Plastics: The Frontier that Molded our World Forever

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Process Paper

I chose this topic because plastic pollution is becoming a huge problem, but it is actually a very useful material that has helped us as humans cross countless frontiers, making things possible that were not possible before. I did my science fair project on global climate change and ocean acidification and I learned that ever since the industrial revolution, people have been creating so much waste and pollution. I am passionate about the environment and making sure that the planet is still habitable for future generations. When plastic began to be mass produced around WWII, a frontier in history was crossed. For a long time companies wanted consumers to believe that plastic was recyclable, however that myth has recently been debunked.

I found my information on the internet and in books and documentaries. My favorite primary source is a video called *The Kingdom of Plastics* made in 1945 teaching about the amazing new product called plastic and showing its many uses. My favorite secondary source is the Susan Freinkel book *Plastic: A Toxic Love Story*. My perspective changed a lot because nowadays people are talking about how bad plastic is all the time, but I gained a better understanding of all of the good and amazing things about plastics.

I chose to make a website because it is the category I am most familiar with because I made a website in Web Central in 5th grade. I think that there are a lot of interesting and impactful pictures to go along with my research that make a good website. I planned for the construction of my website and essay by getting help from my teacher, my mom, and my friend's mom to start the essay and to set up my website.

My thesis is that the invention and wide scale manufacturing of plastics has helped mankind cross countless frontiers in history, changing our world forever. The invention of plastic gave rise to two important frontiers: the robust and flourishing consumer society we have today, and advanced medical technology. However, as with all new frontiers, the mass production of plastics came with unknowns and plastics are now causing immense damage to the planet. My historical argument is that even though plastics have done harm to the environment, plastics initially took pressure off of natural and animal resources.

The legacy of plastics is that although it was a wonderful material with many amazing uses we now need to figure out ways to use less of it, and replace it with biodegradable options, because it is ruining the environment. The impact of plastics on the environment is becoming harder to undo as humans cling to the material embedded in our life. This topic is relevant today because people are seeing the devastating effects and trying to come up with solutions.

Annotated Bibliography

Primary Sources

"The Age of Plastic: From Parkesine to pollution." 2019. Science Museum. https://www.sciencemuseum.org.uk/objects-and-stories/chemistry/age-plastic-parkesine-pollution.
This is a website with pictures of things made of Bakelite, Leo Baekeland's plastic, which was one of the first plastics. This source helped me see some of the medical advancements that are made of plastics, and I used some of the images on my website.

"Bakelite." 2021. Grace's Guide to British Industrial History. https://www.gracesguide.co.uk/Bakelite.
This website has many pictures of advertisements for Bakelite from 1917-1961. It also gives a timeline of the company's history. It helped me understand what the first plastic products looked like. I used some of the pictures of radios on my website.

Blackburn, Mark. 2016. "Life Before Plastic." One Brown Planet. https://www.onebrownplanet.com/life_before_plastic/.
This source was an interview with someone's mum who was alive when there wasn't much plastic around. It helped me understand that plastics are actually really useful in our everyday lives and that life before plastics was not as easy.

"Celluloid Billiard Ball | National Museum of American History." n.d. National Museum of American History. Accessed February 10, 2023. https://americanhistory.si.edu/collections/search/object/nmah_2947.
This is an image of the first celluloid billiard balls made by John Wesley Hyatt displayed at the National Museum of American History that I used on my website. This helped me understand that celluloid looked almost identical to modern plastics and ivory.

"History of the EEG and QEEG." Brainclinics, https://brainclinics.com/history-of-the-eeg-and-qeeg/. Accessed 2 April 2023.
This is where I took the primary source photographs from the 1963 development of equipment designed to measure EEG in space, made possible by plastics. These pictures helped me understand how valuable a lightweight and easy to mold material is.

"History of Plastics: Plastics in World War II: Plastics (1944) - CharlieDeanArchives." 2013. YouTube. https://www.youtube.com/watch?v=GirvOmjPZrc.
This is a video from 1944 teaching about what plastics are and how they are made. It talks about the amazing and varied uses of plastics. It talks about the important role that plastics played in World War II. I saw how chemicals are mixed in a lab to create plastics.

Hyatt, John Wesley. "Letter from J. W. Hyatt to E. Berliner 1888 August 25"
This letter helped me understand better the scientific process and delays that Hyatt experienced while developing celluloid. I used it on my website to show the origins of plastic.

"Kingdom of Plastics, The : Handy (Jam) Organization : Free Download, Borrow, and Streaming." 2002. Internet Archive. https://archive.org/details/Kingdomo1945.
This video was made in 1945 to teach children about the new plastic material that belongs to its own kingdom. It helped me understand that plastics were not always everywhere like they are today. I used a clip from this movie on my website.

