Science Fair Logbook Grade 9

Oct 10, 2024

https://amino.bio/collections/science-fair-experiments/products/z2geh_kitpack1

In September, I got this kit with the book and the DNA Playground containing a cold station, hot station, and incubator.

https://amino.bio/collections/science-fair-experiments/products/extract-it-kit

I also found this kit on the same website, and I realized that you could make paint with it. I know how paints can be toxic and some require protective equipment to use safely, so I wanted to make a safer paint that doesn't cause negative health effects.

Oct 16, 2024

I finished my science fair proposal. These are my problem, variables, and hypothesis as of now:

Problem: Can bio-paint made from pigments extracted from bacteria be a viable alternative to commercial paint? (since commercial paint can cause harmful health effects if inhaled, ingested, or absorbed into the body)

Variables:

Manipulated: The type of paint (bio-paint and store-bought paint)

Responding: colour of paint after exposure to environmental conditions (checked through a picture of it each day during testing)

Controlled: The type of bacteria producing the pigments (K12 E. Coli), The amount of time each type of paint is tested against each type of environmental condition for, the area that the pictures of the paint are taken at after the testing each day (to test the vibrancy/values of the colours.)

Hypothesis:

If bio-paint made from bacterial pigments is applied to various surfaces and exposed to different environmental conditions, then the colour of the bio-paint will remain comparable to that of commercial paint because bacterial pigments have properties that make them resistant to heat, cold, pH changes, and moisture.

Nov 4, 2024

I made a tentative list of SOME of my materials:

- Amino Labs Engineer-it Kit and Extract-it Kit
  - (sterile water, inoculating loops, petri dishes, nutrient agar powder, antibiotics/selection marker, non-pathogenic K12 E. Coli, transformation buffer, recovery media, DNA plasmids to make bacteria produce pigments)
  - (lysis buffer, lysis accelerator, 0.22µL filter, syringe, 1.5mL tubes, pipettes)
- Amino Labs DNA Playground (cold station, hot station, incubator)

- Microcentrifuge (from Amino Labs)
- 1cm by 1cm wooden blocks
- Acrylic medium
- Store bought acrylic paint

I also made a tentative procedure:

1. Grow bacteria expressing magenta pigment
2. Lyse cells with lysis buffer and lysis accelerator to break cell membranes
3. Centrifuge cells at 15000 RPM for 20 minutes
4. Strain solution through 0.22µL filter to sterilize it
5. Mix the pigment together with the acrylic medium to make bio-paint
6. Paint 9 wooden blocks with bio-paint
7. Paint 9 wooden blocks with store-bought paint
8. Incubate 3 wooden blocks for both paint types at 37 degrees Celsius for 10 days
9. Put 3 wooden blocks for both paint types in freezer (-4 Celsius) for 10 days
10. For the last 6 blocks, put one water drop on each one, each day for 10 days
    (for all of the blocks, take one picture of each every day in the same place with controlled lighting.)
11. Check RGB colour values in each of the pictures to measure changes over time

Nov 19, 2024

I decided that I also want to test a completely natural bio-paint, made with the bacterial pigments and egg yolk. (tempera paint.) This is because the paint made with the acrylic medium won't be 100% natural. (however, it would still be much safer than store bought acrylic paint because of the extra toxic additives in store bought paint.)

- ★ I want to look at the ingredients of the acrylic medium I decide to get to make sure it doesn't contain toxic additives.

When I was doing my background research, I found a similar experiment:
https://www.scirp.org/journal/paperinformation?paperid=136808
This is another reason I want to test the completely natural tempera paint with the bacterial pigments; this experiment didn't test completely natural paint.)

I also want to test the paint on wooden blocks to imitate wooden toys for kids. Babies and toddlers are the ones most at risk from toxic chemicals and additives in paint, because they're likely to put toys in their mouth. I'm doing the water drop test on the paint for this reason. I want to see if the bio-paint will fade or change colour if it's exposed to a liquid.

Nov 20, 2024

I did some background research with these sources:

https://pmc.ncbi.nlm.nih.gov/articles/PMC2950131/#s1c1

- ★ Explains how bacterial pigments could be used in industrial settings
- ★ Explains how bacterial pigments could be used in large amounts

https://www.sciencedirect.com/science/article/abs/pii/S0167701224000198

- ★ Potential applications of bacterial biopigments

Nov 30, 2024

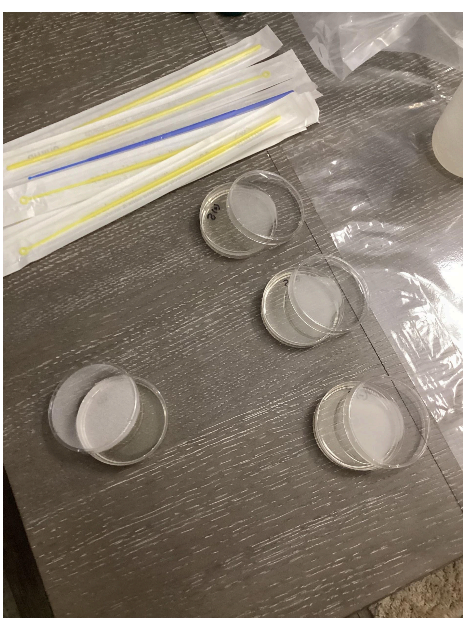
I started writing research questions and answering them for my background research.
https://www.pbslearningmedia.org/resource/biot11.sci.life.gen.genengdna/genetic-engineering-and-working-with-dna/ I used this source along with diagrams from:
https://www.bbc.co.uk/bitesize/guides/zqqs2nb/revision/1
https://sphweb.bumc.bu.edu/otlt/MPH-Modules/PH/GMOs/GMOs3.html
To learn how bacteria are genetically modified to produce pigments they wouldn't normally produce.

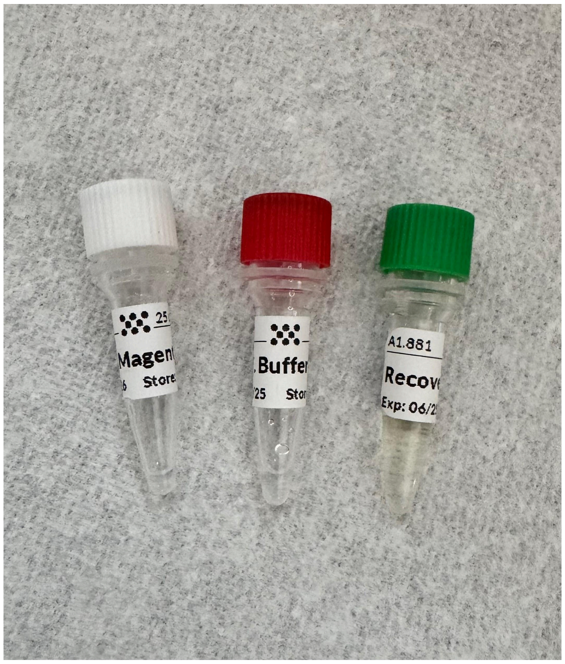
December 1, 2024

I tried making an eco-friendly paint using equal parts water, salt, and flour, and it worked. I'll make the completely eco-friendly paint with this.

December 7, 2024

I started doing my experiment.


solidifying Petri dishes

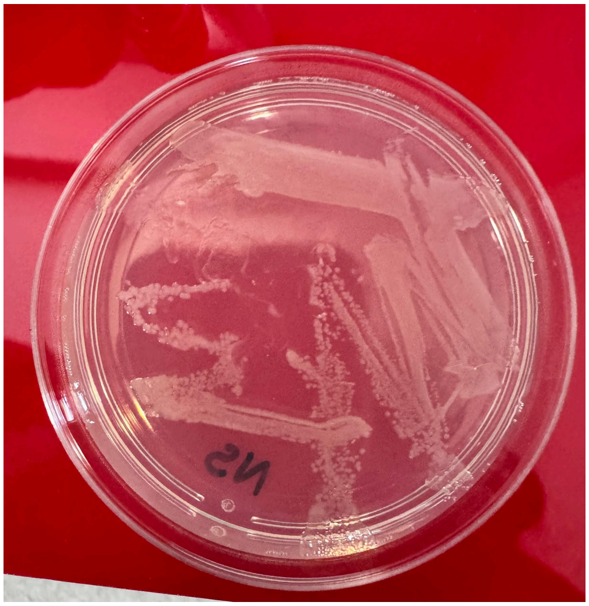


Plasmids to insert into bacteria, transformation buffer, recovery media

DNA playground with incubator, hot station, and cold station

December 8, 2024

I did day 2 of the engineer-it kit experiment.

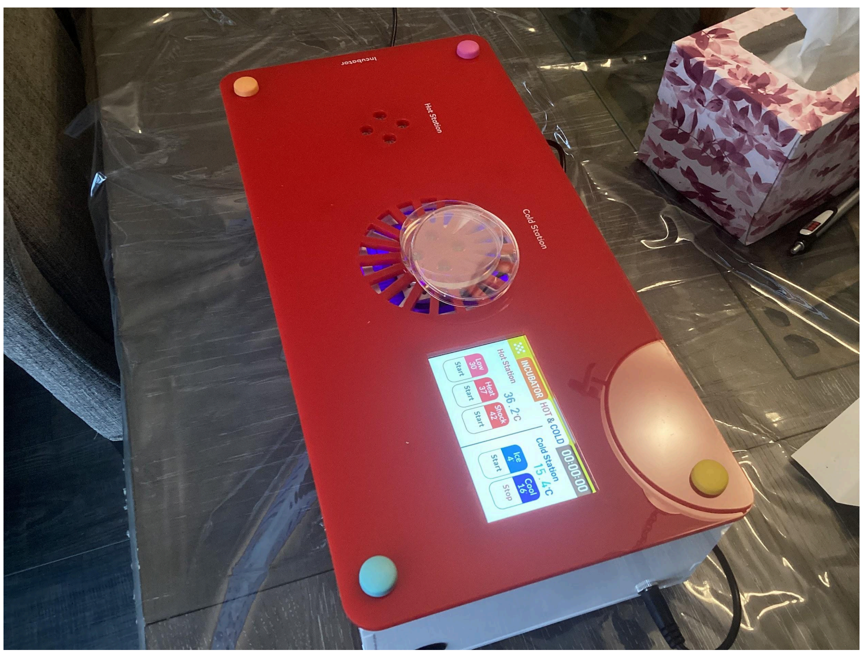


Blank E. Coli cells

Recovery media on hot station, transformation buffer on cold station

December 9, 2024

I plated the transformed bacteria (the bacteria that were genetically engineered and took in the plasmids) and the positive control cells on selective agar plates.



I also asked Amino Labs this question: "What genes or sequences in the plasmid cause the bacteria to produce the colorful pigment?"

This is what they replied with.

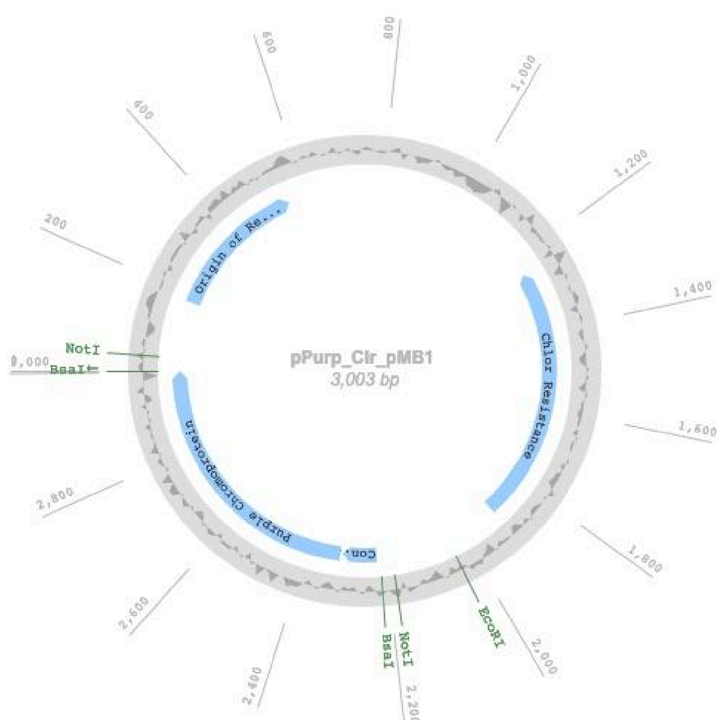
For the plasmid, here is some information

The plasmids in the kits are derivatives of the classic [Green Fluorescent Protein (GFP) from jellyfish]. In our case, most of our colours come from sea anemones, and one color (violet) comes from a molecule naturally found in rainforest organisms. Specifically:

- The fluorescent proteins - magenta, cyan, yellow, raspberry red- are derived from Red Fluorescent Protein called dsRED. This originally comes from the Discosoma species
    - https://en.wikipedia.org/wiki/Red_fluorescent_protein
    - https://en.wikipedia.org/wiki/Discosoma
- The chromoproteins - teal, blue, purple, orange- are derived from Epiactis species.
    - https://en.wikipedia.org/wiki/Epiactis
- The violet is derived from naturally-occurring violacein.
    - https://en.wikipedia.org/wiki/Violacein

