

Black hole explorer



Rules of the Game

Overview

You are going to build a spaceship to fly close enough to a black hole to study it, and be the first back with scientific discoveries that could win you a Nobel Prize! But travelling too close could leave you spiraling into the black hole, never (or probably never) to return!

Black Hole Explorer can be played in two ways: as a competition between missions, or as a team collaboration assembling one mission. The first is more of a race, the second pits the team against the extreme natural forces of the Black Hole.

Game Equipment

Game board; 2 dice; event cards; probe result cards; energy tokens; spaceship data sheet (one per ship); spaceship game pieces (one per ship. Use coins, tiddlywinks or customize your own); pencils, eraser.

Playing the game

The game has three parts. In Part 1 the players have to construct a spaceship based on the amount of money available (determined on a die roll). Once the spaceship is built, you can proceed to part 2: the black hole board. The board has a black hole at its center surrounded by eight circular orbits. The hazards increase as you move to smaller and smaller orbits. The outer two orbits are called the Safe Zone. You then move to the Warning Zone, and finally, close to the black hole, the Danger Zone! To move to lower orbits, you simply have to complete one orbit and then change. But to climb orbits, you need to expend energy to fight against the black hole's gravity. During your mission, events will happen. By landing on an **E** (Event) square, you turn over and read an Event card. The event may be good or bad for your mission. Once you are in the danger zone, you can launch your scientific probes, collect your results, and head for home. Part 3 of the game is when the spaceship(s) return to Earth, and the mission results are assessed, to see if you have done enough to win the Nobel Prize and the game.

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Game Part 1. Spacecraft design

For this first part, you will need to complete your spaceship data sheet. Roll one die and multiply the number you roll by 10 million. This is the amount of money in dollars you have to spend. Write this number in the *Funding* box of your data sheet.

Your money needs to be spent on four items:

- Probes** How many scientific probes your spaceship will carry.
- Shielding** To protect against heat and radiation from the black hole.
- Strength** To protect against the strong gravity of the black hole
- Power** The amount of energy your spaceship will have.

Now, read the details and costs of each item before spending. Then write your purchase in the appropriate box on your data sheet.

Probes:

- 1 probe costs \$5m
- 2 probes cost \$10m
- 3 probes costs \$15m

Shielding:

- Level 1 Shielding costs \$5m. Protects against moderate temperatures
- Level 2 Shielding costs \$10m. Protects against high temperatures and weak radiation.
- Level 3 shielding costs \$15m. Protects against high temperatures and intense radiation.

Strength:

- Level 1 strength costs \$5m. Protects against tidal forces in the Safe zone.
- Level 2 strength costs \$10m. Protects against tidal forces in the Warning zone.
- Level 3 Strength costs \$15m. Protects against tidal forces in the Danger zone.

Power:

- A Single engine costs \$5m. You get 6 energy tokens.
- A Double engine costs \$10m. You get 12 energy tokens.
- A Triple engine costs \$15m. You get 18 energy tokens.

You will also collect (and lose) energy tokens during the mission.

[NOTE: In the competitive game, there is no rule stopping collaboration, especially if mission funding is poor. This way, a game of (say) three players may reduce to three collaborators and one superior spacecraft, increasing the chances of success!]

IMPORTANT. Don't forget to name your spaceship!

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Game part 2. The Game Board

Moving

Start on the spaceship picture and move down the squares until you join the outer orbit. **You then move counterclockwise around the black hole.** Roll two dice to determine how far you move each turn. You always move counterclockwise, both descending to and ascending from the black hole. This is the direction the black hole and its surrounding disc of gas (the accretion disc) is spinning.

You may give yourself an extra boost by expending energy: “buy” an extra die roll for an energy token (up to a maximum of two dice = 2 energy tokens). Example: for the cost of two energy tokens, you roll effectively 4 dice. **Note:** You will still need to expend an energy token as you climb an orbit in addition to any used for the boost.

Event cards

Certain squares in an orbit are marked with an **E**. This means that there is an event happening. These events may be good or bad, and reflect the hazards of a mission. If you land on an **E**, take an event card from the top of the pile. Then place the card on a discard pile unless the card tells you otherwise. When the Event card pile is empty, reshuffle the discards and place them face down to make a new Event pile.

Unless otherwise stated, an event card overrides the prior status of the spaceship.

Example: if a ship had previously been ordered to stay in the same orbit, and an Event card is drawn telling it to change orbit, it must change!

To change orbits

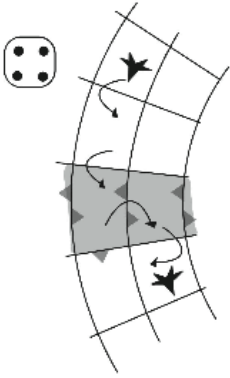
You must make at least one complete orbit before trying to change orbits. You can only change in the *CHANGE ORBIT* zone unless an event card tells you otherwise. You may only change your orbit by one unless an event card tells you otherwise. When changing orbits, move down (or up) vertically one square (see the diagrams below).

You need not change your orbit if you do not wish to (unless an event card tells you to), but... If you run out of energy tokens you automatically drop one orbit every turn (regardless of where you are in the orbit).

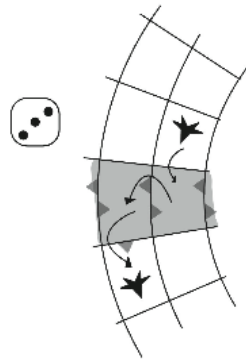
To go down: You can automatically lower your orbit when entering the *CHANGE ORBIT* zone.

