Project Notes:

Project Title: Pathophysiological Disruption of the Endothelial Glycocalyx by Microplastic Contamination

Name: Avani Jain

Note Well: There are NO SHORT-cuts to reading journal articles and taking notes from them. Comprehension is paramount. You will most likely need to read it several times, so set aside enough time in your schedule.

Contents:

Knowledge Gaps:

This list provides a brief overview of the major knowledge gaps for this project, how they were resolved and where to find the information.

Knowledge Gap	Resolved By	Information is located	Date resolved
The structure of the heart and what each individual part does	Google Search	1. Anatomy of Human Heart - Michigan Medicine 2. Structure and Function of the Heart - News Medical 3. Structure of the Heart - National cancer Institute	October 12, 2024
What organs are not directly exposed to microplastics (but indirectly exposed)	Google Search	1. Microplastics are inside us all. What does that mean for our health? - AAMC 2. Microplastics Make Their Way from the Gut to Other Organs, UNM Researchers Find - Health Sciences Newsroom	October 12, 2024
Atherosclerosis and how it impacts the heart	Google Search	1. Article 9 Notes 2. Arteriosclerosis - Cleveland Clinic 3. Atherosclerosis - John Hopkins Medicine	October 12, 2024
Structure of a mouse heart and similarities with human hearts	Google Search	1. The Anatomy of a Laboratory Mouse - Information Jax 2. Developmental anatomy of the heart: a tale of mice and man - Physiological Genomics 3. A detailed comparison of mouse and human cardiac development - Nature	October 12, 2024
How scanning electron microscopy	Google Search Talk to Professor?	1. Scanning Electron Microscopy -	October 12 2024

works		NanoScience Instruments 2. A Brief Introduction to SEM (Scanning Electron Microscopy) - SciMed Education	
Raman Microspectroscopy and its relation to microplastics	Google Search	1. Raman microspectroscopy for microbiology - Nature 2. Identification of microplastics using Raman spectroscopy: Latest developments and future prospects - Water Research 3. Article 10 Notes	September 30, 2024

Literature Search Parameters:

These searches were performed between 09/01/24 and XX/XX/2019.
List of keywords and databases used during this project.

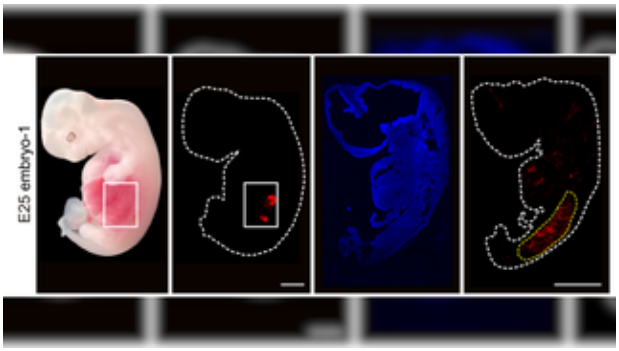
Database/search engine	Keywords	Summary of search
Google	Microplastic separation	There were a few articles about how microplastics have been separated from the body (see #5), however most of them were about separation from the soil or water, not from the human body.
Google	Microplastics and the heart	There were minimal results as little has been done on the effects of microplastics on the heart. Most of the news articles referred to the same study, which has been added to notes (#9).
Google	Cells, Microplastics	There are experiments done on the effects of (mostly) polystyrene microplastics on various cells and various aspects of the cells, some of which were entered into the project notebook
Google	Triton, positive control, cells	Triton has commonly been used as a positive control in. many cell-related experiments; however it is necessary to determine the proper concentration of Triton as too much can ruin the experiment.

Tags:

Tag Name	
#MicroplasticSeparation	#ArtificalOrgans
#MicroplasticInWater	#BreathingManikin
#Seaweed	#MicroplasticInhalation
#EffectOverview	#MicroplasticDetection
#CapturingMicroplastics	#Daphnia
#EndothelialGlycocalyx	#TritonDetermination
#MicroplasticEffects	

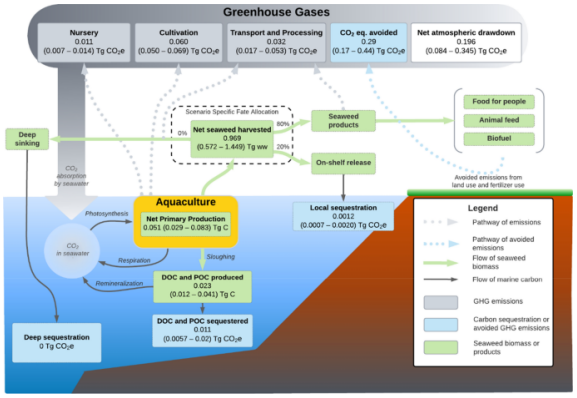
Article #1 Notes: In a 1st, scientists grow human kidneys inside developing pig embryos

Source Title	In a 1st, scientists grow human kidneys inside developing pig embryos
Source citation (APA Format)	Cooke, E. (2023, September 11). *In a 1st, scientists grow human kidneys inside developing pig embryos*. Live Science. https://www.livescience.com/health/in-a-1st-scientists-grow-human-kidneys-inside-developing-pig-embryos
Original URL	https://www.livescience.com/health/in-a-1st-scientists-grow-human-kidneys-inside-developing-pig-embryos
Source type	Scientific Website
Keywords	Pig embryos, artificial organs, kidneys, induced pluripotent stem cells (iPSCs), CRISPR
#Tags	#ArtificalOrgans
Summary of key points + notes (include methodology)	Goal: - Determine whether human organs can be grown inside another animal Methodology: - In a recently published study, researchers inserted human stem cells into pig embryos that were then allowed to grow inside a surrogate pig mother - This was done in pigs using pluripotent stem cells as pigs have similar organs and embryological development to humans - Scientists used CRISPR technology to disable the normal pig genes that allow for kidney development and changing the pluripotent cells so that they match the developmental stage of the pigs Results: - These stem cells grew into kidneys that were made up of 60% human cells and structurally sound for the period of development they were checked during Other: - With this experiment, there was a risk that the pig cells could outcompete the human stem cells - While this research has opened doors to developing artificial organs, there is still a critical challenge that is yet to be overcome: The pig kidneys were still 40% pig cells, and thus there is a high chance of organ rejection - However, this technology can still be used to study human organ development, furthering the research on artificial organs
Research Question/Problem/ Need	Research Problem: Growing proper human organs inside another animal in order to allow for artificial organ development

Important Figures	 Growth of human kidney inside pig embryo shown various ways in two stages
VOCAB: (w/definition)	Induced Pluripotent Stem Cells – Cells taken from an adult somatic cell that are reprogrammed to undergo differentiation CRISPR – Technology that allows researchers and scientists to selectively modify the DNA of a living organism
Cited references to follow up on	1. https://www.livescience.com/health/fertility-pregnancy-birth/most-advanced-lab-made-human-embryo-models-look-like-the-real-thing 2. https://www.cell.com/cell-stem-cell/fulltext/S1934-5909(23)00286-2 3. https://www.livescience.com/first-pig-heart-transplant-to-human
Follow up Questions	1. How can the rest of 40% of the kidney that was pig be transformed to human kidney cells? 2. How can this experiment be used for other organs, such as the heart or brain? 3. How can the concept of immune rejection in artificial organs be reduced by using CRISPR?

Article #2 Notes: The potential climate benefits of seaweed farming in temperate waters

Source Title	The potential climate benefit of seaweed farming in temperate waters
Source citation (APA Format)	Bullen, C. D., Driscoll, J., Burt, J., Stephens, T., Hessing-Lewis, M., & Gregr, E. J. (2024). The potential climate benefits of seaweed farming in temperate waters. *Nature News, 15021 (2024*). https://www.nature.com/articles/s41598-024-65408-3
Original URL	https://www.nature.com/articles/s41598-024-65408-3
Source type	Journal Article
Keywords	Seaweed, climate change, seaweed agriculture, carbon dioxide removal (CDR), sequestration
#Tags	#Seaweed
Summary of key points + notes (include methodology)	Goal: - Determine whether seaweed can be used to help with removing carbon dioxide from the atmosphere Methodology: - They came up with a mathematical model for carbon sequestration potential, emissions of seaweed, and fates for harvested seaweed - To create the scenarios they tested, they conducted surveys and interviewers with the kelp producers in the targeted area - They also used sustainability restrictions to estimate the area available to farm - After conducting a variety of experiments considering different scenarios (all based in British Columbia, Canada), they performed an economic analysis and a sensitivity analysis Results: - Depending on the growth rates and areas the seaweed was present in, the scenarios tested were able to avoid between 0.3% - 13% of annual greenhouse gas emissions in British Columbia - However, after factoring in the economic and sensitivity analysis, they came to the conclusion that seaweed would be most beneficial if used to replace products whose production releases high amounts of CO2 Other: - Sinking seaweed however, as some propose, would make a minimal difference as it would just trap CO2 in our waters - This means that replacing food or fuel with seaweed would be the most efficient way to use seaweed to decrease atmospheric carbon dioxide

	concentrations - There are many other benefits of seaweed farming as well, including improving water quality and protecting shorelines - However, one of the major issues with seaweed farming is the potential for invasive species and harmful algae blooms - However, this research shows the potential for seaweed and seaweed farming to be able to reduce climate change if only further looked into.
Research Question/Problem/ Need	Can seaweed farming help with carbon dioxide removal while also being an economically viable option?
Important Figures	 The carbon pathway used in the math model to determine seaweed benefits
VOCAB: (w/definition)	Carbon sequestration – The process of capturing and storing atmospheric carbon dioxide
Cited references to follow up on	1. Froehlich, H. E., Afflerbach, J. C., Frazier, M. & Halpern, B. S. Blue growth potential to mitigate climate change through seaweed offsetting. *Curr. Biol.* **29**, 3087–3093 (2019). 2. Duarte, C. M., Wu, J., Xiao, X., Bruhn, A. & Krause-Jensen, D. Can seaweed farming play a role in climate change mitigation and adaptation?. *Front. Mar. Sci.* https://doi.org/10.3389/fmars.2017.00100 (2017). 3. National Academies of Sciences, Engineering, and Medicine. *A Research Strategy for Ocean-Based Carbon Dioxide Removal and Sequestration* 26278 (National Academies Press, Washington, 2021). https://doi.org/10.17226/26278.
Follow up Questions	1. Is there a way to increase the economic viability of seaweed farming? 2. Can seaweed farming in other areas (not temperate waters) have higher benefits in terms of CDR? 3. Is there a way to increase the efficiency of sinking seaweed in CDR?

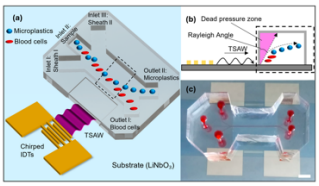
Article #3 Notes: Humans inhale a credit card's worth of microplastics every week. Here's where it ends up.

Source Title	Human inhale a credit card's worth of microplastics every week. Here's where it ends up.
Source citation (APA Format)	Turner, B. (2023, June 19). *Humans inhale a credit card's worth of microplastics every week. Here's where it ends up.* Live Science. https://www.livescience.com/health/humans-inhale-a-credit-cards-worth-of-microplastics-every-week-heres-where-it-ends-up
Original URL	https://www.livescience.com/health/humans-inhale-a-credit-cards-worth-of-microplastics-every-week-heres-where-it-ends-up
Source type	Scientific website
Keywords	Microplastics, Respiratory Issues, Inhalation
#Tags	#MicroplasticInhalation
Summary of key points + notes (include methodology)	Goal: - Determine what happens to microplastics that are inhaled by humans Methodology: - Scientists built a computer model which was used to analyze where the microplastics ended up once inhaled - They analyzed the breathing system under both slow and fast breathing rates using three possible shapes: spherical, tetrahedral, and cylindrical Results: - They discovered that the larger chunks were likely to get stuck, especially in the nasal cavity and back of the throat - The microplastics that mostly got lodged measured around 5.56 microns Other Notes: - Microplastics are tiny plastic remnants of industrial waste and consumer goods - They are found everywhere: across the atmosphere, oceans, and even in human feces - Little has been known about the toxicity of them, but recent research suggests serious health problems as a result of the ingestion of microplastic - While current research on them is lacking, they have been shown to kill human cells and reduce fertility in mice - Microplastics have also been known to carry bacteria and other viruses, which can lead to many respiratory issues
Research Question/Problem/	Where do microplastics go once they are inhaled and what happens when

Need	they get there?
Important Figures	N/A
VOCAB: (w/definition)	Microplastics - Tiny chunks of plastic debris measuring less than 0.2 inch (5 millimeters) long
Cited references to follow up on	1. https://go.redirectingat.com/?id=92X1590019&xcust=livescience_us_111510064539667268 1&xs=1&url=https%3A%2F%2Fwww.nature.com%2Farticles%2Fs41598-019-45054-w&sref=https%3A%2F%2Fwww.livescience.com%2Fhealth%2Fhumans-inhale-a-credit-cards-worth-of-microplastics-every-week-heres-where-it-ends-up 2. https://pubs.aip.org/aip/pof/article/35/6/063319/2895950/How-microplastics-are-transported-and-deposited-in
Follow up Questions	1. How can microplastics be taken out of the lungs once it goes in? 2. What are the effects of microplastics on other bodily systems, such as the circulatory and digestive systems? 3. How can we reduce our microplastic intake?

