

Title: Can pollen bubbles effectively pollinate crops? Logbook

Name: Lily M. and Tala S. Grade: 10 Renert School

POLLINATION DATA (PICTURES):  2024 CYSF - Experiment Procedure

- SHOWN AT BOTTOM OF LOG BOOK

SPREADSHEET POLLINATION DATA:

 Bubble Pollination - Data

- SHOWN AT BOTTOM OF LOG BOOK

DATE (day/month/year)	ACTION (what did you complete in the last week)	RESOURCES USED (websites, textbooks, mentorship, videos)	OTHER NOTES (goals for next week,)
21/9/2023	We chose our topic, created a title and found a mentor.	Mentorship: Mx. Dallas, Dr. Soares, Ms. Haney https://www.nytimes.com/2020/06/17/science/bubbles-pollinating-bees.html https://www.sciencedirect.com/science/article/pii/S2589004220303734 https://news.mongabay.com/2020/07/bubbles-lasers-and-robo-bees-is-artificial-pollination-here-to-stay/ https://www.science.org/content/article/drone-delivered-soap-bubbles-could-help-pollinate-flowers	Discuss with Ms. Haney about topic, conduct more research
29/9/2023	Talked to Mx. Dallas and made our topic more specific. Conducted some more research.	Mentorship: Mx. Dallas https://www.cell.com/iscience/pdf/S2589-0042(20)30373-4.pdf	




13/10/2023	Discussed the possibility of creating a bubble pollination model using glitter or UV powder as pollen with Ms. Haney. Model would include fake flowers.	Mentorship: Ms. Haney	Organize information into specified goals and create a cleaner doc. Create goals, keeping in mind :research for proposal projects and the rubric we will be marked on.
20/10/2023	Information is organized and transferred onto new main doc		
27/10/2023	Further research on background information	https://www.fs.usda.gov/managing-land/wildflowers/pollinators/what-is-pollination#:~:text=Pollination%20is%20the%20act%20of,offspring%20is%20by%20making%20seeds. https://www.nytimes.com/2020/06/17/science/bubbles-pollinating-bees.html https://www.cell.com/chem/fulltext/S2451-9294(17)30032-3 https://www.cell.com/iscience/pdf/S2589-0042(20)30373-4.pdf https://www.sciencedirect.com/science/article/pii/S2589004220303734 https://www.science.org/content/article/drone-delivered-soap-bubbles-could-help-pollinate-flowers	
3/11/2023	Research the problem and why our project is relevant to helping solve the issue.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10299515/#:~:text=The%20number%20of%20%20apiaries%2f%20Colonies,16.96%25)%20(Figure%203).	



		<p>https://beeinformed.org/2023/06/22/united-states-honey-bee-colony-losses-2022-23-preliminary-results-from-the-bee-informed-partnership/#:~:text=Over%20the%20entire%20year%20(1,1).</p> <p>https://capabees.com/shared/CAPA-preliminary-report-on-winter-losses-2023.pdf</p> <p>https://www.fairplanet.org/story/the-risks-and-dangers-of-bee-extinction/</p>	
<p>10/11/2023</p>	<p>Researched other methods of artificial pollination and compared to bubble pollination.</p>	<p>https://www.foodunfolded.com/article/pollinating-orchards-by-hand-lessons-from-sichuan-china#:~:text=In%20the%20apple%20and%20pear,pollinate%20their%20orchards%20by%20hand</p> <p>https://www.foodunfolded.com/article/pollinating-orchards-by-hand-lessons-from-sichuan-china#:~:text=In%20the%20apple%20and%20pear,pollinate%20their%20orchards%20by%20hand</p> <p>https://bioone.org/journals/mountain-research-and-development/volume-32/issue-2/MRD-JOURNAL-D-11-00108.1/The-Human-Pollinators-of-Fruit-Crops-in-Maoxian-County-Sichuan/10.1659/MRD-JOURNAL-D-11-00108.1.full#i0276-4741-32-2-176-t02</p> <p>https://www.sciencedaily.com/releases/2021/09/210908180444.htm</p> <p>https://www.newsweek.com/drone-bees-comically-ineffective-expensive-dangerous-real-bees-554881</p>	

