



Highly Commended

Science Writing Year 5-6

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Space Junk

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Millions of objects larger than 1mm are scattered across the Earth's orbit, and can travel up to speeds of 15 kilometers per second. These objects are space junk, which are man-made objects that have no use. Space junk varies from tiny flecks of paint to used rocket parts and satellites. These flying debris are also a continuous threat to space observation and planet Earth.

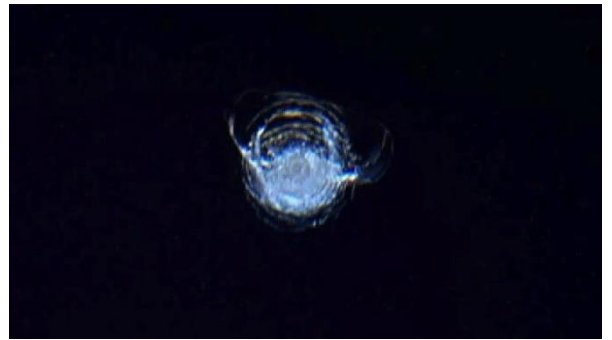


Figure 1: Paint Chip Dents ISS Window: Peake T (2016) ISS Damaged Likely Caused by Paint Flake [photograph], NBC, accessed 25 June 2024. <https://www.nbcnews.com/video/iss-damaged-window-likely-caused-by-paint-flake-687406659659>

The Cause and Effects of Space Junk:

The amount of space junk increases proportionally to the number of times objects are launched into orbit. Satellites that have failed or completed their mission stay in orbit becoming space junk. Space Junk in LEO (Low-Earth Orbit: Altitude of 160 to 2000 km) eventually falls back to the Earth because of gravity, burning in the Earth's atmosphere on its way back. On average, more than 40,000 metric tons of debris fall back into the Earth's atmosphere every year.

Due to this, our stratosphere has been polluted by vaporised metals from space junk. These metals contain aluminum oxide, mainly emitted by solid rocket motors, which both contribute to destroying ozone. Coincidentally, the ozone layer, which restricts Ultraviolet (UV) Radiation from approaching the Earth, is in the stratosphere. Metals from space junk gradually deteriorate the ozone layer's protection.

UV Radiation can also be a factor for global warming, it can accelerate aging, skin cancer, sunburn, and damage to plants (excessive amount of UV radiation can inhibit photosynthesis) and animals.



Figure 2: The Atmosphere Burning up a Satellite: Fleet P (2012 [illustration], Getty, accessed 25 June 2024. <https://www.scientificamerican.com/article/space-junk-is-polluting-earths-stratosphere-with-vaporized-metal/>

Some debris don't burn on their return and often resurface from the ocean years after they collapse.

Space Junk in MEO (Medium-Earth Orbit) and GEO (Geostationary Orbit) can take more than thousands of years to return to the Earth. The abundance of debris in orbits increases the chances of collision exponentially. Although currently collisions are rare in higher orbits, if remain unchecked, it can create an exponential increase in space junk.

Space Junk in the Future:

Exponential increase in space junk could jeopardise future manned or un-manned space explorative missions, and some vital space services, including ubiquitous communications, position, navigation and timing. Space launches can get challenging; chances of collision increase due to abundance of existing debris, and thus creating even more debris. This is essentially the Kessler Syndrome, named after Professor Donald Kessler. As of May 2024, more than 6000 Starlink satellites were in LEO. This increases the chances of collision in space, Each Starlink satellite deorbits five years after its launch. This contributes to the depletion of the Ozone Layer. There are more upcoming satellite constellations like Starlink; these can create a layer of metal that imprisons the Earth, impeding space exploration and services.

The Removal of Space Junk:

As space junk has become more of an emerging problem, there have been ideas and designs to capture it:

ClearSpace, a Swiss startup company, has designed a machine, ClearSpace 1, to capture space junk with 4 claw-like tentacles. ClearSpace 1 has been programmed to spot and retrieve a disused 112kg rocket part (launched in 2013: altitude of 664-801 km) by reciprocating its exact velocity and rotations. When it gets closer, it will extend its 4 tentacles and restrict the rocket, eventually deorbiting and burning in the atmosphere along with the space junk. ClearSpace 1 is planned to launch in 2026. If successful, this type of machine will be a foundation to the removal of space junk, and will be used for debris bigger and traceable pieces of debris (larger than ten cm).

