2004/10/25

PLANETARY PROBE Rules

http://microgravity.grc.nasa.gov/outreach/navigator/game.html
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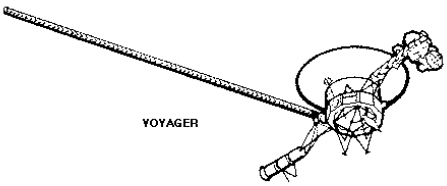


- **GAME OBJECTIVE**
  - Earn the most points by plotting the flight path of a planetary probe so that it can make short-range measurements of other planet(s). Points are earned by flying within gravity wells (□).
- **LAUNCH (TURN 1)**
  - Find the assigned home planet, and then choose any grid point just outside the planet's gravity well (□) as the launch endpoint, marking it with a dot. There are 24 choices. *The spacecraft in the Planetary Probe game does **not** have engines, so this step is the only decision in the game!*
  - Draw a straight line connecting the endpoint to the home planet's grid point.
  - Label the launch endpoint with the turn number 1.
  - For turn 1, record the number of grids moved up (+) or down (-), and right (+) or left (-).
- **SUBSEQUENT TURNS**

Turn Sequence

COAST
+ GRAVITY
= MOVE

Do steps in order!

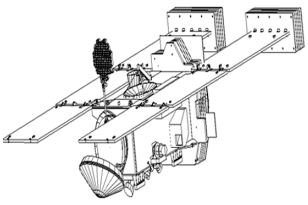
  - **COAST** - Starting at the previous turn's endpoint, count grids matching the movement recorded for the last turn, circling the identified grid point.
    - *This movement is due to inertia, i.e., Newton's first law of motion.*
  - **GRAVITY** - If the circled grid point is within a gravity well (□), then shift one grid point toward the planet in the direction of the short line. Mark this as the endpoint with a dot.
    - *This movement is due to gravity.*
  - **MOVE**
    - Draw a straight line connecting this turn's endpoint with last turn's endpoint.
    - Label the new endpoint with the turn number.
    - For this turn, record the number of grids moved up (+) or down (-), and right (+) or left (-).
- **GAME END**
  - The game ends when the spacecraft flies outside the map boundaries **or** crashes.
  - The probe has crashed if either:
    - a turn's endpoint is at a planet grid point, **or**
    - a turn's flight path exactly crosses a planet grid point (and not just the ○ symbol).
- **SCORING**
  - +3 per each non-home planet surveyed, with at least one turn endpoint in the planet's □ (gravity well).
  - +1 per turn endpoint in a non-home □ (gravity well), except during a crash turn, for surveys.