Article #4 Notes: Separation of Microplastics from Blood Samples Using Traveling Surface Acoustic Waves

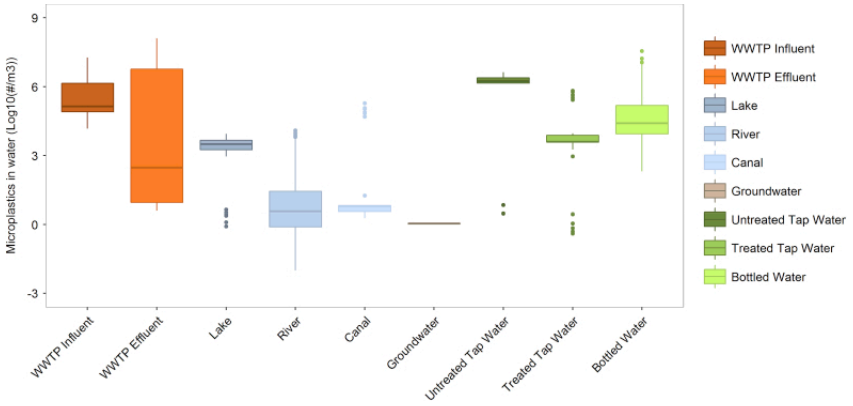
Source Title	Separation of Microplastics from Blood Samples Using Traveling Surface Acoustic Waves
Source citation (APA Format)	Mesquita, P., Lin, Y., Gong, L., & Schwartz, D. (2024). Separation of Microplastics from Blood Samples Using Traveling Surface Acoustic Waves. *Microplastics*, *3*(3), 449–462. https://doi.org/10.3390/microplastics3030028
Original URL	https://www.mdpi.com/2673-8929/3/3/28#
Source type	Journal Article
Keywords	Microplastics, traveling surface acoustic waves (TSAWs), microfluidic device, blood separation, acoustofluidics
#Tags	#MicroplasticSeparation
Summary of key points + notes (include methodology)	Goal: - Determine where TSAWs can be used to separate microplastics from blood Methodology: - To resolve this problem, a microfluidic device which utilizes traveling surface acoustic waves (TSAWs) to displace particles based on their size was proposed - They used different frequencies in their device to separate the microplastics based on size - It's essential for the particle frequency to match the frequency of the microfluidic device in order for them to be separated Results: - They were able to effectively separate both the 5 and 10 micrometer polystyrene microplastics from the blood, which is what they targeted - The most common microplastic size varied based on where in the body they tested Other: - Microplastics, which are harmful contaminants created because of plastic production, have been found in human blood, which poses a significant threat to blood circulation - Microplastics are found in many food types, including salt and seafood and can also be found in simple drinking water - Microplastics can lead to many health issues, including DNA damage and spermatogenesis dysfunction

	- The most common type of microplastic in the human body is those composed of polypropylene and polyethylene - Acoustofluidics has been used in various separations before, which includes cancer cells
Research Question/Problem/ Need	How can the use of traveling surface acoustic waves be used to separate microplastics in the blood, especially those of varying sizes?
Important Figures	 A model of the microfluidic device used where (a) shows the separation mechanism, (b) shows a cross-sectional view of the actual process, and (c) is a photo of the actual device
VOCAB: (w/definition)	Traveling Surface Acoustic Wave – A wave traveling along the surface of a material exhibiting elasticity Microfluidic device – An instrument that uses very small amounts of fluid on a microchip to perform laboratory tests Acoustofluidics- An emerging technology that uses acoustic waves and microfluidic devices to manipulate fluids/particles in micro/nano structures Polypropylene – A common plastic used for packaging and consumer goods that has low density and high heat resistance Polyethylene - A common plastic used for packaging that is softer than polypropylene
Cited references to follow up on	1. Prata, J.C.; da Costa, J.P.; Lopes, I.; Duarte, A.C.; Rocha-Santos, T. Environmental Exposure to Microplastics: An Overview on Possible Human Health Effects. *Sci. Total Environ.* **2020**, *702*, 134455. 2. Dick, V.A.; Juliette, L. Microplastics and Human Health. *Science* **2021**, *371*, 672–674. 3. de Souza Machado, A.A.; Lau, C.W.; Till, J.; Kloas, W.; Lehmann, A.; Becker, R.; Rillig, M.C. Impacts of Microplastics on the Soil Biophysical Environment. *Environ. Sci. Technol.* **2018**, *52*, 9656–9665. 4. Vianello, A.; Jensen, R.L.; Liu, L.; Vollertsen, J. Simulating Human Exposure to Indoor Airborne Microplastics Using a Breathing Thermal Manikin. *Sci. Rep.* **2019**, *9*, 8670.
Follow up Questions	1. How can traveling surface acoustic waves be used to separate particles less than 5µm or bigger than 10 µm?

	2. Do TSAWs also work on the separation of polypropylene and polyethylene microplastics? 3. How can separation of microplastics in the blood using TSAWs be applied to separation of microplastic in other parts of the body, such as the lungs?

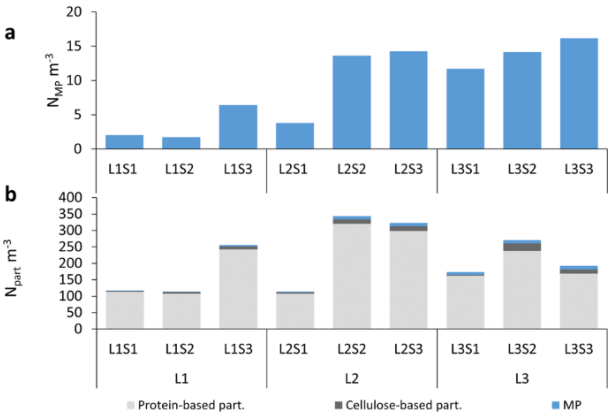
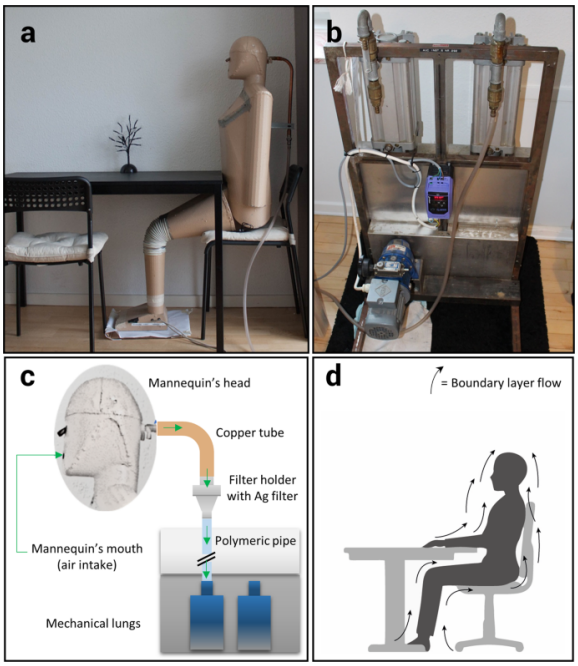
Article #5 Notes: Microplastics in freshwaters and drinking water: Critical review and assessment of data quality

Source Title	Microplastics in freshwaters and drinking water: Critical review and assessment of data quality
Source citation (APA Format)	Koelmans, A. A., Mohamed Nor, N. H., Hermsen, E., Kooi, M., Mintenig, S. M., & De France, J. (2019). Microplastics in freshwaters and drinking water: Critical review and assessment of data quality. *Water Research*, *155*(1), 410–422. https://doi.org/10.1016/j.watres.2019.02.054
Original URL	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6449537/
Source type	Journal Article
Keywords	Microplastics, Drinking water, Waste water, Surface water, and Human health
#Tags	#MicroplasticInWater
Summary of key points + notes (include methodology)	Goal: - Determine whether current studies on microplastic content in water are accurate with their data Methodology: - This method (Hermsen et al.) was applied in this study for analysis for microplastics in freshwater sample - 50 studies on microplastics in drinking water were found using the Scopus database and an additional 3 studies were found using a Google Search - Each study was evaluated based on the adapted criteria from Hermsen et all. - The results were then analyzed using the Mann-Whitney-Wilcoxon test with Bonferroni correction Results and Conclusion: - Only four studies were found to be viable as they received non-zero scores for all the criteria - They concluded that along with quality assurance, it's important to report all methods so the experiment is traceable - Microplastic concentration in water is not directly related to human exposure as there are many other factors that ca affect it - They determined that more high-quality data is necessary to understand the impact on human health Other: - There are no set metrics for studies regarding microplastics (i.e.. Sampling

	size and microplastic identification) - They analyzed data from studies (50) about microplastics in drinking water (both tap and bottled), river/lake water, and groundwater - A method was recently proposed by Hermsen et al. That defined a minimum quality criterion for parts of the analytical procedure
Research Question/Problem/ Need	What is the quality of the data collected regarding microplastics in water and what are the best practices to sample, extract, and detect microplastics?
Important Figures	 A box plot that shows median/variation in microplastic concentrations in different water types
VOCAB: (w/definition)	Mann-Whitney-Wilcoxon Test: A statistical test used to compare two samples of groups in which the null hypothesis states that the two populations are equal Bonferroni Correction: A multiple-comparison correction that is used when there are more than two statistical tests being done at the same time
Cited references to follow up on	1. Carr S.A., Liu J., Tesoro A.G. Transport and fate of microplastic particles in wastewater treatment plants. *Water Res.* 2016;**91**:174–182. 2. Deng Y., Zhang Y., Lemos B., Ren H. Tissue accumulation of microplastics in mice and biomarker responses suggest widespread health risks of exposure. *Sci. Rep.* 2017;**7**:46687. 3. Dyachenko A., Mitchell J., Arsem N. Extraction and identification of microplastic particles from secondary wastewater treatment plant (WWTP) effluent. *Analytical Methods.* 2017;**9**(9):1412–1418.
Follow up Questions	1. How can studies be made to be more accurate in their data collection to the point where it can be used? 2. Does having data that receives a zero score for at least one criterion render the experiment useless? 3. Can this criteria be applied to all data on microplastics if adapted (not just microplastics in water)?