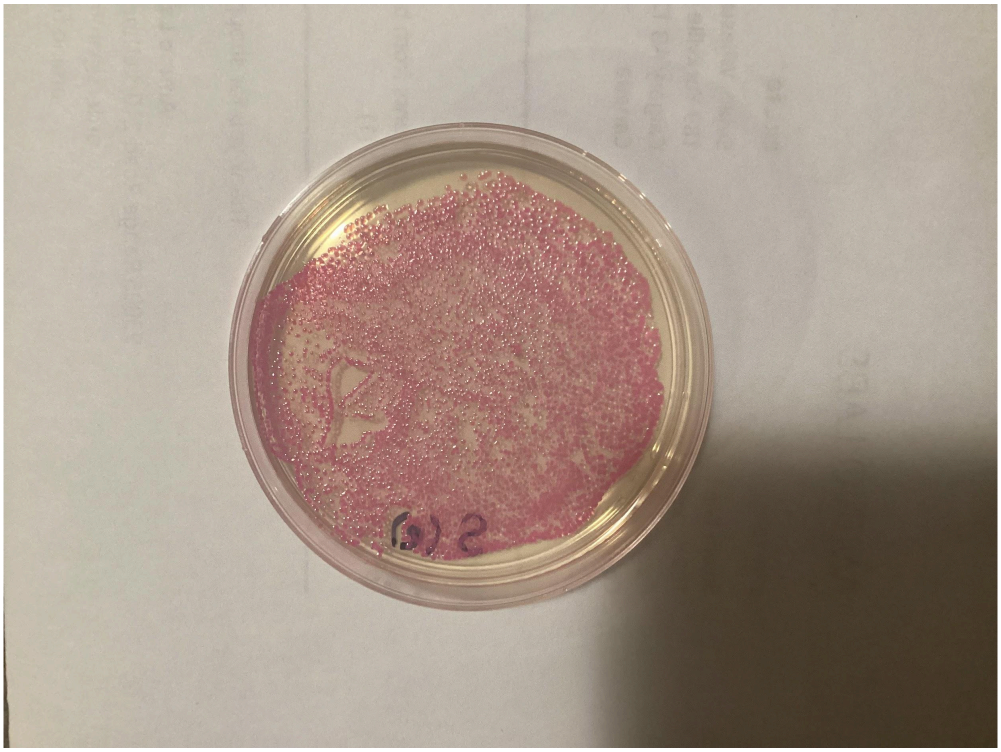
The key plasmids components are:
ColE1 ori (origin of replication)
Chloramphenicol acetyltransferase gene (antibiotic resistance gene - the reason why she made selective agar petri dishes)
Color protein gene

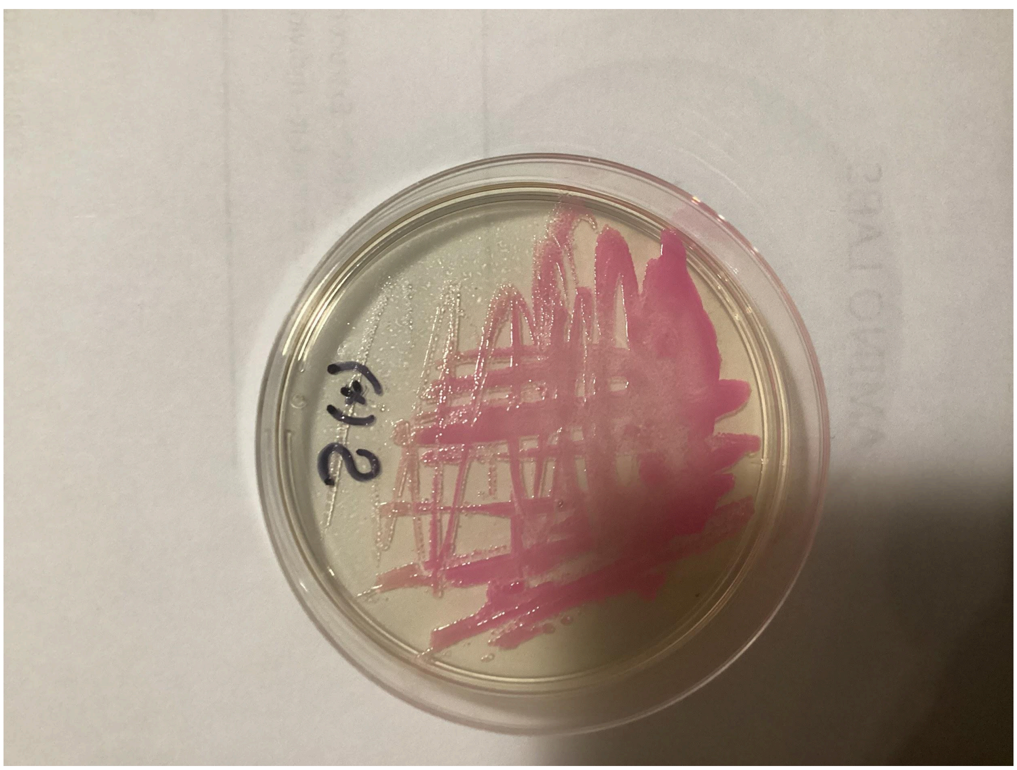
Attached is a sample plasmid map that shows the color gene.



December 10, 2024

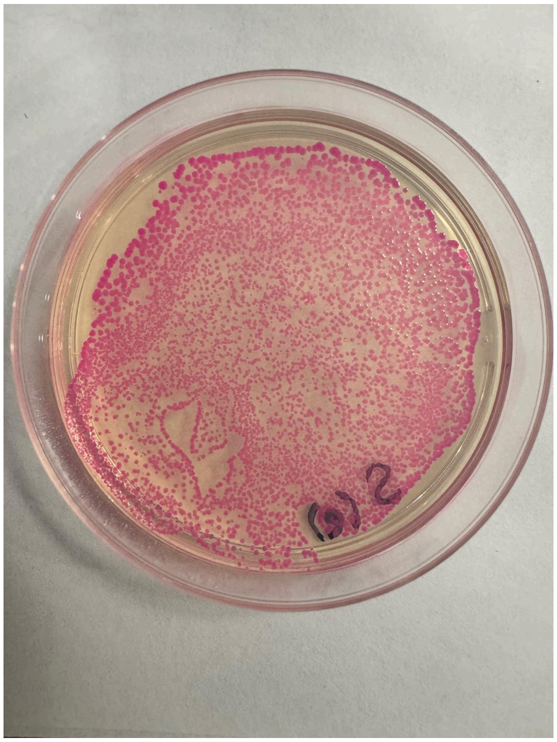
Bacteria after 24 hours incubation:

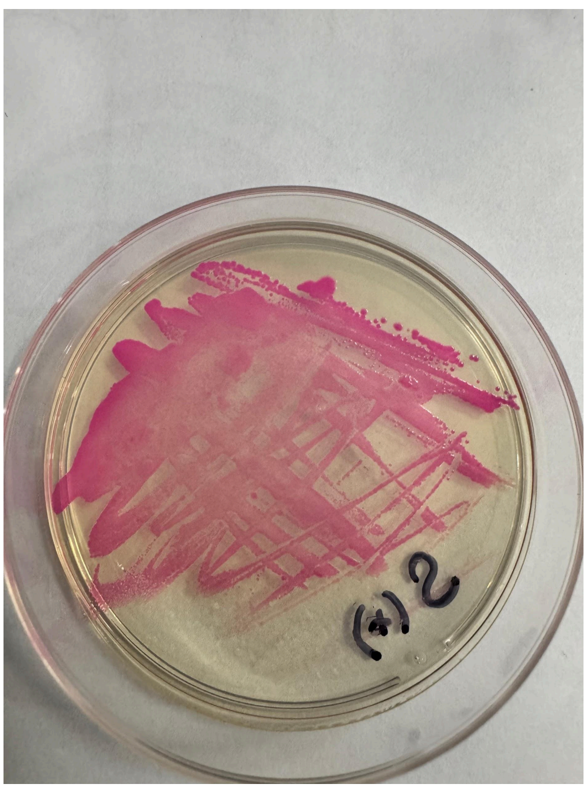




December 11, 2024

Bacteria after 48 hours incubation:



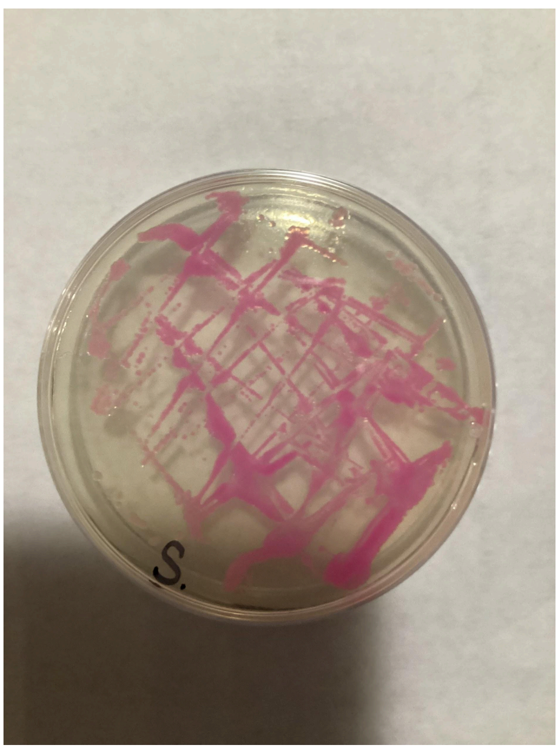


I also started day one of the extract-it kit today. I amplified the genetically engineered bacteria onto 2 Petri dishes.

Dec 12, 2024

Amplified bacteria after 24 hours:

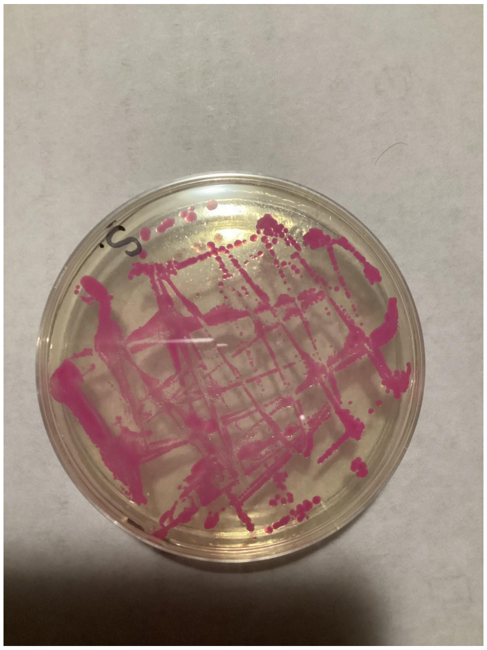
I want the pigments to be a bit brighter. I'll probably leave them for about 16 hours more.



December 13, 2024

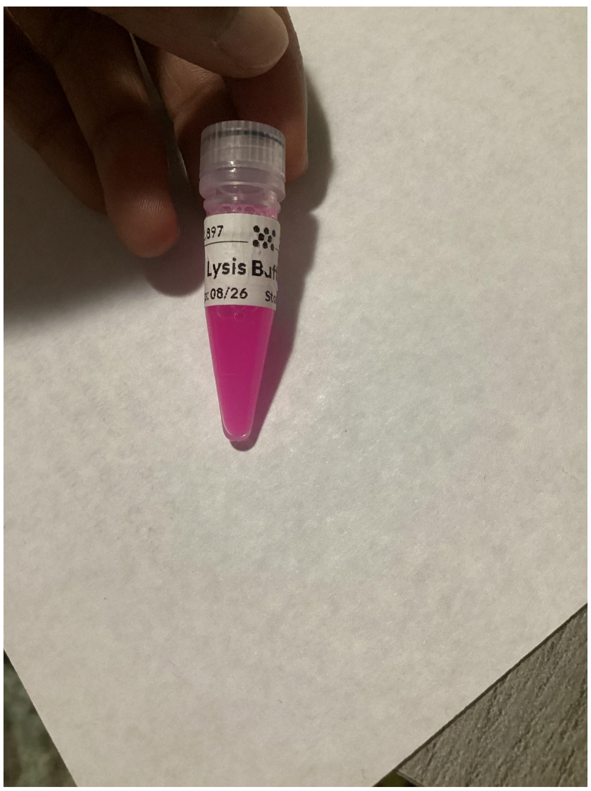
I harvested and lysed the bacteria.

Petri dishes after 48 hours:



Lysis buffer and lysis accelerator:

Bacteria after being lysed:

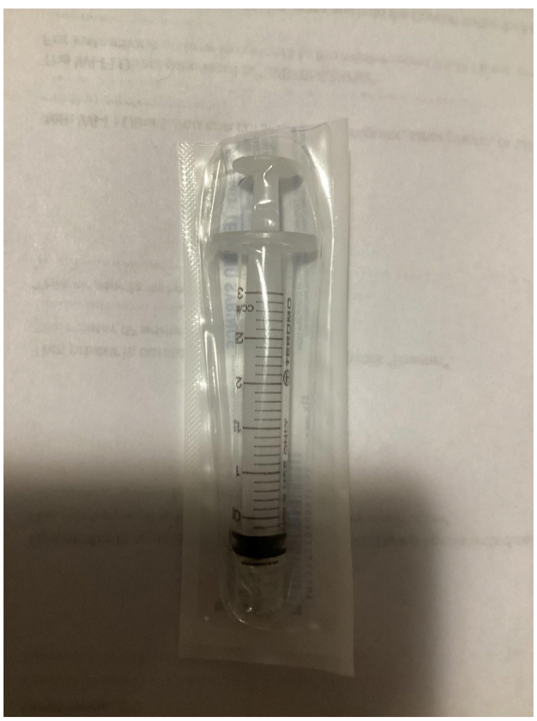


December 14, 2024

I centrifuged and filter-sterilized the bacterial pigments.

