

Is Mars on the Horizon?

Candidate Number: 3251

Center Number: US213

Word Count: 4,988

Introduction

Since the start of civilization, we as humans have always yearned to know more about the unknown, and space is no exception. The idea of space exploration and development has fascinated the public for years. From the start of the space race to the Voyager space craft leaving our solar system heading off to deep space, we have always looked at what else is out beyond the visible light of our own sun, searching the darkness for answers to questions that linger in the back of our minds. Now we have gazed off to a new target, Mars. Spearheaded by entrepreneur Elon Musk, the idea of putting people on Mars seems to have swarmed the public, but not everyone is ready for takeoff.

When looking at how to evaluate the question of “Is Mars on the Horizon?” I will address the ideas that are presented which look at the practicality of going and theoretical challenges that linger. This led me to developing 4 main questions that will help peer into the different angles that need to be addressed.

Do we have the proper technology to go to Mars?

How will we govern the population on Mars?

Are humans for Martian exploration and development?

In short, these questions will take on the technological, political, and cultural sides to answer “Is Mars on the Horizon?”

In each of these questions, I will be using online articles published by college professors as well as random blogger that are interested in Martian exploration, and development. The reasoning behind using such a wide variety of source content is that if we are to conclusively look at public opinion, as well as a professional opinion, we need to address every angle and opinion given. This will allow for a conclusion to be drawn that will consider both empirical data, public ideas, and professional opinion. It will also allow for a much wider scope of analysis when looking at strengths and weaknesses, as typically people only look at what the experts have to say. Although it is wise to trust those who are qualified, it’s also important to address concerns that the everyday person has. After all, this is the advancement of the human species and who are we to say who moves on and who doesn’t. Furthermore, when looking at this topic from a will and won’t happen at all the people need to be behind the idea of going there. If the people are not in support then it will not happen, as what would be the point of going to a place that no one is convinced we should go to.

Furthering the development of the human race isn’t, and shouldn’t be limited to one sect of society, and by including everyone I will be able to take a step back and truly look at the future of us, as humans, and how we address Mars. This is where I stand personally, as I believe that we are not currently ready to go, but with time we will be. I grew up loving space, and even saw the last shuttle launch in Cape Canaveral back in 2011. As I tracked the shuttle upwards into Earth’s atmosphere I stood in awe of how far mankind has advanced, and wondered how much further we can go. I think that if we are to rush there with a gung-ho attitude, we are clearly underestimating the real challenges that we face both getting there, and living there.

Do we have the proper technology to go to Mars?

Science fiction as a genre has captured the minds of children and adults alike, and when looking at how to start evaluating how we as a species are getting to Mars the ideas that were once thought of as impossible 50 years ago, are becoming reality. Firstly, one of the main concerns technologically of making the travel to and from Mars isn't the voyage itself but the landing. Landing on Mars has always been an issue since we began wanting to explore it. Since 1970, of the 16 attempted landings only a total of seven has successfully landed (Whitman, 2017). However, with all these failures, the National Aeronautics and Space Administration (NASA) (an independent agency of the executive branch of the United States federal government responsible for the civilian space program, as well as aeronautics and aerospace research whose budget is dictated by the political scene within the US (NASA, 2017)) and other public and private space fairing companies such as SpaceX (a private American aerospace manufacturer and space transport services company that may hold incentives to maximize profit over anything else (SpaceX Company, 2018)) have data to analyze when looking at what needs to be improved, and both NASA and SpaceX are making improvements concerning landing. Current landing technology that NASA used when landing the rovers in 1976, and 2012 is a basic parachute design (Mohon, 2017). However, due to Mars' atmosphere being 100 times thinner than Earth's, and composing of 95% carbon-dioxide (Sharp, 2017) (Williams, 2016), past parachute designs are very risky as seen by the most recent failure, ExoMars lander, crashing due to atmospheric turbulence which caused it to tumble (Whitman, 2017). Now NASA has begun work on a new Low Density Supersonic Decelerators project. In the Jet Propulsion Laboratory in California, NASA is conducting experiments involving new types of parachutes that also happens to be the largest parachutes ever designed and flown, as well as new pressure vessels that inflate around the entry vehicle to insure safe landings for both crewmembers and cargo (Mohon, 2017). This shows that NASA is not only dedicated to improving their landing success rates, but also recognizes that the safety of the landing needs to be held on a much higher level as humans will be involved rather than machines. It shows that the technology being tested is clearly within reach and that, if successful during testing, we do have the proper technology to land on Mars.

Furthermore, when looking at the feasibility of getting to Mars Bret Drake, an engineering specialist with Los Angeles-based Aerospace Corp., a nonprofit organization that researches launch vehicles, satellite systems, ground control systems and space technology for the United States federal government (ResearchGate, 2018) states that "A Mars voyage requires a spacecraft that can carry multiple people, along with all the supplies for a three-year round-trip, including potential cargo items" (Ghose, 2016). This means that a large-scale rocket, with habitat to sustain the crew needs to be a main priority to insure crew safety during travel (both psychological and physical). There are plans made with an emphasis on current technology by NASA that detail the plans for Mars,

Science missions are already in the Independent phase, with the next rover due in 2020. We will also conduct a round-trip robotic demonstration mission with sample return in the late 2020s. Mars is the next tangible frontier for human exploration, and it's an achievable goal. There are challenges to pioneering Mars, but we know they are solvable. We are well on our way to getting there, landing there, and living there. (Wilson, 2017)

If NASA is focused, and confident that Martian exploration and development is achievable then it would seem like we do have the proper technology to at least travel to Mars. However, there are other points to be made. For instance, navigation. On Earth, we have a Global Positioning System (GPS) that helps us get from point A to point B (GPS, 2018). For space exploration, there is the Deep Space Network. The Deep Space Network is a collection of antenna arrays in California, Australia, and Spain. It is the only tool that works for space travel navigation, and every space traveling object, from satellites to probes depends on its extremely precise atomic clock to be able to pin point where it is within the cosmos (About Deep Space Network, 2018). The issue isn't that it exists, but rather that it's the only one. As WIRED, a monthly American magazine, that focuses on how emerging technologies affect culture, the economy, and politics, however due to a harsh political landscapes could limit or change the information published so that rating stay up (WIRED, 2018), states that,

As more and more missions take flight, the network is getting congested. The switchboard is often busy....The farther rockets go from Earth... the less reliable this method becomes. Sure, radio waves travel at light speed, but transmissions to deep space still take hours. (WIRED Staff, 2016)

Do we trust an already congested highway to relay information that could be the difference between life and death? I don't think we should. If we are to travel to Mars, we need to stay connected to the crew, and ship at all times, so taking the risk of communication black outs or a failure to display proper spatial location is something that needs to be an anomaly, not a high probability. Furthermore, the health of the crew needs to be sustained at high levels throughout the travel through deep space. For our bodies to function properly we need gravity. Without gravity, one of the first parts of our body to be affected is our heart. The New England Journal of Medicine, a weekly medical journal published by the Massachusetts Medical Society (New England Journal of Medicine, 2018). It is among the most prestigious peer-reviewed medical journals as well as the oldest continuously published one, found that the heart can shrink by up to a quarter after just 1 week in orbit (Joseph, 2008). With a decrease in the size of the heart, also known as heart atrophy (Hellerstein, 1950), means a decrease in overall blood pressure which then reduces exercise capacity. Astronauts that return to Earth after several months in the International Space Station (ISS) experience dizziness and blackouts because blood does not reach their brains in the way it did when they were in space (Joseph, 2008). If these are the side effects of a non-gravitational environment for an extended period of time, then implementing a gravitational inducing environment for the astronauts is a necessity. We cannot afford for astronaut's hearts and bodies to be deteriorating in a mission to Mars, and if we are to bring a large number of people to Mars what would be the point as by the time they got there they wouldn't even be able to walk. Our technology in simulating gravity within space needs to progress much further then what we are currently at if travel between Mars and Earth is to become a common practice.

When looking at if we have the proper technology to go to Mars now, we clearly do. We have put rovers there so we can go. However, I believe that we shouldn't if we are to focus on human life and safety. Furthermore, the technology that we currently have should be improved and refined so to improve traveling conditions, landing procedures, rocket transportation

systems, and health related space risks. Yes, we have the technology to go, but I believe that we should improve and refine it before making any rash decisions.

How will we govern the population present on Mars?

Secondly, when looking at if we are ready for Mars, we need to address how we will set up the Martian government. As of right know there are two major ideas. 1 being following the United Nations (UN) 2222 (XXI). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, and the other being Elon Musk's view on promoting a direct democracy, and the establishment of an independent constitution.

