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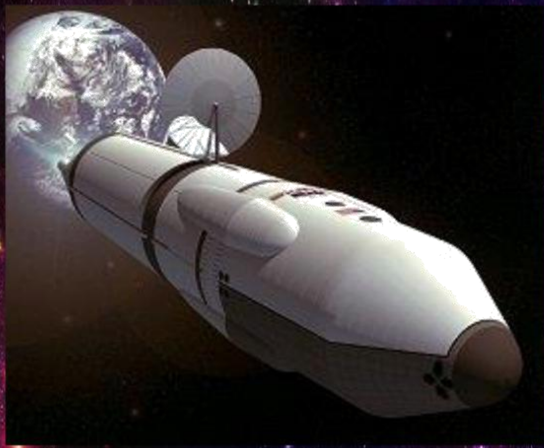
SCIENCE & SOCIETY - #spaceexploration #outerspace

The 12 Greatest Challenges for Space Exploration

Space is, of course, infinitely more hostile to human life than the surface of the sea; escaping Earth's gravity entails a good deal more work and expense than shoving off from the shore. But those boats were the cutting-edge technology of their time. Voyagers carefully planned their expensive, dangerous journeys, and many of them died trying to find out what was beyond the horizon. So why keep doing it?

I could tell you about spin-off technologies, ranging from small products of convenience to discoveries that might feed millions or prevent deadly accidents or save the lives of the sick and injured.

I could tell you that moving farther out into the solar system might be a good plan, if humanity is lucky enough to survive the next 5.5 billion years and the sun expands enough to fry the Earth.



I could tell you all those things: all the reasons we should find some way to live away from this planet, to build space stations and moon bases and cities on Mars and habitats on the moons of Jupiter. All the reasons we should, if we manage that, look out at the stars beyond our sun and say, "Could we go there? Maybe we could go there."

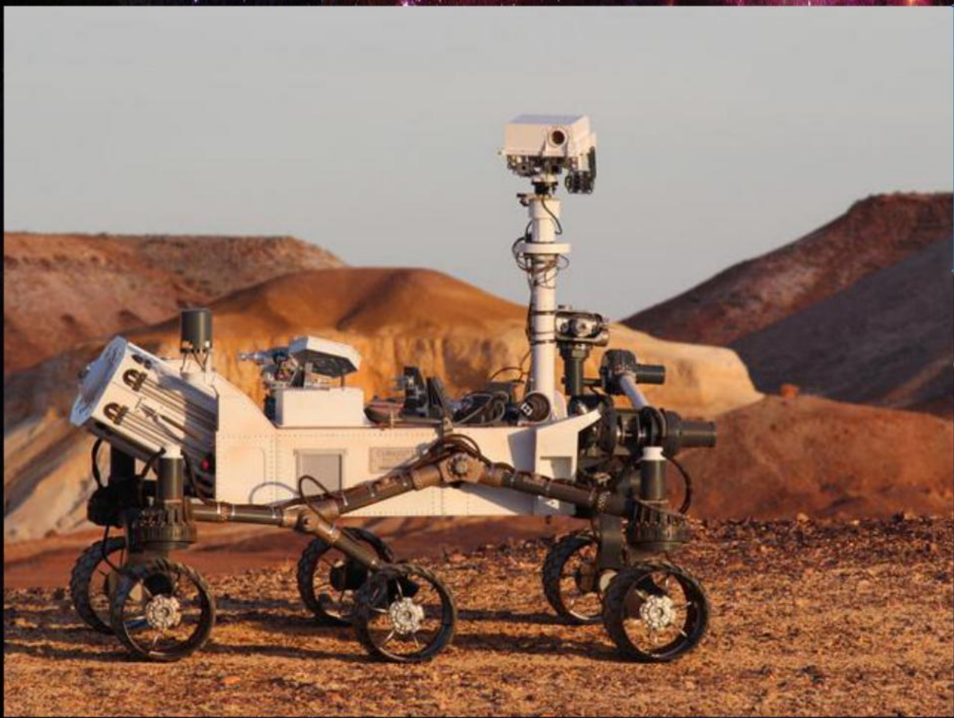
It's a huge, dangerous, maybe impossible project. But that's never stopped humans from trying anyway.

Gravity's a Drag

Getting off Earth is a little like getting divorced: You want to do it quickly, with as little baggage as possible. However, powerful forces conspire against you—specifically, gravity. If an object on Earth's surface wants to fly free, it needs to shoot up and out at speeds exceeding 25,000 mph.

That takes serious oomph—read: dollars. It cost nearly $200 million just to *launch* the Mars Curiosity rover, about a tenth of the mission's budget, and any crewed mission would be weighed down by the stuff needed to sustain life. Composite materials like exotic-metal alloys and fibered sheets could reduce the weight; combine that with more efficient, more powerful fuel mixtures and you get a bigger bang for your booster.