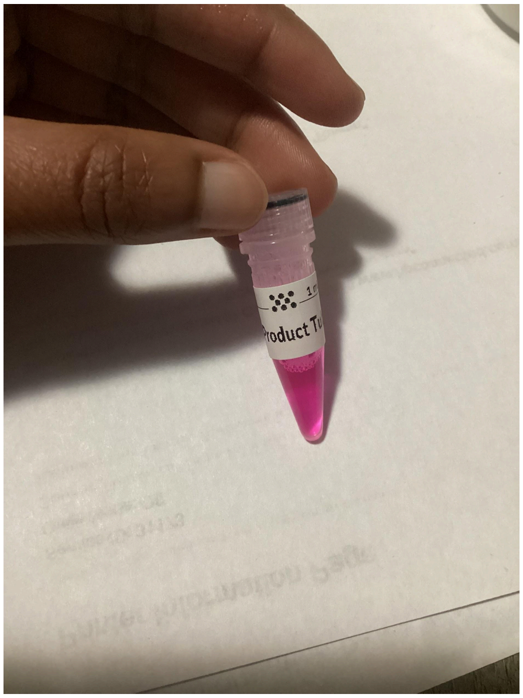
Microcentrifuge:

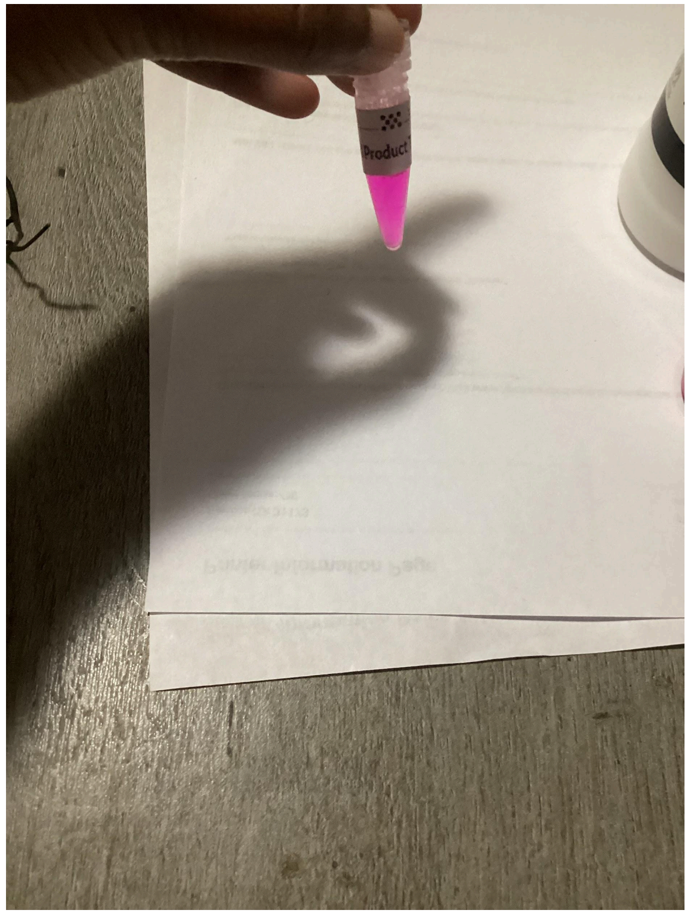
Syringe and syringe filter:



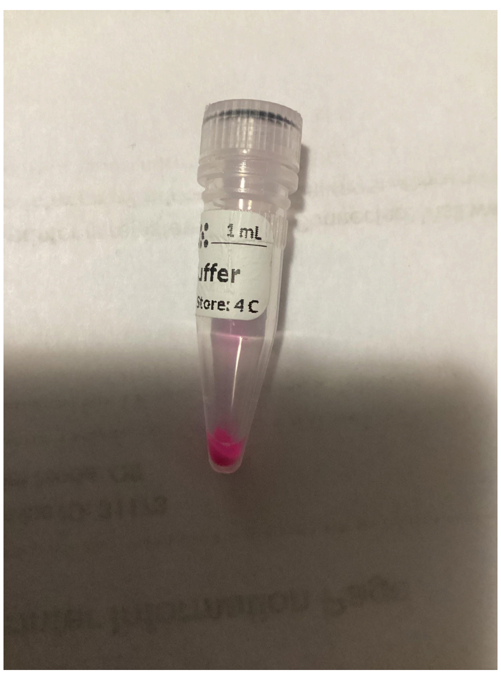
Pigment tube and balancing tube in microcentrifuge:

Pigment after being centrifuged and sterilized:





Cell debris that was left after centrifuging:



Dec 15, 2024

The making of the paint didn't turn out exactly as I expected. The colour of the paint with the bacterial pigments was very light, probably due to the liquid form of the pigments. Getting enough pigment to dehydrate it and make it into a powder would be too expensive because I'm doing this in a kit form (I can't get access to bulk materials for cheap like if I was in a company), so I'm doing the pigment extraction process again. Instead of making it into paint, I'll compare the actual pigment to acrylic paint.

I started the experiment again by amplifying the cells again. (I kept the original engineered cells so I don't have to do the engineer-it kit again.)

Dec 16, 2024

Updated procedure:

To grow bacteria expressing magenta pigment:

1. Label petri dishes 1 N.S, (non-selective) and 3 S. (selective). Label one of the selective petri dishes with a "+", (positive control) a "-", (negative control) and an "e" (experimental sample)
2. Make molten LB agar and pour it into the N.S plate to cover the bottom half.
3. Add the antibiotic pill into the rest of the molten LB agar, and after it dissolves, pour it into the selective petri dishes.
4. Let the agar in the petri dishes harden.
5. Turn on incubator to 37 degrees celsius.
6. Streak provided blank K12 E. Coli cells onto the N.S petri dish using the template.
7. Streak blank cells onto the negative control petri dish. (to see if the antibiotics are effective in preventing the growth of cells without the plasmid that gives them resistance.)
8. Flip the two petri dishes upside down and put them into the incubator with a humidity chamber on top. Incubate for 12-24 hours.
9. If the negative control plate successfully didn't show any growth of cells after incubation, discard it.
10. Turn on the "Ice 4°C" setting on the DNA playground's cold station.
11. Make sure the transformation buffer tube has all the liquid at the bottom. Place it in the cold station on the DNA playground.
12. Take a blue inoculating loop and collect 10-20 colonies of bacteria from the N.S plate.

13. Immerse the loop with the bacteria in the cold transformation buffer without touching the sides of the tube.
14. Twist the loop like a blender to mix and suspend the cells in the liquid while keeping the tube in the cold station.
15. Dip a new blue inoculating loop into the tube with the DNA plasmids (these have the genes for antibiotic resistance and pigment production.) Make sure there's liquid in the loop.
16. Dip and spin the inoculating loop into the competent cells made in step 14. Do this for 10 seconds.
17. Turn on the "Shock 42°C" on the hot station in the DNA playground.
18. Leave the tube with the competent cells on the cold station for 6 minutes, or until the hot station reaches 42°C.
19. Heat shock the cells, transformation buffer, and DNA solution in the tube by moving it onto the hot station for 90 seconds.
20. After 90 seconds, move the tube with the transformed cells back into the cold station and leave it for 2 minutes.
21. Adjust the temperature of the hot station to "Heat 37°C".
22. Pour the tube of recovery media into the tube with the transformed cells.
23. Move that tube into the hot station after making sure it's at 37°C. Leave it for 24 hours to recover.
24. After 24 hours, turn on the incubator to 37°C.
25. On the selective LB agar plate labeled "e", pour half of the transformed and recovered cells.
26. Leave the plate with the lid partially off until all the liquid evaporates.
27. Leave the rest of the transformed cells in the fridge in case this test doesn't work.
28. Get the stab of "+ cells" and the selective LB agar plate labeled "+". Using a single yellow loop, dip into the + cells stab and spread them across the agar plate in a zig zag.
29. Flip both plates upside down, stack them, and put them in the incubator with a humidity chamber over them.
30. Incubate for 24-72 hours until the trait is expressed. (after the first 24 hours, change the temperature of the incubator to 30°C to prevent the petri dishes from drying out.)