Article #6 Notes: Simulating human exposure to indoor airborne microplastics using a Breathing Thermal Manikin

Source Title	Simulating human exposure to indoor airborne microplastics using a Breathing Thermal Manikin
Source citation (APA Format)	Vianello, A., Jensen, R. L., Liu, L., & Vollertsen, J. (2019). Simulating human exposure to indoor airborne microplastics using a Breathing Thermal Manikin. *Scientific Reports*, *9*(1). https://doi.org/10.1038/s41598-019-45054-w
Original URL	https://www.nature.com/articles/s41598-019-45054-w
Source type	Journal Article
Keywords	Microplastics, Inhalation, Manikin, Simulation
#Tags	#BreathingManikin
Summary of key points + notes (include methodology)	Goal: - Create a model to simulate microplastic inhalation by humans Methodology: - The contamination of air samples was measured in three apartments, and it was determined which types of microplastics were most prevalent - Using MPhunter, they determined that there were both microplastics and nonsynthetic particles inhaled by the manikin - The manikin simulated human breathing and metabolic rates Results and Conclusion: - The most common (synthetic) microplastics inhaled were polyester (81%), polyethylene (6%) , and nylon (5%) - The median size of the particles found in the manikin was 1.9 micrometers, however most of the particles found were considered fragments as opposed to fibers - It was difficult to determine how much of the particle inhalation was microplastics, but was determined be around 50% - There was a high variability amongst some of the locations they measured but not others (i.e. L1-L3 = significant variability) in terms of microplastics - It was determined microplastics are inhaled in non-negligible amounts by humans Other: - While commonly believed that only microplastics smaller than 5 micrometers can be deposited in the deep lung, some of the larger ones

	can escape defense mechanisms and also be deposited in the deep lung - The interaction between synthetic particles and microfibers in the lungs can lead to lung inflammation due to cytotoxic factors - Microplastics are suspected to carry many other micropollutants as these can stick to their surfaces (hydrophobic)
Research Question/Problem/ Need	How can the inhalation of microplastics in air by humans be modeled?
Important Figures	 Microplastic and total particle exposure in the manikin across various locations (L1, L2, and L3) (blue = microplastic and second graph = total particle exposure)  The Breathing Manikin used (showing what mechanism was used to simulate human breathing and metabolic rates)

VOCAB: (w/definition)	Spectroscopy- The study of the absorption and emission of light/radiation by matter
Cited references to follow up on	1. Rist, S., Carney Almroth, B., Hartmann, N. B. & Karlsson, T. M. A critical perspective on early communications concerning human health aspects of microplastics. *Sci. Total Environ.* **626**, 720–726, https://doi.org/10.1016/j.marpolbul.2016.01.006 (2018). 2. Pimentel, J. C., Avila, R. & Lourenco, A. G. Respiratory disease caused by synthetic fibres: a new occupational disease. *Thorax* **30**, 204–219, https://doi.org/10.1136/thx.30.2.204 (1975).
Follow up Questions	1. Can a similar manikin be used to determine the intake of microplastics in other areas of the body (such as the heart)? 2. Would changing the filter material (connected to the manikin) affect the results and how? 3. Would the results change if a female's respiration rate was chosen instead of male and how?

Article #7 Notes: Environmental exposure to microplastics: An overview on possible human health effects

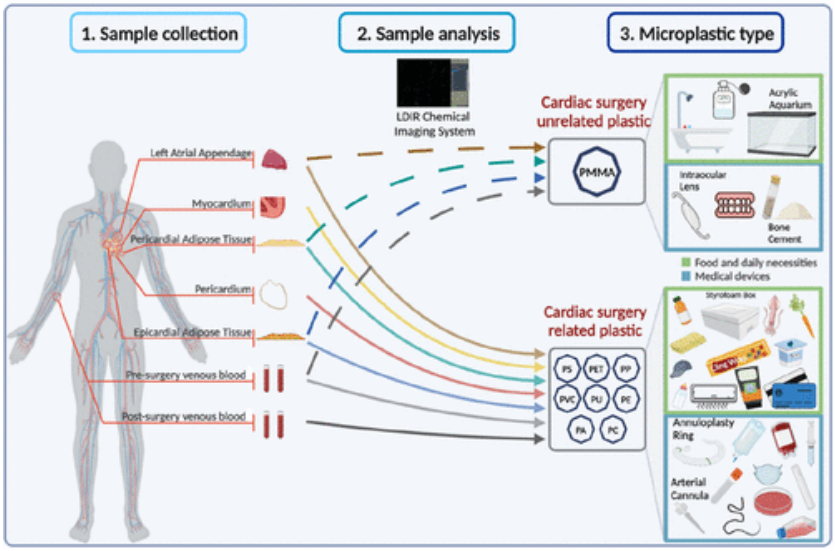
Source Title	Environmental exposure to microplastics: An overview on possible human health effects
Source citation (APA Format)	Prata, J. C., da Costa, J. P., Lopes, I., Duarte, A. C., & Rocha-Santos, T. (2020). Environmental exposure to microplastics: An overview on possible human health effects. *Science of The Total Environment*, *702*, 134455. https://doi.org/10.1016/j.scitotenv.2019.134455
Original URL	https://www.sciencedirect.com/science/article/pii/S0048969719344468?via=ihub#ab010
Source type	Journal Article
Keywords	Microplastics, Nanoplastics, Human health risks, marine litter, toxicology
#Tags	#EffectOverview
Summary of key points + notes (include methodology)	Goal: - Summarize current studies on the effects of microplastics on human health Methodology: - N/A Results/Other: - Microplastics are the results of the biodegradation of plastics - Primary microplastics are those produced on purpose and secondary microplastics are those created by the biodegradation of plastic - Three main ways microplastics enter the body: Inhalation, ingestion, and dermal contact - Ingestion is the major route of exposure– after being ingested, they travel through the gastrointestinal system which can lead to inflammation - They attach to specialized M-cells in a lymphoid tissue and/or penetrate the intestinal mucus - Microplastics can also be deposited in the liver and other systems through the circulatory system - In terms of inhalation, the smaller and less dense particle reach deeper in the lungs and build up over time - The build-up on these particles can lead to the release to chemotactic factors that can then lead to chronic inflammation in the lungs and potentially lead to lung cancer - Dermal contact is considered a possibility for microplastic exposure,

	specifically for nanoplastics as it's believed they can cross the dermal barrier - Epithelial cells suffer oxidative stress from exposure to both micro and nanoplastics - Overall, microplastics can lead to cytotoxicity, chronic inflammation, risk of cancer, and increased risk of neurodegenerative diseases - While most of these haven't been tested in humans, rats have shown to experience inflammation, and zebrafish are shown to have oxidative stress as a result of exposure - Along with all these, microplastics can lead to the disruption of energy and metabolism homeostasis
Research Question/Problem/ Need	What are the possible health complications that can occur as a result of exposure to microplastics in humans?
Important Figures	 Graphical abstract of their experiment – shows the most common sources of microplastics, the most common ways they enter the body, and the effects they have
VOCAB: (w/definition)	Particle transposition: The movement of particles from one location to another Chemotactic factors: Molecules that stimulate the movement of cells, specifically in gradients Cytotoxicity: The degree to which a substance can damage a cell
Cited references to follow up on	1. D.K. Agarwal, J.L. Kaw, P. Srivastava, P.K. Seth (1978) Some biochemical and histopathological changes induced by polyvinyl chloride dust in rat lung. Environ. Res., 16 (1978), pp. 333-341, 10.1016/0013-9351(78)90166-

	4 2. L.G.A. Barboza, L.R. Vieira, V. Branco, N.Figueiredo, F. Carvalho, C. Carvalho, L. Guilhermino (2018) Microplastics cause neurotoxicity, oxidative damage and energy-related changes and interact with the bioaccumulation of mercury in the European seabass, Dicentrarchus labrax (Linnaeus, 1758) Aquat. Toxicol., 195 (2018), pp. 49-57, 10.1016/j.aquatox.2017.12.008
Follow up Questions	1. Would the effects be exactly like those shown in the rats and zebrafish, wildly different, or somewhere in between in humans? 2. Is there a way to prevent microplastic inhalation? 3. Is there a way to separate/take out microplastics once they've been taken into the human body?

Article #8 Notes: Detection of Various Microplastics in Patients Undergoing Cardiac Surgery

Source Title	Detection of Various Microplastics in Patients Undergoing Cardiac Surgery
Source citation (APA Format)	Yang, Y., Xie, E., Du, Z., Peng, Z., Han, Z., Li, L., Zhao, R., Qin, Y., Xue, M., Li, F., Hua, K., & Yang, X. (2023). Detection of various microplastics in patients undergoing cardiac surgery. *Environmental Science & Technology*, *57*(30), 10911–10918. https://doi.org/10.1021/acs.est.2c07179
Original URL	https://pubs.acs.org/doi/epdf/10.1021/acs.est.2c07179
Source type	Journal Article
Keywords	Microplastic, cardiac surgery, cardiac tissue, venous blood, infrared chemical imaging system, scanning electron microscopy
#Tags	#MicroplasticDetection
Summary of key points + notes (include methodology)	Goal: - Determine whether there are microplastics in the human heart Methodology: - They collected tissue samples from 15 patients and blood samples from 7 patients undergoing cardiac surgery - These tissue samples were normal tissues (5 types), some of which can only be found in certain parts of the heart - They then used a LDIR to detect the presence of various microplastics in these samples - Using a scanning electron microscope, they further analyzed the tissue/blood samples Results: - They detected microplastics ranging from 20-490 micrometers in all five types of tissue - The common type of microplastic detected was polyethylene terephthalate (77%) - However, polyethylene was found in all five tissue samples - There were significantly less microplastics in blood than in tissue samples - However, microplastics increased significantly in the blood after surgery than were present before Other: - A new technology – Laser direct infrared – is a new imaging system that allows for reliable detection of microplastics - Microplastics can easily be transported to other tissues that receives blood flow - Medical procedures can leave a lot of microplastics behind in the body,

	especially those that have direct access to the bloodstream or tissues
Research Question/Problem/ Need	Do microplastics exist in the human heart and surrounding tissue, and where do they come from?
Important Figures	 Summary of their experiment – Shows the tissue they collected and where the plastics found in those tissues came from
VOCAB: (w/definition)	Pericardial: Protective fluid-filled sac surrounding the heart in order to help it function properly Epicardial Adipose: Tissue layer between the pericardium and the heart that aids with many of the functions of a heart Adipose: Tissues used for the storage of fat Left atrial appendage: Small part facing the outside of the muscular wall of the left atrium
Cited references to follow up on	1. Campanale, C.; Massarelli, C.; Savino, I.; Locaputo, V.; Uricchio, V. F. A Detailed Review Study on Potential Effects of Microplastics and Additives of Concern on Human Health. *International journal of environmental research and public health.* **2020**, *17* (4), 1212, DOI: 10.3390/ijerph17041212 2. Song, Y.; Cao, C.; Qiu, R.Uptake and adverse effects of polyethylene terephthalate microplastics fibers on terrestrial snails (Achatina fulica) after soil exposure. *Environ. Pollut.* **2019**, *250*, 447– 455, DOI: 10.1016/j.envpol.2019.04.066
Follow up Questions	1. Why were there more microplastics in tissues than blood? 2. How can microplastics be separated from the tissues?

	3. How, specifically, are microplastics transported to other tissues through the blood?

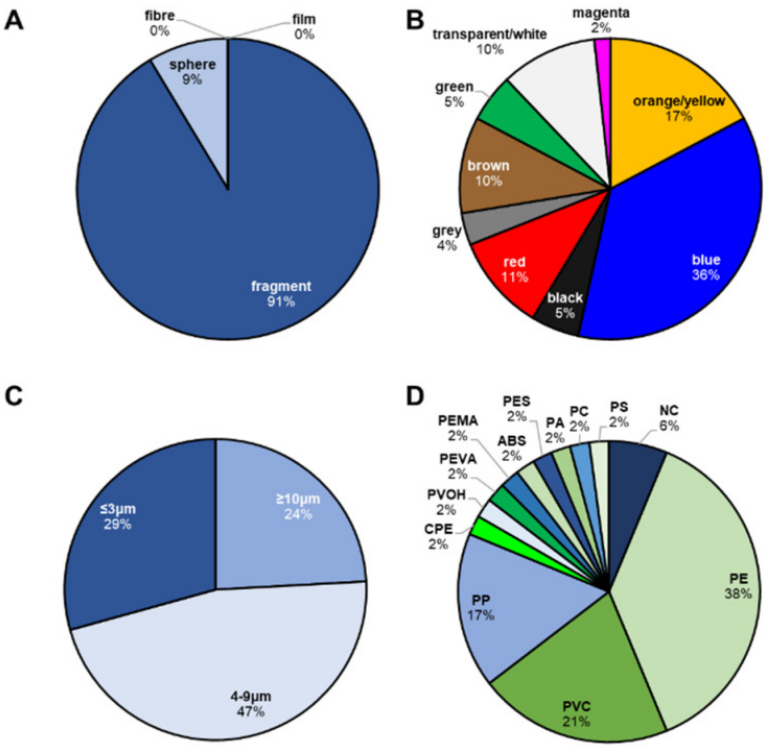
Article #9 Notes: Microplastics and Nanoplastics in Atheromas and Cardiovascular Events

