

# How to catch mosquitoes and its preferences for temperature and carbon dioxide

LUO, XIN YI   HUANG, YU CHIN   LIU, YU HSUAN

Teacher : CHEN, CHENG CHANG

Hsin Tien Senior High School

Taiwan

2022/03/07



新北市立新店高中

New Taipei Municipal Hsin Tien Senior High School



**THE GLOBE PROGRAM TAIWAN**

Global Learning and Observations to Benefit the Environment

# Abstract:

Since the first year of high school participated in the science fair, we were studying the growth environment of larvae, and this year, we decided to study the topic related to mosquitoes. Fishing for larvae in the school ditch, collecting larvae, recording their daily growth, and waiting for them to grow into mosquitoes, after they grow into adult mosquitoes, we discuss whether temperature, color and taste have an effect on them, so we decided to study this related topic. The main research is to observe the effects of temperature, color and taste on mosquitoes.

After observing and recording, we analyze and ask some questions. For example, the larvae collected at the beginning of the observation were placed in a conical flask, and the mosquitoes were fed with honey. During the process, some died because there was not enough air, and some were drowned by honey. Later, the number of mosquitoes was insufficient. For the observation experiment, we directly grabbed the ready-made mosquitoes and placed them in the insect box for observation. This report will describe all of our research processes.

# Research Question and Hypothesis:

1. We assume that mosquitoes move to warmer places.
2. We hypothesize that CO<sub>2</sub> is attractive to mosquitoes.

# Introduction and Review of Literature:

- Abstract
- Research Question and Hypothesis
- Research Methods and Materials
- Results
- Discussion
- Conclusion
- Bibliography/Citations
- Badge Descriptions/Justifications

# Research Methods and Materials

get experiment target

1. Raised after catching mosquitoes.
2. Catch mosquitoes
3. Place artificial water.

# 1. Raised after catching mosquitoes.

## Idea:

Originally, we wanted to observe the growth of larvae at different temperatures. but the larvae we caught soon turned into mosquitoes, so we changed to observe the mosquito's preference for heat and cold and carbon dioxide.

**Location:** School Ditch.

## Materials:

insect box, plastic spoon, dropper, plastic container.

## step:

1. Fishing for water and larvae in gutters with plastic boxes.
2. Remove larvae with a spoon and dropper.
3. Filter the remaining water with a rag for easy observation and pour into the bug box.
4. Finally, put the fished larvae into the insect box.



- Capture results

date	mosquitoes	pupa	larvae
2/12	0	0	0
2/13	1	0	51
2/14	1	12	40
2/15	2	41	9
2/16	14	38	0
2/17	41	11	0
2/18	52	0	0



- keep mosquitoes

	LIU, YU HSUAN	LUO, XIN YI	HUANG, YU CHIN
Materials	Erlenmeyer flask rubber stopper water.	Plastic wrap paper tape insect box Erlenmeyer flask honey water.	Toilet paper rubber bands transparent plastic cups Erlenmeyer flask honey water (honey: water=2:1)
Mosquito causes of death	<ul style="list-style-type: none"> <li>no food</li> <li>no air</li> <li>Too much water (No activity space)</li> <li>The bottle is shaken (to mix the mosquitoes with the water)</li> </ul>	<ul style="list-style-type: none"> <li>Honey water get mouldy.</li> <li>Accidental shaking mixes mosquitoes with honey water and mold.</li> </ul>	<ul style="list-style-type: none"> <li>Accidentally fly away when opening lid.</li> </ul>
advantage	<ul style="list-style-type: none"> <li>Easy to carry.</li> </ul>	<ul style="list-style-type: none"> <li>have food.</li> <li>Ample space for mosquito activity.</li> <li>have air (There are air holes in the plastic wrap)</li> </ul>	<ul style="list-style-type: none"> <li>have air. (toilet paper will be breathable)</li> <li>have food. (honey water)</li> </ul>



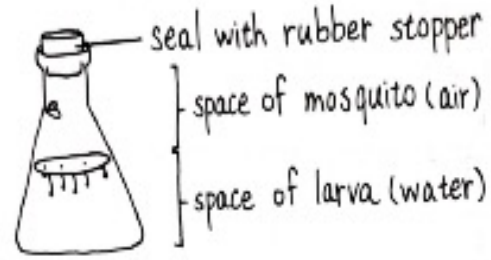
Keep mosquitoes

LIU, YU HSUAN

Materials: Erlenmeyer flask, rubber stopper, water

Mosquito causes of death: No food, no air, too much water (no activity space), the bottle is shaken (to mix the mosquitoes with the water)