		<p>https://www.frontiersin.org/articles/10.3389/fevo.2022.850600/full#:~:text=From%20almonds%2C%20beekeepers%20move%20these,States%20for%20honey%20production%20purposes.</p>	
15/11/2023	Started on CYSF pitch presentation	<p>https://www.fs.usda.gov/mana-ging-land/wildflowers/pollinat-ors/what-is-pollination</p> <p>https://bmcecol.biomedcentral.com/articles/10.1186/s12898-020-00290-x</p> <p>https://www.nytimes.com/2020/06/17/science/bubbles-pollin-ating-bees.html</p> <p>https://news.mongabay.com/2020/07/bubbles-lasers-and-robo-bees-is-artificial-pollination-here-to-stay/</p> <p>https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10299515/#:~:text=The%20number%20of%20apiaries%2fColonies,16.96%25)%20(Figu-re%203).</p>	
16/11/2023	Finalized presentation	<p>Mentorship: Ms. Haney</p> <p>https://www.sciencedaily.com/releases/2021/09/210908180444.htm/</p>	

17/11/2023	Presented project for judging		
24/11/2023	Sent an email to Ms. P asking for a bubble solution. Further planning on Experimentation process Created possible project names		
1/11/2023	Reorganize information and compiled all our findings onto one document Accepted CYSF invitation		
3/11/2023	Started on drafting experiment trial procedures	https://www.cell.com/iscience/fulltext/S2589-0042(20)30373-4	
10/11/2023	More research on experimentation processes and finished creating a procedure	https://www.indeed.com/career-advice/career-development/designing-an-experiment	
17/11/2023	Gathered materials for our experiment: Gazillion bubble solution, bubble machine, glitter, plastic lids, etc.	Mentorship: Ms. Haney	
24/11/2023	Began a pre-experimentation process where we ran through a dummy version of our actual experiment with glitter instead of glo-germ powder (we didn't have all of our main materials yet).		
1/12/2023	Finished gathering all materials for experiment, namely a UV flashlight and glo-germ powder.	Mentorship: Ms. Haney, Mr. Wilcox	

DATE (day/month/year)	ACTION (what did you complete in the last week)	RESOURCES USED (websites, textbooks, mentorship, videos)	OTHER NOTES (goals for next week,)
8/12/2023	Re-wrote our procedure in a school lab experiment format to better help organize our steps and data	Dr. B's titration lab handout: file:///Users/lilyma/Downloads/Chem20_Stoich_Topic_6_Acid-Base_Titration_LAB_Handout%20(2).pdf	
15/12/2023	Tried experiment with Glo-Germ powder and discovered it dissolves in bubble solution (undesirable). Found microfine glitter as an alternate pollen substitute of similar size.	https://www.amazon.ca/Hemway-Polyurethane-Epoxy-Glitter-MICROFINE/dp/B07SNVJT3F/ref=sr_1_1_sspa?crd=6GHK08B3WH82&keywords=0.1mm%2Bglitter&qid=1702673082&s=kitchen&prefix=0%2Bmm%2Bglitter%2Ckitchen%2C139&sr=1-1-spons&sp_csd=d2lkZ2V0TmFtZT1zcF9hdGY&th=1	
4/1/2024	Added to experimentation and background research. Asked questions about our project from an outsider's perspective.		
7/1/2024	*tala write here*		
12/1/2024	Bought microfine glitter, submitted Ethics Due Care 2A and declaration. Made progress on our experimentation procedure by ensuring the PH of solution is 7.0. Added information regarding elements that can be added to the solution to increase germination rates.		

