

Clearing space debris

There are tens of millions of garbage pieces orbiting Earth, left behind from humankind's space missions. What can we do about them?

Humans have gone to outer space and made many discoveries, but they have also made quite a mess out there. We have been launching rockets, spaceships, and satellites into space for the past 50 years. All these activities have generated loads of rubbish in space and this rubbish is becoming a menace to space missions.

The clutter includes items such as broken rocket parts and shattered solar panels, paint flecks from the surfaces of spaceships, astronaut gloves, and tools. Because these objects are orbiting Earth at extremely high speed, any of them could crash into a satellite or a manned spacecraft and destroy it.

The American space agency, NASA, estimates that there are tens of millions of garbage pieces orbiting Earth. Most of them are smaller than 1 cm in diameter. About half a million pieces are as big as 10 cm in diameter. And, there are 21,000 pieces of trash larger than that.

A piece of space junk — a broken-down research satellite — plunged into Earth in 2011. NASA had sent the satellite into space 20 years earlier to study Earth's atmosphere. It had stopped working since 2005. The satellite, as big as a bus and weighing about 6 tonnes, broke into fragments upon entering

Earth's atmosphere. Most of the fragments got burnt up on the way down and the remaining parts landed in the Pacific Ocean.

The fallen satellite reminds us that besides stars, planets, and maybe alien life, there is a whole lot of rubbish floating in space.

High-speed projectiles

Most of the junk is found in low Earth orbit (LEO). This means, they are orbiting Earth within 2,000 km from Earth's surface. This is also the zone in which most of Earth's spacecraft are orbiting.

In LEO, spaceships, satellites or garbage items travel super fast. They have speeds of up to about 28,968 km per hour. This is seven times faster than a bullet. A paint chip travelling that fast could seriously harm an astronaut, spacecraft, or satellite that is in its way. That is why, when astronauts do any work outside their spacecraft, they have to wear spacesuits with a protective layer as strong as a bulletproof vest. Spacecraft also have protective shields built on them.

These protective covers are only effective against the impact of small objects. If a broken satellite as big as a refrigerator travelling as fast as a bullet collides head-on with a spacecraft travelling at the

same speed, the crash would be catastrophic.

All space debris orbiting the earth will eventually succumb to earth's gravitational pull and re-enter Earth like the fallen satellite. However, unlike the fallen satellite, most of the litter in space is destined to remain there for a very long time because they are further away from Earth's gravity.

The further an object is from earth's gravity, the longer it will remain in space. Debris orbiting Earth within 600 km from its surface will fall back into Earth within several years, like the fallen satellite. In contrast, debris orbiting the earth 1,000 km away will remain in space for a century or more.

Since a lot of the space debris is not going to re-enter Earth and get incinerated any time soon, scientists are thinking of ways to clear the rubbish. In order to come up with solutions, we must first understand why space debris orbits Earth super fast and why it remains in space for such a long time.

