

# Hong Kong Student Science Project Competition 2021

Template of Extended Abstract (Invention)  
(Word Limit: 1,000 words, Pages: 2 pages only)

**Team Number: SAPE018**

**Project Title: Food Waste Up-cycler**

**Project Type: Invention**

**Till 28/06/2022, to our best knowledge and after thorough literature research, there are / are no\* similar works. If there are, the reference links are as below:**

Nil.

**The enhancement our project has made for the existing related products or research is summarized as below:**

\*Please delete if not applicable. HKSSPC values the originality of works. Students must conduct literature research thoroughly to ensure that their works are unique, and to list relevant reference materials to complement the research or invention.

## I. Background

According to the Environment Bureau (EB) of Hong Kong, in 2012, 9278 tonnes of municipal solid waste (MSW) was disposed of at landfills everyday. Among these, around 36% (around 3337 tons) were food waste. The food waste disposal is equivalent to 250 double-decker buses. Up to 2019, there were 11057 tonnes of MSW disposed daily and about 30% were food waste (3353 tons). In addition, the EPD (2015) states that the amount of food waste from Commercial and Industry (C&I) sectors has been increasing from 400 tons in 2002 to 1003 tons in 2013, indicating a degradation of the food waste problem.

Therefore, we hope to solve the serious food waste problem by using Black Soldier Flies. It is an insect which can rapidly colonize and consume food waste of their weight over their lifetime.

Comparing other existing methods of dealing with the leftovers like landfills, O.Park, food donating, etc. The BSF sparked a new treatment method for food waste utilization with low energy consumption, high output value, and being environmentally-friendly. Also, as BSF are able to intake varieties of food, prepossessing or sorting of leftovers are not complex and easy to handle.

## II. Objectives

Facing the serious food waste problem, we came up with an idea of using black soldier flies to ease the burden. as it can quickly consume food waste and have many advantages. We aimed to promote an all-in-one set up for food waste consumption, targeted large scale farms for the rural areas and small scale rooftop devices for residential areas.

## III. Methodology

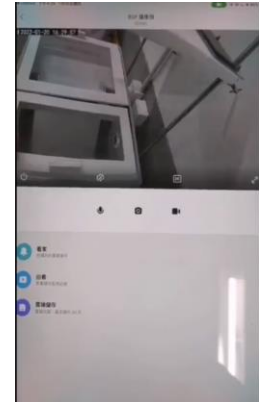
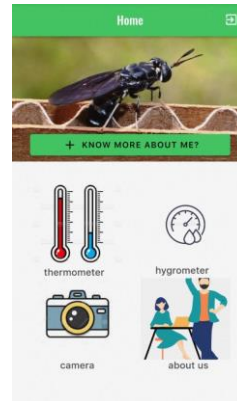
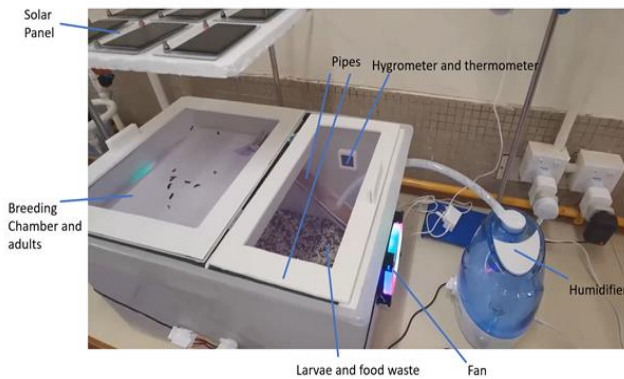
First, to find the efficiency of Black Soldier Flies consuming food waste, 310g food waste (biscuit) was prepared and around 215g of Black Soldier Flies larvae were added. The weight of food waste was measured every 24 hours under room conditions. The experiment was repeated with bread as the food waste source. Second, to find out the efficiency of Black Soldier flies on consuming food under optimum condition, 200g of Black Soldier Flies larvae were added to our automatic system (shown below) and control set up with a box and net only. Crushed bread was added to both boxes and the amount of food consumed was measured every 24 hours.

## IV. Design of Invention

To facilitate food consumption, we designed an automatic system. First, a fabric lid is used to ensure sufficient ventilation and prevent them from escaping. Second, different sensors are installed to monitor their growth condition, including a hygrometer, a thermometer and a camera. A programme was introduced to maintain the optimum environment. A fan will be activated once the temperature exceeds 35 degrees Celsius, while a humidifier will add water to the tank once the humidity drops below 65%.

A phone app with an IoT system is introduced, all data will be collected and shown clearly on it. Users can check the camera images, control the fan and humidifier through the app too.

After 14 days, the larvae will become pupae, they will climb to the upper chamber through pipes because black soldier flies prefer a dry environment for eclosion. Black Soldier flies' adults will mate and hatch there too. It is much easier for us to separate different stages of black soldier flies. This set-up is self-sufficient as we will use solar panels to generate electricity.



## V. Application / Market Need

After digesting food waste, excess larvae can be used as fish feed or food for livestock. Their shells contain chitosan, a flexible material that can produce various products. The rest will become fertilizer. Basically, our system is expected to attain 'low cost, high benefits'. The cost is low because once the system starts to work, 1g of Black Soldier Flies larvae can consume about 2.5kg of food waste over a lifetime. Each can produce about 700 offspring. At the same time, the transportation fee and rental cost can be greatly lowered as each housing estate can set up its own system. The whole process is easily conducted and effective. Not only can it create great benefits by becoming chitosan and fertilizer, Black Soldier Flies also benefits the whole world and even the next generation. Without transportation, the carbon footprint will be reduced and the food waste problem can be solved. Therefore, the system will be 'low cost, high benefits' and construct a circular economy.

This tiny box is expected to be used in housing estates in Hong Kong, spread around urban residential areas and even local school canteens to prevent hefty transportation costs. The box is fully automated and thus will not require advanced prior knowledge in order to use the food waste consumption service.

Unlike the public's image of smelly, dirty flies, Black Soldier Flies does not produce any bad smell during consumption. Black Soldier Flies decomposes toxic bacteria with functional antimicrobial peptides (AMPs), so that the food waste will not stink. Moreover, to survive, they've had to develop an odor that repels other pests so they can also be used to expel other harmful insects.

Therefore, education can be done in the residential region in order to encourage people to support this project, which brings many advantages.

## VI. Conclusion

To conclude, the black soldier fly represents a brand new method for waste resource utilization with low energy consumption but high output value. 200g of black soldier fly could reduce food waste by 130g in 24 hours, with the automatic adjustment by prototype, the food waste consumption was doubled compared to control. With the aid of black soldier flies, not only do we hope to solve the food waste problem in small communities, but also contribute to making the world a better place.

□ Our project is developed based on our school's previous project and the enhancement is as below: