We have almost entirely depleted our current energy sources. They were not used without good cause, and have lasted us generations upon generations. Yet the fact remains, and now it is time to look to the stars, right here from home.

We can stay on Earth.

But we need the energy of a black hole.

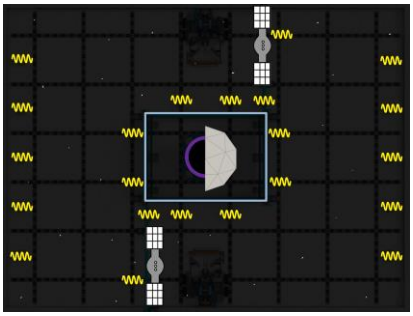
Anything that enters a black hole is gone, never to return. But an object in motion stays in motion, and because of the angular momentum of the star, as the black hole shrinks from something very huge to something very small, the speed only increases. In fact, black holes spin so fast that they drag everything close by, including outer space itself, with them. The area surrounding a black hole that experiences this is called the ergosphere. The rotational energy of this ergosphere is very strong. If something enters the ergosphere, some of its mass is lost to the black hole, but that mass is traded for the energy of the ergosphere, and the object exits the ergosphere far faster than before. But this is not enough; we need a sustainable energy source to last us generations, one we can harness and transport to our homes on Earth.

What we need is a **mirror**.

As members of the World Energy Organization, a group in charge of procuring power for planet Earth, we have already taken the first steps toward this energy source. We have reached a small, fast-spinning black hole and completely surrounded it with mirrors. Now, if some of the mirrors were opened up and **electromagnetic waves** were sent into the ergosphere, the same energy trade would occur: some of the electromagnetic energy would fall into the black hole, but most would go through the ergosphere, giving the waves some of the energy of the ergosphere. Since the ergosphere is enveloped in mirrors, the waves bounce off the mirrors instead of exiting the ergosphere, and the energy is amplified every time it passes through. That is, until part of the mirror is opened --

giving the world enough energy to last us for trillions of years, a period so long as to be considered indefinite.

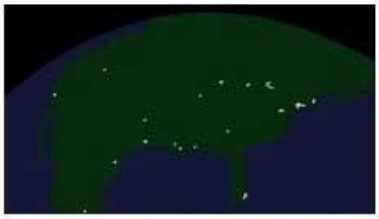
You and your team, along with over a thousand other teams around the world, have been tasked with the responsibility of harvesting energy from this revolutionary source. Since this is an impossible task for a human to perform, you must work together to engineer a **robot** to do it in your stead. You can either program it to do this, control it remotely, or a mix. Luckily for you, you will not bear this burden alone. As often as possible, you will be paired with another team at random, though not always.



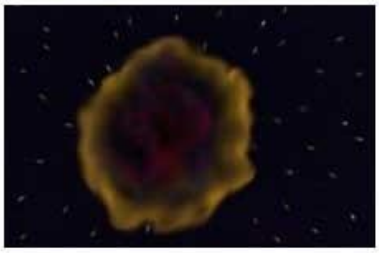
We can get your robot to the black hole, as long as **it meets certain constraints**, but the rest is up to you. To complete your mission, you must collect the electromagnetic waves necessary to harness the energy of the ergosphere. We understand that you don't have access to as much as this task entails, so after collecting these waves, you may **store them to use later** or use the waves now by **sending the electromagnetic waves into the opening in the mirror**. But swiftly; we are running out of **time before the world has completely run out of energy**. You will only have so much time before your robot must return to Earth, and if you haven't used or stored everything you brought, you must leave it behind. Once you're ready, **return to your science lab** to prepare more electromagnetic waves, and others from the **World Energy Organization** will open a mirror to collect the **energy**.

In these figuratively as well as literally darkening times, our species is running out of hope, and our world is running out of chances. You are our hope, and your mission is our last chance at survival. Whether you succeed or fail, we will not need another chance. Let us hope it is because we have found the solution.

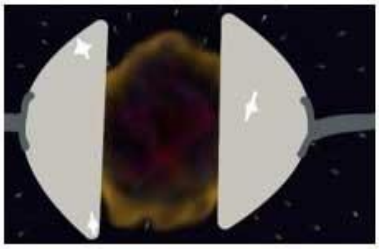
Good luck.



Far in the future, the Earth is running out of energy. We need to find a new, sustainable source, and quickly!

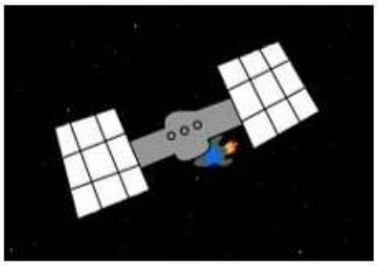


This new, sustainable energy source is a black hole. By using the angular momentum of the black hole and the ergosphere (shown in yellow), we will be able to solve Earth's growing energy crisis!

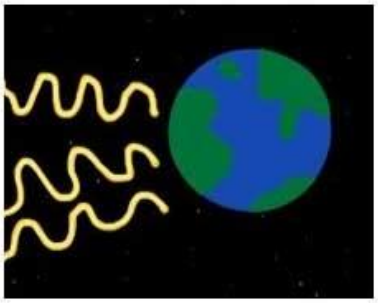


We can make an energy trade with the black hole if we first completely envelop it, and the ergosphere, with mirrors.

If we send electromagnetic waves into the ergosphere, the angular momentum of the ergosphere will exponentially increase the speed of the electromagnetic waves. The mirror keeps the electromagnetic waves in the ergosphere, and they gain more speed the longer they are inside.



Since we are transporting you to and from the black hole, after a certain period of time you must return to the science lab, which is inside our ship.



By opening part of the mirror, we can then harness the energy and speed of the electromagnetic waves to power Earth!

GLOSSARY

Mirror: *High Goal*
Electromagnetic Waves: *balls*
Robot: *robot*
It [your robot] meets certain constraints: *robot size/part rules*
Store them [the electromagnetic waves] to use later: *scoring balls in the Low Goal*
Sending electromagnetic waves into the opening in the mirror: *scoring balls in the High Goal*
Time before the world has completely run out of energy: *one (1) minute timer*
Return to your science lab: *hang*
World Energy Organization: *referees*
Energy: *final score*

CREDITS

Title: *Energy Source*
Team: *4606M*
Entrants: *Mina and Paela*
Location: *Noblesville, IN*
Header Photo: Wallpaper Safari*, 3 Jan. 2018, https://cdn.wallpapersafari.com/27/74/Y7hsMP.jpg. Accessed 2022.*
Sources: *https://www.youtube.com/watch?v=ulCdoCfw-bY (The Black Hole Bomb and Black Hole Civilizations by Kurzgesagt — In a Nutshell)*