

ANGLAIS

En vous appuyant *uniquement* sur les documents du dossier thématique qui vous est proposé, vous rédigerez une synthèse répondant à la question suivante :

Sixty years on, how has space exploration evolved?

Votre synthèse comportera entre 450 et 500 mots et sera précédée d'un titre. Le nombre de mots rédigés (titre inclus) devra être indiqué à la fin de votre copie.

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Document 1

How Elon Musk's Historic Launch Changes the Future of Space Exploration

Eric Betz, discovermagazine.com, December 10, 2020

Before Gmail, YouTube or Facebook, a starry-eyed rocket startup company announced a fantastical vision: a new age, where private companies send humans into space. And in May 2020, some 18 years after its founding, SpaceX and its CEO, Elon Musk, finally made good on that pledge.

The SpaceX Crew Dragon capsule carried two NASA astronauts to the International Space Station (ISS¹) and brought them back to Earth safely. It was the first time a private spacecraft had carried humans into orbit.

The milestone came just as a [number] of private space companies were beginning to take off. Around the world, other rocket enterprises have followed suit, launching constellations of tiny satellites that will change the way we communicate and observe Earth. Industry experts say private spaceflight has now pushed into a new era, similar to how America's railways opened the West to urban development some 150 years ago.

The year was also a pivotal one for NASA. Crew Dragon's passengers, Doug Hurley and Robert Behnken, became the first U.S. astronauts to launch into orbit from American soil since the space shuttle program ended in 2011. Without a ride of its own, NASA had been paying Russia \$90 million per seat to ferry astronauts to the ISS. A trip on SpaceX's Falcon 9 will cost about half that price, thanks to the company's emphasis on reusable rockets.

That backdrop set the stage for the publicity and feat of engineering this summer. Some 10 million viewers, cooped up at home during the COVID-19 pandemic, watched what NASA dubbed "Launch America."

Crew Dragon was built as part of NASA's Commercial Crew Program, which began under an Obama administration policy. [...] The initiative taps the private sector for transport to and from low-Earth orbit, while NASA focuses its efforts on exploring the solar system. [...] Astronomers say Crew Dragon helped validate the concept of relying on private companies instead of large government programs. The Trump administration, for example, turned to private companies for its Artemis program to put humans back on the moon by 2024. [...]

Boeing also was awarded a contract to help put NASA astronauts on the space station. For years, questions have lingered about whether either company could deliver. In March 2019, after many delays and cancellations, SpaceX finally launched an uncrewed spacecraft to the ISS. The mission went flawlessly, but the capsule exploded months later during a routine test back on Earth. Numerous delays followed.

Then, in December 2019, Boeing's Starliner spacecraft suffered a number of embarrassing software failures during its first uncrewed launch and failed to even reach the space station. [...]

Today, with the successful Crew Dragon flight behind him, Musk has already shifted to the next task. His engineers are pioneering an enormous new spacecraft, called Starship, with a promise to carry passengers to "Earth orbit, the moon, Mars and beyond."

¹ The International Space Station (ISS) is a modular space station (habitable artificial satellite) in low Earth orbit. It is a multinational collaborative project involving five participating space agencies: NASA (United States), Roscosmos (Russia), JAXA (Japan), ESA (Europe), and CSA (Canada). The ownership and use of the space station is established by intergovernmental treaties and agreements. (Wikipedia)

Document 2

Space can solve our looming resource crisis – but the space industry itself must be sustainable

Richard Matthews, *The Conversation*, October 3, 2019

Australia's space industry is set to grow into a multibillion-dollar sector that could provide tens of thousands of jobs and help replenish the dwindling stocks of precious resources on Earth. But to make sure they don't flame out prematurely, space companies need to learn some key lessons about sustainability. [...]

We cannot grow without limit. In 1972, the influential report *The Limits to Growth* argued that if society's growth continued at projected rates, humans would experience a "sudden and uncontrollable decline in both population and industrial capacity" by 2070. Recent research from the University of Melbourne's sustainability institute updated and reinforced these conclusions.

Our insatiable hunger for resources increases as we continue to strive to improve our way of life. But how does our resource use relate to the space industry?

There are two ways we could try to avert this forecast collapse: we could change our behaviour from consumption to conservation, or we could find new sources to replenish our stocks of non-renewable resources. Space presents an opportunity to do the latter.

Asteroids provide an almost limitless opportunity to mine rare earth metals such as gold, cobalt, nickel and platinum, as well as the resources required for the future exploration of our solar system, such as water ice. Water ice is crucial to our further exploration efforts as it can be refined into liquid water, oxygen, and rocket fuel.

But for future space missions to top up our dwindling resources on Earth, our space industries themselves must be sustainable. That means building a sustainable culture in these industries as they grow. [...]

While SpaceX has been innovative in designing ways to travel into space, this innovation has not been for environmental reasons. Instead, the company is focused on bringing down the cost of launches.

SpaceX also relies heavily on government contracts. Its profitability has been questioned by several analysts with the capital being raised through the use of loans and the sale of future tickets in the burgeoning space tourism industry. [...]