When looking at how the UN goes about addressing government in space they state in article 1 of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies that,

The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.

Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.

There shall be freedom of scientific investigation in outer space, including the moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation. (United Nations General Assembly, 1966)

And in article 2 that,

Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means. (United Nations General Assembly, 1966)

From here we can see that the UN wants all space exploration and development to be equal among all nations, and that it should remain public. It's a good idea, because if we want to ensure that a new space race doesn't make the disparity between developed and lesser developed nations even more drastic, by limiting space for the scientific advancement for all of mankind we approach the topic in a manner that benefits everyone, not just someone. Furthermore, any advancement in scientific knowledge must be shared throughout the international community which will only benefit mankind. If we are to then take how the UN approaches space colonization, we can conclude that if we are to establish a colony, it should be funded by all nations, have citizens of all nations living there, and be regulated by all nations (UN). This approach shows that if we are going to colonize Mars, we are ready to do so in the area of implementing a government. However, just because it's it seems like a good idea doesn't mean that it will be. We can already see

disagreements within the international community regarding the way the UN treats space by looking at USA and Russia. In 2010, the 4th committee met in order to address the issues that Russia had with the way the UN was enforcing current space laws.

The representative of the Russian Federation stressed that a number of gaps still remained in space law. He called for the multilateral implementation of the current international legal instruments regulating space activities to actualize those regulations that already existed. The development of new technologies, and the commercialization and privatization of space activities demonstrated that further elaboration of a legal framework for space activities was needed. (Fourth Committee, 2010)

What Russia was addressing were real concerns that UN didn't seem to take into account. How could Russia insure that it would remain safe if other countries could have the potential to develop space faring weapons, and then use them against Russia, if the UN wasn't making laws that would address future technological advancement? The Russian representative went on to claim that,

The world faced the risk of turning outer space into an arena for the arms race, which would negatively impact the overall spirit of cooperation and trust amongst countries, he warned. (Fourth Committee, 2010)

This point expresses the main concerns that Elon Musk, and other intellectuals have about the UN's approach to off world colonies, and implementing government. If they are made for only scientific advancement, what is the incentive for people to move to another planet? Here Elon Musk, entrepreneur, creator of PayPal, SpaceX, and Tesla proposes that we take a more modern view on governing.

The form of government on Mars would be a direct democracy, not representative. So it would be people voting directly on issues. And I think that's probably better because the potential of corruption is substantially diminished in a direct versus a representative democracy. It should also be easier to remove a law than create one. 60 percent of people would need to vote *in* a law, but only 40 percent of voters would be needed to later remove it. (Wagner, 2016)

Now although he seems to be the main governing voice with regards to Mars he doesn't have his degree in political science so what he is addressing here should be taken into consideration, but should be refined and debated so that a more qualified opinion can be put on the table. What he addresses is an updated democracy that will function like Switzerland's direct democracy, but with a different approach to laws. He is on the right track, as Charles Cockell, an astrobiologist at the University of Edinburgh and the organizer of the second International Extraterrestrial Liberty Conference (ELC) (University of Edinburgh, 2018) states that

A space colony is a tyranny prone environment... there are things about space that are completely different to the Earth environment, in particular the issue of who controls the oxygen. No other constitution has listed the right to breathable air before. "If somebody gets control of oxygen, they could very well have control over the whole population and

could threaten dire consequences in return for extraordinary levels of power. (Hollingham, 2014)

This is a new issue that hasn't even been fully realized yet. Furthermore, the issue regarding the right to leave, was brought up. We have no need to worry about the "right to oxygen" here on Earth as its natural to our planet, but how can we say that we are ready to govern according to the UN if the UN doesn't even bother addressing real concerns that could be the difference between life and death? Cockell later address how a direct democracy would best suit a new colony as the low population could, and should get directly involved with the laws being passed by a congressional body (Hollingham, 2014).

With the UN, and private idea's being shared and brought up, I believe that if the UN is shown to have failed with regards to current space laws, then they shouldn't be trusted to properly set up a government on Mars. Furthermore, we should take the ideas presented by people such as Elon Musk, and Charles Cockell, and fine tune them to the point where everything from the soil on the planet to the potential ruling and treatment of alien lifeforms is addressed. This way, we are ready to let the population of the planets we colonize to rule themselves effectively, while still maintaining a connection with Earth. Based off of this, I do not believe that we are current ready to govern Mars, but with time and effort put into clarifying and refining issue, we soon will be.