McCool, Bill, and Wallace Carothers. 2020. "The History of Plastic: The Invention of Throwaway Living." Dieline. https://thedieline.com/blog/2020/3/10/the-history-of-plastic-the-invention-of-throwaway-living?
This source had 17 different primary source images showing advertisements for new plastics throughout history. I learned about the plastic companies purposefully trying to get consumers to throw away plastics so that they would have to buy more.

Millett, Adam, and Holly O'Neill. 2019. "The Story of Plastic: How Plastic has Changed the World, and Where to Go from Here." VirtueBrush. https://virtuebrush.com/blogs/news/the-story-of-plastic-how-plastic-has-changed-the-world.
This source is a very thorough look at plastic through the ages. I used this source for a Bakelite advertisement from 1938 and also a Life Magazine image from 1955. It also gave me the idea to do some more research on the plastic syringe.

ChroniclingAmerica.n.d.https://chroniclingamerica.loc.gov/lccn/sn83045462/1952-04-27/ed-1/seq-176/.
This site gave me an ad from 1952 for aprons made from Vinylite brand plastic. It helped me realize that there are so many different types of plastic materials used for so many different purposes. I had never heard of Vinylite before.

"Photographs of DuPont Company exhibits at Atlantic City, Wilmington, and elsewhere." n.d. Hagley Digital Archives. Accessed February 8, 2023. https://digital.hagley.org/1972270.
This is a digital photo archive showing various different DuPont Company exhibits. The online collection includes images dating from 1946 to 1949 of plastic product displays at the company's Boardwalk site in Atlantic City.

"Plastics and Modern Materials." n.d. Science Museum Group Collection. Accessed March 22, 2023. https://collection.sciencemuseumgroup.org.uk/search/categories/plastics-and-modern-materials
This is a digital museum collection of the Science Museum group showing primary source photographs of items made of plastic and other materials from the 19th century. This exhibit helped me understand the

Simon, Matt. "Feb. 24, 1938: Americans Can Now Stop Chewing on Pig Hair." WIRED, 24 February 2012, https://www.wired.com/2012/02/feb-24-1938-americans-can-now-stop-chewing-on-pig-hair/. Accessed 2 April 2023.
This is the site where I found the photograph of 1938 Dr. West's toothbrush advertisement that I used on my website. It helped me understand how toothbrush technology evolved.

"TIME Magazine Cover: Pierre S. DuPont - Jan. 31, 1927." n.d. Videos Index on TIME.com. Accessed February 10, 2023. https://content.time.com/time/covers/0,16641,19270131,00.html.
This source is the cover of the January 31, 1927 *Time* magazine of Pierre DuPont. Pierre DuPont was a leading pioneer in the plastics industry. The fact that he made the cover helped me understand that he made a significant contribution to the country.

"Top MedTech Advances from the Last 100 Years." H1, https://h1.co/blog/top-medical-technology-advances-from-the-last-100-years/. Accessed 2 April 2023.
This is where I took the primary source photographs from the 1963 development of equipment designed to measure EEG in space, made possible by plastics. Originally from the Computer History Museum.

UNITED STATES PATENT OFFICE. - METHOD OF MAKING INSOLUBLE PRODUCTs of PHENOL AND FORMALDEHYDE. Accessed January 4, 2023. https://patentimages.storage.googleapis.com/54/8e/f5/ac666496b972b8/US942699.pdf
This source is the PDF patent for Leo Baekeland's Bakelite, the first fully synthetic plastic. It states that Leo Baekeland has the rights to Bakelite. I learned about patents and how products can be patented.

UNITED STATES PATENT OFFICE., https://patentimages.storage.googleapis.com/2f/e5/7a/61213a2e49a600/US88633.pdf. Accessed 1 May 2023.
This is John Wesley Hyatt's patent for celluloid, the plastic created to replace ivory billiard balls. It helped me understand more about the novel material he created in 1869.

Waring, Sophie. 2017. "Bakelite: The First Synthetic Plastic." Science Museum Blog. https://blog.sciencemuseum.org.uk/bakelite-the-first-synthetic-plastic/.
I got pictures of original Bakelite items off this Science Museum website. These helped me see the beautiful materials and design created using the newly invented plastics.