Source Title	Microplastics and Nanoplastics in Atheromas and Cardiovascular Events
Source citation (APA Format)	Marfella, R., Prattichizzo, F., Sardu, C., Fulgenzi, G., Graciotti, L., Spadoni, T., D'Onofrio, N., Scisciola, L., La Grotta, R., Frigé, C., Pellegrini, V., Municinò, M., Siniscalchi, M., Spinetti, F., Vigliotti, G., Vecchione, C., Carrizzo, A., Accarino, G., Squillante, A., & Spaziano, G. (2024). Microplastics and Nanoplastics in Atheromas and Cardiovascular Events. *The New England Journal of Medicine*, *390*(10), 900-910. https://doi.org/10.1056/NEJMoa2309822
Original URL	https://www.nejm.org/doi/full/10.1056/NEJMoa2309822#:~:text=Data%20from%20in%20vitro%20studies,myocardial%20fibrosis%2C%20and%20endothelial%20dysfunction
Source type	Journal Article
Keywords	Microplastics, atheroma, electron microscopy, pyrolysis-gas chromatography-mass spectrometry
#Tags	#MicroplasticDetection
Summary of key points + notes (include methodology)	Goal: - Determine the effects of microplastics and nanoplastics on pre-existing heart conditions Methodology: - Two groups of people were found: those with plaque containing MNPs and those with plaque not containing MNPs - After surgery removing the plaque, they followed up on the patients for three years to monitor infarction, stroke, and/or death - They collected the plaques and measured the microplastics in them using pyrolysis-gas chromatography-spectrometry - They further analyzed the above results using electron microscopy and stable isotope analysis - They then compared the composite of myocardial infraction, stroke, or death of those with and without MNPs Results: - In all the patients, 150/257 had detectable amounts of polyethylene and 31/257 had detectable amounts of polyvinyl chloride - Patients with microplastics tended to be younger males who were more likely to have diabetes, cardiovascular disease, and dyslipidemia and had higher creatinine values - The geographic area of the patients had no impact on the MNP levels

	- Those plaques with MNPs had a reduction of carbon and oxygen in the plaque, but a higher presence of chlorine - Myocardial infarction, stroke, or death occurred in 8/107 patients without MNPs and 30/150 patients with MNPs Other: - Nanoplastics are plastic particles smaller than 1000 nanometers - Microplastics have been found in the placenta, lungs, liver, breast milk, urine, and blood in humans - It is suggested that microplastics lead to oxidative stress, inflammation, and apoptosis in vascular cells
Research Question/Problem/ Need	Are patients with microplastics in the atheroma more likely to have the condition worsen than those without them?
Important Figures	N/A
VOCAB: (w/definition)	Atheroma – Fatty material that builds up inside your heart Myocardial infarction – When heart muscles begin to die due to lack of blood flow Stable isotope analysis – Separation of isotopes that allows scientists to identify isotopic markers
Cited references to follow up on	1. Vethaak AD, Legler J. Microplastics and human health. *Science* 2021;371:672-674. 2. Kumar R, Manna C, Padha S, et al. Micro(nano)plastics pollution and human health: How plastics can induce carcinogenesis to humans? *Chemosphere* 2022;298:134267-134267. 3. Ragusa A, Notarstefano V, Svelato A, et al. Raman microspectroscopy detection and characterisation of microplastics in human breastmilk. *Polymers (Basel)* 2022;14:2700-2700.
Follow up Questions	1. Can similar techniques be applied to other types of plaque on the heart? 2. Do microplastics block the arteries, leading to myocardial infarction? 3. Why were those males with microplastics more likely to have diabetes?

Article #10 Notes: Raman Microspectroscopy Detection and Characterization of Microplastics in Human Breastmilk

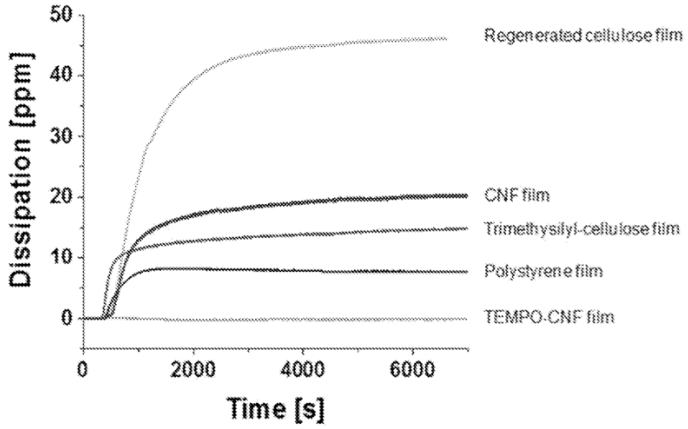
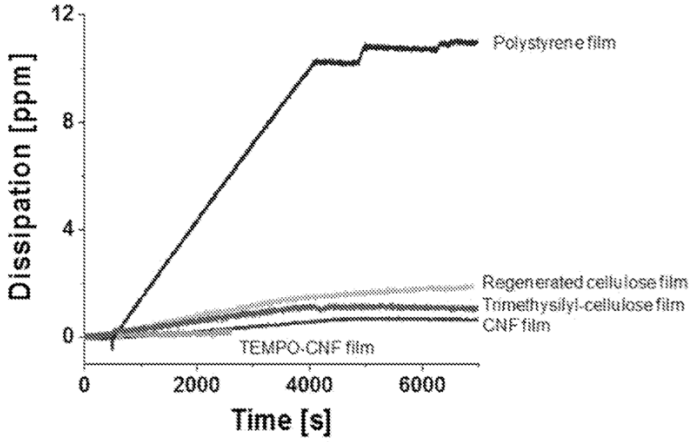
Source Title	Raman Microspectroscopy Detection and Characterization of Microplastics in Human Breastmilk
Source citation (APA Format)	Ragusa, A., Notarstefano, V., Svelato, A., Belloni, A., Gioacchini, G., Blondeel, C., Zucchelli, E., De Luca, C., D'Avino, S., Gulotta, A., Carnevali, O., & Giorgini, E. (2022). Raman Microspectroscopy Detection and Characterisation of Microplastics in Human Breastmilk. *Polymers*, *14*(13), 2700. https://doi.org/10.3390/polym14132700
Original URL	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9269371/
Source type	Journal Article
Keywords	microplastics, human breastmilk, Raman microspectroscopy, infants' nutrition
#Tags	#MicroplasticDetection
Summary of key points + notes (include methodology)	Goal: - Determine if microplastics can be found in human breastmilk Methodology: - Breastmilk samples were collected from 34 patients, all of whom had pregnancies without complications - These samples were collected 1 week after delivery (without breast pumps as to not contaminate the samples) - Organic components were removed from the sample samples using a digestion protocol - Raman Microspectroscopy was then used to analyze all the milk samples - There was quality control in terms of milk collection, storage, processing and analysis in order to avoid microplastic contamination Results: - Microplastics were detected in 26/34 of the breastmilk samples - Microplastic shapes in the breastmilk were only irregular fragments and spheres (no fibers or films) - The microplastics detected were also pigmented (mostly blue and orange/yellow) - 47% of the microplastics (highest percentage) ranged in size from 4-9 micrometers - The most common types of microplastics found were polyethylene, polyvinyl chloride, and polypropylene

	Other: - Microplastics are formed as a result of waves, abrasion, UV radiation, and photo-oxidation breaking down plastic - Microplastics can pass across the cell membrane once inside the cell, leading to many issues due to the internalization and accumulation of them - In early life stages, newborns are more sensitive to the toxic effects of polychlorinated bisphenyls and polybrominated diphenyl esters, both of which can be found in microplastics - Microplastics have also been detected in human placenta
Research Question/Problem/ Need	Can microplastics be found in human breastmilk, and if yes, what kind?
Important Figures	 Percentage of microplastics detected in the breastmilk samples in terms of (a) shape, (b) color, (c) size, and (d) type
VOCAB: (w/definition)	Raman Microspectroscopy – Chemical analysis based on the interaction of light with chemical bonds to find detailed information about chemical structure and molecular interactions within a substance
Cited references to follow up on	1. Cox K.D., Covernton G.A., Davies H.L., Dower J.F., Juanes F., Dudas S.E. Human Consumption of Microplastics. *Environ. Sci. Technol.* 2019;53:7068–7074. doi: 10.1021/acs.est.9b01517 2. Alimba C.G., Faggio C., Sivanesan S., Ogunkanmi A.L., Krishnamurthi K. Micro(nano)-plastics in the environment and risk of carcinogenesis: Insight

	into possible mechanisms. *J. Hazard. Mater.* 2021;416:126143. doi: 10.1016/j.jhazmat.2021.126143 3. Danopoulos E., Twiddy M., West R., Rotchell J.M. A rapid review and meta-regression analyses of the toxicological impacts of microplastic exposure in human cells. *J. Hazard. Mater.* 2021:127861. doi: 10.1016/j.jhazmat.2021.127861.
Follow up Questions	1. Does the microplastic in breastmilk get transferred into the newborn? 2. If yes to the above question, what effects can it have on the newborn? 3. Are there ways to prevent breastmilk from being contaminated with microplastics?

Patent #1 Notes: A method of capturing and analysing microplastic particles from aqueous medium

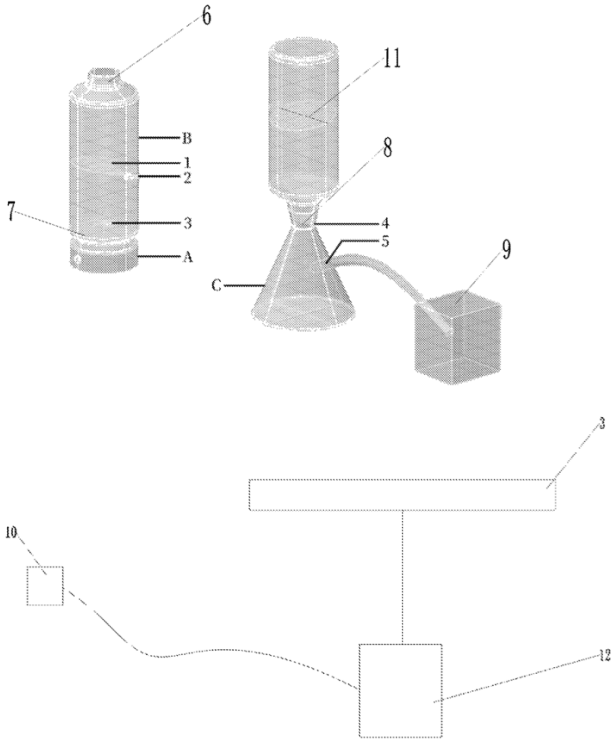
Source Title	A method of capturing and analysing microplastics particles from aqueous medium
Source citation (APA Format)	Hakalahti, M., Tammelin,T., Jääskeläinen, A., Arola, S. (2020). *A Method of Capturing and Analysing Microplastic Particles from Aqueous Mediums* (WO 225475 A1). Word Intellectual Property Organisation.
Original URL	https://patents.google.com/patent/WO2020225475A1/en
Source type	Patent
Keywords	Microplastics, nanoscaled lignocellulosic structures, hygroscopic, porous
#Tags	#CapturingMicroplastics
Summary of key points + notes (include methodology)	Goal: - Develop a way to remove microplastics from aqueous solutions Methodology: - Based on finding that there are certain porous and hydrophilic materials (also hygroscopic) that can capture small microplastics - The porous nature of the materials they discovered can be manipulated using water - The nanoscaled lignocellulosic structures include any network that is derived from a plant source (preferably wood-based) or produced by bacteria - To test the product, they used synthetic polystyrene latex beads of two different sizes (100 nm and 1.1 μm) - They measured adsorption using a surface sensitive quartz crystal microplastic with dissipation - They also fluorescently labeled microplastic particles to determine adsorption to different films Results/Claims: - Use of nanoscaled lignocellulosic structures to capture the microplastics in aqueous mediums - The invention is low-cost, efficient, non-toxic, and recyclable - The invention can be used to capture microplastics for the purpose of analyzing them to identify them - The solid content of the structure does not matter as both high solid and low solid content grades work Other: - Existing methodology for extraction is based on the density flotation but only applicable to larger microplastics

Research Question/Problem/ Need	There are high amounts of microplastics in water, but there are no known ways to effectively separate them from water
Important Figures	 Shows the dissipation change when 100 nm microplastic particles attach onto various films  Shows the dissipation change when 1.1 μm microplastic particles attach onto various films
VOCAB: (w/definition)	Lignocellulosic Structures– A supramolecular structure that is a combination of cellulose, hemicellulose, lignin, ash, etc. (plant dry matter) Elutriation- A process for separating particles based on size, shape, and density using a stream of gas/liquid flowing in a certain direction Hygroscopic – A substance that tends to absorb moisture from the air

	Colloidal – Any substance with particles bigger than atoms but too small to be visible normally Adsorption – Adhesion of atoms from gas, liquid, or dissolve solid to a surface
Cited references to follow up on	1. Coppock, R.L. et al, A small-scale, portable method for extracting microplastics from marine sediments. Environmental Pollution 230(2017) 829-937.
Follow up Questions	1. How can this technique be applied to removing microplastics from air? 2. How can this technique be used to remove microplastics from the human body, specifically the blood? 3. How can this model be improved upon to remove smaller microplastics/nanoplastics?