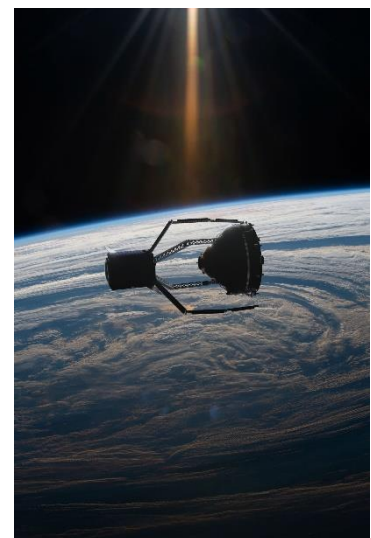


Figure 3: ClearSpace-1 captures Vespa (2020) [illustration], ESA, accessed 25 June 2024.

https://www.esa.int/ESA_Multimedia/Images/2020/11/ClearSpace-1_captures_Vespa

For smaller and untraceable pieces of debris, space junk lasers were ideated. Devices would detect debris by sending out radio waves to find out its location and speed (RADAR). A laser-powered telescope would then shoot out a beam of energy to deviate the debris, avoiding collision with operating satellites. This is accomplished either by lowering it into Earth's atmosphere where it will burn, or sending it up higher up into orbit.

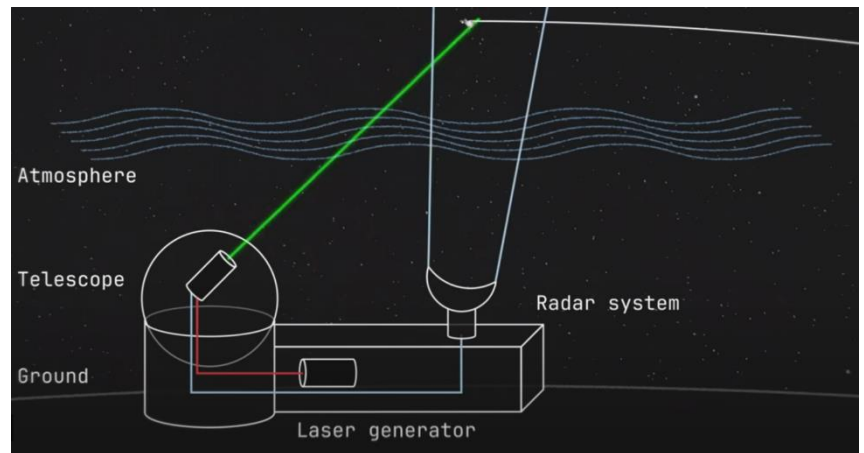


Figure 3: Diagram of Space Junk Laser on Earth: (2024) [screenshot], Vox, accessed 25 June 2024. <https://www.youtube.com/watch?v=VQKpMmBDtZo>

Space junk lasers can also deviate big pieces away from operating space machines, as it can be more efficient to do so. Although these are designed to be on the ground, they can be designed to be in space with cost-effective solutions, allowing for convenient angles to deorbit space debris. However, if this was in space, it would be disconnected to a power grid, making it harder to maintain its functions.

