Bruce Hemp, Chris Royce, Teena Della, and David Thompson. Special thanks to the Space Place Team at JPL.

Image Credits:

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