Patent #2 Notes: Integrated separation unit for microplastics in the coastal sediments and collection method of microplastics

Source Title	Integrated separation unit for microplastics in the coastal sediments and collection method of microplastics
Source citation (APA Format)	Yin, L., Wenyong, W., Mingli, Y., Qing, M., Xiaolu, X., Deyong, Z. (2022). *Integrated Separation Unit for Microplastics in the Coastal Sediments and Collection Method of Microplastics.* (US Patent No. 11,420,140). U.S. Patent and Trade-mark Office.
Original URL	https://patents.google.com/patent/ES2730553T3/en?q=(microplastic)&oq=microplastic
Source type	Patent
Keywords	Sediment, microplastics, density,
#Tags	#CapturingMicroplastics
Summary of key points + notes (include methodology)	Goal: - Develop a method to separate microplastics from sediment Methodology: - Uses density to remove organic matter, then non-microplastics, and finally collecting microplastic particles - Relies on the use of a sodium chloride solution - They tested their invention by obtaining sediment samples from various sites, filtering out the debris in the sediment sample, actually separating the microplastics using their device, and then determining the collection of microplastics in the filter membrane Results/Claims: - The invention includes a holder, separation cylinder, a collection bottle, a central baffle plate, a baffle plate control knob, a stirring propeller, a motor, a cylinder switch, a filtration screen, a welding nozzle, a filter membrane and a vacuum pump - The filter has various apertures (0.15 µm, 0.22 µm, 0.45 µm, 0.80 µm, and 1.20 µm) - The invention has an easy operation, it's economical and environmentally friendly, and has both high efficiency and durability Other: - East Asian seas have the most microplastic pollution due to China being the world's largest plastic consumer and producer - The separation of microplastics from sediments is difficult compared to

	the water due to the presence of sediment particles
Research Question/Problem/ Need	There are a lot of microplastics in sediments, however there are no known ways to effectively separate microplastics from the sediment
Important Figures	 Diagram(s) of their invention **A**—holder, **B**—separation cylinder, **C**—collection bottle, **1**—central baffle plate, **2**—baffle plate control knob, **3**—stirring blade, **4**—filtration screen, **5**—welding nozzle, **6**—neck, **7**—inner bottom of the separation cylinder, **8**—filter membrane, **9**—vacuum pump, **10**—cylinder switch, **11**—rotating shaft, **12**—motor
VOCAB: (w/definition)	Aperture – An open space/opening Baffle Plate – A plate used to control the flow of liquids/fluids
Cited references to follow up on	N/A
Follow up Questions	1. Can this method be applied to removing microplastics from cells? 2. Does this device work for all sizes of microplastics or only a certain range? 3. Can this device be used for microplastics in air too?

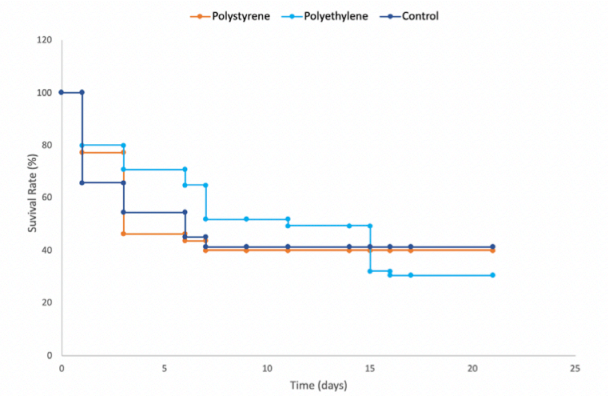
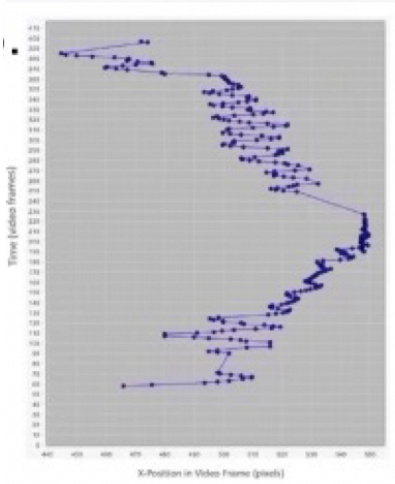
Article #11 Notes: Detection of microplastics in human saphenous vein tissue using µFTIR: A pilot study

Source Title	Detection of microplastics in human saphenous vein tissue using µFTIR: A pilot study
Source citation (APA Format)	Rotchell, J. M., Jenner, L. C., Chapman, E., Bennett, R. T., Bolanle, I. O., Loubani, M., Sadofsky, L., & Palmer, T. M. (2023). Detection of microplastics in human saphenous vein tissue using µFTIR: A pilot study. *PLOS ONE*, *18*(2), e0280594. https://doi.org/10.1371/journal.pone.0280594
Original URL	https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0280594
Source type	Journal Article
Keywords	Microplastics, vein tissue, µFTIR spectroscopy, procedural blanks
#Tags	#MicroplasticDetection
Summary of key points + notes (include methodology)	Goal: - Determine if microplastics are found in human vein tissue Methodology: - Used µFTIR spectroscopy - Excess human saphenous vein tissues were collected from patients undergoing surgery (coronary artery bypass graft procedures) - Tissue was acquired from 5 patients: two females and three males - Procedural blanks were collected to quantify and characterize contamination from the surgical environment - Particles that were 5 µm or greater in size were detected - Standard deviation and mean were calculated for all results Results: - They detected a total of 242 particles, 220 of which were determined to be microplastics - There was 29.28 MP/g (with background contamination) in the tissue samples - There was 14.99 MP/g when background contamination was subtracted in the tissue samples - The microplastics detected included alkyd resin fragment, trimethylolpropane trinononoate containing fragments, poly vinyl propionate/acetate fragments, and polyvinyl acetate: ethylene fragments - Alkyd resin fragments were the most common followed by poly vinyl propionate/acetate fragments - Particles in the procedural blanks had an average MP contamination rate of 10.4 MP/sample

	- These values are similar to that of the colon and higher than those of the lungs Other: - Microplastics have been detected in human stool, blood, cadaver lung, lung, and colon - Microplastics have been determined to cause inflammation and oxidative stress, but not much is known
Research Question/Problem/ Need	What types of microplastics are found in human saphenous vein tissue while accounting for procedural blank contamination?
Important Figures	N/A
VOCAB: (w/definition)	Saphenous vein: Blood vessels in legs that sends blood back to heart µFTIR spectroscopy: Technique that uses infrared light to analyze the molecular composition of a sample Procedural blank: Sample analyzed in the same way as the test sample but does not contain the matrix (used to analyze contamination of atmosphere, etc.)
Cited references to follow up on	1. Cobanoglu H, Belivermis M, Sikdokur E, Kilic O, Cayir A. Genotoxic and cytotoxic effects of polyethylene microplastics on human peripheral blood lymphocytes. Chemosphere 2021;272: 129805. pmid:35534956 2. Yan Z, Liu Y, Zhang T, Zhang F, Ren H, Zhang, Y. Analysis of microplastics in human Feces reveals a correlation between fecal microplastics and inflammatory bowel disease status. Environ Sci Technol. 2021;56: 414–421. pmid:34935363
Follow up Questions	1. Why are there more microplastics in the colon and saphenous vein tissue than in the lungs? 2. What are the effects of these microplastics on the veins? 3. How do these values compare to that in human stool?

Article #12 Notes: The effect of microplastics on the speed, mortality rate, and swimming patterns of Daphnia Magna

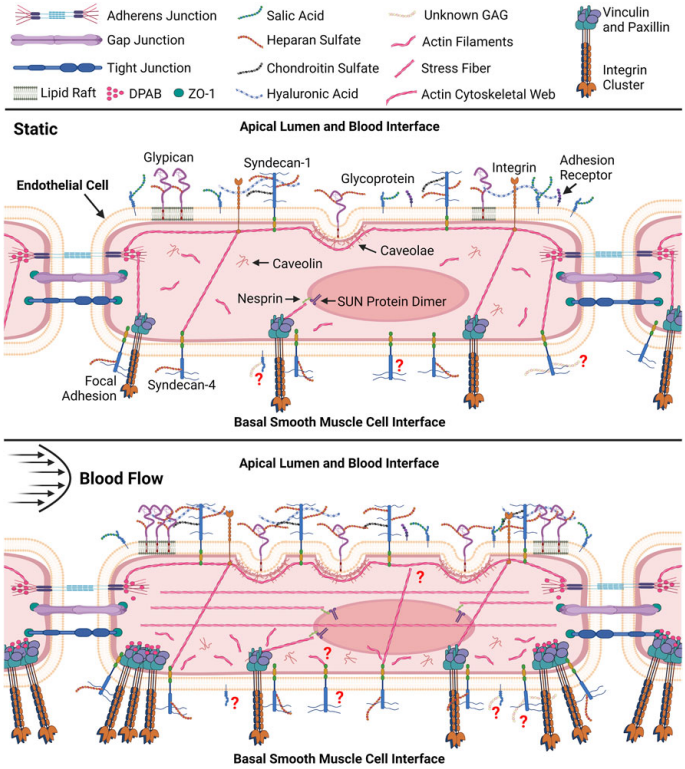
Source Title	The effect of microplastics on the speed, mortality rate, and swimming patterns of *Daphnia Magna*
Source citation (APA Format)	Fabricant, L., Edelstein, O., Dispigno, J., & Weseley, A. (2021). The effect of microplastics on the speed, mortality rate, and swimming patterns of Daphnia Magna. Journal of Emerging Investigators. https://doi.org/10.59720/20-096
Original URL	https://emerginginvestigators.org/articles/20-096
Source type	Website
Keywords	Microplastics, Daphnia Magna, Mortality Rate, Photo-tactic response, Swimming behavior, ecosystem, pollution
#Tags	#Daphnia
Summary of key points + notes (include methodology)	Goal: - Determine the effects of two types of microplastics on Daphnia behavior Methodology: - Used clear polyethylene and polystyrene polymer spheres - They fed the Daphnia either algae + polyethylene, algae + polystyrene, or just algae - They counted the number of living Daphnia every other weekday for 21 days - Administered a phototactic response test on one Daphnia from each group to determine speed - Analyzed videos from the phototactic response to determine swimming patterns - Used ImageJ and and TrackMate to analyze the results Results: - The most Daphnia survived in the control (41.25%), followed by polystyrene (39.9%), and then polyethylene (30.4%) but the result was determined to be not statistically significant - Daphnia fed polyethylene had the highest speed (1.24 cm/s), followed by the polystyrene (1.21 cm/s), and then the control (0.92 cm/s) but the results were determined not statistically significant - Those fed microplastics swam in spirals while those in the control swam downwards directly Other:

	- Microspheres were bought from Cospheric - Daphnia, algae, and fresh pond water were bought from Carolina Biological Supply Company
Research Question/Problem/ Need	What are the effects of both polystyrene and polyethylene microplastics on speed, mortality rate, and swimming patterns of Daphnia Magna?
Important Figures	 Survival curve for Daphnia Magna over the 21 days it was measured where orange represents polystyrene, blue is polyethylene, and dark blue is the control  Swimming path of one Daphnia Magna from the polyethylene group over time graphed using TrackMate
VOCAB: (w/definition)	N/A
Cited references to follow up on	1. Rehse, S., Kloas, W., & Zarfl, C. (2016). Short-term exposure with high concentrations of pristine microplastic particles leads to immobilisation of Daphnia magna. *Chemosphere*, *153*, 91–99. https://doi.org/10.1016/j.chemosphere.2016.02.133 2. Kelpsiene, E., Torstensson, O., Ekvall, M.T. *et al.* Long-term exposure to nanoplastics reduces life-time in *Daphnia magna*. *Sci Rep* 10, 5979 (2020).

	https://doi.org/10.1038/s41598-020-63028-1
Follow up Questions	1. Why were there no effects on mortality and speed? 2. Why did polystyrene and polyethylene microplastics have different effects? 3. Are there other Daphnia behaviors that can be tested?