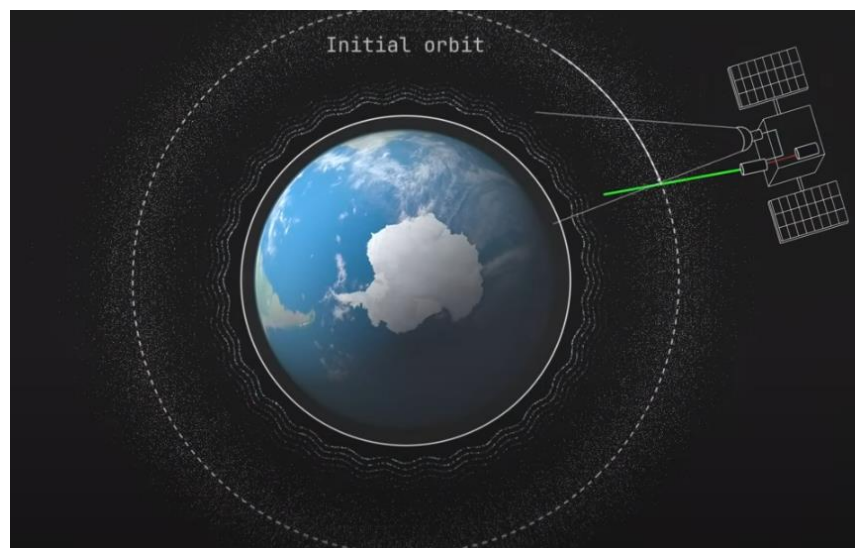


Figure 4: A Space Junk Lasers in space: (2024) [screenshot], Vox, accessed 26 June 2024. <https://www.youtube.com/watch?v=VQKpMmBDtZo>

Space junk can cause a cascade of events such as the depletion of the ozone layer, climate change, and the Kessler Syndrome, a global phenomenon where space exploration is impossible due to tons of existing debris. However, designs such as lasers and tentacles are useful to combat the metal rubbish left in space. Space junk can be

an impediment to the services offered through satellites, and a future to where space is a preserved place where exploration is key to a sustainable Earth with thriving species.

Space Junk References:

Websites:

Writing Format:

- [Writing an Information Report: Overview, Parts and Examples](#) (2024), Study. Com, accessed 17 June 2024
- [A Short Guide to Science Writing](#) (1 July 2021), Oliphant Science Awards, accessed 17 June 2024

Space Junk:

- [ARES|Orbital Debris Program Office| Frequently Asked Questions](#) (2021), NASA, accessed 17 June 2024
- [Burned-Up space Junk pollutes Earth's upper atmosphere. NASA planes found](#) (19 October 2023), Space.Com, accessed 17 June 2024
- Safdie S (10 May 2024) [Why is Space Junk a Problem for both Exploration the Earth](#), Greenly.earth, accessed 17 June 2024
- Safdie S (1 December 2023) [What are Ozone Depleting Substances \("ODS"\)?](#), Greenly. earth, accessed 18 June 2024
- [Changes in Ultra Violet Radiation](#) , Smithsonian Environmental Research Center, accessed 18 June 2024
- [Solar Radiation and Photosynthetically Active Radiation](#), Fondriest Environmental Learning Center, accessed 18 June 2024
- [What are the effects of aluminum oxide on ozone in the atmosphere?](#) (3 December 2023), Typeset.io, accessed 18 June 2024
- [Clearspace-1](#) , European Space Agency, accessed 18 June 2024
- Tingley B (14 February 2024) [SpaceX deorbiting 100 older Starlink satellites to 'keep space safe and sustainable'](#), Space.com, accessed 18 June 2024

- Pultarova T, Howell E, Dobrijevic D & Mann A (30 May 2024) [Starlink satellites: Facts, tracking and impact on astronomy](#), Space.com, accessed 18 June 2024

Videos:

Scientific Writing and Information Reports:

- Suetrong A (1 July 2021) [A short guide to science writing](#) [video], Oliphant Science Awards, YouTube, accessed 18 June 2024
- EasyTeaching (30 September 2020) [How to Write an Information Report | EasyTeaching](#) [video], EasyTeaching, YouTube, accessed 18 June 2024

Space Junk:

- Interesting Engineering (19 August 2021) [Space debris: A problem that's only getting bigger](#) [video], Interesting Engineering, YouTube, accessed 18 June 2024
- Dr Miles B (15 November 2021) [4 Ways To Capture Space Debris](#) [video], Dr Ben Miles, YouTube, accessed 18 June 2024.
- Lowndes C (29 February) [How giant lasers could get rid of space trash](#) [video], Vox, YouTube, accessed 24 June 2024
- Be Smart (16 February 2024) [Space is Full of Junk. Here's How to Clean It Up...](#)[video], Be Smart, YouTube, accessed 18 June 2024
- Dr Muller D (27 November 2012) [How To Clean Up Space Junk](#) [video], Veritasium, YouTube, accessed 20 June 2024

Types of Orbits:

- Global Invacom Group (6 November 2022) [The Orbits Explained - What is LEO, MEO & GEO?](#) [video], Global Invacom Group, YouTube, accessed 20 June 2024.