Advantage: Easy to carry

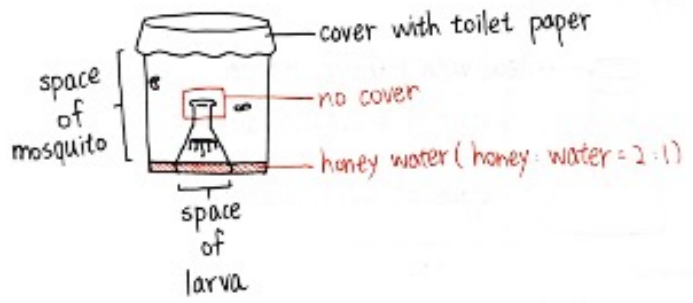


HUANG, YU CHIN

Materials: Erlenmeyer flask, toilet paper, rubber bands, transparent plastic cups, honey, water

Causes of death: Accidentally fly away when opening lid.

Advantage: Have air (toilet paper will be breathable), have food (honey: water = 2:1)

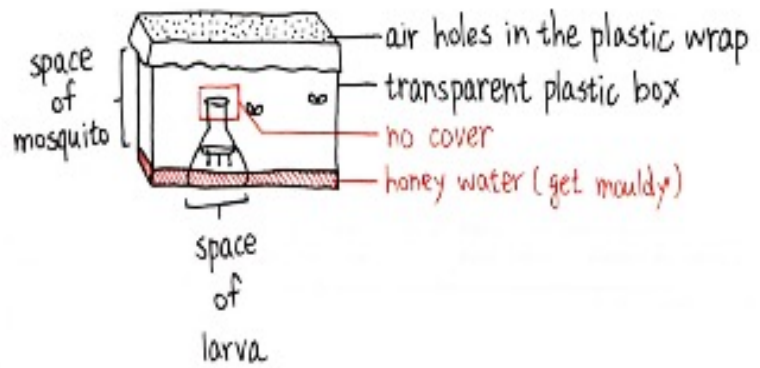


LUO, XIN YI

Materials: Erlenmeyer flask, plastic wrap, paper tape, insect box, honey water

Causes of death: Honey water get mouldy, accidental shaking mixes mosquitoes with honey water and mold.

Advantage: Have food, ample space for mosquito activity, have air (there are air holes in the plastic wrap)



## **result:**

A total of 52 larvae were caught. Because some of the larvae caught that day were about to turn into pupae, one hatched into an adult after two days. According to the observation, we found that it only took one to two days for the larvae to turn from pupae to mosquitoes.

Because we have artificial reasons to cause the mosquitoes we raise to die, such as: too much water makes mosquitoes drown, Mosquitoes starved to death by not putting honey in cultured bottles, Add honey without dilution to let mosquitoes stick to death, mosquitoes fly away, etc...

## 2. Catch mosquitoes.

- Idea: Skip raising the larvae and go straight to the ready-made mosquitoes, saving time waiting for the larvae to grow into adults.

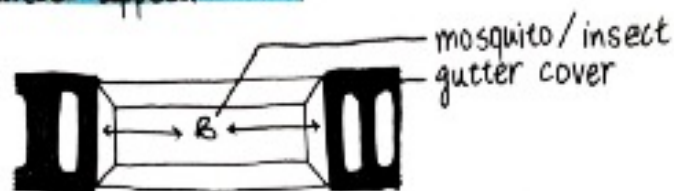
	Plan A	Plan B	Plan C
Location	School ditch	Two of toilets in school	Playground and recycling room
How mosquitoes appear	Flying 4 centimeter off the ground along the ditch.	Staying at wall , door or ceiling.	Flying near people.
Material	Transparent plastic cups, paper, insect box	Transparent plastic cup, paper, insect box	Transparent plastic cup, paper insect box