Are Humans for Martian exploration and development?

Now although I addressed technology, and political progress, there is still another topic that I would like to discuss, and that would-be people, and their cultures, religions, and ideas on space exploration and development. Throughout history, we have always been afraid of the unknown. We can see this from our past ideas of a flat earth, and a geocentric (having or representing the earth as a center (Dictionary.com, 2018)) model of our solar system. However, with Mars, do we have a right to be afraid of going and developing it? Are we alone? Will the possibility of finding life on Mars, or even throughout our solar system, influence Earthly views about the universe? Taking religion on as a first opinion, Ken Ham was one of the first major religious figures to talk about Mars, and the possibility of other life existing in the universe. Ken Ham is a prominent voice and figure in the fundamentalist Christian community in America, however he does not believe that evolution exists, and that the Earth and universe are ~6,000 years old, yet has earned a BS in, Applied Science (environmental biology), at the Queensland Institute of Technology, Australia (Ham, 2018). On one of his major websites, "Answers in Genesis" he writes,

The search for extraterrestrial life is really driven by man's rebellion against God in a desperate attempt to supposedly prove evolution! ... Life did not evolve but was specially created by God, as Genesis clearly teaches. Christians certainly shouldn't expect alien life to be cropping up across the universe. (Ham, 2014)

From this, we can see Ham pushing a narrative that addresses all Christians. Pastors, which get their way of teaching from other, higher-level priests, pastors, and evangelicals to then preach it to the church-going congregation, would then be preaching this narrative as Ken Ham is highly regarded. It is then safe to assume that this idea can be found among the Christian community.

This is something to note as per Gallup Polls, an American research-based, global performance-management consulting company based in DC, which may shift information being presented, based off the current political atmosphere (Gallup, 2018), 75% of the population identifies with a Christian religion in America (Gallup, 2015). This means that his messages is reflective of the ideas of the exploration and development of space in America, at least on a religious point of view. However, the viewpoint of not wanting to go to Mars due to spiritual reasons is held in not only the US, but also all around the world. The Islamic leaders in the United Arab Emirates (UAE) issued a religious ruling (Fatwa) saying Muslims should not go to the Red Planet (Atherton, 2014). The General Authority of Islamic Affairs and Endowment (GAIAE) ruling compares a Mars mission to suicide, and says,

Those who attempt it can expect the same consequences in the afterlife. Those seeking to escape God's judgment on Mars would be unable to do so. This is an absolutely baseless and unacceptable belief because not even an atom falls outside the purview of Allah, the Creator of everything. (Henderson, 2014)

This proclamation is a bit harsher than Hams, and taking a different approach to Martian development and exploration, but still hits the same “we should not go, and we should not expect anything” theme. The GAIAE is a UAE leading institution in promoting social awareness and progress based on the tolerant teachings of Islam (Abu Dhabi Departments, 2016). However, it has come under scrutiny in the past due to its views on other religions, and how it addresses scientific advancement when in contradiction to the Quran. Seeing as it stands a bit against scientific development in general, I think that it should be listened to as a source, but left outside the realm of scientific discussion as theology and science are two separate topics. When looking at how those from the scientific community have responded to these two points of view we can see stark differences. In response to the GAIAE’s Fatwa, Mars One issued their own statement saying,

The GAIAE should not analyze the risk as they perceive it today. The GAIAE should assess the potential risk for humans as if an unmanned habitable outpost is ready and waiting on Mars. Only when that outpost is established will human lives be risked in Mars One's plan.... Any progress requires taking risks, but in this case the reward is 'the next giant leap for mankind'. That reward is certainly worth the risks involved in this mission. (Atherton, 2014)

The Mars One foundation is a private, not-for profit organization based in the Netherlands that goal is to establish a colony on Mars by 2032, however due to its small size, and limited funding it doesn’t have much credibility or notoriety (Mars One, 2018). They are all for the exploration and development of Mars, and when looking at where most of their donations come from, of the roughly \$1 million donated from January 1st through July 4th, 2016, \$371,102 came from the United States, with Canada have the 2nd most at \$94,580 (Mars One, 2016). This sheds some light on how Americans view space exploration. It could be possible that the narratives told by people like Ken Ham and the GAIAE are largely ignored, and that the people actually do care about space and Mars, regardless of what the religious authorities have to say. This could mean that religious views are not held highly when being compared to space and Mars, or that the space community is largely composed of rich people who like to donate a lot. I feel that it would be more likely that the first reason would be true, as according to a 2013 poll conducted by Phillips & Company, a global communications, and wealth management firm (Phillips &