Secondary Sources

Carrington, Damian. "After bronze and iron, welcome to the plastic age, say scientists." The Guardian, 4 September 2019, https://www.theguardian.com/environment/2019/sep/04/plastic-pollution-fossil-record. Accessed 22 March 2023.
This article talks about how plastic pollution is now in the fossil record. I learned about how microplastics enter the water through washing our clothes. Once in the water, fish eat them and we eat the fish and they end up in our stomachs.

Colman, Sharon. 2020. "A brief history of plastic." YouTube. https://www.youtube.com/watch?v=9GMbRG9CZJw.

This video gave me a wide understanding of why people tried to make the material called plastic. It taught me that the people needed an alternative for ivory which was used to make billiard balls. I used this information in my essay.

Craig, Robert. 2018. “A history of syringes and needles.” Faculty of Medicine - University of Queensland. https://medicine.uq.edu.au/blog/2018/12/history-syringes-and-needles.
This source is all about the history of syringes and needles. It has pictures of every different type of syringe and needle from the 1910s - now. I used this source to learn about how plastic syringes technology is important in medical care.

Edmond, Charlotte. “Plastic pollution is bad, but how exactly is it linked to climate change?” *GreenBiz*, 18 February 2022, https://www.greenbiz.com/article/plastic-pollution-bad-how-exactly-it-linked-climate-change. Accessed 5 May 2023.
I used this source to learn more about how plastics in the environment are linked to climate change. I used a quote to show that not only do plastics harm animals, but they also release greenhouse gasses as they decompose.

“Eternal Plastic: A Toxic Love Story | Susan Freinkel.” 2020. YouTube. https://www.youtube.com/watch?v=B8cjqXGpPcw.
This is a talk by Susan Freinkel talking about the ideas in her book. Susan Freinkel wrote the book, *Plastic: A Toxic Love Story*, that is a look at the world through different inventions made from plastics.

“5 Ways Plastics Revolutionized The Healthcare Industry.” 2017. Medical Product Outsourcing. https://www.mpo-mag.com/contents/view_online-exclusives/2017-10-09/5-ways-plastics-revolutionized-the-healthcare-industry/.
This source is a website about some of the different ways plastic has enhanced safety in hospitals. The five ways it cites are sterility, enhanced safety, increased comfort, innovative applications, and cost effectiveness. It taught me about the benefits of plastics.

Freinkel, Susan. 2011. “A Brief History of Plastic's Conquest of the World.” Scientific American. https://www.scientificamerican.com/article/a-brief-history-of-plastic-world-conquest/.
This source is a short version of the book by Susan Freinkel *Plastic: A Toxic Love Story*. Freinkel uses different everyday items to show how plastic changed the world. It helped me understand how much we rely on plastics today.

Frienkel, Susan. 2011. Plastic: A Toxic Love Story. N.p.: Houghton Mifflin Harcourt.
This book is all about the history of plastics from their invention until now. Freinkel tells her story through eight everyday plastic objects. This is one of my most important sources as I used it to write my research portion of my essay.

Geyer, Roland, Jenna R. Jambeck, and Kara L. Law. 2017. “Production, use, and fate of all plastics ever made.” Science Advances 3, no. 7 (July).

This is a scholarly article about the production, use, and fate of all plastics ever made. It has numerous graphs and charts about where all the plastic has ended up. I got the graph title "Cumulative plastic waste generation and disposal" from this journal article.

Gibbens, Sarah. 2019. "Can medical care exist without plastic?" National Geographic. https://www.nationalgeographic.com/science/article/can-medical-care-exist-without-plastic?loggedin=true&rnd=1672907254105
This article talks about the many ways plastic has revolutionized healthcare. It also talked about how people are now trying to make biodegradable plastics and reverse some effects of plastic on our environment.

Gomez, Fernando, and Simonetta Rima. 2019. "Setting the facts straight on plastics | World Economic Forum." The World Economic Forum. https://www.weforum.org/agenda/2019/10/plastics-what-are-they-explainer/.
This article helped me understand where plastics come from and how they are made. It has many charts and graphs showing the different types of plastics and their uses. It talks about how plastic isn't easily recyclable.

Greenwood, Michael. 2021. "History of Microbiology – Germ Theory and Immunity." News Medical. https://www.news-medical.net/life-sciences/History-of-Microbiology-e28093-Germ-Theory-and-Immunity.aspx.
This article gives a background on germ theory and immunity throughout the centuries. People learned about sterilization of materials. It helped me understand why sterile plastic is important in healthcare.

Haynes, Todd, dir. 2019. Dark Waters. Focus Features.
This movie is based on a true story about the harmful chemicals which are the byproduct of Teflon (a plastic) manufacturing. Until recently the harmful effects were not regulated or known. It helped me understand that the plastics industry is extremely powerful.