SpaceX's culture also rates poorly for sustainability. As at many startups, employees at SpaceX are known to work more than 80 hours a week without taking their mandatory breaks. This problem was the subject of a lawsuit settled in 2017. [...]

Australia is in a unique position. As the newest player in the global space industry, the investment opportunity is big. The federal government predicts that by 2030, the space sector could be a A\$12 billion industry employing 20,000 people.

[The] Australian Space Agency [has] made one thing clear: regulation is coming.

By embedding sustainability principles into emerging space startups, we can avoid the economic cost of having to correct bad behaviours later. [...] To ensure that the space sector can last long enough to provide real benefits for Australia and the world, its defining principle must be sustainability.

Document 3

Renewed space rivalry between nations ignores a tradition of cooperation

Scott Shackelford, *The Conversation*, January 10, 2019

Since the breakup of the Soviet Union space governance has only gotten more complicated due to an increasing number of space powers, both public and private. [...]

The list of leading space powers has expanded beyond the U.S. and Russia to include China, India, Japan and members of the European Space Agency – especially France, Germany and Italy. Each regularly spends over US\$1 billion on their space programs, with estimates of China's space spending surpassing \$8 billion in 2017, though the U.S. continues to spend more than all other nations combined on space related efforts. But space has become important to every nation that relies on everything from weather forecasting to satellite telecommunications. By 2015, the global space industry was worth more than \$320 billion, a figure that is expected to grow to \$1.1 trillion by 2040.

Private companies, such as SpaceX, are working to dramatically lower the cost of launching payloads into low Earth orbit, which has long stood at approximately \$10,000 per pound. Such innovation holds the promise of opening up space to new development. It also raises concerns over the sustainability of space operations.

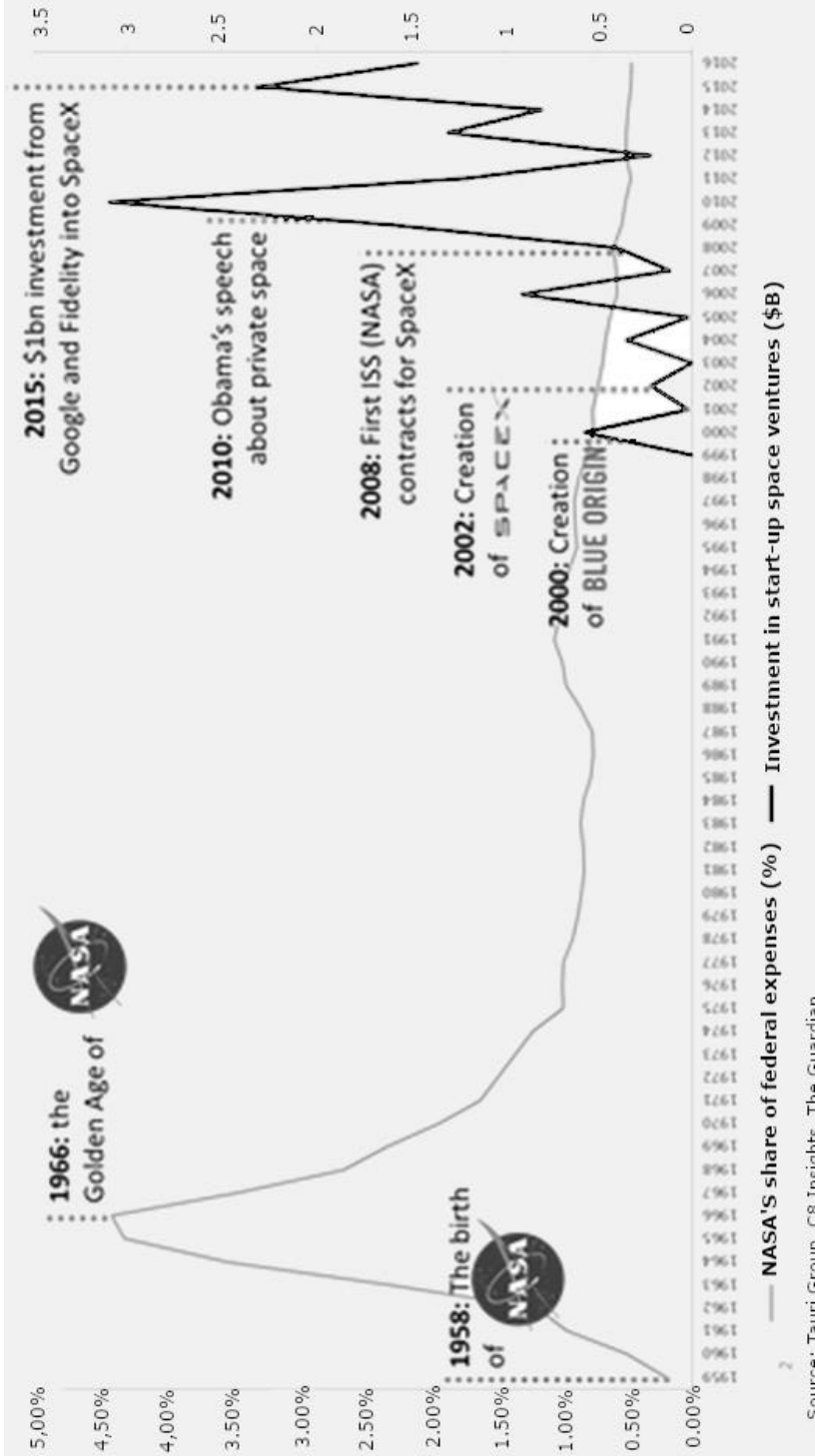
At the same time, the Trump administration's public desire to launch a Space Force has fueled concerns over a new arms race, which, if created, could exacerbate both the issues of space weapons and debris. The two issues are related since the use of weapons in space can increase the amount of debris through fragments from destroyed satellites. For example, China performed a successful anti-satellite test in 2007 that destroyed an aging weather satellite at an altitude of some 500 miles. This single event contributed more than 35,000 pieces of orbital debris boosting the amount of space junk by approximately 25 percent. [...]