To extract the pigments from the bacteria that are now expressing the pigment:

1. Mix antibiotic into molten LB agar.
2. Pour the molten agar into 2 petri dishes and let the agar harden.
3. Turn on the incubator to 37°C.

4. With the engineered bacteria cells from the previous steps, take one yellow inoculating loop and collect a few colonies of bacteria.
5. Trace a double zigzag pattern on the petri dish with the inoculating loop.
6. Using the same inoculating loop, repeat steps 4-5 on the second petri dish.
7. Incubate the two petri dishes upside down with the humidity chamber over them for 16-24 hours.
8. When the bacteria are expressing their colour traits, take them out of the incubator.
9. Turn on the Cold Station on the DNA Playground to Ice (4°C), and set the tubes of lysis buffer and lysis accelerator in the cold station.
10. Take a yellow inoculating loop and gently drag it across the surface of one of the petri dishes, collecting some cells.
11. Once the loop is full, dip it into the lysis buffer tube and twist it to dislodge and mix in the cells in the buffer. Repeat this until all cells from both petri dishes are in the lysis buffer.
12. Mix/blend the cells for another 60 seconds using the same yellow inoculating loop to make sure they're fully suspended in the lysis buffer.
13. Using a pipette, move the lysis buffer and cells mixture into the tube of lysis accelerator that is also on the cold station.
14. Firmly close the lid of the lysis accelerator tube and vigorously shake it for 30 seconds to ensure that it's fully mixed.
15. Place the lysis accelerator tube on the cold station to cool for 5 minutes.
16. After 5 minutes, use the pipette to move the liquid from the lysis accelerator tube back to the lysis buffer tube.
17. Turn off the cold station and leave the mixture to incubate for up to 24 hours at room temperature.
18. After 24 hours, put the tube of lysis buffer and cells into the microcentrifuge. Balance it with placing a similarly weighted tube across from it.
19. Spin the microcentrifuge at maximum speed (13,000 x g to 15,000 x g) for 20 minutes.
20. Get the final product tube and place it in the hot station of the DNA Playground (in the off setting) to hold it.
21. Remove the syringe plunger from the syringe and lay it on a clean surface.
22. Open the syringe filter's container, but don't touch or contaminate the end where the filtered solution will come out of.
23. Screw the syringe filter onto the syringe.
24. Place the syringe and filter inside the burst bag, with the tip of the filter poking out of the triangle cut at the bottom of the burst bag

25. Once the bacteria pigment sample is done centrifuging, gently pour the liquid into the syringe, making sure to pour only the liquid and not the pellet of cell debris at the bottom.
26. Hold the end of the syringe in the final product tube.
27. Put the syringe plunger back into the syringe, and gently press down to filter the bacteria pigment solution. (this removes the bacteria from the solution and leaves only the pigment.)

To test the pigments:

1. Use a syringe to put equal amounts of the bacterial pigments into 3 containers
2. Use a syringe to put equal amounts of acrylic paint into 3 containers
3. Add one tablespoon of water to one tablespoon of tempera paint powder
4. Use a syringe to put equal amounts of tempera paint into 3 containers
5. Put all containers into the incubator at 30°C for 5 days, taking pictures of each in the same place, every day at the same time.
6. Put all containers into the fridge at 4°C for 5 days, taking pictures of each in the same place every day at the same time.
7. Put all containers in the incubator at 37°C for 2 days, taking pictures of each in the same place every day at the same time
8. Put all containers in front of a window for 4 days, taking pictures of each in the same place every day at the same time.
9. Check the RGB colour values of all the pictures to measure changes over time.

Dec 17, 2024

I did steps 8-17 in the extract-it kit (the steps in my procedure)

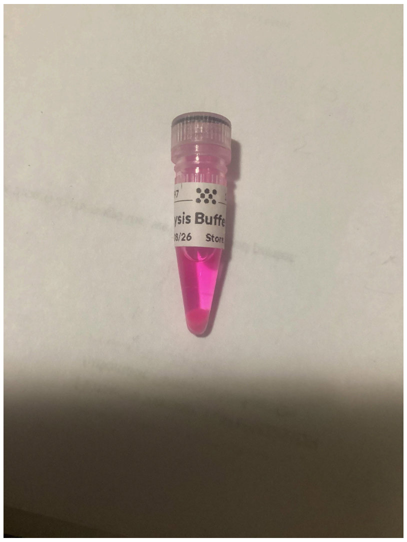
I also made a finalized material list:

- ★ Amino Labs DNA playground
- ★ Bleach (for deactivation)
- ★ Acrylic paint
- ★ Tempera paint powder
- ★ Fridge
- ★ 3g capacity clear plastic containers
- ★ Small clear plastic containers
- ★ Sharpie marker (to label petri dishes)
- ★ Amino Labs microcentrifuge
- ★ Amino Labs Engineer-it kit
    - ○ Sterile water

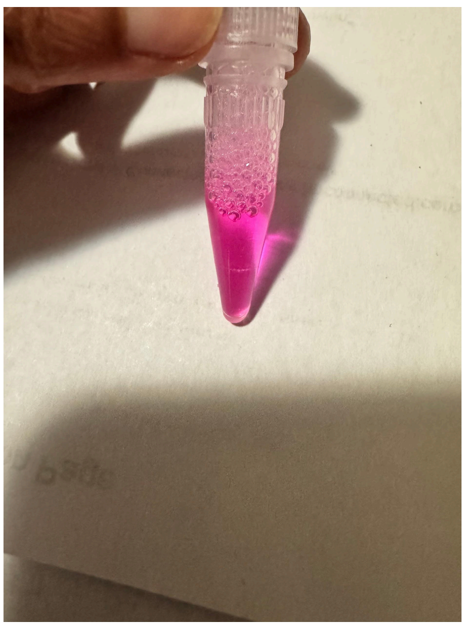
- Blue inoculating loops (1 uL)
- Yellow inoculating loops (10 uL)
- 4 6cm petri dishes
- Streaking stencil (for streaking petri dishes properly)
- Inactivation bag
- LB agar powder
- Antibiotics - chloramphenicol (selection marker)
- Blank bacteria/cells (K12 E. Coli)
- Transformation buffer
- Recovery media
- Positive control cells
- DNA plasmids
- Inactivation bag

★ Amino Labs Extract-it kit
- Lysis buffer
- Lysis accelerator
- 0.22 μm filter
- Syringe
- Microcentrifuge balance tube
- Final product tube (1.5 mL)
- Burst bag to put over the syringe
- Pipettes
- Agar, sterile water, antibiotics, inoculation loops, Petri dishes
- Inactivation bag

December 18, 2024
I extracted the pigments from the bacteria. I'll test the pigments, acrylic paint, and tempera paint tomorrow.
Solution after centrifuging: (pellet of cell debris at the bottom)



Solution after filter sterilizing:



December 21, 2024

I did steps 1-4 of the testing part of my procedure. I took pictures on day one before they were put into the incubator at 30 degrees.