"History and Future of Plastics." n.d. Science History Institute. Accessed January 3, 2023. https://www.sciencehistory.org/the-history-and-future-of-plastics
This source is an article that tells all about plastic from the beginning of when it was invented until today and the growing concerns about the future of plastic in our environment.

"The History of Plastic [INFOGRAPHIC] - SIMCO Disclosures." Simcobox, 13 March 2014, https://www.simcobox.com/blog/the-history-of-plastic/. Accessed 2 April 2023.
This is the infographic/timeline that I used. It was created by the Standard Injection Molding Company. It helped me understand that it wouldn't be possible to have solar panels or wind turbines without plastics.

"The History of Plastic | Visual.ly." 2022. Visually. https://visual.ly/community/Infographics/other/history-plastic.

This is where I got an infographic chronicling the timeline of the history of plastic and who invented each kind of material. It helped me understand that plastic went through a long process to get the materials we have today. I used this timeline originally, but chose the other one instead.

Ktori, Sophia. “Plastic Waste-Eating Bacteria Break Down Ring Carbon Compounds.” *Genetic Engineering and Biotechnology News*, 7 February 2023, https://www.genengnews.com/topics/bioprocessing/industrial-biotech/plastic-waste-eating-bacteria-break-down-ring-carbon-compounds/. Accessed 15 May 2023.
This source taught me about the bacteria that is able to eat petroleum plastics. I used it on my legacy page to support the idea that there is hope for the future.

Leiva, Noe. “'Trash islands' off Central America indicate ocean pollution problem.” Phys.org, 24 November 2017, https://phys.org/news/2017-11-trash-islands-central-america-ocean.html. Accessed 2 April 2023.
I used this source for pictures of plastics in the ocean to illustrate the legacy of plastics. This image is of a bunch of plastic floating in the ocean in the middle of the ocean. It helped me visually understand the magnitude of the plastic problem in the environment.

“The life-saving power of medical oxygen.” 2021. World Health Organization (WHO). https://www.who.int/news-room/feature-stories/detail/the-life-saving-power-of-medical-oxygen.
I got the picture of the baby in the plastic incubator from this site. This photograph illustrates the importance of plastic to the medical field. It helped me understand how prevalent plastic is in every single aspect of our lives.

Lim, XiaoZhi. “How Postwar Ads Got Us Hooked On 'Disposable' Single-Use Plastic.” *HuffPost*, 16 May 2019, https://www.huffpost.com/entry/vintage-ads-plastic_n_5cdb1768e4b01e9bd3540ffa. Accessed 15 May 2023.
This article helped me understand that the idea of single use plastics was pushed by the companies to get consumers to buy more. I used this source for the picture of a disposable baby bottle from 1971.

Parker, Laura. 2019. “Plastic pollution facts and information.” National Geographic. https://www.nationalgeographic.com/environment/article/plastic-pollution.
This is an article by National Geographic showing that plastics are killing animals and that plastic may start harming humans. This supported my thesis because one of my main points is how plastic is now damaging wildlife and our planet.

Petsko, Emily. 2021. “The global plastic pollution crisis is approaching an irreversible 'tipping point.'” Oceana. https://oceana.org/blog/global-plastic-pollution-crisis-approaching-irreversible-tipping-point/.
This source's main focus point is to educate the reader on the fact that plastic pollution is reaching a “tipping point” and will soon be irreversible. It helped me understand that we need to change our consumption habits.

“Plastic contamination of the ocean is irreversible, warns WWF | WWF.” 2022. WWF Mediterranean. https://www.wwfmmi.org/?5947466/Plastic-contamination-of-the-ocean-

is-irreversible-warns-WWF.
This source is about the effects of plastics on our ocean and how microplastics are now everywhere. This source is written by the World Wildlife Federation and focuses on the impact on wildlife. It helped me understand that plastic pollution is a major problem.

Ragusa A, Svelato A, Santacroce C, Catalano P, Notarstefano V, Carnevali O, Papa F, Rongioletti MCA, Baiocco F, Draghi S, D'Amore E, Rinaldo D, Matta M, Giorgini E. Plasticenta: First evidence of microplastics in human placenta. Environ Int. 2021 Jan;146:106274. doi: 10.1016/j.envint.2020.106274. Epub 2020 Dec 2. PMID: 33395930.
This is a scholarly journal article that published the research showing that microplastics were found in human placenta. It helped me understand how scientists can detect microplastics with a microscope.