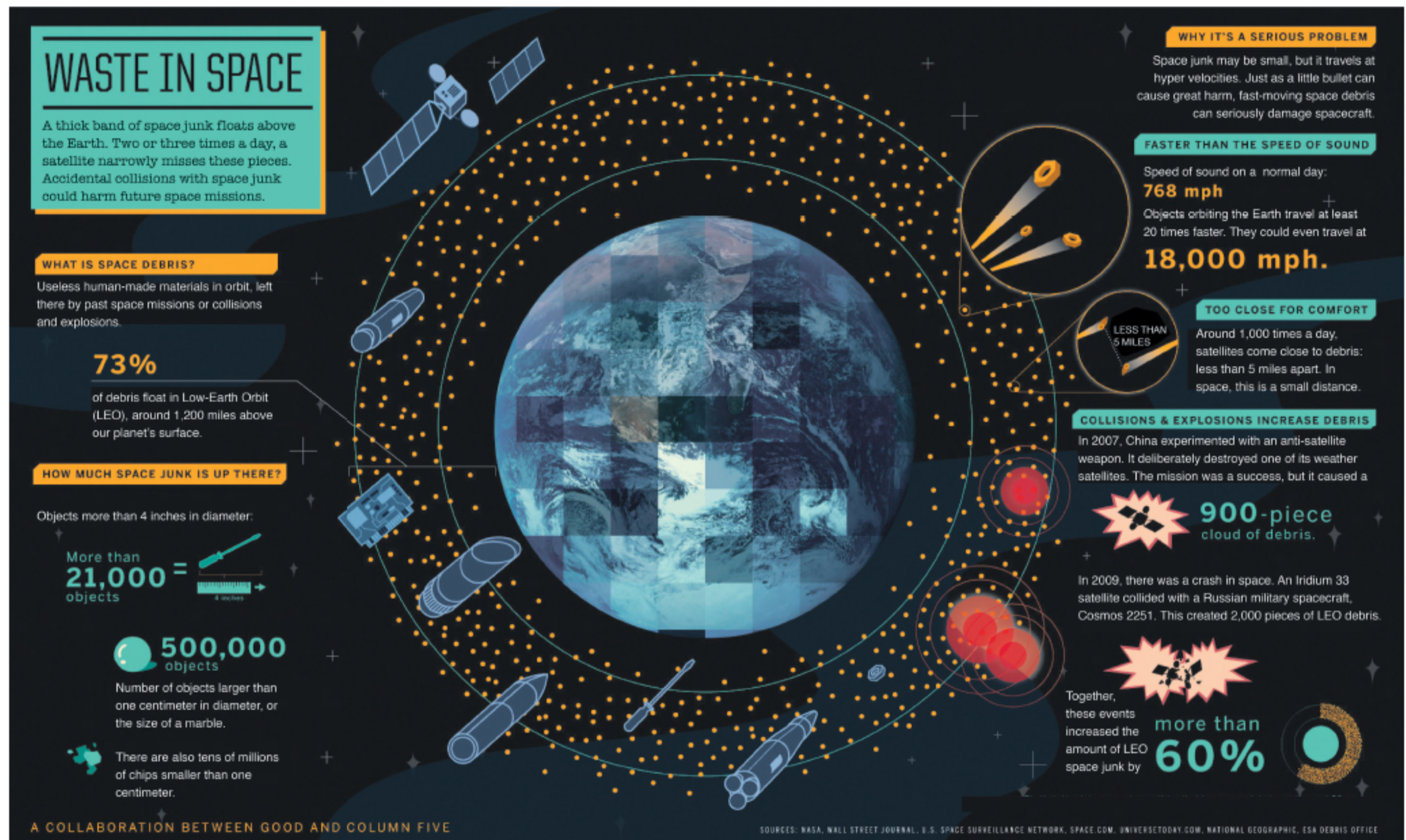
Why space junk stays up

For a space machine like a television satellite to do its job, it has to continuously float in space close to Earth without getting sucked back into it by gravity. To do this, the satellite must move at a speed high enough to counter Earth's pull.

If the satellite has too much velocity, it will become more powerful than Earth's pull and travel in a straight line, deeper and deeper into space, until it vanishes from sight. If the satellite has too little velocity, Earth will pull it back in, and the satellite won't be able to stay up in space. So, the velocity must be just right.

The balance between the two forces — the satellite's velocity and earth's gravity — is what keeps the satellite or any other space machine circling earth continuously, in other words, in Earth's orbit.

A satellite can remain in orbit for a long time because there is no air in space and therefore no air friction to slow it down. The lack of friction is also the reason why, when in orbit, the spacecraft does



Technical Sergeant John Lowe (right) weighs a hydrogen fuel tank, part of the debris from a Delta II rocket launch in 2010. The crew returned the debris to the Space and Missiles Systems Center at Los Angeles Air Base in California.

not need continuous fuel power to push it round the Earth. There is no air friction to stop a spacecraft from moving once it has already started doing so.

Hence, the velocity it had already gained from the firepower of the rockets that boosted it into space, and Earth's gravity, keep it circling Earth almost indefinitely, without fuel power. Satellites and spaceships have small rocket engines to power their movement in space, but these are used for adjusting their path every now and then. That is how they are able to avoid the debris in their path. Space agencies keep track of all the large pieces of debris so that they can alert astronauts in spacecrafts to dodge debris coming their way.

But, dodging rubbish is not going to solve the problem. The solution is to limit the clutter in space. Space agencies all over the world are taking steps to limit the clutter in space.

Spring-cleaning space

One step is to ensure that a satellite has enough fuel-power to transfer itself from LEO to a higher orbit once it has completed its mission. That way, it will not obstruct other space machines in LEO. This would reduce the risk of it colliding with other spacecraft and increasing orbital debris.

Scientists are also cracking their brains to come up with ideas to clear the litter once and for all. Most of

these ideas, like catching the rubbish with a giant net or firing a harpoon into a piece of space debris and pulling it back into Earth, are simply not practicable.

However, one idea has come up, which may work. Experts are planning to send a robot into orbit. According to the European Space Agency (ESA), the robot will attach itself onto a piece of space debris before bringing it back to Earth. Both robot and debris will burn up in Earth's atmosphere. Work on the first mission, named ClearSpace-1, will begin in 2020, with the official launch planned for 2025.

Although there is so much rubbish hanging over our heads, experts believe that we are unlikely to get hit by a piece of old rocket

or a satellite part. Before NASA's research satellite fell, the agency predicted that the chance of a person being struck by a piece of the satellite is less than the chance of a person being struck by lightning.

— By RICHARD PHILIP

VOCAB BUILDER

NASA (say "nah-sah"; noun) = acronym for National Aeronautics and Space Administration.

catastrophic (say "ke-tes-tro-fik"; adjective) = extremely destructive or harmful.

incinerated (say "in-si-ne-ray-ted"; verb) = completely destroyed by burning.

SHOW AND TELL!

Many kids love to act out how space wars happen. Some can even tell you what big words like "intergalactic" mean, thanks to sci-fi cartoons and games. Very few know about the serious issue of human garbage in space though. Being aware of this issue is the first step towards imagining solutions. Help to spread the word!

- Carefully study this beautiful infographic, "Waste in Space". ↑ Think of the information given as an important story.
- Share the Waste-in-Space story with two or three younger kids. Use the infographic as your poster and point to the parts as you tell your story.
- Encourage your audience to ask you questions and share their thoughts.

Who knows? One day, one of you might invent a great solution to cleaning up the trash in space.