Company, 2018), and Explore Mars, a non-profit corporation committed to advancing the cause for human exploration of Mars (Explore Mars, 2017),

To the question: It is worthwhile to increase NASA's percentage of the federal budget to 1 percent to fund initiatives, including a mission to Mars. 31.61% responded strongly agree, 44.14% responded agree, 20.25% responded disagree, and 4.00% responded strongly disagree. (Explore Mars, Inc, 2013)

This poll questioned 1,101 people: 550 female, 541 male, 10 preferred not to answer, 876 identified as Caucasian, 72 identified as African American, 40 identified as Hispanic, 80 identified as Asian, 10 identified as Native American, 1 identified as Pacific Islander, 7 identified as other, and 15 preferred not to answer (Explore Mars, Inc, 2013). From this break down, we can see that the sample size was fairly large, with equal size male and female groups. However, it does appear as if those who identify as Caucasian were the vast majority of those asked the questions, compared to African Americans, Hispanics, and Asians. Therefore, this might have some impact on the overall reported results. Regardless, this opinion poll does seem to contradict the messages being proposed by people like Ken Ham, which makes it seem as if the population does want to go to Mars, or at the very least fund a trip to go there.

Overall, I think that numerically, humans are on board with a mission to Mars, but numbers don't address spiritual concerns, as thus should be viewed as an equal so that it can take on a comparison role. Both Ham, and the GAIAE bring up concerns that people of each respective faith both have. I think in order for a conclusive conclusion to be drawn the idea of religion, and race should be eliminated, but not in the sense of ignored, but rather society moving on to a point where we don't differentiate other humans simply based off of what they believe, or don't believe in, or what we look like, or where we came from. Once we hit a point to where everyone views each other as human, can we truly get a feel for who is and who is not opposed. However, this idea is a bit far-fetched, as it seems a bit hopeful. Planetary Unification would be extremely helpful when coming to a common consensus, but humans always seem to find ways to alienate others; the word "alienate" seems a bit ironic when used this way. Therefore, with these ideas in mind, I think that overall using the data is more reliable in this case as the poll seemed to lack any religious ties, thus not having an influence in how the person being questioned would answer.

Conclusion

When looking at the different stages of analysis that go into developing a thought-out conclusion I must assess the role that technology, politics, and culture have on whether or not Mars is on the horizon. After exploring countless opinions, talking to friends that love space just as much as I do, and even discussing the ideas of space explorations with teachers, I have developed a new level of respect for the time and energy that goes into making dreams reality. Based off the research conducted for this paper I believe that Mars is on the Horizon in the sense that we should expect humans to go in the near future. I believe that if we were to attempt to go now we could, but the risks discussed with landing weigh heavily in my opinion to wait until further testing is done. What would be the point of rushing to Mars, only to crash and burn trying to land? I do believe that with time we will have the technology to master this aspect as we are already researching better ways as evident by the research being conducted in NASA's Jet

Propulsion Laboratory in California. With regards to the political side of Martian development I believe that we can handle a basic colony of less than 10,000 people effectively with a direct democracy system, but as it grows the political system will need to evolve with it to include the population that live on Mars, the citizens of Mars, and any super advanced machines. When looking at culture it is clearly obvious that the major religions of Christianity and Islam are both opposed to Martian exploration, and development on a fundamental level by the way some of their respected leaders act and talk about it. However, when looking at straight data it appears that people are on board with Martian exploration and development, and even increasing the funding of NASA's budget. With this in mind, I feel as if we, as humans, are curious enough to want to find out more about the universe that we live in, regardless of our held beliefs. With all of this being said, it is clear that we are wanting to, and trying to, get off our planet to explore the mysteries of space, and Mars is no exception, but I believe the only factor that plays a serious role when now asking "When will we go to Mars?" is technology. We need to put more money and energy into developing greater space-faring technology if we are to travel around our solar system efficiently and safely (psychologically, and physically). Mars poses as a great stepping-stone for testing our mastery in space based technology, evolving political systems, and questioning everything about what we think it means to be human, and by having Mars as a first colony, we would be able to test new technology, theories, and ideas in new environments. I believe that Mars is on the horizon, and I am hopefully that, with time, humans will be looking at the sun setting on the horizon on planets other than our own, asking the questions that got them there.