30 degrees day 1

Dec 22, 2024

I took pictures of the different paints after 1 day of being in the incubator at 30 degrees.

30 degrees day 2

The acrylic paint and the bacterial pigments look the same, but the tempera paint lost some water (especially test 1 and test 2) and it’s not a liquid anymore.

December 23, 2024
I took pictures of the different paints/pigments after 2 days of being in the incubator.
Test one of the tempera paint dried a lot and now there’s bubble-like shapes on it.
Now all of the paints (not the bacterial pigments) are not liquids anymore.
30 degrees day 3

December 24, 2024
I took pictures of the different paints/pigments after 3 days of being in the incubator.
30 degrees day 4

December 25, 2024
I took pictures of the different paints/pigments after 4 days of being in the incubator.
30 degrees day 5

December 26, 2024
I took pictures of the different paints/pigments after 5 days of being in the incubator.
30 degrees day 6
I put them in the fridge now to test if cold temperatures affect anything. (3 degrees)

December 27, 2024
I took pictures of the different paints/pigments after 1 day of being in the fridge.
Fridge 3 degrees day 1

December 28, 2024
I took pictures of the different paints/pigments after 2 days of being in the fridge.
Fridge 3 degrees day 2

December 29, 2024
I took pictures of the different paints/pigments after 3 days of being in the fridge.
Fridge 3 degrees day 3

December 30, 2024
I took pictures of the different paints/pigments after 4 days of being in the fridge.
Fridge 3 degrees day 4

December 31, 2024
I took pictures of the different paints/pigments after 5 days of being in the fridge.
Fridge 3 degrees day 5

I put them in front of a window to test how stable the colours are when exposed to UV light.

Jan 1, 2025
I took pictures of the different paints/pigments after 1 day of being in front of a window.
Window day 1

Jan 2, 2025
I took pictures of the different paints/pigments after 2 days of being in front of a window.
Window day 2
I also worked on my background research.

Jan 3, 2025
I took pictures of the different paints/pigments after 3 days of being in front of a window.
Window day 3
I also worked on my background research.

Jan 4, 2025
I took pictures of the different paints/pigments after 4 days of being in front of a window.
Window day 4
I also worked on my lab report. (Title, problem, hypothesis, variables, materials, procedure, data tables) I filled these all in.

January 5, 2025
I took pictures of the different paints/pigments after 5 days of being in front of a window.

I also started working on my presentation.

January 12, 2025

I finished putting my data into these data tables.

Testing against heat:

Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint Each Day After Being Incubated at 30°C (Test 1)

Total Difference of RGB Colour Values

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment (255, 68, 177)	**255, 84, 144**	**255, 84, 148**	**255, 84, 144**	**255, 81, 143**	**254, 75, 143**
Acrylic paint (245, 110, 160)	**(236, 102, 152)**	**236, 103, 151**	**239, 103, 153**	**240, 102, 157**	**250, 102, 158**
Tempera paint (150, 18, 38)	**174, 10, 42**	**178, 18, 40**	**173, 23, 42**	**174, 14, 41**	**174, 16, 44**

Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint Each Day After Being Incubated at 30°C (Test 2)

Total Difference of RGB Colour Values

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment (253, 66, 162)	**251, 81, 139**	**255, 79, 144**	**255, 79, 145**	**255, 79, 148**	**255, 77, 148**
Acrylic paint (232, 105, 150)	**(231, 101, 148)**	**235, 104, 151**	**236, 105, 152**	**237, 103, 153**	**244, 101, 152**
Tempera paint (146, 15, 33)	**159, 5, 30**	**177, 2, 32**	**173, 3, 32**	**172, 16, 41**	**174, 3, 32**

Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint Each Day After Being Incubated at 30°C (Test 3)

Total Difference of RGB Colour Values

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment (255, 81, 175)	**255, 86, 143**	**255, 81, 143**	**255, 81, 142**	**255, 81, 144**	**255, 81, 149**
Acrylic paint (228, 107, 148)	**242, 109, 158**	**243, 110, 158**	**243, 107, 157**	**234, 108, 155**	**245, 108, 155**
Tempera paint (170, 16, 42)	**186, 17, 46**	**189, 19, 42**	**189, 14, 43**	**184, 25, 49**	**182, 15, 40**

Testing against cold temperatures:

Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint After Each Day at Temperature 3°C (Test 1)

RGB Colour Value At 3°C

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**255, 75, 138**	**255, 75, 135**	**255, 75, 134**	**255, 75, 134**	**255, 75, 135**
Acrylic paint	**250, 108, 157**	**251, 108, 154**	**247, 109, 156**	**247, 103, 157**	**247, 116, 156**
Tempera paint	**175, 13, 40**	**187, 15, 42**	**184, 15, 43**	**183, 16, 47**	**182, 10, 41**

<u>Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint After Each Day at Temperature 3°C (Test 2)</u>

RGB Colour Value At 3°C

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**255, 77, 137**	**255, 78, 137**	**255, 78, 137**	**255, 78, 138**	**255, 78, 135**
Acrylic paint	**248, 102, 149**	**248, 103, 153**	**244, 106, 153**	**246, 100, 156**	**246, 101, 151**
Tempera paint	**175, 6, 26**	**178, 5, 25**	**173, 5, 28**	**170, 6, 27**	**172, 6, 26**

<u>Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint After Each Day at Temperature 3°C (Test 3)</u>

RGB Colour Value At 3°C

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**255, 81, 145**	**255, 81, 133**	**255, 81, 138**	**255, 78, 138**	**255, 78, 132**
Acrylic paint	**245, 107, 154**	**251, 107, 153**	**249, 107, 156**	**247, 109, 160**	**247, 107, 155**
Tempera paint	**188, 6, 32**	**195, 6, 35**	**195, 7, 38**	**197, 8, 35**	**196, 3, 36**

Testing against sunlight/UV rays:

Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint After Each Day in Front of a Window (Test 1)

RGB Colour Value

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**254, 64, 135**	**255, 70, 149**	**255, 71, 150**	**255, 74, 150**	**255, 74, 146**
Acrylic paint	**249, 111, 158**	**255, 105, 164**	**251, 104, 160**	**255, 100, 154**	**255, 102, 156**
Tempera paint	**189, 25, 54**	**189, 18, 49**	**189, 27, 60**	**194, 20, 54**	**193, 27, 60**

Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint After Each Day in Front of a Window (Test 2)

RGB Colour Value

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**255, 71, 136**	**255, 69, 154**	**255, 75, 152**	**225, 75, 153**	**255, 75, 141**
Acrylic paint	**248, 100, 151**	**255, 105, 164**	**253, 103, 156**	**253, 103, 156**	**255, 104, 153**
Tempera paint	**175, 7, 31**	**189, 16, 48**	**199, 19, 52**	**203, 17, 51**	**204, 15, 50**

Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint After Each Day in Front of a Window (Test 3)

RGB Colour Value

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**255, 72, 140**	**254, 69, 143**	**255, 64, 143**	**255, 64, 144**	**255, 69, 144**
Acrylic paint	**245, 108, 155**	**255, 107, 164**	**253, 105, 162**	**254, 104, 158**	**254, 104, 152**
Tempera paint	**189, 16, 38**	**226, 24, 67**	**213, 21, 61**	**223, 22, 60**	**226, 26, 64**

I'm going to calculate the actual differences now.