<p style="text-align: center;">Step</p>	<ol style="list-style-type: none"> <li>1. Slowly trap the mosquitoes with two clear plastic cups</li> <li>2. Put the paper between the two cups</li> <li>3. Turn the insect box upside down and open the cover</li> <li>4. Carefully make transparent plastic cup close to insect box</li> <li>5. Carefully take away the paper</li> <li>6. Waiting it flying into insect box</li> <li>7. Close the lid of the insect box</li> <li>8. Successfully caught mosquitoes</li> </ol>	<ol style="list-style-type: none"> <li>1. Open the door of toilet cleaning room or kick the trash can to, frighten mosquitoes</li> <li>2. Observe the movement of the mosquito and wait for it to stop on the plane</li> <li>3. Cover with a transparent plastic cup</li> <li>4. Put the paper between the cup and the flat surface</li> <li>5. Turn the insect box upside down and open the cover</li> <li>6. Carefully make transparent plastic cup close to insect box</li> <li>7. Carefully take away the paper</li> <li>8. Waiting it flying into insect box</li> <li>9. Close the lid of the insect box</li> <li>10. Successfully caught mosquitoes</li> </ol>	<ol style="list-style-type: none"> <li>1. Sports, make the body warm, spit out more carbon dioxide than usual and sweat more than usually</li> <li>2. Stand still</li> <li>3. When mosquitoes flying over, cover with a plastic cup</li> <li>4. Cover the cup with paper</li> <li>5. Turn the insect box upside down and open the cover</li> <li>6. Carefully make transparent plastic cup close to insect box</li> <li>7. Carefully take away the paper</li> <li>8. Waiting it flying into insect box</li> <li>9. Close the lid of the insect box</li> <li>10. Successfully caught mosquitoes</li> </ol>
---	---	--	---

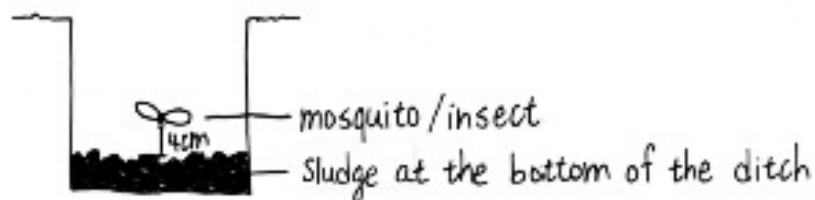
<p>Advantage</p>	<ol style="list-style-type: none"> <li>1. In a familiar location, high chance of catching mosquitoes of the same species</li> <li>2. Lots of choose of place catch mosquitoes, high chance of success</li> <li>3. Learn more about other species in ditch</li> </ol>	<ol style="list-style-type: none"> <li>1. Mosquitoes will stop on a flat surface</li> <li>2. Single background color</li> <li>3. Sufficient lighting</li> <li>4. Lots of choose of place catch mosquitoes</li> </ol>	<ol style="list-style-type: none"> <li>1. Good for health</li> <li>2. Similar to a general the way mosquito appear .</li> </ol>
<p>Shortcoming</p>	<ol style="list-style-type: none"> <li>1. Three-dimensional space</li> <li>2. Background color is too rich,</li> <li>3. Poor light</li> <li>4. Easily affected by weather and strong winds</li> <li>5. Moving the gutter cover is laborious</li> <li>6. The stench of the gutters is unbearable</li> </ol>	<ol style="list-style-type: none"> <li>1. Some toilets are too clean</li> <li>2. Users may be troubled</li> <li>3. Can't catch if mosquitoes stay at place that too high to catch</li> </ol>	<ol style="list-style-type: none"> <li>1. The person who is the bait will tired</li> <li>2. Will itching if bitten</li> <li>3. Have risk of contracting disease</li> <li>4. Spend more time</li> </ol>
<p>Results</p>	<p>Caught 8 mosquitoes</p>	<p>Caught 17 mosquitoes</p>	<p>Caught 3 mosquitoes</p>

Location: Ditch

How mosquitoes appear:

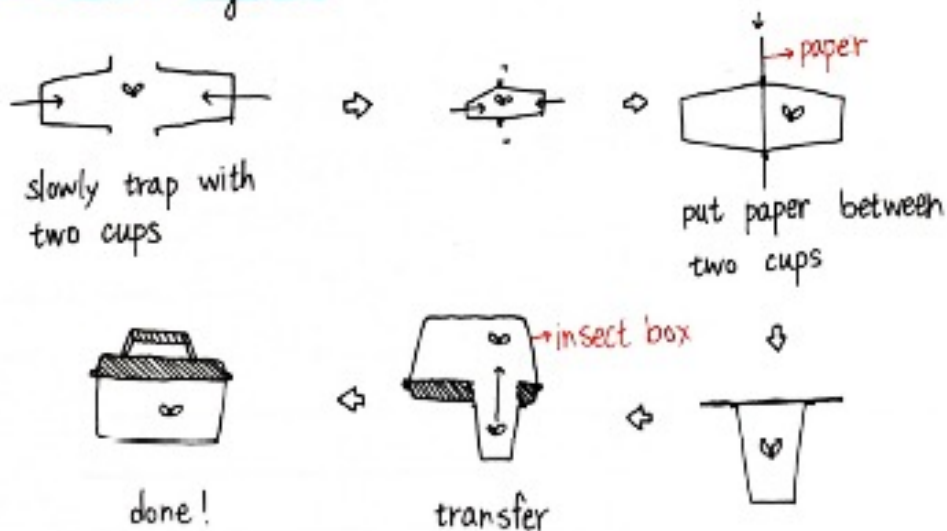


↳ Top view



↳ Flying 4 centimeter off the ground along the ditch.

How we caught:



# 3. Place artificial water.

## Idea:

Due to the lack of rain for many days, there was no water accumulation in the ditch, so no mosquitoes or larvae could be caught. Place artificial stagnant water to attract mosquitoes to lay eggs, and then raise larvae.

## Location:

Water ditches (three ditches were selected)

## Material:

a container

## **Capture method:**

Put a water container in the ditches

Wait for the mosquitoes to lay their eggs

After a few days, observe whether there are any larvae in the container

Number of leeches caught this way: 0

## **advantage:**

No need to spend time and effort catching mosquitoes

## **shortcoming:**

Take time to wait for mosquitoes to lay eggs

There is a risk of promoting mosquito breeding



# Experiment

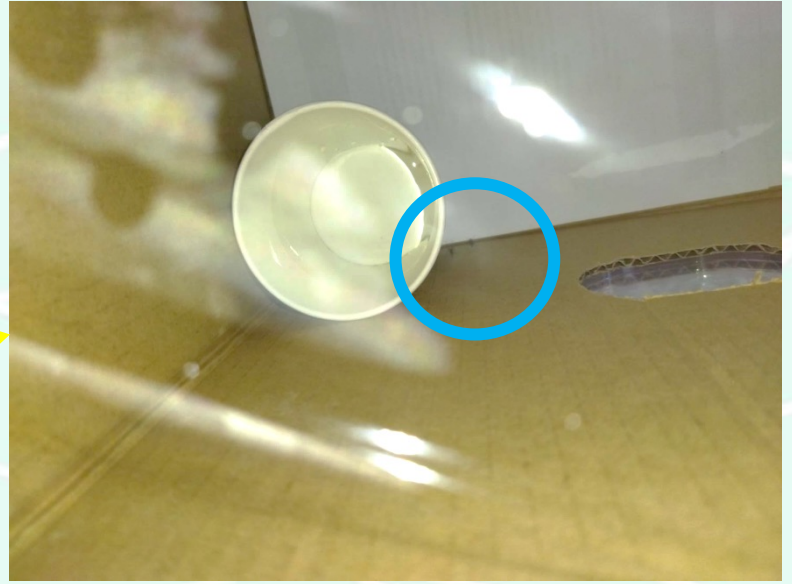
# (1) Mosquito's preference for hot and cold

## **Material:**

150ml hot water at 96°C, 150ml cold water at 7°C, paper cup, carton, plastic wrap, rough tape, white paper, Graduated cylinder, Thermometer

## **step:**

1. Put a piece of white paper at the bottom of the carton for observation
2. Put a cup of 7°C 150ml cold water and 96°C 150ml hot water in the carton,
3. Put the plastic cup with mosquitoes upside down into the carton
4. Seal the carton with plastic wrap and tape, leaving a small hole for hand access
5. Put your hand into the box, open the plastic cup, quickly pull out and seal the hole, and start timing
6. Observe the movement of mosquitoes
7. Observe where the mosquitoes stay after 10 minutes
8. Experimental results:
9. Four mosquitoes flew into the gap between the cardboard box and the cold water cup, and the others did not move in particular. We observed that mosquitoes prefer shady spaces.



## (2) Experiment of carbon dioxide's attraction to mosquito

**Creature:** 8 mosquitoes

**Chemical material :**

calcium carbonate(grams) 、 32% hydrochloric acid(50milliliters)

**Material :**

paper 、 carton 、 fine tape 、 thick tape 、 transparent plastic box 、 plastic wrap 、 transparent plastic cup 、 burette 、 burette holder 、 ring stand 、 three prong clamp 、 rubber stopper 、 rubber hose 、 spatula 、 electronic scale 、 scale paper 、 Styrofoam board 、 filtering flask

**principle:**

Calcium carbonate (marble, limestone) will have an Exothermic reaction with hydrochloric acid, resulting in calcium chloride, water and carbon dioxide.



