

Dead satellites are filling space with trash. That could affect Earth's magnetic field

Level 3: Advanced

1 Warmer

a. Discuss these questions with a partner.

- What are satellites used for?
- Do you know what happens to satellites when they reach the end of their operational life?

2 Key words

a. Write the correct words from the wordpool to complete the definitions below. Then, find and highlight them in the article so that you can read them in context.

debris	deflect	demise	deploy	disposable
erode	ignite	intertwined	perturb	rip through
sheer	shrouding	ventures	void	wreckage

1. catch fire _____
2. move violently though something often resulting in damage or destruction _____
3. put into use or operation _____
4. intended to be used once and then thrown away _____
5. hiding or covering something _____
6. empty space _____
7. used to emphasise the importance of something _____
8. closely connected and difficult to separate _____
9. business undertakings involving risks _____
10. scattered pieces of waste coming from the destruction of something larger _____
11. the remains of something that was badly damaged _____
12. change direction or purpose after hitting an obstacle _____
13. worry or upset someone _____
14. gradually reduce or destroy _____
15. end or death of something or someone _____

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b. Complete the sentences with words from the previous activity. You might have to change the form of the word.

1. Waves _____ coastlines by slowly wearing them down over time.
2. The _____ of the company came as a total shock for everyone.
3. Her departure left a huge _____ in the company.
4. These concepts are undoubtedly _____ so it is impossible to analyse them in isolation.
5. The new software was _____ yesterday so we'll receive feedback soon.
6. We should definitely use fewer _____ products in order to protect our planet.
7. They used an explosion to _____ the meteorite and stop it from reaching the Earth.
8. The news _____ everyone in the office, causing a tense atmosphere.
9. _____ from the plane was scattered over a large area.
10. They've embarked on a new _____ and they are really excited about it.

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Our ozone is pennies thick – and soon we'll put at least an Eiffel Tower's worth of metallic ash into the ionosphere every year

Sierra Solter

16 April, 2024

- 1 A dead spacecraft the size of a lorry ignites with plasma and pulverises into dust and litter as it rips through the ionosphere and atmosphere. This is what happens to internet service satellites during re-entry. When the full mega-constellation of satellites is deployed in the 2030s, companies will do this every hour because satellite internet requires thousands of satellites to be constantly replaced. And it could compromise our atmosphere or even our magnetosphere.
- 2 Space entrepreneurs are betting on disposable satellites as key to a new means of wealth. There are currently nearly 10,000 active satellites and companies are working as fast as possible to get tens of thousands more into orbit – for a projected 1m in the next three to four decades.
- 3 Those satellites power hyper-connected internet services and may turn some billionaires into trillionaires – at the cost of shrouding the planet with toxic trash. The problem is that space, contrary to popular belief, isn't really a giant, self-cleaning void. Space holds systems like the magnetosphere that keep us alive and supplied with oxygen by protecting our atmosphere.
- 4 It is easy to assume that the magnetosphere is too vast and robust for humanity ever to have any impact on it, but I don't think that's true. I'm a plasma physicist and the author of recent research that found that the space debris generated by dead and dying commercial satellites could compromise our ionosphere or magnetosphere, also known as our planet's plasma environment.
- 5 After studying the problem for over a year, I have no doubt that the sheer vastness of this pollution is going to disrupt our delicate plasma environment in one way or another. Yet few people are discussing this potential crisis – in part, I suspect, because so much scientific research about space is intertwined with commercial space ventures, which have a vested interest in avoiding these questions.
- 6 Upon investigating how much dust in the form of satellite and rocket debris the space industry has dumped into the ionosphere during re-entry, I was alarmed to find that it is currently multiple Eiffel Towers'-worth of metallic ash. Our ozone is mere pennies thick, and soon we will be putting at least an Eiffel Tower's worth of metallic ash a year directly into the ionosphere. And all of that will stay there, indefinitely.
- 7 How could we possibly think that burning rubbish in our atmosphere 24/7 is going to be fine? Although some study is being devoted to the phenomenon of satellite and rocket chemicals saturating the atmosphere with ozone-depleting alumina, no one else is studying the pollution of the magnetosphere except me.
- 8 We don't even have an estimate of the mass of all regions in the magnetosphere, yet we are going to load it with the wreckage of countless giant spacecraft. Unlike meteorites, which are small and only contain trace amounts of aluminium, these wrecked spacecraft are huge and consist entirely of aluminium and other highly conductive materials, which can create charging effects and act as a magnetic shield.
- 9 If all of these conductive materials accumulate into a huge layer of rubbish, it could trap or deflect all or parts of our magnetic field. The Earth is a ball magnet that we're surrounding with fast-moving metal rubbish. And so far, the current debris in the ionosphere shows an apparent human-made electrostatic signature. It is known that individual spacecrafts can perturb their environment with plasma wakes; imagine how 100,000 or more of them and their associated rubbish could perturb the magnetosphere.
- 10 Even if we only induce perturbations regionally, it could cause holes above the ozone. This could in turn allow atmospheric stripping, which could erode our atmosphere over time and put the planet at risk of losing habitability.

