PAINTING WITH BACTERIA WORKSHOP

SUSTAINABLE SYSTEMS SCIENCE MODULE | PARSONS | SPRING 2018 | KATAYOUN CHAMANY
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bacterial painting by Amy Chase Gulden

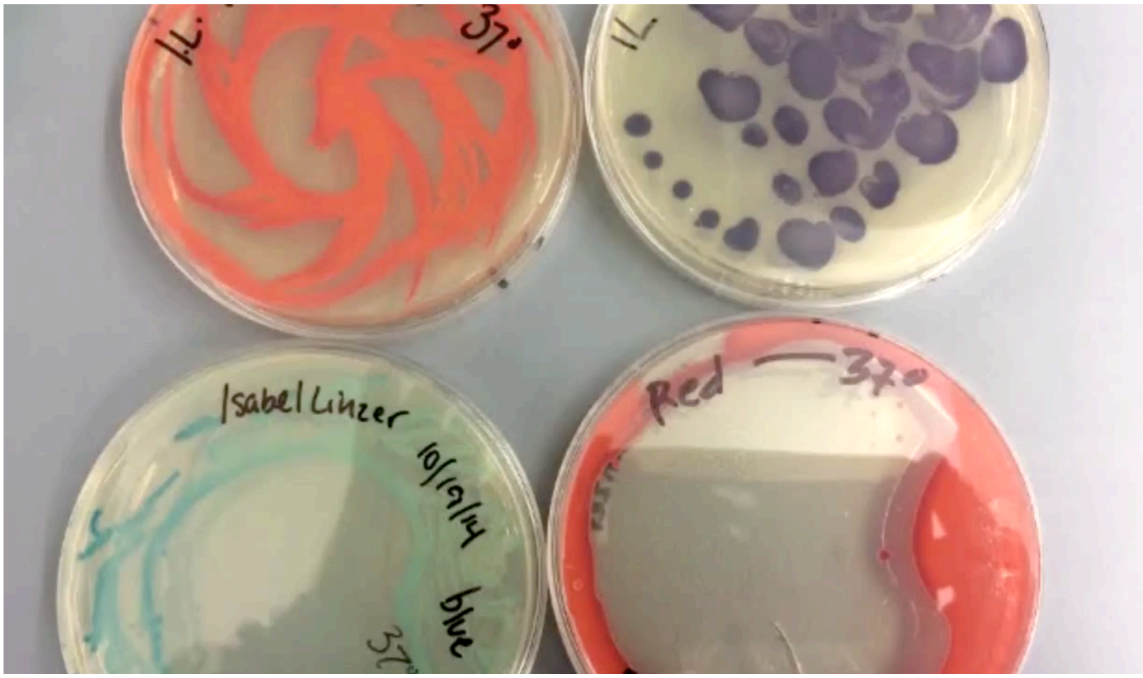
WHY PAINT WITH BACTERIA?

Using bacteria that display vibrant colors to create paintings dates back to Alexander Fleming, the proclaimed discoverer of the penicillin antibiotic. Fleming applied bacteria in brush-like strokes to create a variety of different images on agar plates. **Since then, many art-scientists have adapted this technique to answer different kinds of questions and to explore how "living" paint differs from that of traditional paints made from chemicals and vegetable dyes**, which can be harmful to the environment in terms of chemical run off, energy and land use.

PRELAB RESEARCH:

In preparation for a two-week workshop with the New School Science Lab, please see the following links for inspiration and to learn more about what you will be doing in-class:

1) **New School Painting with Bacteria workshop**
   https://www.youtube.com/watch?v=0IlWsRuhsxA
2) **Dyeing Textiles with Bacteria:** http://bit.ly/2Fta6CC
3) **Scientists Make Bacteria Dyed Jeans:**
   http://abcnews.go.com/Technology/story?id=97864
4) **Learn about the long history of using bacterial dyes in fashion:**
   https://www.asm.org/index.php/general-science-blog/item/6929-bacterial-dyes-in-fashion
5) **Explore the biofabrication company PILI.**
   http://www.pili.bio
6) **RESEARCH REFLECTION:** After viewing these sites do you think bacteria might offer alternative dyeing methods that are less toxic? Are you inspired by this potential? What questions or concerns do you have? Based on your major and personal interests, **conduct independent research on either the effects of 1) the fashion industry or 2) synthetic inks and paints on environmental systems.** Summarize your research.