## Experimental methods and materials:

1. Dig 5centimeter diameter holes on the opposite of the carton.
2. Fold the paper into L-shape channel.
3. Cut the Styrofoam board into a shape that fits closely with the transparent plastic box. Both Styrofoam board are dug a hole with a diameter of 5 centimeter. One of them dug a hole with diameter of 1 centimeter.
4. Stick Styrofoam board and transparent plastic box together with thick tape.
5. Stick paper channel and Styrofoam board with fine tape.
6. Stick paper channel and carton together with fine tape.
7. Join 150g grams calcium carbonate in filtering flask.
8. Fasten burette holder on ring stand.
9. Fasten burette to burette holder.
10. Put filtering flask on ring stand.
11. Join 50 milliliters 32% hydrochloric acid in burette.
12. Use carton to make the box with carbon dioxide height higher.
13. Stick rubber hose and Styrofoam board with fine tape.
14. Fix carton to plastic wrap with thick tape.
15. Dig a hole on carton that can let hand pass through.
16. Put mosquitoes into carton.
17. Fix plastic wrap to carton with thick tape.
18. Turn on the switch of burette. Let 32% hydrochloric acid and calcium carbonate mix.
19. Observe the movement of mosquitoes.



## results:

- Six mosquitoes flew into the box containing carbon dioxide, and two remained in the main box.
- The mosquitoes that flew into the CO<sub>2</sub> box all died, but the ones that stayed in the main box didn't.
- Mosquitoes fly around when exposed to carbon dioxide at first, and die quickly after a while.
- Carbon dioxide is indeed attractive to mosquitoes, but too much carbon dioxide can kill mosquitoes.

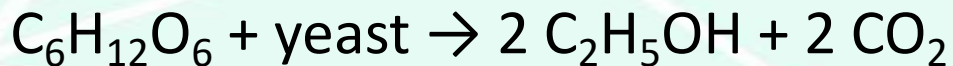
### (3) Using yeast to produce carbon dioxide to capture mosquitoes

#### **Material:**

Two identical plastic bottles, yeast, sugar, heating panel, water, spoon, Dropper, Graduated cylinder, Beaker, utility knife, Thermometer, weighing paper, Petri dish, tape, electronic balance

#### **principle:**

Using the EMP (Embden-Meyerhof Parnas) approach



Since this process is mostly done under anoxic conditions.

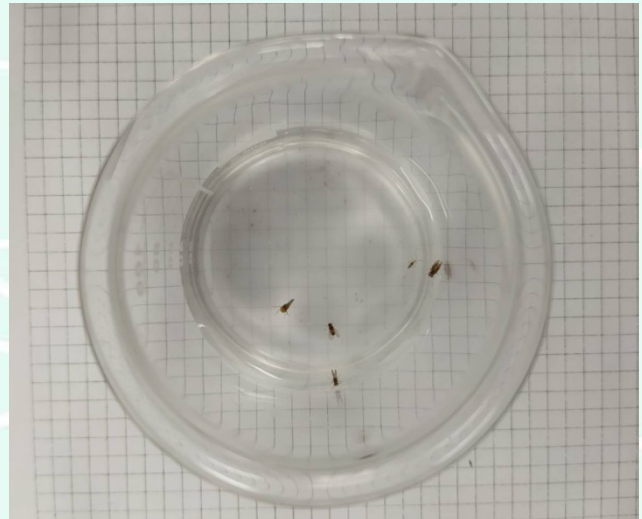
Alcohol fermentation is generally an anaerobic process, in which yeast and other microorganisms undergo fermentation.

Conversion of sugars in reactants such as glucose, fructose and sucrose to produce energy, ethanol and carbon dioxide



## Step:

1. Add 28ml of water and 2g of sugar to two beakers.
2. Place on a heating panel and heat to 40°C.
3. Cut two plastic bottles 5cm away from the bottle mouth during heating.
4. Pour the heated sugar water into two plastic bottles.
5. Add 0.5g yeast to one of the cups.
6. Finally, put the cut bottle mouth upside down on the bottle body and fix it with tape.
7. Put the finished device in a dark place beside the ditch for one night.