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- 11 Low Earth orbit is being promoted as a destination for satellites and even low-gravity space hotels. People like Elon Musk and Jeff Bezos repeatedly state that space is the key to human longevity. But what if it is the opposite? What if the space industry leads to our pale blue dot's demise? And what if all of this pollution that space entrepreneurs are creating is happening in such a multi-disciplinary, inaccessible, un-studied way that we don't even understand the risks?
- 12 Our magnetosphere keeps us alive. It is our first line of defence against an otherwise lethal solar system, and any pollution of it should be intensely studied and monitored. Indeed, if an asteroid the size of a Starlink satellite was heading towards Earth, it would activate planetary defence monitoring. But since it's a human-made object impacting the atmosphere, we don't monitor it at all.
- 13 Space companies need to stop launching satellites if they can't provide studies that show that their pollution will not harm the stratosphere and magnetosphere. Until this pollution is studied further, we should all reconsider satellite internet.

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3 Comprehension check

a. Are these sentences true (T) or false (F) according to the article? Correct any that are false.

1. Satellites will soon be utilised to provide internet services.
2. Companies are investing in single-use satellites with a view to making larger profits.
3. Many people hold the belief that space cannot deal with large quantities of rubbish.
4. The writer states commercial satellites alone are unlikely to damage our plasma environment.
5. The writer affirms the lack of research responds to hidden interests.
6. Aluminium is potentially dangerous because it can alter the Earth's magnetic field.
7. The author believes the space industry is the future of human kind.
8. Space pollution should be much more closely monitored than it currently is.

4 Key language

a. Complete the phrases from the article with words from the box to form collocations.

devoted	keep	launching	potential
sheer	vested	with	put

1. Space holds systems like the magnetosphere that _____ us alive and supplied _____ oxygen by protecting our atmosphere.
2. After studying the problem for over a year, I have no doubt that the _____ vastness of this pollution is going to disrupt our delicate plasma environment in one way or another.
3. Yet few people are discussing this _____ crisis – in part, I suspect, because so much scientific research about space is intertwined with commercial space ventures, which have a _____ interest in avoiding these questions.
4. Although some study is being _____ to the phenomenon of satellite and rocket chemicals saturating the atmosphere with ozone-depleting alumina, no one else is studying the pollution of the magnetosphere except me.
5. This could in turn allow atmospheric stripping, which could erode our atmosphere over time and _____ the planet at risk of losing habitability.
6. Space companies need to stop _____ satellites if they can't provide studies that show that their pollution will not harm the stratosphere and magnetosphere.

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5 Discussion

a. Discuss these statements.

- 'Few people are discussing this potential crisis – in part, I suspect, because so much scientific research about space is intertwined with commercial space ventures, which have a vested interest in avoiding these questions.'
- 'People like Elon Musk and Jeff Bezos repeatedly state that space is the key to human longevity. But what if it is the opposite? What if the space industry leads to our pale blue dot's demise? And what if all of this pollution that space entrepreneurs are creating is happening in such a multi-disciplinary, inaccessible, un-studied way that we don't even understand the risks?'
- 'Space companies need to stop launching satellites if they can't provide studies that show that their pollution will not harm the stratosphere and magnetosphere. Until this pollution is studied further, we should all reconsider satellite internet.'

6 In your own words

- a. With a partner, make a list of the pros and cons of employing disposable satellites.**
- b. Write an essay outlining the pros and cons of utilising disposable satellites, including your own opinion on the matter.**