

Saturnian Settlers

Mission Brief + Instructions



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MISSION BRIEF

After much planning and preparation, it is finally time for the Titan 3023 crew, the Saturnian Settlers, to execute the mission. The Settlers are going to Titan, Saturn's icy moon! They will establish the first human settlement and advance society through exploration. Even though Titan is considered one of the top targets for human settlement, there are serious challenges that must be addressed.

- Gravity is only 1/7 Earth normal.
- The atmosphere is toxic. It is mostly nitrogen with some methane.
- The temperature is -179°C (-290°F). That is way below freezing!
- At a distance of 1 billion miles, travel time with today's technology is at least 7 years.
- Titan's atmosphere is so dense, it gets less than 1% of the light we receive on Earth.
- Titan is outside the protective magnetosphere of Saturn about 5% of the time. This means that settlers and equipment are not always protected from solar radiation.

Each round should bring the settlement closer to sustainable independence. It is up to the Saturnian Settler's leaders to decide what choices are made for each round to sustain human life.

Space exploration is controlled by a global alliance called the Consolidated Space Agencies of Earth (CSEA). CSEA derives its mission priorities and funding from its member states. They have seeded the settlement mission by launching a series of rockets containing the essential settlement structures needed to bootstrap the settlement. They have also secured funding for seven supply missions to provide critical resources and additional settlers to the settlement.

Our settlers are about to embark on the journey of a lifetime to Titan where they intend to establish the first human settlement beyond the asteroid belt! Will they succeed? Their fate lies in your hands and in the choices you make on production and resource allocation both on Earth and within the settlement. Good luck!

OBJECTIVE

Saturnian Settlers is a turn-based space mission simulation game designed for 1-4 players. The goal of the game is to create a self-sustainable settlement. Our goal for players is to provide an entertaining experience while educating them on the challenges faced by settlers trying to establish a self-sustainable settlement on a distant moon or planet. The game is played over a number of rounds.

The game is set in the far future. Humanity has overcome many of the challenges they faced in the early industrial and technology ages. Our settlers live in a time where science and technology have advanced sufficiently to enable discovery and exploration of the solar system. Society on Earth and the inner planets are still challenged by the issues we face today where politics, personalities, and nature keep life interesting.

IMPORTANT VOCABULARY

Rounds

The game is played in 7 rounds with Supply Ships plus additional rounds until the players win (complete the self-sustaining settlement) or lose (run out of resources). Each round has a specific sequence of actions and events. Some of these actions may be skipped depending on the state of the game. For example, in the first round, the settlement has produced no resources, so there is no need to harvest resources.

Turns

Two actions during a round allow players to take turns. Starting with the *First Player*, players proceed in clockwise order to place resources on building tiles and the Supply Ship. Within a round, turn order is preserved. So if Player 2 was the last one to place resources on a

building, Player 3 would be the next player to become the active player when placing resources on the Supply Ship.

Settlers

Settlers are portrayed by the space meeples. Settlers are required to maintain a healthy self-sufficient settlement.

In the basic game, all of our settlers are multi-talented and can function in any role required by the settlement. Therefore, when we need farmers, engineers, biologists, or any other skill, anyone available can step in to help.

In a more advanced game, settlers will specialize. The different colored meeples indicate their specialty. Any meeple can be used if no special skill is expected. The unspecialized meeples are referred to as settlers in the building tile inputs.

Active Building Tile

A building tile is active if it has all of the settlers and resources needed and sufficient power to produce its outputs or sustain its function.

At any time, if a building transitions from active to inactive, all resources and settlers on that building tile are permanently lost.

Mandatory Building Tile

Certain building tiles are mission-critical for the settlement. At least one MANDATORY building tile of each type is required at the end of every round or the settlement immediately collapses. The RBA doesn't need resources if it isn't currently producing a new building but it must always have power to remain in play.

At the end of the round, players must check the following:

1. If there are not enough Fusion Generators for all ACTIVE building tiles, players have to decide which building tiles will be deactivated. Resources and settlers assigned to these building tiles are immediately lost and removed from the settlement.
2. If there are not enough Habitat Modules to support the population, players must remove excess settlers from the settlement. They are first removed from the *Control Console* and then from building tiles.
3. If there is not enough power to the Robotic Building Assemblers, unpowered assemblers are removed from the settlement. Even when idle, they must have power to maintain their readiness. They don't need resources unless the players wish to create a new building tile.

Refer to the section on *Active Building Tiles* if a building tile transitions from active to inactive.

If players can't decide within a reasonable time which buildings will be affected, the last *Active Player* is empowered to make a final decision.

Active Player

During resource placement actions, the person currently placing resources is considered the Active Player. Other players can give input to decisions made by the active player but the final decision is with the active player. The Active Player role rotates around the table to the player who is currently placing resources. The last player to place a resource remains the Active Player until the round ends or another resource placement action occurs.

First Player

At the beginning of a round, the person holding the First Player Token will be the first player to initiate placement actions and is designated the Active Player.

CONTENTS

All game elements can be printed. If you have access to the tools, some game elements have 3D printable or laser cutter options. For setup and game play, you'll need:

- 1 Mission Brief + Instructions (this document)
- 1 Resource Management Quick Reference
- 4 Player Turn Reference Cards
- 1 Control Console
- 1 First Player Token
- 2 identical Supply Ships
- 3 of each Building Tile
- 1 of each Building Hex for the RBAs
- Event Cards
- 80 assorted space meeples
 - 20 Engineers
 - 20 Biologists
 - 40 Settlers
- 50 of each resource token
 - Regolith
 - ice/water
 - Nitrogen
 - Energy
 - Food
 - Oxygen

COMPONENTS

BUILDING TILES

Building tiles provide the foundations of the settlement. Building tiles are activated if they are provided with all input resources and enough Fusion Generator capacity exists to provide it with power. They include structures to support the settlers, harvesting of natural resources, and converting resources into other resources necessary to sustain the settlement.

Mandatory building tiles are critical to the survival of the settlement. If zero of any mandatory building tile types are not activated in the current turn, the game ends immediately and the settlement collapses.

Building tiles require a combination of settlers, resources and power to function. To activate a building tile, ALL inputs and power must be allocated to it. Some building tiles produce new resources while some simply exist to ensure the settlement's survival.

All building tiles require power from Fusion Generators. The Robotic Building Assembler requires 4 Power Banks. Generators are self-powering. All other building tiles require 1 Power Bank.

Habitat Module (MANDATORY)



A Habitat Module can sustain up to 20 settlers. This structure is essential to the survival of the settlement. At least one Habitat Module must remain active throughout the game.

Each Habitat Module consumes 3 Ice, 3 Oxygen, and 3 Food resources per round. It produces no resources.

Fusion Generator (MANDATORY)



The Fusion Generator converts Energy resources into power. It is used by the settlement to power other structures via its Power Banks. It produces no additional resources. At least one Fusion Generator must remain active throughout the game.

Each Fusion Generator requires 2 Engineers and consumes 1 Energy Resource. It produces 10 Power Banks.

Robotic Building Assembler (MANDATORY)



The Robotic Building Assembler (RBA) enables the creation of new building tiles. This function is critical for expanding the settlement and replacing aging structures. It is a mission-critical piece for a self-sustaining settlement. At least one RBA must be fully powered throughout the game.

When activated with 2 Engineers, 2 Settlers, 2 Energy, and 4 Regolith resources, it produces one new building. The building is chosen by the Active Player when all inputs are placed. Because the RBA is massive compared to other building tiles, building an additional RBA requires two fully resourced rounds to complete. The rounds don't have to be consecutive.

Ice Driller



Subterranean water exists on Titan. Unfortunately, it is typically 50-100 KM below the moon's surface. The Ice Driller provides access to these reservoirs. Some of the ice is used as water. The remaining ice is cracked into the Energy and Oxygen resources.

When activated with 1 Engineer and 2 Settlers, it will produce 2 Ice, 4 Oxygen, and 2 Energy resources.

Hydroponic Farm



Everyone needs to eat! The hydroponic farm provides sustenance to the Settlers in the settlement.

When activated with 1 Biologist, 1 Oxygen, 1 Nitrogen, and 1 Ice resource, it can produce 4 food resources.

Atmospheric Nitrogen (N_2) Extractor



The Titan Atmosphere contains over 90% nitrogen. Nitrogen is critical to recreating a breathable atmosphere for the living things in the settlement and as a component for building new structures.