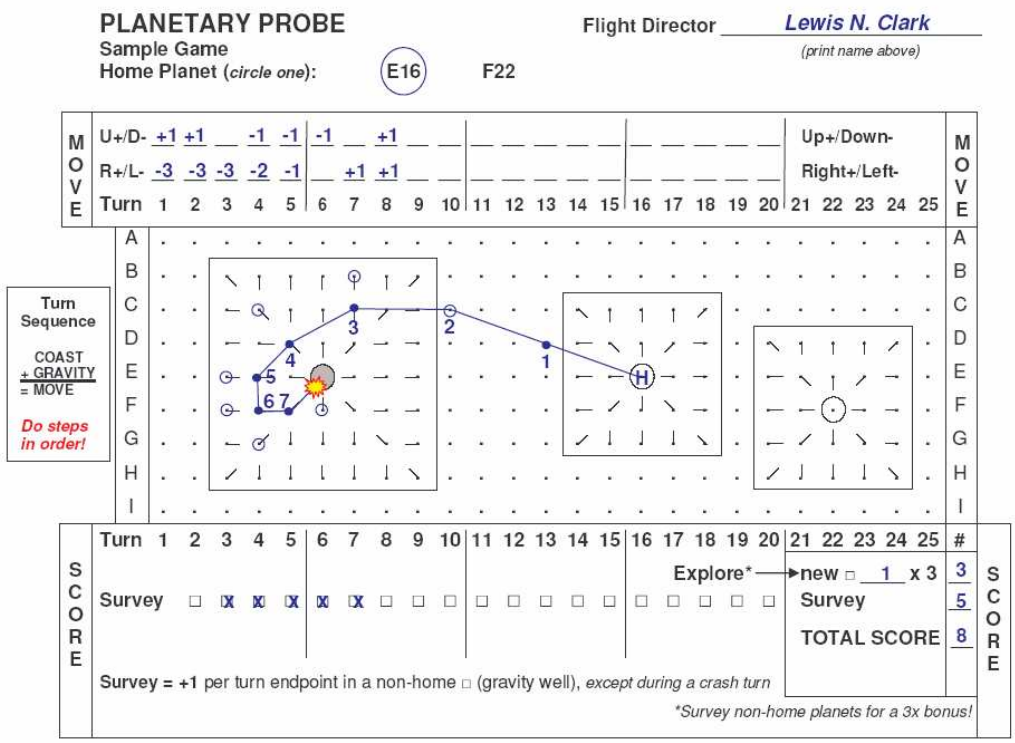
SAMPLE GAME

Probe launches from home planet E16. On turn 8, the probe crashes on planet E6, after being pulled in by the planet's gravity.

Score
3 for exploration
+5 for surveying
8 total

Note that points are neither earned nor lost during a crash turn.





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SPACESHIP COMMANDER Rules

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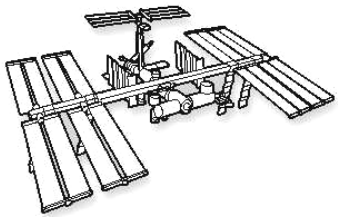


- **GAME OBJECTIVE**
  - Earn the most points by plotting the flight path of a spaceship so that the astronauts can perform microgravity experiments, and make short-range measurements of other planet(s).
- **LAUNCH (TURN 1)**
  - Follow launch instructions for Planetary Probe game.
- **SUBSEQUENT TURNS**
  - **COAST -** Starting at the previous turn's endpoint, count grids matching the movement recorded for the last turn, circling the identified grid point.
    - *This movement is due to inertia, i.e., Newton's first law of motion.*
  - **GRAVITY** - If the circled grid point is within a gravity well (□), then shift one grid point toward the planet in the direction of the short line. Mark this grid point with a dot.
    - *This movement is due to gravity.*
  - **ENGINES** - If desired, the engines may be used for -2 points to shift one grid point in any direction: horizontal, vertical, or diagonal. Draw an arrow for this shift and mark the endpoint with a dot. Although fuel is unlimited, the engines cannot be fired more than once per turn.
    - *This movement is due to thrust.*
  - **MOVE**
    - Draw a straight line connecting this turn's endpoint with last turn's endpoint.
    - Label the new endpoint with the turn number.
    - For this turn, record the number of grids moved up (+) or down (-), and right (+) or left (-).
    - If the engines were fired, circle the turn number in the movement log.

Turn Sequence

COAST
+ GRAVITY
+ ENGINES
= MOVE

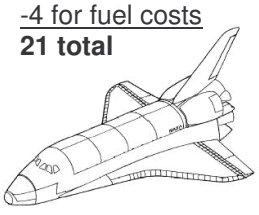
Do steps in order!