Ratcliffe, Rebecca. “Photos show Manila Bay mangroves 'choking' in plastic pollution.” The Guardian, 5 October 2021, https://www.theguardian.com/world/2021/oct/05/photos-show-manila-bay-mangroves-choking-in-plastic-pollution. Accessed 2 April 2023.
I used this source to find pictures for my legacy page, such as the picture of the forest with plastic strangling the trees. This source illustrates some of the impacts of plastics on the environment. We don’t really have rivers that look like that in Hawaii, but it showed me that it is a problem in other parts of the world.

Rochman, Chelsea M. 2020. “The Story of Plastic Pollution: From the Distant Ocean Gyres to the Global Policy Stage.” Oceanography 33, no. 3 (September). https://www.researchgate.net/publication/347732523_The_Story_of_Plastic_Pollution_From_the_Distant_Ocean_Gyres_to_the_Global_Policy_Stage#pf8
This is a very in depth analysis written in 2020 about the story of plastic pollution. I will definitely need to read this one more time. This source also had an extensive bibliography that could guide future research on this topic.

Santoro, Helen. 2019. “These tiny microbes are munching away at plastic waste in the ocean.” https://www.science.org/content/article/these-tiny-microbes-are-munching-away-plastic-waste-ocean.
This short article talks about research that is being done on microbes that are breaking down plastic. I learned that there are actually microbes that are now able to break down plastic making it more biodegradable. This is exciting because it could really help our planet.

Sanchez, Rudy. “BTW, You’re Eating And Breathing In Plastic Too.” Dieline, 10 06 2019, https://thedieline.com/blog/2019/6/10/btw-youre-eating-and-breathing-in-plastic-too? Accessed 2 3 2023.
In this article I learned how we are eating and breathing microplastics now. It cites scholarly journal articles where the research to support the claims can be found. It helped me understand the larger scale impacts that plastics are having on us. Scientists are continuing to do research in this area.

"'They all have plastic inside them': New film explores our impact on Pacific albatrosses." 2017. CBC. https://www.cbc.ca/radio/asithappens/as-it-happens-wednesday-edition-1.4129380/they-all-have-plastic-inside-them-new-film-explores-our-impact-on-pacific-albatrosses-1.4129387.
I got the picture of the albatross with plastic in its belly from this site. It helped me understand the birds are mistaking plastic for food and it is causing them to starve because they don't have room for food. I used the images on my unintended harms page.

Thompson RC, Moore CJ, vom Saal FS, Swan SH. Plastics, the environment and human health: current consensus and future trends. Philos Trans R Soc Lond B Biol Sci. 2009 Jul 27;364(1526):2153-66. doi: 10.1098/rstb.2009.0053. PMID: 19528062; PMCID: PMC2873021.
This scholarly journal article has lots of good information about what could be done in the future to change the negative trends that are happening with plastic waste. It was published in 2009, so a lot of the information is outdated. The language is a little above my level but I was able to understand the main ideas.

Whiting, Tabitha. 2019. "How We Created A Throwaway Society | by Tabitha Whiting | Medium." https://tabitha-whiting.medium.com/how-we-created-a-throwaway-society-3b31bd097533.
This source gave me information about how Americans were convinced by plastic companies to throw things away after a single use so that they would have to buy more. When plastics first came into widespread use the people were not used to having a lot of things and kept the things they had forever. This helped me understand that companies often value making money above the environment.

Waugh, Rob. "Hi-tech fishing nets reduce the number of turtles and sharks being caught by accident by up to 95%." Yahoo News NZ, 24 January 2022, https://nz.news.yahoo.com/hi-tech-fishing-nets-reduce-the-number-of-turtles-and-sharks-being-caught-by-accident-by-up-to-95-160936429.html. Accessed 2 April 2023.
This article is reporting good news about the creation of high tech fishing nets that won't entangle sea creatures accidentally. I used the picture to represent turtles that have been accidentally caught in free floating plastic fishing nets.

"Why Is Medical Plastic Packaging So Essential?" n.d. This Is Plastics. Accessed January 3, 2023. https://thisisplastics.com/safety/why-are-medical-plastic-packages-so-essential/.
This is a website that shares why plastic is so essential to provide safe medical treatment. I used the information to widen my understanding on how plastic provides safety in hospitals. This relates to the frontier because it shows how plastics changed our healthcare system.

Xia, Q., Chen, C., Yao, Y. et al. A strong, biodegradable and recyclable lignocellulosic bioplastic. Nat Sustain 4, 627–635 (2021). https://doi.org/10.1038/s41893-021-00702-w. Accessed 1 May 2023.
This journal article helped me learn about one promising bioplastic material called lignocellulosic. I used a picture diagram showing what lignocellulosic is.