When provided with 1 Engineer, it can produce 1 Nitrogen resource.

Mining Rig



Building materials are massive. To enable settlement expansion, the Mining Rig allows for local sourcing of building materials by quarrying and processing Regolith. It's a dirty but necessary job!

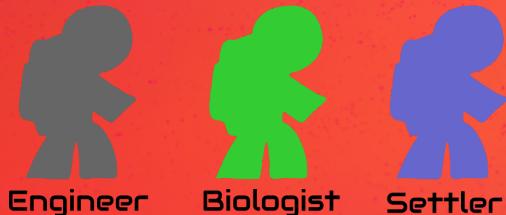
When provided with 2 Settlers, 1 Nitrogen, and 1 Energy, the Mining Rig can produce 2 Regolith resources.

RESOURCE TOKENS



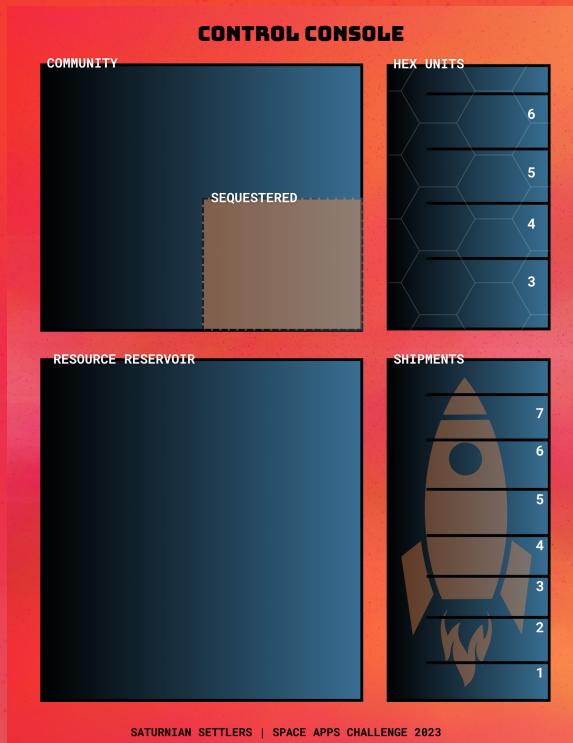
The game uses resource tokens to enable actions. Resources can be consumed, destroyed, and created throughout the game.

SETTLERS



Settlers are portrayed by the space meeples. We randomly assigned each specialty to a color but feel free to substitute as you wish!

CONTROL CONSOLE



The Control Console provides a place to keep track of idle and quarantined settlers and stored resources. There are also sliders to track the round number and the capacity of hexes on the Supply Ship.

SUPPLY SHIP



The Supply Ship provides an important role in helping the settlement become self-sufficient. During the settlement's growth phase, it provided critical resources and settlers to help grow the settlement. Each round, the Supply Ship is loaded with resources and settlers chosen by the players. It arrives at the

start of the next round (if all goes well). The cargo capacity of the Supply Ship can be set by the players to adjust the game difficulty.

Easy: 7 cargo hexes

Moderate: 6 cargo hexes

Hard: 5 cargo hexes

EVENT CARDS

EVENT

2 settlers have died of dysentery!

Remove them from the community.

Event cards affect the gameplay in various ways. Sometimes they help, sometimes not so much. Events take place immediately when drawn unless the card specifies otherwise.

SETUP

(picture of setup with numbered areas)

1. Establish the initial colony by arranging building tiles in the center of the table. The arrangement doesn't matter. We don't place any importance in how the tiles are organized since the settlement will need to exist harmoniously with the landscape at the settlement site. Leave room to the left of the settlement for expansion.
2. Place the Control Console to one side.
3. Choose a Supply Ship with the desired number of cargo hexes for the game. Fewer hexes makes the game harder. Place it above the settlement.
4. Create the Resource Reservoir. Place it to the right of the Control Console. Store all of the resources and space meeples not available to the settlement. You might want to have a container with compartments to keep them organized. An egg carton or ice cube tray would work great.
5. Before the first round, players perform the Placement Action to stock the Supply Ship with resources and settlers. For the initial Supply Ship, players must place, AT A MINIMUM, settlers, ice, oxygen, and food.