PRELAB DESIGN:

You will be following in great bioartists' footsteps to create your own works of art in a petri dish using invisible paint, which will grow over 24-48 hours. You will have a variety of strains, different concentrations of bacteria to paint with, and different applicator tools (brushes, pipettes, beads), and different size plates. You can also use different temperatures and media for incubation and bacterial growth. To prepare for this project consider what design you want to paint and how the medium affects your choice. You can sketch your design in advance, as the agar plates are transparent to allow for tracing with invisible bacterial paint. You may also choose to do a free hand drawing.

DESIGN INSPIRATION:

1) Watch this 15 minute video of artist **Maria Peñil Cobo's** work with bacteria:
https://www.youtube.com/watch?v=-6OknbmJCSI
Did this video change your perception of bacteria? What did you learn? Were you inspired by her art? Do you think bacteria might be a useful medium for art and design (why/why not)?

2) Bioartist Jenifer Wightman, and faculty member at Parsons, uses an older microbial technique called the Winograsky method, named after the soil scientist who developed it. Much to the public's surprise "paintings" she created from Gowanus Canal, one of the most polluted waters in New York City, was the result of a complex ecosystem of microbes capable of sustaining growth in what would be considered a waste field. Review these links of her work:
http://www.audiblewink.com/statement.html
http://www.audiblewink.com/Winogradsky.html (scroll to right)
http://www.audiblewink.com/portraits_NYC.html
https://vimeo.com/62655839

RESEARCH REFLECTION: After viewing these links, what do you think of bacteria as an artistic media? Are you excited to try it yourself? Do you sense a difference in color (more variation etc.) between what is found naturally in bacteria, as opposed to synthetic colors? Consider our class discussions on Long Life Design. **How might painting with bacteria relate to this theme?**

CREATING A DESIGN + AN ARTIST STATEMENT

In preparation for the lab, come to class with an artist's statement and four design ideas that you would like to "paint" with bacteria. Your designs need to have aesthetic motivations. What kind of image would you like to make with bacteria and why? The diameter of your design should be 3.25 inches.

DESIGN/CONNECTIONS TO ART AND SCIENCE (DUE BY MARCH 8th)

1) Why this design? How does it relate to themes of our class and your work at Parsons?
2) Are there particular artworks, methods, or artists that influenced your choice?
3) How does the medium influence your design choice?

FOUR PETRI DISH DESIGN SKETCHES (bring to lab completed on March 8th)

LAB PROCESS:

DUE MARCH 15th

PAINT (Bacteria Variables)

1. Which bacteria did you use and why?
2. How does the genotype of the bacteria constrain or expand your ability to "paint" with it?
3. Did you consider how temperature might influence how your paint would appear?
4. Hypothesize about the results of your choices in the lab. What do you expect to occur?

CANVAS (Environment, Growth Media Variables)

1. Which petri dishes and why?
2. Which components in the canvas alter the perception of the artwork?
3. Which components can be varied and which must remain stable?
4. Do you think your work can keep growing? What would make the paint "die"?

APPLICATION (Brush, pipette, finger, other variables)

1. Which applicator(s) did you use and why?
2. What effect does the application have?
3. How did you control the amount of paint distributed?
4. Were you hoping to influence intensity, layering, or something else?
5. What did you see, do patterns regarding applications emerge?

POST-LAB REFLECTION:

DUE MARCH 29th

RESULTS/ INTERPRETATIONS

1. Did the work come out as expected (or as you **hypothesized)**?
2. Did your canvas mature over time? Did you manipulate different things over time?