But the ultimate money saver will be reusability. "As the number of flights increases, economies of scale kick in," says Les Johnson, a technical assistant at NASA's Advanced Concepts Office. "That's the key to getting the cost to drop dramatically." SpaceX's Falcon 9, for example, was designed to relaunch time and again. The more you go to space, the cheaper it gets. —*Nick Stockton*



Mars Curiosity Rover

Our Ships Are Way Too Slow

Hurtling through space is easy. It's a vacuum, after all; nothing to slow you down. But getting started? That's a bear. The larger an object's mass, the more force it takes to move it—and rockets are kind of massive. Chemical propellants are great for an initial push, but your precious kerosene will burn up in a matter of minutes. After that, expect to reach the moons of Jupiter in, oh, five to seven years. That's a heck of a lot of in-flight movies. Propulsion needs a radical new method. Here's a look at what rocket scientists now have, or are working on, or wish they had. —*Nick Stockton*

It’s a Minefield Up There

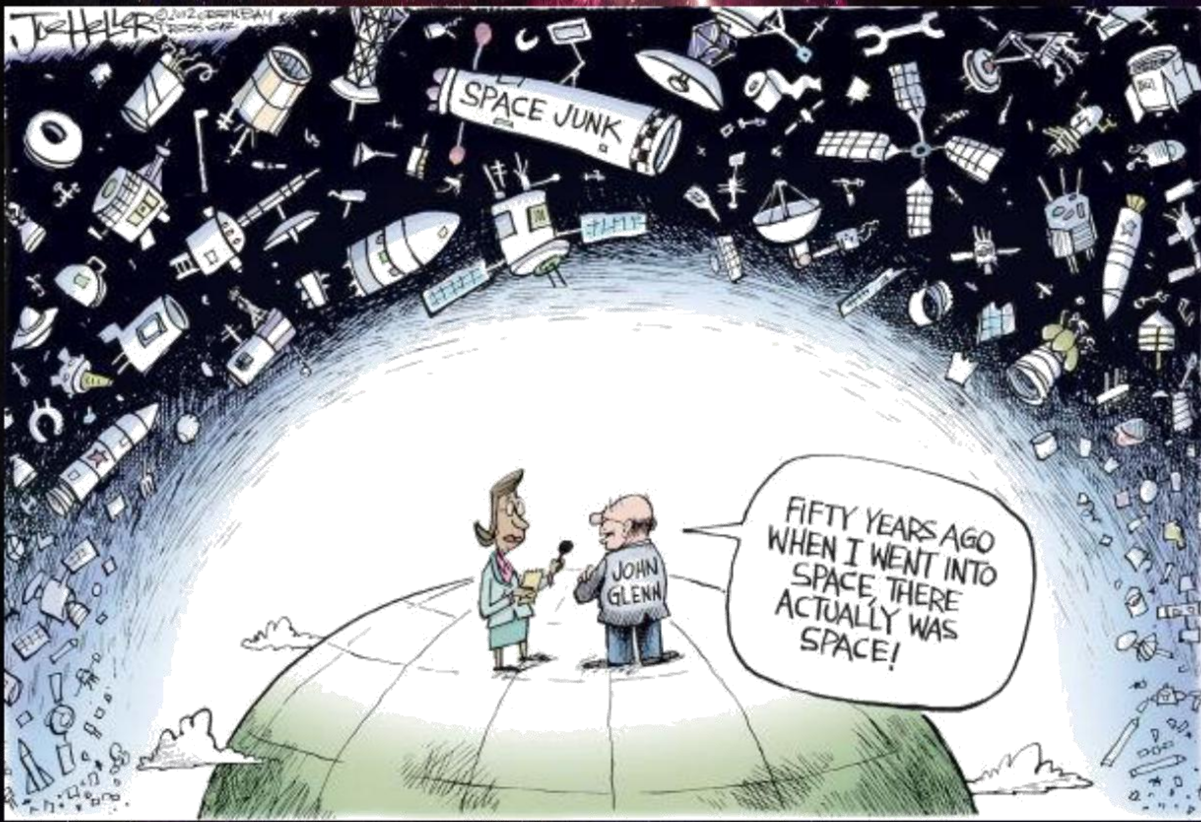
Congratulations! You’ve successfully launched a rocket into orbit. But before you break into outer space, a rogue bit of broke-ass satellite comes from out of nowhere and caps your second-stage fuel tank. No more rocket.

This is the problem of space debris, and it’s very real. The US Space Surveillance Network has eyes on 17,000 objects— each at least the size of a softball—hurtling around Earth at speeds of more than 17,500 mph; if you count pieces under 10 centimeters, it is closer to 500,000 objects. Launch adapters, lens covers, even a fleck of paint can punch a crater in critical systems.