19/1/2024	<p>Research ratios for bubble solution and pollen (glitter). Finalize the experiment procedure and table.</p> <p>Also researched the toxicity of the soaps used in the research paper.</p>		
23/1/2024	<p>Experimented. Made a solution with correct concentration. Got materials. Need to figure out a way to collect quantitative data (through microscope or technology).</p>		
30/1/2024	<p>Explored the idea of painting flower stigmas black, created a to-do list for gathering materials. Finalized experiment.</p>		
2/2/2024	<p>Completed experimenting with controlled scenarios for each flower type. Refer to POLLINATION DATA (PICTURES):</p> <p> 2024 CYSF - Experiment...</p>		
6/2/2024	<p>Started experimenting with distance scenarios for each flower type. Refer to POLLINATION DATA (PICTURES):</p> <p> 2024 CYSF - Experiment...</p>		
8/2/2024	<p>Finished experimenting with distance scenarios for each flower type. Refer to POLLINATION DATA (PICTURES):</p> <p> 2024 CYSF - Experiment...</p>		
9/2/2024	<p>Started formalizing research.</p>		

13/2/2024	Continued formalizing research paper.		
15/2/2024	Completed a portion of formal research paper and had edits made by Ms. Madison.		
16/2/2024	Talked to Ms. Haney about our plan for CYSF over February break and were given some helpful links regarding APA citations.	https://www.mendeley.com/ https://endnote.com/ https://refworks.proquest.com/	
20/2/2024	Finished experimentation of water and wind scenarios. All experimentation completed and data collected. Refer to POLLINATION DATA (PICTURES): 		
22/2/2024	Continued formalizing background research and imputed data into a spreadsheet. SPREADSHEET POLLINATION DATA: 		

DATE (day/month/year)	ACTION (what did you complete in the last week)	RESOURCES USED (websites, textbooks, mentorship, videos)	OTHER NOTES (goals for next week,)
26/2/2024	Self-edited formal write-up and had Ms. Madison help edit.		

27/2/2024	Photoshopped flower pollination images in order to further contrast glitter transfer and black background. Started formal write-up of the Data section.		Complete draft of formal write up by March 1st.
29/2/2024	Edited formal write-up and added all citations.		
1/3/2024	Attended Keeyan Hirji's trifold making orientation session. Acquired Renert in-house science fair trifold.		
4/3/2024	Started making the presentation, chose a template and began inputting information. Finished		https://slidesgo.com/theme/goyang-international-flower-festival
7/3/2024	Finished making the presentation.		
8/3/2024	Had our presentation reviewed by Ms. Haney, Dr. Soares and Mx. Dallas.		
9/3/2024	Started and finished the script for the presentation.		
10/3/2024	Practiced presentation on zoom and went through 3 takes.		

POLLINATION DATA (PICTURES): 2024 CYSF - Experiment Procedure

Data and Observations:

CONTROL EXPERIMENT CONDITIONS:

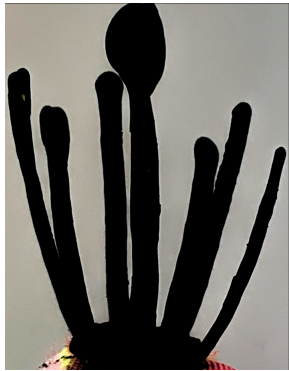
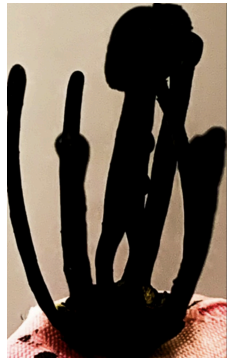

- 15 cm in Distance
- No Wind
- No Water
- 45 Degrees

CONTROL

Tulips

Hypothesis: If a glitter bubble is blown onto the stigma of a tulip, then the bubble will not transfer glitter onto the stigma due to the fact that the petal is obscuring the pollen bubble from making contact with the stigma