## Results:

No mosquitoes were caught, but other insects were caught. Most *Drosophila* flies into sugar water with yeast that produces carbon dioxide, and is also caught in sugar water, but in smaller numbers. Many ants were caught in sugar water, while significantly fewer ants were caught in sugar water with yeast.

	2022/2/25	2022/2/26
Sugar and water	<i>Drosophila</i> : 4	Big ant: 39 Small ant: 8 <i>Drosophila</i> : 17 Housefly: 1
Sugar water with yeast	<i>Drosophila</i> : 56	Big ant: 2 <i>Drosophila</i> : 48 Small <i>Drosophila</i> : 30 Housefly: 2



# Discussion

# **(1) Mosquitoes' preference for hot and cold**

## **Assumptions:**

Mosquitoes will move closer to the warmer side. Because people are more likely to be bitten by mosquitoes after exercising, their body temperature will rise after exercise.

## **Experimental results:**

Mosquitoes move closer to cooler temperatures

## **Speculated reason:**

There are other reasons why mosquitoes are more attractive to mosquitoes than temperature. Mosquitoes like to live in shady places because the temperature is usually cooler where there is water, and mosquitoes lay their eggs in water. In other words, a shady place means that mosquitoes can lay their eggs there, so there are more mosquitoes in a shady place.

## **(2) Carbon dioxide's attraction to mosquito**

### **Assumptions:**

Mosquitoes will fly to places with high carbon dioxide levels.

### **Experimental results:**

Mosquitoes fly to places with higher carbon dioxide concentrations, but die after a while.

### **Speculated reason:**

A place with more carbon dioxide is usually a place where creature is infested. Mosquitoes need suck blood to reproduce, and they may link carbon dioxide to a food source. As for why they died after a while? Carbon dioxide is lighter than air and floats into the air. The upper layer of the experimental device was filled with carbon dioxide, and the mosquitoes were attracted to fly over, but could not find the place where the air was, and they died of lack of oxygen.

### **(3) Using yeast to produce carbon dioxide to capture mosquitoes**

#### **Assumptions:**

Mosquitoes fly into plastic bottles where carbon dioxide is produced by sugar water with yeast.

#### **Experimental results:**

No mosquitoes flew into two plastic bottles, but most *Drosophila*, Housefly flew into plastic bottles with yeast.

#### **Speculated reason:**

Carbon dioxide may be attractive to *Drosophila*. But under normal observation, *Drosophila* does not fly to humans who exhale carbon dioxide. *Drosophila* is more likely to fly to places with odors than to places with carbon dioxide. While sugar water with yeast can produce odors, *Drosophila* may be attracted to the smell, not the carbon dioxide.

# Conclusion

- People who have just finished exercising attract mosquitoes.
- Compared to temperature , carbon dioxide is the main factor that attracts mosquitoes.
- Mosquitoes like shady places , because shady places usually have water.
- The easiest and most time-saving way to catch mosquitoes is captured with transparent plastic cup in toilet.



# Bibliography/Citations

- Embden–Meyerhof–Parnas:  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5440799/>
- Embden-Meyerhof Parnas:  
<https://zh.wikipedia.org/wiki/%E9%85%92%E7%B2%BE%E7%99%BC%E9%85%B5#%E5%8C%96%E5%AD%B8%E5%8F%8D%E6%87%89>
- Calcium Carbonate and Hydrochloric Acid Reaction:  
<https://www.chemistryscl.com/reactions/CaCO3+HCl/index.php>

# Division of labor

Team member	Assign work
LUO, XIN YI	catch mosquitoes Experiment 1 Mosquito's preference for hot and cold Experiment 2 Carbon dioxide's attraction to mosquito <ul style="list-style-type: none"><li>● Research question and hypothesis</li><li>● Research methods and materials</li><li>● Results</li><li>● Discussion</li><li>● Conclusion</li></ul>
HUANG, YU CHIN	catch mosquitoes Experiment 1 Mosquito's preference for hot and cold Experiment 2 Carbon dioxide's attraction to mosquito Experiment 3 Using yeast to produce carbon dioxide to capture mosquitoes <ul style="list-style-type: none"><li>● Research question and hypothesis</li><li>● Research methods and materials</li><li>● Results</li><li>● Discussion</li><li>● Conclusion</li></ul>
LIU, YU HSUAN	catch mosquitoes <ul style="list-style-type: none"><li>● Abstract</li></ul>



**Thanks For Listening.**