"The Earth is the cradle of humanity, but mankind cannot stay in the cradle forever."

-Konstantin Tsiolkovsky

References

- About Deep Space Network. (2018). Retrieved January 28, 2018, from <https://deepspace.jpl.nasa.gov/about/#>
- Abu Dhabi Departments. (2016, July 25). General Authority of Islamic Affairs & Endowment (GAIAE). Retrieved February 11, 2018, from https://www.abudhabi.ae/portal/public/en/departments/gaiae;jsessionid=16uFt_QQ4azgXVVc35jzvrC7hAjkBAHXxTDCA6mjsYyF49_8UVj_!1447653943!-560619160!1518366880784
- Atherton, K. D. (2014, February 21). No Mars For Muslims? Mars One Asks Imams To Rescind Fatwa. Retrieved February 11, 2018, from <https://www.popsoci.com/article/science/no-mars-muslims-mars-one-asks-imams-rescind-fatwa>
- Baraka, A. (2018, January 12). The Responsibility to Protect the World ... from the United States. Retrieved January 28, 2018, from <https://www.counterpunch.org/2018/01/12/the-responsibility-to-protect-the-world-from-the-united-states/>
- Cowing Posted March 7, 2013 1:26 PM View Comments, K. (2013, March 7). Survey on Sending Humans to Mars. Retrieved February 12, 2018, from <http://spaceref.com/mars/survey-on-sending-humans-to-mars.html>
- Dictionary.com. (2018). Geocentric. Retrieved February 11, 2018, from <http://www.dictionary.com/browse/geocentric>
- Explore Mars, Inc, & Phillips & Company. (2013, March 7). Mars Generation National Opinion Poll. Retrieved February 12, 2018, from <https://www.exploremars.org/wp-content/uploads/2013/03/Mars-Generation-Survey-full-report-March-7-2013.pdf>
- Explore Mars. (2017). About Us. Retrieved February 19, 2018, from <https://www.exploremars.org/>
- Fourth Committee. (2010, October 14). Strength of International Space Law to Prevent Militarization of Outer Space, Respond to Other Current Challenges Weighed in Fourth Committee | Meetings Coverage and Press Releases. Retrieved February 06, 2018, from <https://www.un.org/press/en/2010/gaspd458.doc.htm>
- Gallup. (2015, December 24). Percentage of Christians in U.S. Drifting Down, but Still High. Retrieved February 11, 2018, from <http://news.gallup.com/poll/187955/percentage-christians-drifting-down-high.aspx>
- Gallup. (2018). Who Are We? Retrieved February 19, 2018, from <http://www.gallup.com/corporate/212381/who-we-are.aspx>
- Ghose, T. (2016, October 12). Sending Humans to Mars: 8 Steps to Red Planet Colonization. Retrieved January 28, 2018, from <https://www.livescience.com/56462-how-to-travel-to-mars.html>
- GPS: The Global Positioning System. (2018, January 23). Retrieved January 28, 2018, from <https://www.gps.gov/>
- Ham, K. (2014, July 20). "We'll find a new earth within 20 years". Retrieved February 11, 2018, from <https://answersingenesis.org/blogs/ken-ham/2014/07/20/well-find-a-new-earth-within-20-years/>