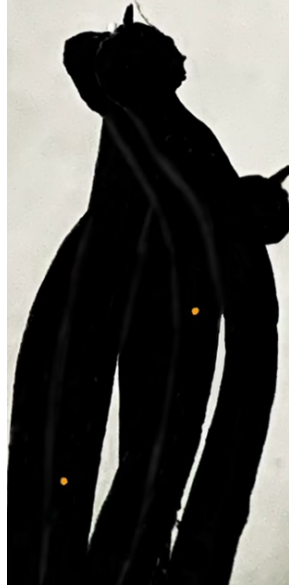

Table 1: Transfer of microfine glitter with “best scenario” using Gazillion bubble solution on **Tulips**

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations(how much transfer)	No transfer however there is glitter on the upper internal portion of the petals.	No transfer however there is glitter on the bottom and top internal portion of the petals.	No and nothing on the petals.
Did it transfer?	No.	No.	No.
How much transfer?	0	0	0

Jasmines

Hypothesis: If a glitter bubble is blown onto the stigma of an aster, then the bubble will transfer glitter onto the stigma due to the petals' very open nature and the bigger area of stigma, making it more accessible for the pollen bubble.

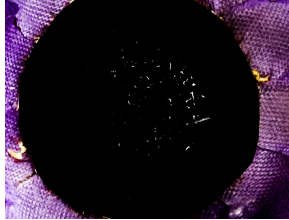
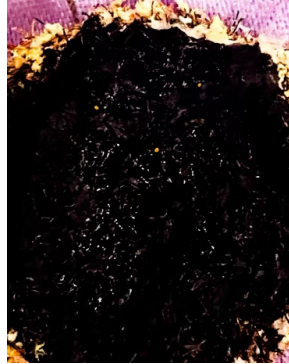
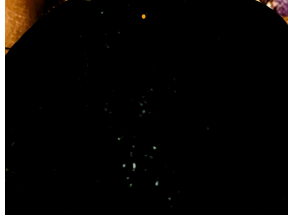
Table 2: Transfer of microfine glitter with “best scenario” using Gazillion bubble solution on **Jasmines**

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations	Lots on the petals, none on the stigma.	Lots on the petals, none on the stigma.	2-3 glitters on the stigma.
Did it transfer?	Yes	Yes (2)	Yes
How much transfer?	2	2	2

Asters

Hypothesis: If a glitter bubble is blown onto the stigma of a jasmine, then the bubble will transfer glitter onto the stigma due to the petals' semi open nature and because the flowers are smaller but more.

Table 3: Transfer of microfine glitter with “best scenario” using Gazillion bubble solution on **Asters**

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations	Lots on the petals, none on the stigma	Lots on the petals again, 3-5 on the stigma	Lots on the petals, 1 on the stigma
Did it transfer?	No	Yes	Yes
How much transfer?	0	3	1

DISTANCE 30




DISTANCE 30 EXPERIMENT CONDITIONS:

- 30 cm in Distance
- No Wind
- No Water
- 45 Degrees

Tulips

Hypothesis: If the distance away from the flower is increased, then the success rate of pollination in Tulips will decrease because the bubbles will not be able to reach the stigma as easily.




Table 1: Transfer of microfine glitter with far distance (30cm) using Gazillion bubble solution on tulips.

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations	N/A	N/A	N/A
Did it transfer?	no	no	no
How much transfer?	0	0	0

Jasmines

Hypothesis: If the distance away from the flower is increased, then the success rate of pollination in Jasmines will decrease because the bubbles will not be able to reach the stigma as easily.



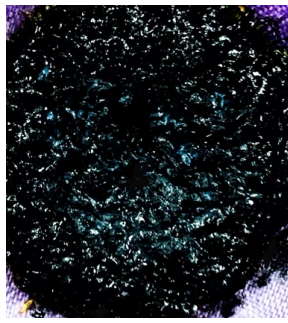
Table 2: Transfer of microfine glitter with far distance (30 cm) using Gazillion bubble solution on **jasmines**.

