Hong Kong Student Science Project Competition 2023
Template of Extended Abstract (Investigation)
(Word Limit: 1,600 words, Pages: 3 pages only)

Team Number:

Project Title:

Project Type: Investigation

To our best knowledge, there <u>are / ~~are no~~</u> * similar works in the field; (if there are,) related research links are as below:

Aumentado, Dominic. "A Comparative Study of the Efficacy of Tenebrio molitor larvae and Zophobas morio larvae as Degradation Agents of Expanded Polystyrene Foam". Academia. Retrieved May 5, 2020.

The enhancement our project made / the difference with related research are:

To propose an industrial process to systematically treat polystyrene foam with the aid of superoworms.

*Please delete if not applicable. The competition values the originality of works. Students must do enough literature research to ensure that their works are unique and list relevant reference materials before starting research or invention.

I.   Background

☐   Provide background information of project and/or state the problem to tackle
● With the tremendous amount of polystyrene (PS) foam produced every year, PS foam pollution has been a huge problem with its negative impacts. In fact, current methods to treat PS foam and other forms of plastic are mostly landfill or incineration, while little amount is used as a fuel for electricity production. Along with the stunning discovery on superworm's ability to digest plastic, conversion to biomass might be able to be an alternative solution for the desperate problem of plastic waste.
☐   Provide highlights of the **literature review** with the support of pertinent and reliable references
● *Zophobas morio*, whose larvae are commonly known as "superworms", can break down plastics such as polystyrene and polypropylene through enzymes and bacteria, namely Pseudomonas, Rhodococcus and Corynebacterium, in its saliva and guts (Jiarui Sun, 2022).
☐   Provide an overview of work and mention the **research gap that the project is trying to fill**
● Although superworm's capability in degrading plastic has been discovered for several years, a systemic process to utilise ability of superworm has not been proposed nor put into practice. It arises our curiosity on the feasibility of industrial usage of superworm to treat plastic waste by conversion to biomass. This report can offer new insight on plastic treatment by proposing a sustainable and clean method to break down plastic, particularly PS foam

II.   Objectives

☐   State the **aim(s)** of project
The aim of the project is to propose an industrial process to systemically treat polystyrene foam waste by a combination of chemical and biological methods, in which an energy cycle is formed to fully recycle useful materials, achieving a cradle-to-cradle concept.

III.   Hypothesis

☐   Propose an explanation for a phenomenon and stating how the **hypothesis** can be tested by experiments

- Superworms can digest polystyrene and gain energy from it
  - Measure the biomass and survival rate of superworms on a polystyrene diet

IV.   Methodology

☐   List out the materials used
☐   Describe the **experimental protocol** including the set-up of **control experiment** (if any), **repeated experiment** (if any), and its scientific theory
☐   Indicate with the support of reasons, the **analysis** used in the investigation

Apparatus:

1. Superworms
2. Plastic (polystyrene and polyethene)
3. Hive Explorer (for keeping superworms)
4. Electronic balance

Procedure:

1. Put 3 piles of 100 worms into 3 separate Hive Explorers
2. Measure the initial weight of the worm in each Hive Explorer
3. A: feeding with oatmeal; B: feeding with polystyrene; C: feeding with polyethene; D: no food given
4. Measure biomass and surviving unit of worms, and the mass of food eaten on a daily basis
5. Calculate the average biomass of each worm

V.   Results

☐   Present the **data** with figures, tables or photos

A. Significant increase in average biomass
B. Average biomass remains fairly stable
C. Average biomass significantly decreases
D. Average biomass significantly decreases.

- Superworms show little interest in stiff plastics
- Superworms tend to dig burrows in plastics and create microplastic powder

☐   **Data analysis** (if any, with emphasis on data reliability and the reproducibility based on statistics)
☐   Interpret the results and its implication

- Polystyrene is a fair food source for superworms, albeit inferior to a normal diet, and can be used for plastic waste treatment
- Enhancements are necessary as the decomposition is inconsistent and incomplete

☐ Discuss **limitation** and compare with existing related works (if any)

- Insufficient apparatus to investigate adverse impact of plastic diet on superworms
- The plastic may not be fully digested and is excreted
- Detailed reasons for difference between each group cannot be examined
- Condition of each superworm is uncertain and not uniform
- Mass of plastic consumed cannot be accurately measured due to microplastic produced during ingestion of superworm

☐ Discuss the importance or impact of the research and how it is applicable to real problems

- Proving superworm is a sustainable and green option to break down plastic
- Offering a new perspective on the problem of plastic waste treatment

VI. If your team will compete the Sustainable Development Award, please indicate the specific sustainable development goal the project is related to, and provide justification for competing for this award. *(Word limit: 300 words)*

VII. If your team will compete the Social Innovation Award, please list the target group or social issue the project focuses on, and provide justification for competing for this award. *(Word limit: 300 words)*

VIII. Conclusion

☐ Make a **data-driven** conclusion of the project and the way forward of the research
☐ Justify if the proposed project meets the objective(s)

This project integrates different studies on Zophobas morio and proposes an industrial method to systematically treat PS foam waste. Methods for improvement are also discovered through observing habit and characteristics. Further study can be conducted on other polymers.Through this investigation, we hope to offer a new angle to the issue of plastic waste treatment.

☐ **Our project is developed based on previous project and the enhancement is below:**