GAME PLAY

The game is played in 7 supply rounds with additional rounds while resources exist. The game continues until either the settlement becomes self-sufficient or collapses.

1. Setup the game.
2. Pick a First Player to start the game and give them the first player token.
3. Players take turns with the Place Resources and Settlers Action to populate the first Supply Ship.
4. Start Round 1!

ORDER OF ROUND OPERATIONS

For each round, players will perform the following actions. There may be circumstances where players are forced to skip actions. For example no resources may be available to harvest or an event card may cause a change.

1. Draw Action - draw one event card and do what it says. Skip this action in the first round.
2. Unload Action - Unload the Supply Ship to the Control Console.
3. Harvest Action
 - a. Harvest new resources from the output area of the activated building tiles. Place them in the appropriate area of the Control Console.
 - b. Return resource inputs to the Resource Reservoir.
 - c. Return settlers to the Community on the Control Console.
 - d. Place newly constructed building tiles into the settlement.
4. Settlement Placement Action
 - a. Starting with First Player, place resources and settlers to complete a building tile.
 - b. Continue clockwise until no more buildings can be activated or the team chooses by consensus to stop.
5. Prime Outputs Action - add output resources to all ACTIVE building tiles.
6. Supply Ship Placement Action
 - a. Continuing the turn order, players load resources into a hex on the Supply Ship from the Control Console. Each hex may contain only a single resource type OR settlers. The number of resources/settlers placed is governed by the Hex Capacity on the Control Console.
7. Check to see if the settlement is self-sufficient OR has collapsed. See END OF GAME for checklists.
8. Move the Shipment Marker on the Control Console. Pass the first player token to the left.

END OF GAME (AKA HOW TO WIN OR LOSE)

HOW TO WIN (SELF-SUFFICIENCY)

Players win if they can answer Yes to all of the following questions.

1. Can the outputs of the buildings sustain the colony through a round without depleting the reserve resources on the Control Console?
2. Is there enough power from the Fusion Generators to power the building needed to generate those outputs?
3. Is there enough power to maintain at least one Robotic Building Assembler?
4. Are there a sufficient number of Habitat Modules to support the number of building tiles needed for 1, 2 and 3.

HOW NOT TO WIN (SETTLEMENT COLLAPSE)

There are three mandatory buildings. At the end of every round, the following conditions must exist.

1. At least one Habitat Module must be ACTIVE and have power from a Fusion Generator.
2. At least one Fusion Generator must be ACTIVE.
3. At least one Robotic Building Assembler must have power from a Fusion Generator. Remember that the RBA consumes 4 of the 10 Power Banks from the generator.

If any of these conditions are not met, the settlement immediately collapses and the game ends.

GAME PLAY EXAMPLES

TBD

FAQ

1. Treat bonuses as random events. For example, if you lose resources from a Supply Ship and the event card doesn't say which resources, put them in a cup and pick the number of resources you lose randomly.
2. If an event doesn't apply, it does nothing. For example, if you get bonus nitrogen from the Atmospheric Nitrogen Extractor and there isn't an active one in the settlement, there is no bonus.

MISSIONS TO SATURN AND TITAN

PIONEER 11

The first fly-by of Saturn occurred with Pioneer 11 in September, 1979. Pioneer 11 was able to measure the temperature of Titan's surface at a chilly 250K (-24°C or -10°F)! Imagery was fairly low resolution. By comparison, Cassini image quality was over 40 times better.

VOYAGER 1

About a year later, in October, 1980, Voyager 1 made a close fly-by of Titan and gathered much better pictures. Even with better quality, the surface was invisible to Voyager thanks to Titan's dense atmosphere.

VOYAGER 2

In August 1981, Voyager traversed the Saturnian System taking pictures and using RADAR imagery to capture images of the moons, rings, and planet. It also discovered several new satellites near and inside Saturn's rings.