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations	Lots on the petals.	2 speckles on the stigma. Not as much on petals as control.	A couple on the petals.
Did it transfer?	no	yes	no
How much transfer?	0	2	0

Asters

Hypothesis: If the distance away from the flower is increased, then the success rate of pollination in the Asters will decrease because the bubbles will not be able to reach the stigma as easily.

Table 3: Transfer of microfine glitter with a far distance (30 cm) using Gazillion bubble solution on **aspers**.

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations	A couple of petals.	Not much on petals (but still some)	N/A
Did it transfer?	yes	yes	no
How much transfer?	1	1	0

DISTANCE 60




DISTANCE 60 EXPERIMENT CONDITIONS:

- 60 cm in Distance
- No Wind
- No Water
- 45 Degrees

Tulips

Hypothesis: If the distance away from the flower is increased, then the success rate of pollination in the Tulips will decrease because the bubbles will not be able to reach the stigma as easily.


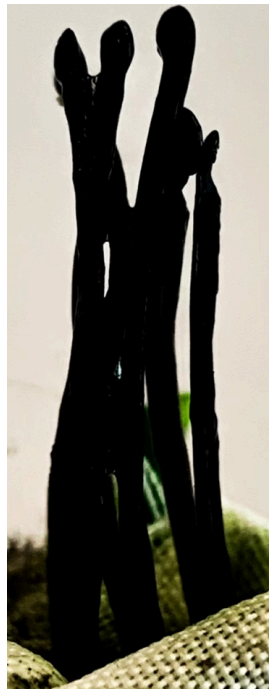
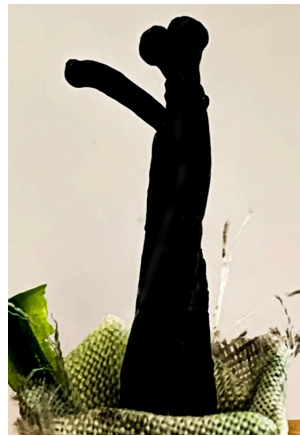
Table 1: Transfer of microfine glitter with far distance (60cm) using Gazillion bubble solution on **tulips**.

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations	Landed in a way that it looked like it could possibly go in.	N/A	Some transfer on the lower inside of the petals.
Did it transfer?	no	no	no
How much transfer?	0	0	0

Jasmines

Hypothesis: If the distance away from the flower is increased, then the success rate of pollination in the Jasmines will decrease because the bubbles will not be able to reach the stigma as easily.

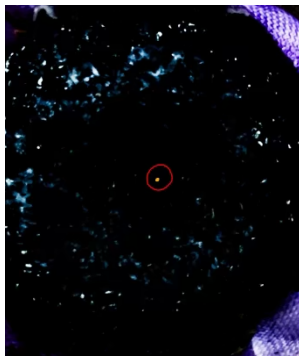
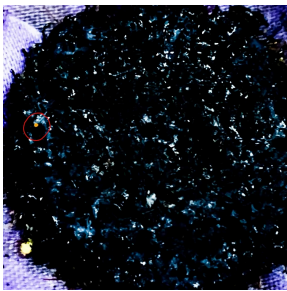
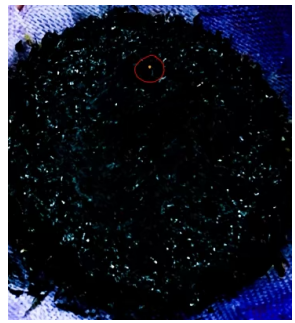
Table 2: Transfer of microfine glitter with far distance (60 cm) using Gazillion bubble solution on **jasmines**.

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations	N/A	N/A	N/A
Did it transfer?	no	no	no
How much transfer?	0	0	0

Asters

Hypothesis: If the distance away from the flower is increased, then the success rate of pollination in the Asters will decrease because the bubbles will not be able to reach the stigma as easily.

Table 3: Transfer of microfine glitter with a far distance (60 cm) using Gazillion bubble solution on **aspers**.