Article #13 Notes: Basal endothelial glycocalyx's response to shear stress: a review of structure, function, and clinical implications

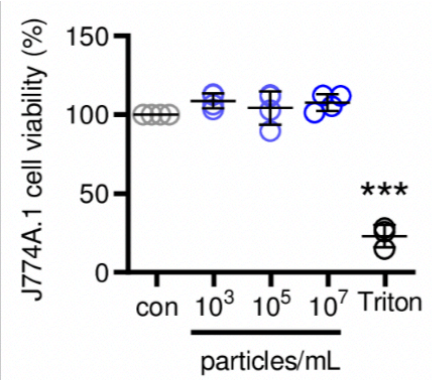
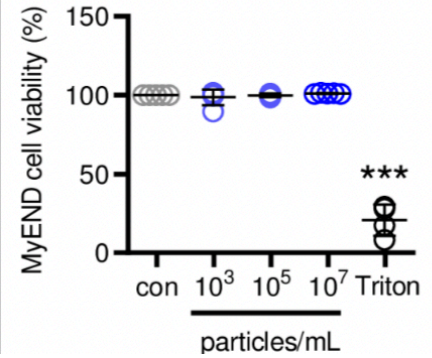
Source Title	Basal endothelial glycocalyx's response to shear stress: a review of structure, function, and clinical implications
Source citation (APA Format)	Vittum, Z., Cocchiaro, S., & Mensah, S. A. (2024). Basal endothelial glycocalyx's response to shear stress: a review of structure, function, and clinical implications. *Frontiers in Cell and Developmental Biology*, *12*. https://doi.org/10.3389/fcell.2024.1371769
Original URL	https://www.frontiersin.org/journals/cell-and-developmental-biology/articles/10.3389/fcell.2024.1371769/full
Source type	Journal Article
Keywords	Basal glycocalyx, endothelial glycocalyx, heparan sulfate, mechanotransduction, syndecan 1, syndecan 4.
#Tags	#EndothelialGlycocalyx
Summary of key points + notes (include methodology)	Goal: - Analyze current literature to determine the effects of stress on the basal endothelial glycocalyx Methodology: - Analysis of current literature - Determine knowledge gaps regarding the basal endothelial glycocalyx and show why resolving them is important Results: - Syndecan-4 plays a key role in endothelial cell remodeling by allowing them to align to the direction of the flow - Due to this, investigation other basal proteoglycans could show their potential involvement in morphological changes during shear stress - Investigating basal proteoglycans and the cytoskeleton could also allow for more knowledge about interaction between basal glycocalyx components and the cytoskeleton - Visualizing synedcan-4 next to the cytoskeleton in the basal cell might show an augmented colocalized expression of F-actin and synecdan-4 right after shear stress - It is necessary to characterize basal GAGs to figure out their interaction with the cytoskeleton - Studying degradation of the basal endothelial glycocalyx could help with understanding of various diseases, such as atherosclerosis, cancer, and

	sepsis Other: - Endothelial glycocalyx influences permeability, tone, inflammation, and signals - Apical side forms the lumen and interact with blood flow - Basal endothelial interacts with the smooth muscle and other basement membrane proteins - Lack of research on basal endothelial glycocalyx, research focuses on apical glycocalyx - Some therapies have been targeting the glycocalyx in order to stabilize and reform the glycocalyx layer after degradation
Research Question/Problem/ Need	How does shear stress effect the basal endothelial glycocalyx and why is this important?
Important Figures	 Resting endothelial cell in comparison to endothelial cell remodeling in response to fluid shear
VOCAB: (w/definition)	Shear Stress: Force tending to cause deformation of a material by acting coplanar with the cross section of materials Mechanotransduction: Process by which cells convert mechanical forces into biochemical signals that trigger cellular responses
Cited references to follow up	1. Jin, J., Fang, F., Gao, W., Chen, H., Wen, J., Wen, X., et al. (2021). The

on	structure and function of the glycocalyx and its connection with blood-brain barrier. *Front. Cell. Neurosci.* 15, 739699. doi:10.3389/fncel.2021.739699 2. Mensah, S. A., Nersesyan, A. A., Harding, I. C., Lee, C. I., Tan, X., Banerjee, S., et al. (2020). Flow-regulated endothelial glycocalyx determines metastatic cancer cell activity. *FASEB J.* 34 (5), 6166–6184. doi:10.1096/fj.201901920R
Follow up Questions	1. Why do scientists tend to focus on the apical glycocalyx in comparison to the basal glycocalyx? 2. How could altering the basal glycocalyx help with cancer and sepsis? 3. Do microplastics harm the basal glycocalyx, apical glycocalyx, or both?

Article #14 Notes: Polystyrene microplastic particles induce endothelial activation

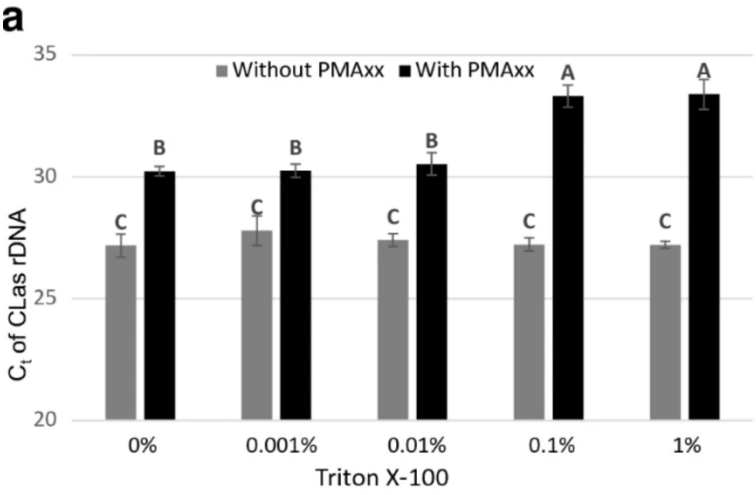
Source Title	Polystyrene microplastic particles induce endothelial activation
Source citation (APA Format)	Vlacil, A.-K., Bänfer, S., Jacob, R., Trippel, N., Kuzu, I., Schieffer, B., & Grote, K. (2021). Polystyrene microplastic particles induce endothelial activation. *PLOS ONE*, *16*(11), e0260181. https://doi.org/10.1371/journal.pone.0260181
Original URL	https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0260181
Source type	Journal Article
Keywords	Inflammation, polystyrene, blood, cytokinesis, plastic, polymerase chain reactions, endothelial cells, white blood cells,
#Tags	#EndothelialGlycocalyx
Summary of key points + notes (include methodology)	Goal: - Determine the effects of carboxylated polystyrene microplastic particles on murine endothelial and immune cells Methodology: - They cultured endothelial myEND cells and monocytic J774A.1 cells in a humidified incubator - Polystyrene was confirmed by Raman spectroscopy and the size was measured by dynamic light scattering - Cell viability was analyzed using alamarBlue Cell Viability Assay, where triton was a positive control - Wild-type mice were given either PS-TRITC or PBS particles through an intravenous injection - They collected peripheral blood, liver tissue, and aortic tissue - They calculated mean and standard deviation for all data - The groups were compared using a parametric 2-tailed Student t-test - Adhesion of monocytes under both static and flow conditions was also tested using fluorescence microscopy Results: - Polystyrene particles with concentrations from 10^3–10^7 particles/mL had no cytotoxic effects (after 16 hours) - The greatest effect on inflammatory cytokine expression was at 3 hours for the J774A.1 and 6 hours for myEND cells, both at 10^7 particles/mL - After polystyrene particle simulation, there were significantly more monocytic J774A.1 cells under both static and flow conditions - In mice, polystyrene particles were detected in the liver and upregulated

	hepatic expression of Saa1, 2, and 3 – which indicted an inflammatory acute-phase response Other: - Polypropylene, polyethylene, and polystyrene are the most commonly used/found microplastics - When microplastics accumulate in the heart, they can intake with immune cells and the endothelium which can lead to inflammatory effects
Research Question/Problem/ Need	What are the effects of microplastics on endothelial and immune cells?
Important Figures	  Cell viability of myEnd and J774A.1 cells after 16 hours of PS particles determined using alamarBlue cell viability assay
VOCAB: (w/definition)	Hepatoxicity: Injury to or impairment of the liver function which is chemical-driven Neutrophils: A type of white blood-cell that helps fight infections and injury Monocyte: Another type of white blood-cell
Cited references to follow up on	1. Li, S., Ma, Y., Ye, S., Tang, S., Liang, N., Liang, Y., & Xiao, F. (2021). Polystyrene microplastics trigger hepatocyte apoptosis and abnormal glycolytic flux via ROS-driven calcium overload. *Journal of Hazardous Materials*, *417*, 126025–126025.

	https://doi.org/10.1016/j.jhazmat.2021.126025 2. Barshtein, G., Livshits, L., Shvartsman, L. D., Shlomai, N. O., Yedgar, S., & Arbell, D. (2015). Polystyrene Nanoparticles Activate Erythrocyte Aggregation and Adhesion to Endothelial Cells. *Cell Biochemistry and Biophysics*, *74*(1), 19–27. https://doi.org/10.1007/s12013-015-0705-6
Follow up Questions	1. Why were effects not significant after 16 hours but significant at 3/6 hours? 2. What are the effects of polypropylene and polyethylene cells on inflammation? 3. How does this inflammation affect human health?

Article #15 Notes: An in vitro protocol for rapidly assessing the effects of antimicrobial compounds on the unculturable bacterial plant pathogen, Candidatus Liberibacter asiaticus

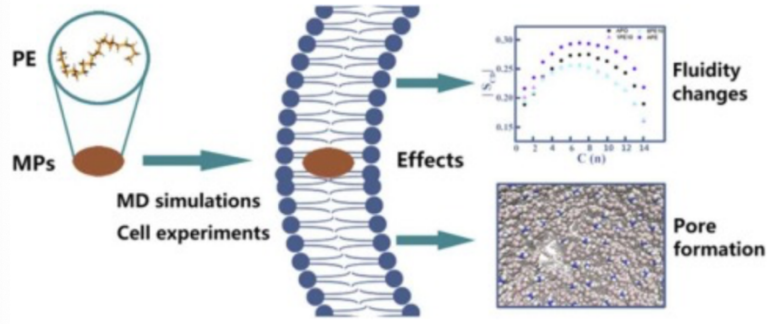
Source Title	An in vitro protocol for rapidly assessing the effects of antimicrobial compounds on the unculturable bacterial plant pathogen, Candidatus Liberibacter asiaticus
Source citation (APA Format)	Krystel, J., Shi, Q., Shaw, J., Gupta, G., Hall, D., & Stover, E. (2019). An in vitro protocol for rapidly assessing the effects of antimicrobial compounds on the unculturable bacterial plant pathogen, Candidatus Liberibacter asiaticus. *Plant Methods, 15*(1). https://doi.org/10.1186/s13007-019-0465-1
Original URL	https://plantmethods.biomedcentral.com/articles/10.1186/s13007-019-0465-1
Source type	Journal Article
Keywords	Candidatus Liberibacter asiaticus, propidium monoazide assay, psyllid homogenate assay, antimicrobial activity, therapeutic agents
#Tags	#TritonDetermination
Summary of key points + notes (include methodology)	Goal: - Develop a protocol to quickly test the effectiveness of potential therapeutic agents against Candidatus Liberibacter asiaticus (CLas) Methodology: - ACP were collected from maintained colonies and then raised on CLas + citrus plants - 20 mature adult psyllids were collected for isolation - Extraction was done based on an extraction done in a drosophila study - Viability assay was performed using PMAxx - DNA was isolated from all samples using a lysis buffer - Sterile nuclear free water was negative control - Positive control was Triton X-100 at 0.1% (non-ionic) - Serial dilutions from 1% down to 0.001% Triton was done to determine the proper control - Data was analyzed using Wilcoxon non-parametric analysis using a p-value of 0.05 Results: - Peak excitement of PMAxx occurred at 464 nm

	- Active PMAxx dye in the sample after light treatment might interfere with PCR - Samples exposed to light for 2.5-10 min have a relative reduction in intact cell signals compared to those with longer exposures - Treatment with 0.1% or 1% Triton had a significant decrease in intact cells - Peptide 1 had no effect on CLas disruption streptomycin had some inconsistent effects, and Triton X-100 had the greatest disruption through the trials Other: - Vast majority of bacteria hasn't and cannot be cultured through traditional ways of culturing - Current methods for investigating pathogenicity are not usable for unculturable pathogens - Current assessment methods include assessing DNA transcription/translation, metabolic activity, and maintenance of intact cell membranes
Research Question/Problem/ Need	Candidatus Liberibacter asiaticus is a very impactful pathogen and lacks effective treatments or resistance cultivars
Important Figures	 Effects of various dilutions of Triton (and sterile water) on CLas containing ACP homogenate shown through Ct values from the v-qPCR as averages
VOCAB: (w/definition)	Koch's Postulates: A set of four criteria (causality, identification, isolation, and consistency) that establish a causal relationship between a microbe and a disease Psyllids: A type of insect, also known as jumping plant lice Leafhoppers: Another type of insect
Cited references to follow up on	N/A

Follow up Questions	1. Does the Triton concentration used for the bacteria work for endothelial cells? 2. Are there other similar chemicals to Triton that can have similar effects? 3. Why was 0.1% chosen over 0.01% if they had similar results?