To go up: You can move to a higher orbit when entering the *CHANGE ORBIT* zone, but you need to expend 1 energy token to do so (otherwise you must remain in the same orbit).

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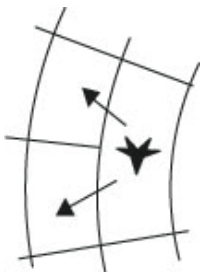
Moving Down example. On a roll of 4, your spacecraft moves into the *CHANGE ORBIT* zone, and steps down to a lower orbit.



Moving Up example. Here a roll of 3 takes you into the *CHANGE ORBIT* zone, and out into a higher orbit, but you must expend one energy token.

Forced change of orbit by an Event?

An event card may order you to change orbits immediately. If this change takes you into another Zone (say *Warning to Safe*), you will have a choice of two spaces to occupy, one of which may be an Event space. You may choose which space to enter. (This is not an issue when moving down).



Moving up by order of an Event card. You have a choice of which space to occupy.

Launching a probe

You can only (successfully) launch a probe in the *Danger Zone*. A probe can be launched at the end of your turn (that is, after you have rolled, moved and drawn an event card should you have landed on an **E**). Each probe launch costs 1 energy token.

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The probe's chance of success increases the closer you are to the Black hole:

Highest orbit of Danger Zone: success with 1,2 on a die roll

Middle orbit of Danger Zone: success with 1,2,3,4 on die roll

Lowest orbit of Danger Zone: automatic success!

If your probe is successful, take a Probe Result card, read it out loud, and keep it in front of you. If your probe is unsuccessful, you do not get a Probe Result card. Note that a probe is lost and destroyed even when it is successful, as it has fallen into the black hole. A successful probe transmits its findings back to you – a failed probe (for whatever reason) does not.

What if I fall into the Black Hole?

Falling into a black hole is a one-way trip to oblivion. However, some scientists think that a black hole is a sort of gateway, or wormhole, to another part of the universe. This is very unlikely to be true, and even if it was, it is almost certainly impossible for a spaceship to journey through such a gateway. But this is only a game, so all is not lost! As soon as you fall in to the black hole, roll two dice. If you get 2 sixes, you emerge from a wormhole close to Earth and instantly win the Nobel Prize (and the game) for your discovery! If you don't, then go back and build another spaceship!

Game Part 3. Winning the game

End by returning to the “Home” Square (that is, climbing back up to the spaceship figure). You don't need to roll an exact number. If playing competitively, the first ship back home can present its results and attempt to win the Prize.

With one probe result, you win the Prize by rolling 5 or 6 on die roll.

With two probe results, you win the Prize by rolling 3,4,5 or 6 on die roll

With three probe results, you win the Prize automatically!

Reflection

At the end of the game you may want to reflect on your experience. Here are a few thoughtful questions.

1. Has your picture of what a black hole is changed because of this game? In what way?
2. How do you think events in the game would differ from a real mission to a black hole?
3. If you had to play the game again (or plan a real mission), what would you do differently, in the design phase, and in the mission phase?

Frequently Asked Questions

Here are some questions that have come up during the playing of Black Hole Explorer.

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What's the difference between the spaceship and the probes?

The spaceship is a large vessel with a crew of scientists and engineers. The probes are small robotic craft that are launched by your spaceship. The probes are equipped with cameras and an array of scientific equipment, and radio their findings back to the spaceship.

What if I roll a 1 for funding? What chance have I got?

There are several options. You could agree that a roll of one means roll again. Or it's time to arrange a collaboration. Some \$10M ships have made it through – so think of it as a challenge!

Why do I have to expend energy climbing, but not descending?

When climbing you are working against the gravity of the black hole. The Space Shuttle needs tremendous energy to fight Earth's gravity on take-off, but glides back down to Earth without power.

If I'm "bumped up" an orbit by a collision or other event, do I need to expend energy?

No, because the move is a forced on you from outside, and not a result of firing your own engines. "Climbing" an orbit does expend energy, because you are making the move under your own power.

What if I have zero shields (or strength), and an event card says I lose 1 shield (or strength)?

If you are at zero you stay at zero (you can't go negative) and be thankful that you're still in one piece!

Can I help another spaceship that is in trouble?

Yes. If you can land on an adjacent square (either side, above, below or diagonal), you can donate a probe, repair robot or energy. This act of charity will cost YOU an energy token for each service given. Example: to give another spaceship one energy point will cost you two energy tokens.

I want lasers to shoot things!

This is not really in the spirit of exploration, although we appreciate that the USS Enterprise is quite heavily armed! If you want to turn "Black Hole Explorer" into "Black Hole Buccaneer" the tools are all here – energy, shields and strength.

What if the space I land on is occupied by another ship?

Two ships can occupy the same space (a ship is a few hundred feet long, and each space is many square miles in size). You may want to add new rules to bring in chances of collision, or (dare we say) combat!

Why does the black hole spin counterclockwise?

Why not? All real black holes rotate (probably), as do all stars and planets. Whether a black hole spins clockwise or counterclockwise depends on your perspective.

Can I move my spaceship in the opposite direction (clockwise?)

The rules say no. In reality, it would be tough to orbit "retrograde." The inner accretion disc will be rotating very rapidly – we're talking 10 million mph! Fighting against this would be like white water rafting back up a mountain. Feel free to adapt the rules if you want to fight the rotation, but get ready to burn energy and shields!