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations	N/A	Lots of transfer on the petals	Lots of transfer on the petals
Did it transfer?	Yes	Yes	Yes
How much transfer?	1	1	1

WIND




WIND EXPERIMENT CONDITIONS:

- 15 cm in Distance
- Wind
- No Water
- 45 Degrees

Tulips

Hypothesis: If the environment is windy, then the success rate of pollination in tulips will decrease since the bubble will be blown away from the flower.


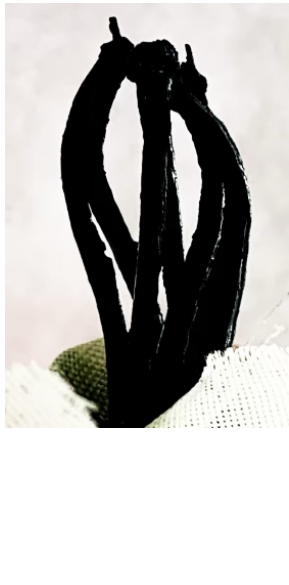

Table 1: Transfer of microfine glitter with wind using Gazillion bubble solution on **tulips**.

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations	Literally just went past it (2 meters away)	Literally just went past it (2 meters away)	Literally just went past it (2 meters away)
Did it transfer?	no	no	no
How much transfer?	0	0	0

Jasmines

Hypothesis: If the environment is windy, then the success rate of pollination in jasmines will decrease since the bubble will be blown away from the flower.



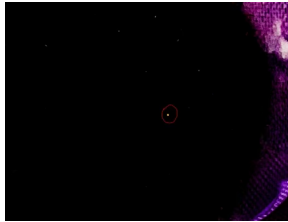
Table 3: Transfer of microfine glitter with wind degree angle using Gazillion bubble solution on **jasmines**.

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations	Petals come up and block it, preventing it from being pollinated. However, it still was able to pollinate.	Petals come up and block it, preventing it from being pollinated.	Petals come up and block it, preventing it from being pollinated.
Did it transfer?	yes	no	no
How much transfer?	2	0	0

Asters

Hypothesis: If the environment is windy, then the success rate of pollination in asters will decrease since the bubble will be blown away from the flower.

Table 3: Transfer of microfine glitter with wind using Gazillion bubble solution on **aspers**.

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations	Leaves cover petals, but still manage to pollinate.	Leaves cover petals, so they can't pollinate.	Leaves cover petals, but still manage to pollinate.
Did it transfer?	yes	no	Yes
How much transfer?	2	0	1

WATER


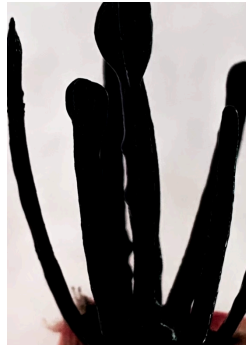
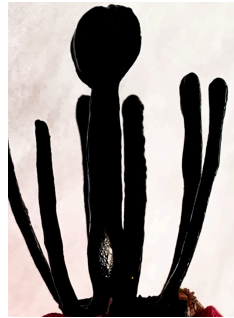
WIND EXPERIMENT CONDITIONS:

- 15 cm in Distance
- No Wind
- Water (5 water mist sprays)
- 45 Degrees

Tulips

Hypothesis: If the flowers are watered before being pollinated, then the success rate of pollination in tulips will increase because the bubbles will stick onto the flower more easily as a result of cohesive forces between the soap bubble and water




Table 1: Transfer of microfine glitter wet using Gazillion bubble solution on **tulips**.