Article #16 Notes: Effects of polyethylene microplastics on cell membranes: A combined study of experiments and molecular dynamics simulations

Source Title	Effects of polyethylene microplastics on cell membranes: A combined study of experiments and molecular dynamics simulations
Source citation (APA Format)	Wang, W., Zhang, J., Qiu, Z., Cui, Z., Li, N., Li, X., Wang, Y., Zhang, H., & Zhao, C. (2022). Effects of polyethylene microplastics on cell membranes: A combined study of experiments and molecular dynamics simulations. *Journal of Hazardous Materials, 429*, 128323. https://doi.org/10.1016/j.jhazmat.2022.128323
Original URL	https://www.sciencedirect.com/science/article/abs/pii/S030438942200111X#sec0045
Source type	Journal Article
Keywords	MPs, DPPC bilayer, Membrane damage, MD simulation
#Tags	#MicroplasticEffects
Summary of key points + notes (include methodology)	Goal: - Determine how polyethylene microplastics impact the cell membrane and as a result, the cell Methodology: - HepG2 cells were cultured in High glucose Dulbecco's Modified Eagle's Medium, fetal bovine serum, and streptomycin in the ratio of 89:10:1 - Polyethylene microplastics were suspended in DMSO and observed using transmission electron microscopy - Size distribution was determined using dynamic light scattering - Polyethylene microplastics were suspended in DMSO to create concentrations of 10 µg/ml, 40 µg/ml, and 100 µg/mL - Cells were exposed to concentrations for 24 hours - After exposure, they were analyzed using a fluorescence microscope - Similarly, another three group of cells after exposure were incubated in green nucleic acid stain and reexamined using a fluorescence microscope - Cells were lysed using radio immunoprecipitation assay lysis buffer - Another software was used to perform MD simulations of the four polyethylene microplastics chosen (PE10, PE20, PE40, and PE60) Results: - An assay using acetoxymethyl ester derivative of calcein was used to determine effects of cell membrane integrity - As the concentrations of microplastics increased, the number of abnormal

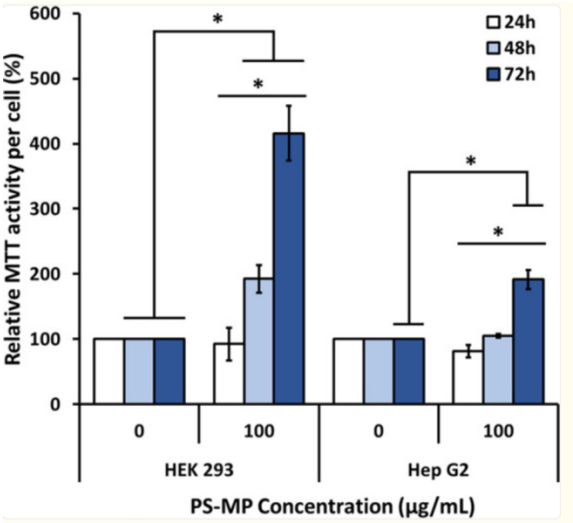
	cells and damage to the cells increased - To determine effects in greater detail, a SYTOX green assay was performed - Similarly, the higher the PE concentration, the higher the number of membrane-damaged cells - Polyethylene microplastics induce the release of lactate dehydrogenase in HepG2 cells - Using fluorescence anisotropy, it was determined that the presence of polyethylene microplastics reduces the fluidity of the cell membrane model - Using the simulation, it was determined that polyethylene molecules can easily enter the DPPC bilayer and tend to stay in the middle of the phospholipid bilayer - After analyzing free energy of permeation, it was determined that short-chain PE molecules can enter more easily than long-chain PE molecules - The bigger and more prevalent the clusters of microplastics the more serious the damage to the membrane structure - PE microplastics also reduced membrane density Other: - Plastic is broken down into microplastics after exposure to light, weathering, erosion, and immersion in water - Large microplastics can cause inflammation in the gastrointestinal tract and airways - Smaller microplastics and nanoplastics can migrate and accumulate in different organs - Smaller microplastics are able to easily enter the cell membrane and disrupt the cell - There have been studies that found that varying types of microplastics can impact the membranes differently (and some contradict each other) - PE nanoparticles can dissolve in the hydrophobic part of the cell membrane which can alter bilayer structure and thus function of the membrane
Research Question/Problem/ Need	What are the effects of microplastics on the cell membranes?
Important Figures	 Graphical abstract of experimentation- shows microplastics entering the cell membrane and the resulting effects of them entering

VOCAB: (w/definition)	Bioinformatics: Scientific field that uses computers, math, and statistics to analyze large sets of biological data Molecular Dynamic Simulation: Computer-based technique that models the physical movements of atoms and molecules over time Elucidation: Explanation that makes something clear
Cited references to follow up on	Choi, D., Bang, J., Kim, T., Oh, Y., Hwang, Y., & Hong, J. (2020). In vitro chemical and physical toxicities of polystyrene microfragments in human-derived cells. Journal of Hazardous Materials, 400, 123308. https://doi.org/10.1016/j.jhazmat.2020.123308
Follow up Questions	1. Can a SYTOX green assay be applicable to all cell types? 2. Would a different type of microplastic – such as polypropylene or polystyrene- have different effects?

Article #17 Notes: Effects of Polystyrene Microplastics on Human Kidney and Liver Cell Morphology, Cellular Proliferation, and Metabolism

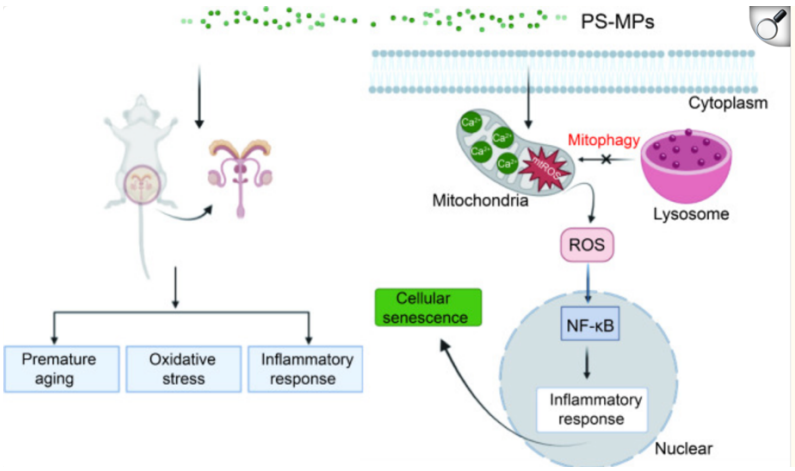
Source Title	Effects of Polystyrene Microplastics on Human Kidney and Liver Cell Morphology, Cellular Proliferation, and Metabolism
Source citation (APA Format)	Goodman, K. E., Hua, T., & Sang, Q.-X. A. (2022). Effects of Polystyrene Microplastics on Human Kidney and Liver Cell Morphology, Cellular Proliferation, and Metabolism. *ACS Omega, 7*(38), 34136–34153. https://doi.org/10.1021/acsomega.2c03453
Original URL	https://pmc.ncbi.nlm.nih.gov/articles/PMC9520709/ - sec2
Source type	Journal Article
Keywords	PS Microplastics, HepG2 cells, HEK 293 cells, trypan blue staining assay, confocal fluorescent microscopy, flow cytometry
#Tags	#MicroplasticEffects
Summary of key points + notes (include methodology)	Goal: - Determine the effects of PS microplastics on morphology, proliferation, and metabolism of HepG2 and HEK 293 cells Methodology: - Microspheres (green-fluorescent PS) of 1 µm were used - Fourier-transform infrared spectroscopy was conducted into another study of additional characteristics of these microplastics - Cultured in Dulbecco's modified Eagle's medium with 10% fetal bovine serum, penicillin, streptomycin, and L-glutamine - Treated with 5 µg/mL PS-MPs for Live Cell Imaging - Data was collected at 24 hours, 48 hours, and 72 hours after exposure to microplastics - An MTT assay was used to measure changes in metabolic activity - For the MTT assay, cells were exposed to 0.05, 5, 10, 25, 50, 75, and 100 µg/mL concentrations of microplastics using the same time point as Live Cell Imaging - Cell proliferation assay was conducted using 100 µg/mL PS exposure and trypsin at the same time points as the other two assays - Hemocytometer and trypan blue (1:4 dilution) was used to count live and dead cells - For confocal fluorescence microscopy, 5 µg/mL of PS exposure was used - For flow cytometry, 5 µg/mL and 100 µg/mL PS exposure was used at the same time frames as other assays

	- For the RSO assay, 5 µg/mL, 50 µg/mL, and 100 µg/mL PS exposure was used and measured at 0, 2, 4, 6 12, and 24 hours after exposure Results: - At 24 hours, the morphology of the exposed and control were the same for HEK 293 cells. However, at 48 and 72 hours, there was blebbing (more severe in 72 hours) in many of the cells with minimal cell grouping - Similar results were seen for the HepG2 cells, however, the results were more severe - Microplastics can be detected in the cells at 24 hours and as time goes on, more microplastics can be detected in the cells - By 48 hours, the proliferation of HEK 293 cells was significantly impacted by PS but continued to grow and by 72 hours, the final number of cells was 9% of the control group - By 48 hours, the Hep G2 cells were inhibited in growth and at 72 hours, the final number of cells was 39% of the control group - Microplastics did not cause significant cell death in either cell group - HEK 293 cells internalized most of the microplastics within 24 hours and only up took slightly more in 24 and 72 hours - Concentration and time affected the internalization of PS microplastics in both cell types - Metabolic activity decreased in both cells after exposure, however this was more significant for HEK 293 cells - ROS levels were increased in both cell lines after exposure - Glycolytic activity and gene expression of ROS cleanup markers was reduced after microplastic exposure Other: - It's estimated the Americans consume 39,000 to 52,000 microplastics annually from just food and beverages - Differences in microplastics found in salt varies from region to region - Studies carried out in marine organisms have found that microplastics can have toxic effects of the liver (such as oxidative stress) - Microplastics entering the body through ingestion can have severe effects on intestinal and colon cells
Research Question/Problem/ Need	What are the effects of microplastics on various aspects of human kidney and lung cells?

Important Figures	 MTT Assay- Metabolic activity of both HEK 293 and HepG2 cells when treated with 100 µg/mL of PS microplastics at 24 hours, 48 hours and 72 hours after exposure
VOCAB: (w/definition)	N/A
Cited references to follow up on	Xu, K., Zhang, Y., Huang, Y., & Wang, J. (2021). Toxicological effects of microplastics and phenanthrene to zebrafish (Danio rerio). Science of the Total Environment, 757, 143730. https://doi.org/10.1016/j.scitotenv.2020.143730
Follow up Questions	1. Would different types of microplastics have different effects on both of these cells? 2. Why did the different types of cells have different results when everything else was kept constant? 3. Why did microplastics not lead to cell death but induce other toxic effects?