A ball of twisted metal, purported to be fallen space junk, is pictured in James Stirton's farm in southwestern Queensland in this undated handout photograph received March 28, 2008.

Whipple shields—layers of metal and Kevlar—can protect against the little pieces, but nothing can save you from a whole satellite. Some 4,000 orbit Earth, most dead in the air. Mission control avoids dangerous paths, but tracking isn’t perfect.

Pulling the satellites out of orbit isn’t realistic—it would take a whole mission to capture just one. So starting now, all satellites will have to fall out of orbit on their own. They’ll abandon extra fuel, then use rocket boosters or solar sails to angle down and burn up on re-entry. Put decommissioning programs in 90 percent of new launches or you’ll get the Kessler syndrome: One collision leads to more collisions until there’s so much crap up there, no one can fly at all. That might be a century hence—or a lot sooner if space war breaks out. If someone starts blowing up enemy satellites, "it would be a disaster," says Holger Krag, head of the Space Debris Office at the European Space Agency. Essential to the future of space travel: world peace. *—Jason Kehe*



There's No GPS for Space

The Deep Space Network, a collection of antenna arrays in California, Australia, and Spain, is the only navigation tool for space. An ultraprecise atomic clock on Earth times how long it takes for a signal to get from the network to a spacecraft and back, and navigators use that to determine the craft's position.

However, as more and more missions take flight, the network is getting congested. The switchboard is often busy. So in the near term, NASA is working to lighten the load. Atomic clocks on the crafts themselves will cut transmission time in half, allowing distance calculations with a single downlink. And higher-bandwidth lasers will handle big data packages, like photos or video messages.

The farther rockets go from Earth, however, the less reliable this method becomes. Sure, radio waves travel at light speed, but transmissions to deep space still take hours. And the stars can tell you where to go, but they're too distant to tell you where you are. For future missions, deep-space navigation expert Joseph Guinn wants to design an autonomous system that would collect images of targets and nearby objects and use their relative location to triangulate a spaceship's coordinates—no ground control required. "It'll be like GPS on Earth," Guinn says. "You put a GPS receiver on your car and problem solved." He calls it a deep-space positioning system—DPS for short. —*Katie M. Palmer*

Space Turns You into a Bag of Cancer

Outside the safe cocoon of Earth's atmosphere and magnetic field, subatomic particles zip around at close to the speed of light. This is space radiation, and it's deadly. Aside from cancer, it can also cause cataracts and possibly Alzheimer's.

When these particles knock into the atoms of aluminium that make up a spacecraft hull, their nuclei blow up, emitting yet more superfast particles called secondary radiation. "You're actually making the problem worse," says Nasser Barghouty, a physicist at NASA's Marshall Space Flight Centre.

Mars Has No Supermarkets

Lettuce got to be a hero last August. That's when astronauts on the ISS ate a few leaves they'd grown in space for the first time. But large-scale gardening in zero g is tricky. Water wants to float around in bubbles instead of trickling through soil, so engineers have devised ceramic tubes that wick it down to the plants' roots. "It's like a Chia pet," says Raymond Wheeler, a botanist at Kennedy Space Center. Also, existing vehicles are cramped. Some veggies are already pretty space-efficient, but scientists are working on a genetically modified dwarf plum tree that's just 2 feet tall. Proteins, fats, and carbs could come from a more diverse harvest—like potatoes and peanuts.

All that's for naught, though, if you run out of water. (On the ISS, the pee-and-water recycling system needs periodic fixing, and interplanetary crews won't be able to rely on a resupply of new parts.) GMOs could help here too. Michael Flynn, an engineer at NASA Ames Research Centre, is working on a water filter made of genetically modified bacteria. He likens it to how your small intestine recycles what you drink. "Basically you are a water recycling system," he says. "with a useful life of 75 or 80 years." This filter would continually replenish itself, just like your innards do. —*Sarah Zhang*

Zero Gravity Will Transform You into Mush

Weightlessness wrecks the body: It makes certain immune cells unable to do their jobs, and red blood cells explode. It gives you kidney stones and makes your heart lazy. Astronauts on the ISS exercise to combat muscle wasting and bone loss, but they still lose bone mass in space.

Well…

But that's a dangerous line of thinking. "It creates a moral hazard," Robinson says. "People think if we mess up here on Earth we can always go to Mars or the stars. It's pernicious." His latest book, Aurora, again makes a forceful case about settlement beyond the solar system: You probably can't. As far as anyone knows, Earth is the only habitable place in the universe. If we're going to leave this planet, let's go because we want to—not because we have to. —Adam Rogers

Article adapted from: https://www.wired.com/2016/02/space-is-cold-vast-and-deadly-humans-will-explore-it-anyway/