TITLE:

1. What is the title of your completed artwork? Did you choose something literal or provocative, why?

REFLECTIONS:

1. What new questions do you have?
2. What would you do differently next time?
3. What is unique about bacteria as an art material?
4. What messages/images does painting with bacteria best convey?
5. How might using bacterial paint express the concept of Long Life Design?
6. What connections can you make with bacterial paint and the Long Life Design criteria?

KEY VOCABULARY:

antibiotic: A substance that inhibits the growth of bacteria. We take antibiotics when we have infections because they effectively kill pathogenic bacteria—bacteria that make us sick.

bacterium (plural: bacteria): An organism that does not have sub-cellular compartments (like a studio apartment where the recycling center, the kitchen, the toilet are all in one room of this in one structure). They usually measure a few micrometers in length and exist together in communities of millions. A gram of soil typically contains about 40 million bacterial cells.

bacterial colony: A visible mass of bacteria, all originating from one mother cell—making them genetically identical, or clonal. The reason bacterial colonies are visible to our naked eye is because they are made up of billions of cells.

cell: The smallest unit of living organisms. All plants, insects, animals, and microbes are made up of cells. All cells come from other cells through a process of cell division. Cells are about 70-90% water, and a fatty membrane creates the barrier between outside and inside of the cell.

dowel: A dowel is often made of wood and resembles a very long toothpick. They are sterile, like pipette tips, and are used in the lab to deposit (or streak) bacteria on growth media plates, or as a tool in the Painting with Bacteria module for puncturing growth media and making very clear, specific designs when painting.

growth media: A collection of nutrients, vitamins, sugars, and correct pH to support the growth of bacteria and other micro-organisms in a laboratory environment. Growth media is typically liquid in form, but can also take a solid form when mixed with seaweed agar. Scientists can formulate media, to induce specific behaviors, colors, and responses; for this workshop, we use this quality to our advantage to result in specific colors.

microbe: A broad term that encompasses bacteria, yeast, and sometimes viruses. Microbes tend to be small, hence the prefix "micro." Most are essential for our living ecosystems; for instance our microbiome. Some can be disease causing and are referred to as "pathogenic" (illness).

negative space: The space around and between the subject of an image.

petri plate: a small dish containing sterile, solid growth media inside of it. We use petri plates to grow bacteria in a contained and sterile place. The "bottom" of a petri plate is the part that contains a layer of growth media on it.

pipettor: A pipettor is a tool to measure very small volumes. Pipetting instruments comes in different sizes.

pipette tip: A pipette tip is made out of plastic and used in conjunction with the **pipettor** for sterility. Pipette tips, like pipettors, also come in different sizes, and are placed on pipettors to keep the pipettors clean, so that they can be reused without contaminating the cell culture.

pigment: The natural coloring of a plant or animal cell. There are diverse groups of pigments produced by bacteria, and they often play an important role in the survival of the bacteria that produce them.

mitosis: a type of cell division, in which a "mother" cell duplicates her DNA and divides into two "daughter" cells that are genetically identical to one another. In lab grown bacteria like *E. coli*, mitosis takes place every 20 minutes. In our bodies, mitosis takes place everyday in some of our regenerative tissues, like skin, hair, and gut lining.

LAB PROTOCOLS + SAFETY:

We place new, sterile **pipette tips** on the pipettor every time we use it, to keep everything sterile in a microbiology lab, to keep our cell cultures pure. It is very important to keep the pipettor vertical at all times, and never hold it horizontally, as it uses a vacuum to operate and liquid will damage the vacuum.

After using a pipette tip, it must be ejected into a waste beaker. A new pipette tip must be placed on the pipettor every time you want to extract volume from a different different liquid.

When storing petri plates, we place them upside down, because as bacteria metabolize sugar, they generate heat and water, and plates' lids collect condensation, which can drip onto the growth media and contaminate it, or dilute your designs.