Article #18 Notes: Long-term exposure to polystyrene microplastics triggers premature testicular aging

Source Title	Long-term exposure to polystyrene microplastics triggers premature testicular aging
Source citation (APA Format)	Wu, D., Zhang, M., Bao, T., & Lan, H. (2023). Long-term exposure to polystyrene microplastics triggers premature testicular aging. *Particle and Fibre Toxicology, 20*(1). https://doi.org/10.1186/s12989-023-00546-6
Original URL	https://pmc.ncbi.nlm.nih.gov/articles/PMC10463354/ - Sec2
Source type	Journal Article
Keywords	Polystyrene microplastics, Premature testicular aging, TM4 cells, ROS, NF-κB
#Tags	#MicroplasticEffects #TritonDetermination
Summary of key points + notes (include methodology)	Goal: - Determine the effects of long-term exposure to PS microplastics on testicular aging Methodology: - PS microplastics and fluorescent-labeled PS microplastics (1 μm) - Testicular sertoli cells (TM4 cells) were used - Cells were cultured in medium with 2.5% fetal bovine serum, 5% horse serum, and 1% penicillin/streptomycin - Three concentrations were used: 0.25 mg/mL, 0.5 mg/mL and 1 mg/mL and the cells were exposed to these for 24 hours - 8-week-old male C57 mice were used and were given either 1 mg/kg (low) or 5 mg/kg (high) PS microplastics - Fluorescence images were observed using a confocal laser scanning microscope - An MTT assay was used to determine cell viability - Sa-β-gal level was detected using CellEvent Senescence Green Kit - Cell cycle was determined using propidium staining - Apoptosis was measured using Annexin V-FITC/ PI Apoptosis Detection Kit - ROS levels were determined using Reactive Oxygen Species Assay Kit - An indirect immunofluorescence assay and immunohistochemistry assay was also run - 0.1% Triton for 1 hour was used to permeabilize the cells - Ca2+ was determined using Fluo-4 Calcium assay Kit Results: - Testicular tissue fibrosis was highly pronounced after exposure to PS

	- PS microplastics trigger premature testicular aging - PS microplastics can induce oxidative stress in the testis which is associated with a Ca2+ overload in the mitochondria - As a result, PS exposure can lead to mitochondrial dyshomeostasis - They can lead to increased expression of downstream pro-inflammatory factors in the testis - The PS microplastics can internalize into the TM4 cells - Similarly, cell viability was decreased as a result of PS presence however the PS exposure at lower concentrations (0.25 mg/mL and 0.5 mg/mL) did not induce apoptosis - PS exposure can trigger the NF-kB signaling pathway, which is why there is premature testicular aging Other: - High doses of microplastics can lead to cell apoptosis - The reproductive system is highly sensitive to environmental pollution - PS exposure reduced testosterone levels, hatching, and survival rates of offspring in freshwater prawn
Research Question/Problem/ Need	What are the effects of microplastics on testicular aging?
Important Figures	 A diagram depicting the molecular mechanism behind how exposure to polystyrene microplastics can cause premature testicular aging
VOCAB: (w/definition)	Spermatozoa: Male sex cells that carry the genetic material
Cited references to follow up on	Liang, B., Zhong, Y., Huang, Y., Lin, X., Liu, J., Lin, L., Hu, M., Jiang, J., Dai, M., Wang, B., Zhang, B., Meng, H., Lelaka, J. J. J., Sui, H., Yang, X., & Huang, Z. (2021). Underestimated health risks: polystyrene micro- and nanoplastics jointly induce intestinal barrier dysfunction by ROS-mediated epithelial cell apoptosis. Particle and Fibre Toxicology, 18(1). https://doi.org/10.1186/s12989-021-00414-1
Follow up Questions	1. Do microplastics have similar effects on the female reproductive system

	(i.e. ovaries)? 2. What would be the effects of polypropylene or polyethene microplastics on testicular aging? 3. How can these microplastics be removed from the testis?

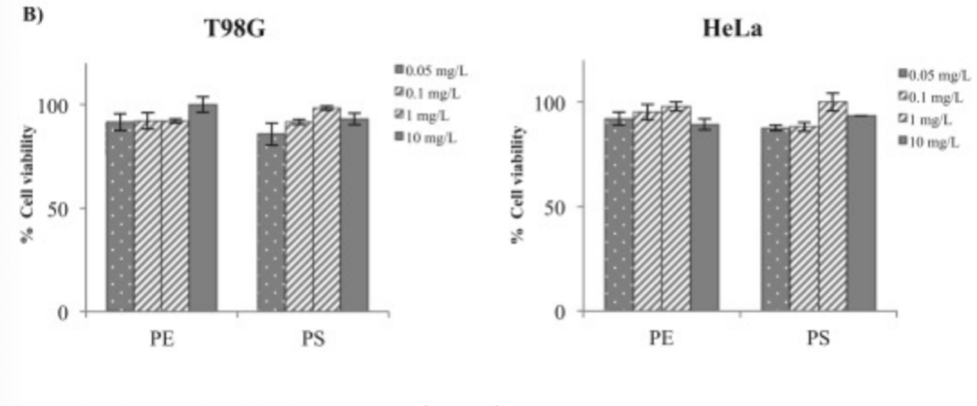
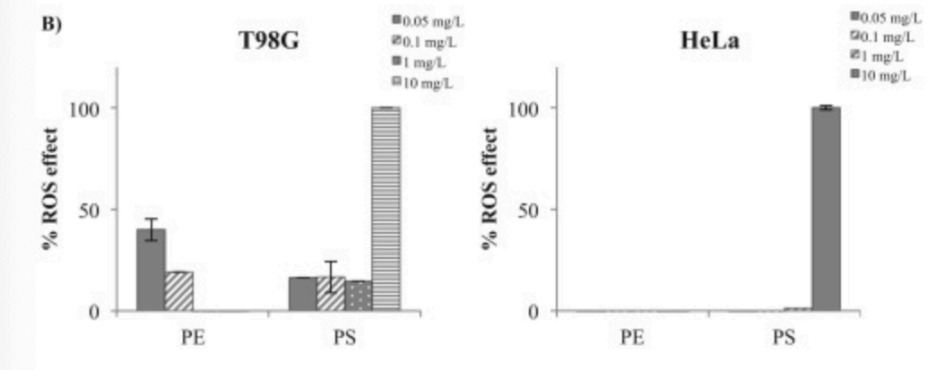
Article #19 Notes: Triton X-100 concentration effects on membrane permeability of a single HeLa cell by scanning electrochemical microscopy (SECM)

Source Title	Triton X-100 concentration effects on membrane permeability of a single HeLa cell by scanning electrochemical microscopy (SECM)
Source citation (APA Format)	Koley, D., & Bard, A. J. (2010). Triton X-100 concentration effects on membrane permeability of a single HeLa cell by scanning electrochemical microscopy (SECM). *Proceedings of the National Academy of Sciences, 107*(39), 16783–16787. https://doi.org/10.1073/pnas.1011614107
Original URL	https://pmc.ncbi.nlm.nih.gov/articles/PMC2947864/ - SEC3
Source type	Journal Article
Keywords	Live and intact cells, hydrophilic molecules, Comsol Multiphysics Simulation
#Tags	#TritonDetermination
Summary of key points + notes (include methodology)	Goal: - Determine the effects of varying concentrations of Triton X-100 on the permeability of the cell membrane Methodology: - HeLa cells were cultured in ATCC-formulated Eagle's Minimum Essential Medium supplemented with 10% fetal bovine serum - Used a fluorescent based viability assay kit with two dyes: Calcein Am and EthD-III - The cytotoxicity of HeLa cells was recorded at 5, 10, and 15 minutes - Using scanning electron microscopy, the height and diameter of cells on the surface was measured - Then, SECM scans were carried out in the presence of Triton - Used SECM approach curves Results: - Cell viability dropped sharply when the Triton concentrations were close to critical micelle concentration - Micelle showed that there is a greater impact of Triton on the lipid bilayer compared to the individual surfactant molecule - TX100 at higher concentrations was lethal to the cells which caused the cell membranes to break apart and detach from the surface of the dish - Conducted a side experiment to show that obtaining SECM approach curves on a single ell is a good technique for monitoring cell height - The cells consume ferrocyanide molecules when the tip is held at the diffusion-controlled potential

	- Any concentration of Triton at or above the CMC concentration (0.18 to 0.24 mM) is fatal to the HeLa cells - The damages are irreversible when exposed to the Triton for 10 to 20 seconds Other: - Detergents such as Triton are often used in biology for protein extraction from cell membrane and as permeabilizing agents - Large amounts of TX100 can cause cell death, while propose amounts can lyse the cells - Cholesterol or similar molecule-rich domains are more tolerant towards detergents like TX100 - Scanning electron microscopy has been used to discover permeability of redox species in live cells
Research Question/Problem/ Need	How do varying concentrations of Triton X-100 affect the cell membrane?
Important Figures	N/A
VOCAB: (w/definition)	Micelle: Small spherical particle that forms when amphiphilic molecules aggregate in water Critical micelle concentration: Concentration of a surfactant in a solution in which micelles begin to form
Cited references to follow up on	Borner, M. M., Schneider, E., Pirnia, F., Sartor, O., Trepel, J. B., & Myers, C. E. (1994). The detergent Triton X-100 induces a death pattern in human carcinoma cell lines that resembles cytotoxic lymphocyte-induced apoptosis. FEBS Letters, 353(2), 129–132. https://doi.org/10.1016/0014-5793(94)01023-4
Follow up Questions	1. What concentrations were used in the study? 2. How was the critical micelle concentration for the Triton determined? 3. Do different concentrations affect different cells differently?

Article #20 Notes: Cytotoxic effects of commonly used nanomaterials and microplastics on cerebral and epithelial human cells

Source Title	Cytotoxic effects of commonly used nanomaterials and microplastics on cerebral and epithelial human cells
Source citation (APA Format)	Schirinzi, G. F., Pérez-Pomeda, I., Sanchís, J., Rossini, C., Farré, M., & Barceló, D. (2017). Cytotoxic effects of commonly used nanomaterials and microplastics on cerebral and epithelial human cells. *Environmental Research, 159*, 579–587. https://doi.org/10.1016/j.envres.2017.08.043
Original URL	https://www.sciencedirect.com/science/article/pii/S0013935117310770
Source type	Journal Article
Keywords	Nanomaterials, Microplastics-nanoplastics Cytotoxicity, ROS effect
#Tags	#MicroplasticEffects
Summary of key points + notes (include methodology)	Goal: - Further the understanding of the cytotoxicity of nanomaterials and microplastics in terms of oxidative stress and cell viability in HeLA and T98G cells Methodology: - Cells (T98G and HeLa) were cultured in a media using DMEM supplemented with 10% fetal bovine serum and 1% antibiotics (100 U/mL penicillin and 100 µg/mL streptomycin) - Original solutions were diluted in the assay range of 50 µg/L to 1–10 mg/L - Cells were exposed to the various treatments for 24-48 hours at concentrations from 10 ng/mL to 10 µg/mL - Cell viability and oxidative stress was measured via HCA (High-Content Analysis) – this technique uses automated microscopy and cell fluorescence-tagging - Hoechst 33258 was used as a staining solution for cell survival rates - One-way ANOVA followed by Dunnett's test was used to analyze the data - A cytotoxic assay using DHE for staining was used to obtain information about oxidative stress Results: - None of the nanomaterials or microplastics led to significant reductions in cell viability - Consequently, cytolysis was not produced - Cytotoxicity is highly affected by size and shape of the nanomaterials - Polyethylene microplastics only affected ROS levels significantly in T98G

	cells - Polystyrene microplastics affected ROS levels significantly in both cell types Other: - Microplastics originated as microbeads in cosmetic facial cleansers - Microplastics may be able to act as a vector for transferring pollutants to biota, leading to their bioaccumulation - Nanomaterials, such as silver and gold nanoparticles, are now being proposed as alternatives to microplastics - Cells uptake biomolecules through endocytosis or involve and entrap them through clathrin or vaeolin pits or proteins
Research Question/Problem/ Need	What are the effects of microplastics in terms of oxidative stress and cell viability?
Important Figures	 This figure shows the effects of polystyrene and polyethylene microplastics at various concentrations on cell viability of T98G and HeLA cells after 24 hours of exposure  This figure shows the effects of polystyrene and polyethylene microplastics at various concentrations on ROS levels (oxidative stress) in T98G and HeLA cells after 24 hours of exposure
VOCAB: (w/definition)	Nanomaterials: Materials with unique properties that are created from chemical substances with a single unit size of 1-100 nm

	Cytolysis: Process by which cell breaks down and/or bursts
Cited references to follow up on	N/A
Follow up Questions	1. Why did polyethylene and polystyrene affect ROS levels differently? 2. Why did both microplastics have minimal impact on cell viability? 3. How would higher concentrations change the results?