Jan 13, 2025

I calculated the differences in colour values for each day and updated my graphs.

Testing against heat:

Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint Each Day After Being Incubated at 30°C (Test 1)

Total Difference of RGB Colour Values

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**17**	**4**	**4**	**4**	**7**
Acrylic paint	**25**	**2**	**5**	**6**	**11**
Tempera paint	**36**	**14**	**12**	**11**	**5**

Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint Each Day After Being Incubated at 30°C (Test 2)

Total Difference of RGB Colour Values

Type of	1 Day	2 Days	3 Days	4 Days	5 Days

pigment					
Bacterial pigment	**10**	**11**	**1**	**3**	**2**
Acrylic paint	**7**	**10**	**3**	**4**	**10**
Tempera paint	**26**	**23**	**5**	**23**	**27**

Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint Each Day After Being Incubated at 30°C (Test 3)

Total Difference of RGB Colour Values

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**27**	**5**	**1**	**2**	**5**
Acrylic paint	**26**	**2**	**4**	**4**	**11**
Tempera paint	**21**	**9**	**6**	**22**	**21**

Testing against cold temperatures:

Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint After Each Day at Temperature 3°C (Test 1)

Total Difference of RGB Colour Values

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**6**	**3**	**1**	**0**	**1**
Acrylic paint	**7**	**4**	**7**	**7**	**14**
Tempera	**8**	**16**	**4**	**6**	**13**

paint					

<u>Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint After Each Day at Temperature 3°C (Test 2)</u>

Total Difference of RGB Colour Values

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**11**	**1**	**0**	**1**	**3**
Acrylic paint	**8**	**5**	**7**	**11**	**6**
Tempera paint	**10**	**5**	**8**	**5**	**3**

<u>Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint After Each Day at Temperature 3°C (Test 3)</u>

Total Difference of RGB Colour Values

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**4**	**12**	**5**	**3**	**6**
Acrylic paint	**2**	**7**	**5**	**8**	**7**
Tempera paint	**23**	**10**	**4**	**6**	**7**

Testing against sunlight/UV rays:

<u>Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint After Each Day in Front of a Window (Test 1)</u>

Total Difference of RGB Colour Values

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**12**	**20**	**2**	**3**	**4**
Acrylic paint	**9**	**13**	**9**	**12**	**4**
Tempera paint	**35**	**12**	**20**	**18**	**14**

Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint After Each Day in Front of a Window (Test 2)

Total Difference of RGB Colour Values

Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**8**	**20**	**8**	**1**	**12**
Acrylic paint	**3**	**25**	**12**	**0**	**6**
Tempera paint	**9**	**40**	**17**	**7**	**4**

Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint After Each Day in Front of a Window (Test 3)

Total Difference of RGB Colour Values

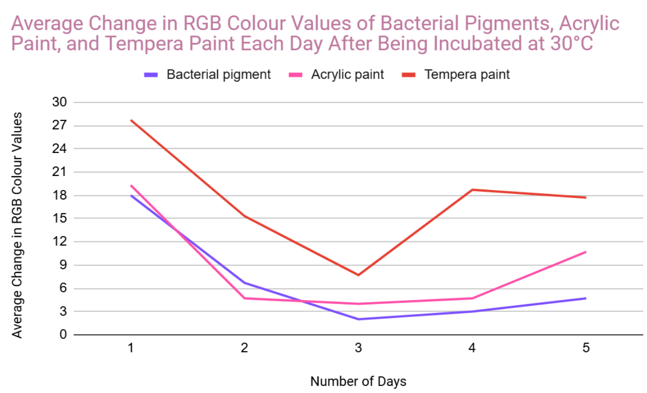
Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**14**	**7**	**6**	**1**	**5**
Acrylic paint	**3**	**20**	**6**	**6**	**6**
Tempera paint	**22**	**46**	**17**	**12**	**11**

Jan 15, 2025

I calculated the average difference in colour values for each test, for each day. I also made my graphs.

Average Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint Each Day After Being Incubated at 30°C

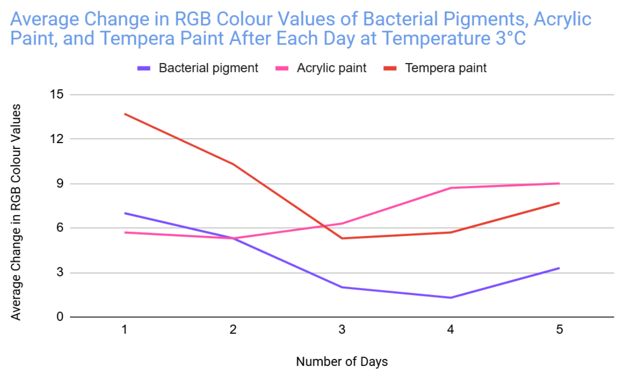
	Average Change in RGB Colour Values				
Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**18**	**6.7**	**2**	**3**	**4.7**
Acrylic paint	**19.3**	**4.7**	**4**	**4.7**	**10.7**
Tempera paint	**27.7**	**15.3**	**7.7**	**18.7**	**17.7**



Average Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint After Each Day at Temperature 3°C

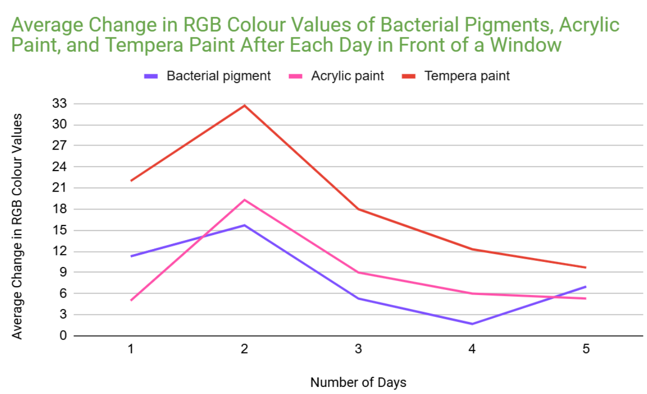
	Average Change in RGB Colour Values				
Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**7**	**5.3**	**2**	**1.3**	**3.3**

Acrylic paint	**5.7**	**5.3**	**6.3**	**8.7**	**9**
Tempera paint	**13.7**	**10.3**	**5.3**	**5.7**	**7.7**



<u>Average Change in RGB Colour Values of Bacterial Pigments, Acrylic Paint, and Tempera Paint After Each Day in Front of a Window</u>

	Average Change in RGB Colour Values				
Type of pigment	1 Day	2 Days	3 Days	4 Days	5 Days
Bacterial pigment	**11.3**	**15.7**	**5.3**	**1.7**	**7**
Acrylic paint	**5**	**19.3**	**9**	**6**	**5.3**
Tempera paint	**22**	**32.7**	**18**	**12.3**	**9.7**



Jan 18, 2025

I worked on my analysis.