- Ham, K. (2018). Answers in Genesis: Ken Ham. Retrieved February 19, 2018, from <https://answersingenesis.org/bios/ken-ham/>
- Hellerstein, H., & Santiago-Stevenson, C. (1950). Atrophy of the Heart: A Correlative Study of Eighty-Five Proved Cases. Retrieved January 28, 2018, from <http://circ.ahajournals.org/content/circulationaha/1/1/93.full.pdf>
- Henderson, B. (2014, February 19). Muslims 'warned in Fatwa not to live on Mars'. Retrieved February 11, 2018, from <http://www.telegraph.co.uk/news/worldnews/middleeast/unitedarabemirates/10649939/Muslims-warned-in-Fatwa-not-to-live-on-Mars.html>
- Holler, M. (2013, March 6). Retrieved February 12, 2018, from <https://www.exploremars.org/full-report-of-mars-generation-survey-results-available>
- Hollingham, R. (2014, July 09). Future - How to create a bill of rights for Mars colonies. Retrieved February 06, 2018, from <http://www.bbc.com/future/story/20140709-why-mars-needs-a-bill-of-rights>
- Joseph, H., & Olson, E. (2008, March 27). Cardiac Plasticity. Retrieved January 28, 2018, from <http://www.nejm.org/doi/full/10.1056/NEJMra072139>
- Koebler, J. (2013, February 11). Poll: Americans Overwhelmingly Support Manned Mars Mission . Retrieved February 12, 2018, from <https://www.usnews.com/news/articles/2013/02/11/poll-americans-overwhelmingly-support-manned-mars-mission>
- Mars One. (2016, July 4). Overview of Donations and Merchandise Revenue. Retrieved February 12, 2018, from <http://www.mars-one.com/overview-of-donations-and-merchandise-revenue>
- Mars One. (2018). About Us. Retrieved February 19, 2018, from <https://www.mars-one.com/about-mars-one>
- Mattis: US national security focus no longer terrorism. (2018, January 19). Retrieved January 28, 2018, from <http://www.bbc.com/news/world-us-canada-42752298>
- Mohon, L. (2017, August 7). The Journey to Mars: Bridging the Technology Gap. Retrieved January 28, 2018, from <https://www.nasa.gov/centers/marshall/news/releases/2015/the-journey-to-mars-bridging-the-technology-gap.html>
- NASA. (2017, August 3). About NASA. Retrieved February 19, 2018, from <https://www.nasa.gov/about/index.html>
- New England Journal of Medicine. (2018). About NEJM. Retrieved February 19, 2018, from <http://www.nejm.org/about-nejm/about-nejm?query=footer>
- Phillips & Company. (2018). About Us. Retrieved February 19, 2018, from <http://phillipsandco.com/about-us/>
- ResearchGate. (2018). About Bret G. Drake. Retrieved February 19, 2018, from https://www.researchgate.net/profile/Bret_Drake
- SETI. (2017). Fermi Paradox. Retrieved February 11, 2018, from <https://www.seti.org/seti-institute/project/details/fermi-paradox>
- Sharp, T. (2017, September 11). Mars' Atmosphere: Composition, Climate & Weather. Retrieved January 28, 2018, from <https://www.space.com/16903-mars-atmosphere-climate-weather.html>
- SpaceX Company. (2018). About Us. Retrieved February 19, 2018, from <http://www.spacex.com/about>

- Tsiolkovsky, K. (2018). Konstantin Tsiolkovsky Quotes. Retrieved February 19, 2018, from https://www.brainyquote.com/quotes/konstantin_tsiolkovsky_183177
- United Nations General Assembly. (1966, December 19). United Nations Office for Outer Space Affairs. Retrieved February 06, 2018, from <http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html>
- United Nations. (2018). About the UN. Retrieved February 19, 2018, from <http://www.un.org/en/about-un/>
- University of Edinburgh. (2018). Charles Cockell. Retrieved February 19, 2018, from <https://www.ph.ed.ac.uk/people/charles-cockell>
- Wagner, K. (2016, June 03). Elon Musk has already mapped out how government will work on Mars. Retrieved February 06, 2018, from <https://www.recode.net/2016/6/3/11852148/elon-musk-mars-government-direct-democracy>
- Whitwarm, R. (2017, July 17). NASA Now Says Manned Mars Mission in 2030s Is Unlikely. Retrieved January 28, 2018, from <https://www.extremetech.com/extreme/252461-nasa-now-says-manned-mars-mission-2030s-unlikely>
- Williams, D. (2016, December 23). Mars Fact Sheet. Retrieved January 28, 2018, from <https://nssdc.gsfc.nasa.gov/planetary/factsheet/marsfact.html>
- Wilson, J. (2017, August 3). Journey to Mars Overview. Retrieved January 28, 2018, from <https://www.nasa.gov/content/journey-to-mars-overview>
- WIRED Staff. (2016, February 16). The 12 Greatest Challenges for Space Exploration. Retrieved January 28, 2018, from <https://www.wired.com/2016/02/space-is-cold-vast-and-deadly-humans-will-explore-it-anyway/>
- WIRED. (2018). Press: About WIRED. Retrieved February 19, 2018, from https://www.wired.com/about/press_about/