CASSINI-HUYGENS

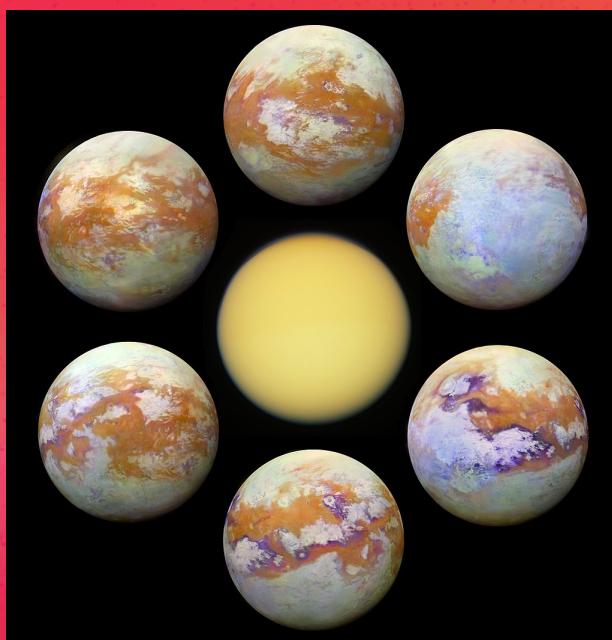
The Cassini-Huygens mission was launched on October 15, 1997 to study Saturn and its system. It entered Saturn's orbit on July 1, 2004 and spent 13 years surveying the system and collecting over 635 GB of scientific data on Saturn, the rings, and its moons. The mission culminated in a suicide mission collecting data as it deorbited and burned up in Saturn's upper atmosphere on September 15, 2017.

As part of its mission, it carried the Huygens Lander which parachuted to the surface of Titan on January 14, 2005 from where it relayed data through Cassini to Earth for about 90 minutes. This was the first

landing of a craft in the outer Solar System and the first landing on a moon other than Earth's Moon.

The data collected from Cassini-Huygens proved to be invaluable and elevated Titan to prominence as a potential target for future human settlement.

All told, Cassini conducted 45 close fly-bys of Titan collecting detailed imagery using radar and infrared cameras. The images showed a relatively flat surface and lakes of liquid methane.



Infrared views of Titan.

(Image by NASA/JPL-Caltech/University of Nantes/University of Arizona - https://photojournal.jpl.nasa.gov/figures/PIA21923_fig1.jpg, Public Domain, <https://commons.wikimedia.org/w/index.php?curid=70984405>)

DRAGONFLY



This illustration shows NASA's Dragonfly rotorcraft-lander approaching a site on Saturn's exotic moon, Titan. Taking advantage of Titan's dense atmosphere and low gravity, Dragonfly will explore dozens of locations across the icy world, sampling and measuring the compositions of Titan's organic surface materials to characterize the habitability of Titan's environment and investigate the progression of prebiotic chemistry. Credits: NASA/JHU-APL

Expected to launch in 2026, the NASA Dragonfly mission will land and fly an octocopter (8 rotors) on Titan looking for the building blocks of life. Thanks to Titan's dense atmosphere, it will be able to fly its entire science payload from site to site and not rely on a ground-based rover to complete its mission.

"It will first land at the equatorial "Shangri-La" dune fields, which are terrestrially similar to the linear dunes in Namibia in southern Africa and offer a diverse sampling location. Dragonfly will explore this region in short flights, building up to a series of longer "leapfrog" flights of up to 5 miles (8 kilometers), stopping along the way to take samples from compelling areas with diverse geography. It will finally reach the Selk impact crater, where there is evidence of past liquid water, organics – the complex molecules that contain carbon, combined with hydrogen, oxygen, and nitrogen – and energy, which together make up the recipe for life."

CREDITS

Game Design by Jon Adair, Bill Shaw, Ashle Thompson, and Ann Adair.

This game was produced as part of the 2023 NASA Space Apps Challenge. Our thanks go out to the global organizing team, the local sponsors and organizers for the Tampa Event, Tampa Hackerspace for providing the community and resources needed to pull this all together, and to our competitors who helped us raise the bar to accomplish everything in less than 48 hours.

CREATIVE CREDITS

3D Models

Mining Rig by Tezca <https://www.thingiverse.com/thing:4792433>

Random building by Noobie3Dmaker

<https://www.thingiverse.com/thing:5886121>

Most buildings from the Settlers of Mars collection by AntonKossmann

<https://www.thingiverse.com/thing:3581526>

Artwork

Logo and building imagery generated by Bing Image Creator Powered by Dall-E3

Energy Resource image by macrovector on Freepik

Regolity Resource image by pikisuperstar on Freepik

Food Resource image by rawpixel.com on Freepik

RESEARCH CREDITS

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