

Purpose

The purpose of this project is to characterize the trans-generational effects of different polymers and sizes of microplastics on the cardiovascular system.

Background

Plastic and Microplastics (MPs):

- 400 million tons of plastic is produced each year, only 9% recycled (Yu et al., 2024).
- MPs classified <5mm and can be grouped by size, shape, polymer, etc. (Yu et al., 2024).
- Can be consumed or inhaled into our bodies (Roslan et al., 2024).

Effects on Body:

- MPs have been found in 8/12 organ systems (Roslan et al., 2024).
- MPs have been found in vein plaque and have been correlated to an increased risk of cardiovascular issues (Marfella et al., 2024).
- MPs have been found in the reproductive system and have been shown to transfer down into the organs of offspring rats (Yu et al., 2024).

Methodology

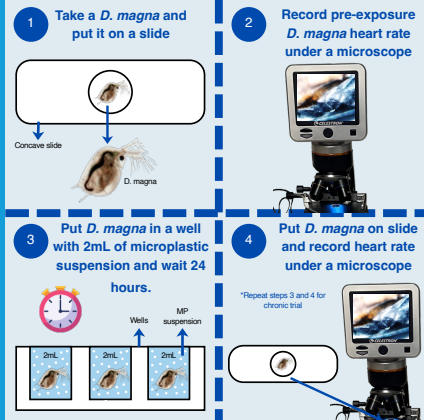


Figure 1. An infographic created on Canva of the methodology used for the acute and chronic experiments.

The Effect of Microplastic Type on the Heart Rate of Filial Generation *D. magna*



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Research Question

How do different types of microplastics affect the heart rate of the offspring of affected *D. magna*?

Hypothesis

If *D. magna* are exposed to smaller sizes of MPs, their heart rate will decrease the most.
If *D. magna* are exposed to polystyrene MPs, their heart rate will decrease the most.

Results

The Change in Average Heart Rates of *D. magna* When Exposed to Different Polymers of Microplastics

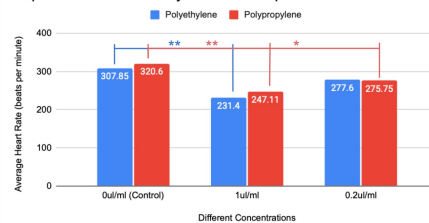


Figure 2. A bar graph that compares the average heart rates between the different concentrations of polyethylene and polypropylene microplastics in the acute test. Compared to the control, the polyethylene and polypropylene 1ul/ml concentrations were significant by $p < 0.01$ ($p = 0.002$ and $p = 0.009$), while the polypropylene concentration of 0.2ul/ml was significant by a $p < 0.05$ ($p = 0.03$).

Different Polymers and Concentrations of Microplastics Affecting *D. magna* Heart Rate Over Time

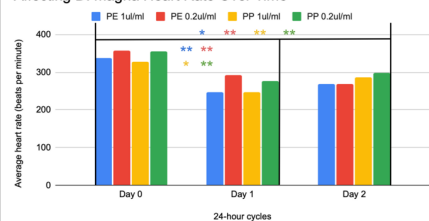


Figure 3. A bar graph showing the change in the average heart rate of a *D. magna* over time in 24-hour periods when exposed to the different microplastic polymers and concentrations in the chronic test. Compared to Day 0, all suspensions in Day 1 and Day 2 were significant by $p < 0.01$ except for Day 1 polypropylene 1ul/ml and Day 2 polyethylene 1ul/ml, which were significant by $p < 0.05$.

Survival Rate of *D. magna* When Exposed to the Different Suspensions from Day 0 to Day 2

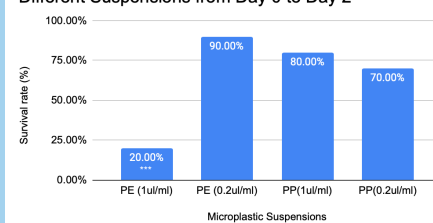


Figure 4. A bar graph that represents the survival rate of *D. magna* after being exposed to the different suspensions from Day 0 to Day 2. Only the 1ul/ml polyethylene suspension had a p value < 0.001 (1.13×10^{-5}).

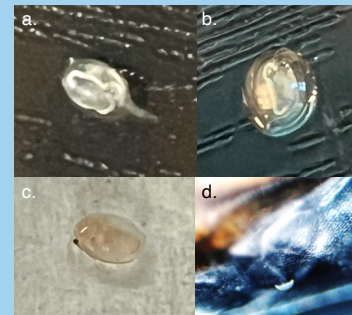


Figure 5. Images a-c depict qualitative data, where image c is a control *D. magna* whereas images a and b are *D. magna* post exposure to a microplastic suspension. The gut in image c is darker than the guts in images a and b, which are white. Image d is a *D. magna* heart under the microscope.

Conclusion

The hypothesis is supported by the data

- When an ANOVA was performed on each of the graphs, most had a p value of < 0.05 or < 0.01 , allowing the null hypothesis to be rejected.
- MPs can affect *D. magna* heart rate, especially at higher concentrations.
- MPs end up in the gut of *D. magna* when ingested.
- Polyethylene decreased the heart rate more than polypropylene.
- MPs show evidence to increase mortality rate in *D. magna*.

Implication:

- When ingested, MPs can affect the heart rate of the organism.
- Polyethylene affects the heart rate more than polypropylene.

Further Research

- Effects of different sizes and polymers on second generation *D. magna*.
- Effects of polystyrene on *D. magna* heart rate.
- Effects of different sizes of microplastics on *D. magna* heart rate.
- Effects of different sizes of microplastics on *D. magna* mortality rate.
- Effects of different sizes and polymers on egg production in *D. magna*.

References

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- Roslan, N. S., Lee, Y. Y., Ibrahim, Y. S., Tuan Anuar, S., Yusof, K. M., Lai, L. A., & Brentnall, T. (2024). Detection of microplastics in human tissues and organs: A scoping review. *Journal of Global Health*, 14. <https://doi.org/10.7189/jogh.14.04173>
- Yu, H.-R., Sheen, J.-M., & Tiao, M.-M. (2024). The Impact of Maternal Nanoplastic and Microplastic Particle Exposure on Mammal's Offspring. *Cells (Basel, Switzerland)*, 13(16), 1380. <https://doi.org/10.3390/cells13161380>