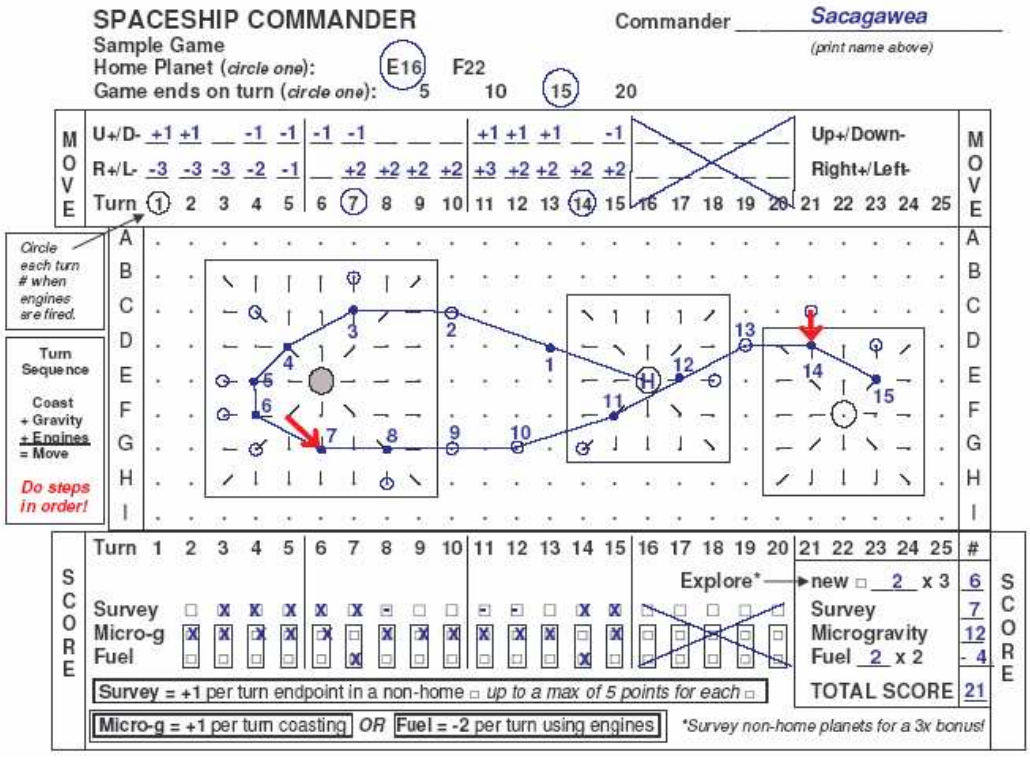
- **GAME END**
  - The game ends at the end of the specified end turn **or** when the spacecraft flies off the map.
  - In this game, the spaceship cannot land or crash! See Planetary Probe rules explaining crashing.
- **SCORING**
  - +3 per each non-home planet surveyed, with at least one turn endpoint in the planet's □ (gravity well).
  - +1 per turn endpoint in a non-home □ (gravity well), up to a max of 5 per □, for planetary surveys.
  - +1 per turn coasting (when engines are not used), for microgravity experiments.
  - -2 per turn for using engines after launch, for fuel and spacecraft costs.

SAMPLE GAME

The spaceship launches from home planet E16 in a 15-turn game. After circling planet E6, the the engines are used on turn 7 causing the spaceship to fly back past E16. On turn 14, the engines are used again to turn toward planet F22.

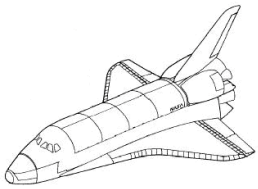
Score
6 for exploration
7 for surveys
12 for microgravity
-4 for fuel costs
21 total





2004/10/25

SPACESHIP COMMANDER Optional Rules



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The options below can be used independently or jointly. For example, a race mission with limited fuel can be a good challenge for experienced players. In contrast, a race mission with unlimited fuel can be a good game for beginning players because of the well-defined objective. The options shown in italics require use of the rules on the Advanced Rules Score Sheet.