The tragedy of the commons scenario refers to the "unconstrained consumption of a shared resource [...] by individuals acting in rational pursuit of their self-interest," according to commons governance expert Brett Frischmann. This can and often does lead to destruction of the resource. Given that space is largely an open-access system, the predictions of the tragedy of the commons are self-evident. Space law expert Robert Bird, has argued that nations treat orbital space as a kind of communal pasture that may be over-exploited and polluted through debris.

But luckily, there is a way out of this scenario besides either nationalization or privatization. [...] In some cases, groups can and do self-organize and cooperate to avoid tragic over exploitation. [...]

Coordination between sovereign nations is possible, as was shown in the golden age of space law [in the 1960s and 1970s]. By finding common ground, including the importance of sustainable development, we can ensure that humanity's development of space is less a race than a peaceful march – not a flags and footprints mission for one nation, but a destination serving the development of science, the economy and the betterment of international relations.

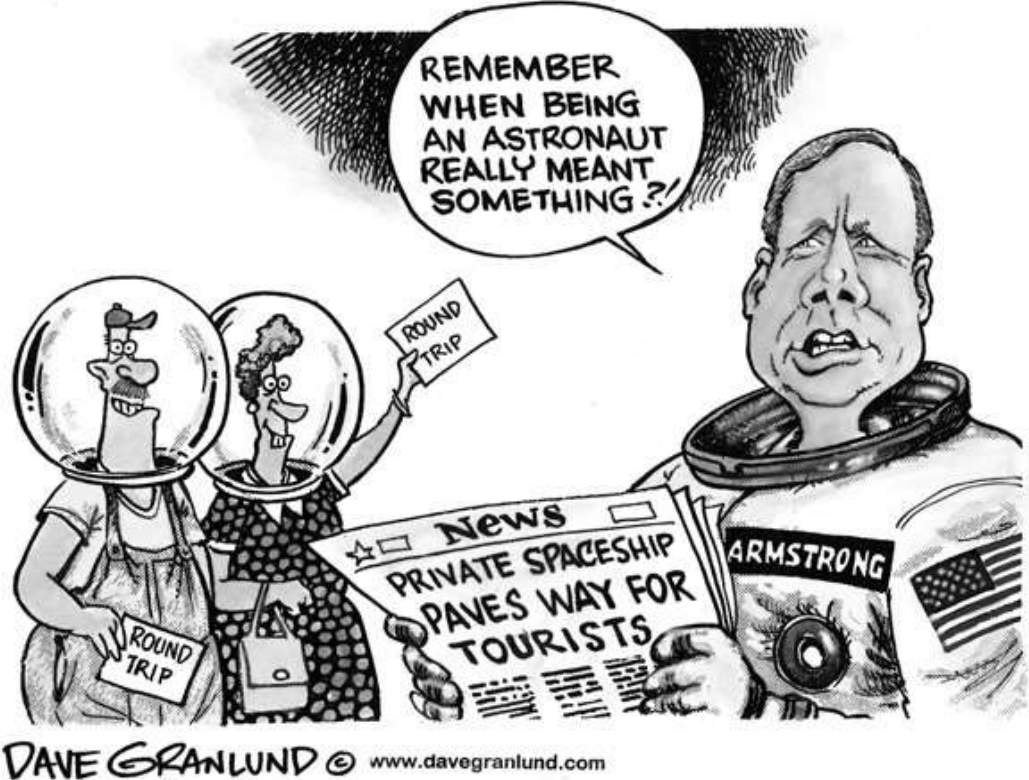
Document 4



Nasa's share of federal expenses (%) and investment in start-up space ventures (\$B), 1959-2016, aster.com, January 2017

On the x-axis: years from 1959 to 2016

Blue Origin is another American privately funded aerospace manufacturer and sub-orbital spaceflight services company, funded by Jeff Bezos, also founder and main shareholder of Amazon. Fidelity is an American multinational financial services corporation, one of the largest asset managers in the world.



“Space tourists”, Dave Granlund, 2009