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations	Sticks on to the petals!	Sticks on to petal and on leaf (a lot)	Sticks on to petals and leaf
Did it transfer?	Yes	no	yes
How much transfer?	1	0	1

Jamines

Hypothesis: If the flowers are watered before being pollinated, then the success rate of pollination in jasmynes will increase because the bubbles will stick onto the flower more easily as a result of cohesive forces between the soap bubble and water

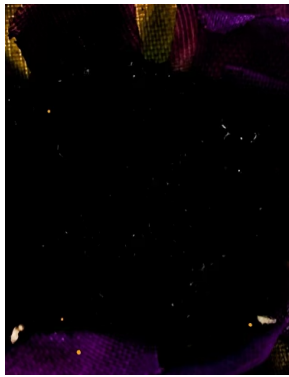
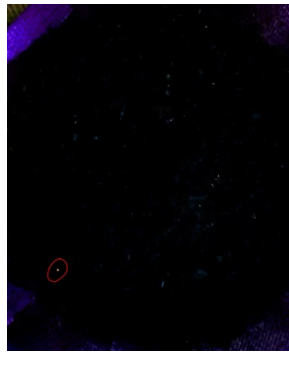

Table 2: Transfer of microfine glitter wet using Gazillion bubble solution on **jasmynes**.

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations	Sticks to petals, leaf, and on to stigma	Sticks to petals, leaf, and on to stigma	Sticks to petals, leaf, and on to stigma
Did it transfer?	Yes	Yes (a lot)	no
How much transfer?	1	3	0

Asters

Hypothesis: If the flowers are watered before being pollinated, then the success rate of pollination in asters will increase because the bubbles will stick onto the flower more easily as a result of cohesive forces between the soap bubble and water

Table 3: Transfer of microfine glitter wet using Gazillion bubble solution on **aspers**.

Trial	1	2	3
Amount of bubble gun triggers	3	3	3
Pictures			
Observations	Sticks really well onto petals, leaves, and stigma.	Sticks really well onto petals, leaves, and stigma.	Sticks to petals, leaves and stigma
Did it transfer?	Yes	Yes	Yes
How much transfer?	4	1	2

SPREADSHEET POLLINATION DATA:

 Bubble Pollination - Data

AMOUNT OF TRANSFER				
Control	Trial 1	Trial 2	Trial 3	Final (average)
Tulips	0	0	0	0
Jasmines	2	2	2	2
Asters	0	3	1	1.33

Distance (30 cm)	Transfer (number)	Transfer (number)	Transfer (number)	Final (average)
Tulips	0	0	0	0
Jasmines	0	2	0	0.67
Asters	1	1	1	1.00
Distance (60 cm)	Transfer (number)	Transfer (number)	Transfer (number)	Final (average)
Tulips	0	0	0	0
Jasmines	0	0	0	0
Asters	1	1	1	1
Water	Transfer (number)	Transfer (number)	Transfer (number)	Final (average)
Tulips	3	0	1	1.33
Jasmines	1	3	0	1.33
Asters	4	1	2	2.33
Wind	Transfer (number)	Transfer (number)	Transfer (number)	Final (average)
Tulips	0	0	0	0
Jasmines	2	0	0	0.67
Asters	2	0	1	1.00

SUCCESS RATE				
Control	Transfer	Transfer	Transfer	Success rate
Tulips	no	no	no	0.00%
Jasmines	yes	yes	yes	100.00%
Asters	no	yes	yes	66.67%
Distance (30 cm)	Transfer	Transfer	Transfer	Success rate
Tulips	no	no	no	0.00%
Jasmines	no	yes	no	33.33%
Asters	yes	yes	yes	100.00%
Distance (60 cm)	Transfer	Transfer	Transfer	Success rate
Tulips	no	no	no	0.00%
Jasmines	no	no	no	0.00%

Asters	yes	yes	yes	100.00%
Water	Transfer	Transfer	Transfer	Success rate
Tulips	yes	no	yes	66.67%
Jasmines	yes	yes	no	66.67%
Asters	yes	yes	yes	100.00%
Wind	Transfer	Transfer	Transfer	Success rate
Tulips	no	no	no	0.00%
Jasmines	yes	no	no	33.33%
Asters	yes	no	yes	66.67%

Note*** When transfer amount is not specific e.g 2-3, lowest values is chosen