- ***Adv. Rules?***
  - This option allows landing on and subsequent launch from weak-gravity planets, including the collection and return of samples from non-home planets. The option is described in detail on the Advanced Rules Score Sheet.
- **End at ….**
  - In this option, there is a defined end location for the game, for example within a specified □ (gravity well), on a certain weak-gravity planet, or at a space station (see below). The game ends when the spaceship reaches the specified location, but the mission may or may not be a race (see below).
  - Winning solutions are those where the spaceship reaches the defined end location. If the game is not a race, the best solutions are those with the highest score.
  - This option is good for beginning players who are not familiar with the scoring and are still learning how to plot paths that will maximize their score.
- ***Land on …. (requires Advanced Rules)***
  - In this option, winning solutions must include a landing on the specified planet(s).
- **Limited Fuel**
  - In this option, there is a maximum number of points that can be expended for both fuel and launch costs, not including the launch on turn 1.
  - For standard scoring, the limited fuel value should be an even number of 10 or less for a 20-turn game because there are no launch costs. Shorter games should have smaller fuel limits.
  - With advanced scoring, a limited fuel value of 10 to 30 (for example, 20) is suggested for a typical 20-turn game, with the understanding that launch capability will be severely limited.
- **Race?**
  - In this option, the mission is to fly the spaceship to specified location(s) within the minimum number of turns. The final destination is specified in the "End at" option, and any intermediate locations are specified in the "Land on" and "Survey" options.
  - The winning solutions are those with the shortest mission length in turns where the flight path includes all specified locations. Of solutions with the same mission length, the best are those with the highest score.
  - A race mission might be envisioned as a rescue mission or perhaps a technical competition between countries like the Moon race of the 1960s.
  - A race mission can be a good game for beginning players, because the objective is clear and success is less dependent on the scoring.
- ***Station (requires Advanced Rules)***
  - Grid point(s) marked with a ◊ (diamond) represent space station(s) at which the spaceship can dock and earn the same points as for landing.
  - As with landing, the spaceship can only move a distance of one grid during its docking turn. Movement of more than one grid would result in a crash, which is not allowed.
  - Launch rules do not apply when undocking from a space station. There is no coasting (inertial) motion. The movement during undocking results from gravity if in a □ (gravity well), and the normal use of engines to move one space in any direction.
  - Movement directly across a space station grid point does not result in a crash, unlike similar motion across a planet grid.
  - Microgravity points are earned when the spaceship is docked to a space station, and survey points can be earned if the space station is within the □ (gravity well) of a non-home planet.
  - Docking points can only be earned once during the game for each different space station.
- **Survey ….**
  - In this option, winning solutions must include at least one survey of the specified planet(s). In other words, at least one turn endpoint must be within the □ (gravity well) of the identified planet(s).

2004/10/25

SPACESHIP COMMANDER

Advanced Rules Score Sheet

Commander _____

(print name above)

SCORE

Turn	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	+	-
																					Explore →	new □ ____ x 3				__	
																					Return? →	samples __ x 5				__	
Landing	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	Landing __ x10					__	
Survey	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	Survey					__	
Micro-g	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	Micrograv					__	
Fuel	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	Fuel _____ x 2						-__
Launch	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	Launch __ x 5						-__
																					Subtotals					__	-__
																					TOTAL SCORE						

Scoring Key

Explore	**+3** per each non-home planet surveyed, with at least one turn endpoint in the planet's □
Return	**+5** per landing on different non-home planet(s) followed by a landing on the home planet
Landing	**+10** per landing (or docking) *up to a max of 1 landing for each planet (or space station)*
Survey	**+1** per turn endpoint in a non-home planet □ *up to a max of 5 points for each* □
Micro-g	**+1** per turn coasting (when the spaceship is not on a planet and is not using its engines)
Fuel	**-2** per turn using engines
Launch	**-5** per launch (in addition to the -2 fuel cost), except for the free launch on turn 1

Additional Rules & Explanation

- **Explore**
  - One or more turn endpoints must be within a non-home planet's □ (gravity well) to earn the exploration bonus for that planet.
- **Landing & Launch**
  - During the landing turn, the spaceship follows the standard movement rules but can only move one grid to the planet (whether horizontal, vertical, or diagonal). A move of more than one grid in the landing turn would result in a crash, which is not allowed.
    - *To avoid crashing, the spaceship may need to slow down prior to its landing turn.*
  - The spacecraft can only land on weak-gravity planets identified with an open circle. Any planets shown by a shaded circle have gravity that is too strong for the spaceship to escape.
  - On the turn after landing, there is no coasting (inertia-caused) motion of the spaceship. Normal launch rules apply, but there is a point cost as described above.
- **Microgravity (i.e., Micro-g)**
  - Microgravity points are earned during a landing turn where the spacecraft does not use its engines (because of the time while the spacecraft coasts before entering the atmosphere).
- **Return of samples**
  - Bonus points are earned for the return of samples collected on non-home planets. To earn these points, the spaceship must first land on non-home planet(s) to collect samples, and then must afterward land on its home planet. In other words, these points are only earned if the spaceship collects and then delivers sample(s) to its home planet.
  - Additional points are not earned for repeated returns (i.e., landings on the home planet) with the same samples, or repeated sampling at the same non-home planet(s).
- **Survey**
  - Survey points are earned during turns when the spaceship lands or remains landed on a non-home planet. Survey points are not earned on the home planet or within its □ (gravity well).