

# Team Waxworms: Degradation of Polyethylene Plastic with *Galleria mellonella*

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## Introduction

- Our grand challenge was that of micro-plastic pollution and degradation of polyethylene plastic
- Annually 380 million tons of plastic is produced worldwide with the majority of it becoming mismanaged waste and dumped into ecosystems. The plastic that is dumped into ecosystems such as the ocean damage an environment as well as the planet (Ritchie, 2018).
- Polyethylene plastic is the most common type of plastic that is used in everyday life, and due to its abundance was why PE plastic was chosen for this experiment.
- Polyethylene plastic is non biodegradable and takes up to 1000 years to decompose.
- Our objective was to find a way to allow a catalyzed breakdown of polyethylene plastic that could be implemented into society to limit the pollution of microplastics.



**Figure 1:** image of waxworms used in experiment.



**Figure 2:** size comparison of microplastics with the goal to eliminate the abundance of microplastics.

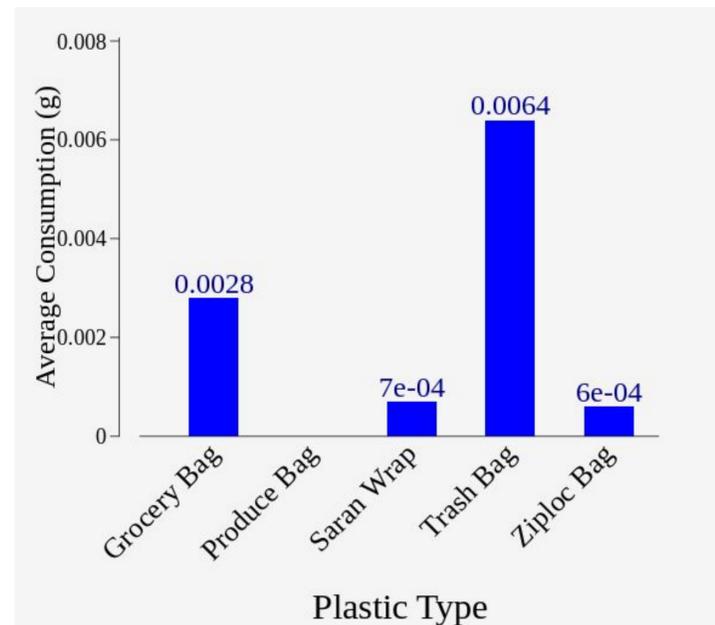
## Methods

- Sample size of 10 worms in 5 containers each
- Types of Plastics: grocery bag, trash bag, produce bag, ziploc bag, plastic food wrapper
- Timeline of 10 days to collect sample
- Measure weight of plastics before and after 10 days
- Perform ddQpcr
  - Gut bacteria present in worms after consuming plastic
  - 16S - gene of interest assisted in looking at the bacteria
- Visual Inspection of possible consumption of plastic by worms

## Acknowledgments

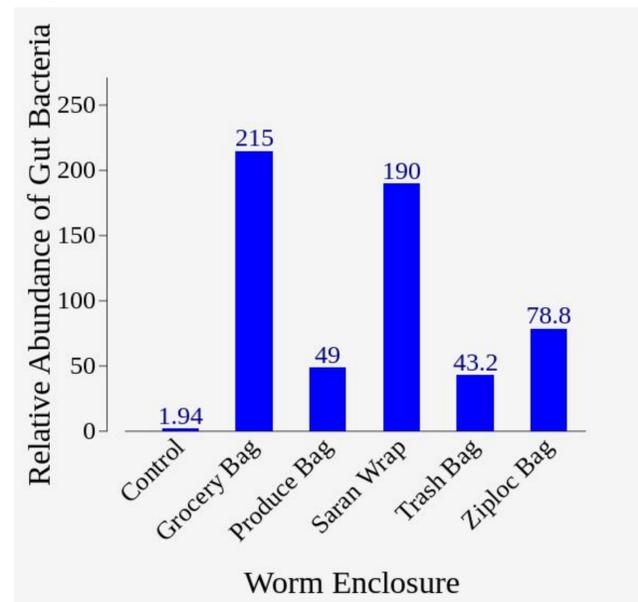
We would like to thank Dr. Brenna Gormally and Dr. Kenjiro Quides for their mentorship and assistance with gathering the experimental supplies, as well as with the isolation of bacteria and QPCR. Special thanks to Bowdie Isanhart for providing the team with extensive knowledge from his profession and studies of polyethylene plastic.

## Results



**Figure 3:** Average Worm Consumption of Various Plastic Types

Average total weight difference of the 5 pieces of plastic in each box before and after consumption. 4 out of 5 of the plastic types experienced some form of consumption weight loss.



**Figure 4:** Relative Abundance of Gut Bacteria in Worms Given Various Plastic Types

Relative abundance of gut bacteria present in the worms after consuming different types and amounts of plastic. 16S was the gene of interest and assisted in looking at the bacteria (bacillus YP1). All worms that were given plastic showed evidence of gut bacteria that was significantly more abundant than the gut bacteria present in the control.

**Visible Consumption:** When plastics were viewed under the microscope after the experiment, there was no consumption visible at 100X magnification

## Conclusion

- Research shows *Galleria mellonella* are capable of biodegrading low density polyethylene
- 80% of the plastic types studied showed consumption weight loss
- Most consumed plastic by weight: Trash bag
  - Expected result—trash bag studied was low density polyethylene
- No visible consumption under microscope
  - Would like to understand what factors may be contributing to the absence of visible consumption
- In qPCR: *Galleria mellonella* showed evidence of gut bacteria responsible for plastic consumption
- 16S gene of interest:
  - Low levels in control (no plastic)
  - High levels in plastic
- Most consumed plastic by qPCR: Grocery bag
  - Unexpected result—grocery bag studied is made from high-density polyethylene

## Implications & Future Directions

- Getting the organism itself to consume plastic is difficult, even when they are capable of digesting it
- Implementing this method on large-scale operations to remove plastic pollution, using waxworms as they are, is not a viable solution due to little consumption
- Plastic pollution as a global issue, needs a method capable of degrading larger volumes of plastic
- Research what bigger animals are capable of consuming plastic and genetically engineer gut bacteria in them
  - Increase ability to consume and breakdown plastics at a faster rate than waxworms

## Literature Cited

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