HARLEM ACADEMY
GENERATIVE TEXTILES
LESSON PLAN

GENERAL:

1. Mentors come prepared for each day by reading carefully the script for the day
2. Mentors Groups:
    a. Group 1
    b. Group 2
    c. Group 3
3. All: Document how everything works out (take pictures, take notes!)
4. Students should be reminded to document their work continuously. Last five minutes of every (larger) exercise is concluded by students revising their notes and documentation

Summary: Between June 7-9 the students from Harlem Academy will learn about the use of scientific experimentation to provide a generative approach to textile dyes. First they will learn about the problems created by synthetic dye industry, and contrast that with the ecological and cultural value generated by natural dyes and artisanal labor. Then they will experiment with pattern simulation to see how information technology might improve traditional textile prints. Then they will experiment with natural dyes to see how chemistry can help leverage natural, environmentally and socially just resources for dye making. Their final project will create wall hangings using these natural dyes and technology-enhanced techniques.

Workshop theme:

Textiles cloth our bodies, warm our beds and shade us from sun. But the modern textile industry extracts value from nature, and returns little other than pollution. It extracts enormous value from our labor, yet textile factory workers are among the most poorly paid. Traditional textile making, before colonialism, was based on the circular generation of value, rather than extraction. Natural dyes came from plants, and the waste could be recycled back into the soil. Artisanal labor was respected, and fairly exchanged for equally valued goods. But today's high speed factories make it hard for these traditional methods to compete. The challenge of this workshop is to explore how modern science and technology can empower traditional textile methods and communities. Students learn how synergies between traditional practices of color making and scientific experimentation can facilitate a more generative approach, one that circulates value to people and the environment rather than extracting it.

Through hands-on experimentation we will explore

- tensions between automation and labor;
- the chemistry, ecology and economy of fabric processing and dying (especially environmental and health impacts/labor and resource injustices, implications of dying processes and chemical processing of fabrics);
- the social, economic and cultural issues within industrial and local (semi-) manufacturing fabric and fashion industry;
- new roles for of cultural/traditional knowledge and expertise;

to foreground potential opportunities emerging from creating symbioses between local manufacturing, technological and scientific innovation, and traditional cultural knowledge and expertise, embedded in the lifeworlds and -experiences of the students.

Day 1: Wednesday June 7

Overarching theme of the day:
Social, cultural, environmental aspects of dying processes in textiles.

2pm - 7pm, Location: PDI studio
Materials: Laptops for simulation; printer; notebooks for documentation; thumb drive; google drive with research material
Work sheet No. 1.

1| INTRO 2pm - 2.30pm
Setting the Theme: The Textile Industry & Dyes: Environmental Impact

Young researchers arrive, rounds of introductions. We discuss the context of the workshop, contextualizing it through the concept of *research programs*. This gives us simultaneously the opportunity to personalize the concept, explaining that this workshop itself mirrors what makes a research program.

- Welcome
- Ron: a brief word about what we are doing, what we are researching on → say that we are a research program;
    - Individual Introductions with the roles each of us play in the context of a research program, but don't make explicit what a research program is

Some examples of Research Programs: In a PPT format project images that reference three research programs.

- 2) Cancer Research (Chemists, Botanists, Clinicians and Doctors, Environmental Science, etc.)
- 2) Space program (Mathematicians, Rocket scientists, Biologists, Social Scientists, Chemists, Physicists, Engineers, Computer Scientists, Psychologists…)
- 3) Climate Change (project pictures, show Geologists, Chemists, Urban Planners, etc.)
- 4) Our project is a research program as well:
    - Explain to them how we fulfil different roles in developing what we try to achieve (**Ron**).

After, explaining that a research program has a "hard core" set of common theories and goals that are accepted by all researchers, who engage in smaller projects to support the goals research program. Some of these projects will be in competitions with each other, allowing the best project to prevail.

Students ask mentors questions in the groups (**WORKSHEET 0**)
Pass out students "Lab" notebooks. Explain to students the importance of keeping a lab notebook as a scientist. Explain how it proves the experiment you are conducting to be your intellectual property and will then help you to **patent** your work.

Explain that each one of these research programs takes place across multiple laboratories. **Ask students if they have been in a lab before, ask them for descriptions on how it looked like/they imagine how a laboratory looks like.** Emphasis that laboratories might look like we imagine (lab coats and a slick clean working environment) or they might look like a metal shop or makerspace.

While the laboratories are different they all use the **scientific method** and try to **falsify** their hypothesis.

- **[Mentors describe how their laboratories look]**.
- Explain to them what a **scientific method** and **falsifying hypothesis** is, generally and briefly, and why we do this that way.
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2| SYNTHETIC AND NATURAL DYES **2.30 - 3.30PM**

Discuss how coming up with synthetic dyes also was embedded in a research program:

(Synthetic) Dye-Making: Chemists, Manufacturers, Engineers, Biologists and Botanics all worked together to understand how colors can be made efficiently. For that they learned what we already knew, and formulated new ideas about how dyes can be improved.

- Eventually they came up - and still do so – new chemicals that made dyes stronger, more reliable in always looking the same, more durable, water proof, resistant to modern washing soaps, etc. → project on the screen and introduce the actual terms that signify those aspects:
  - Durability
  - Water proof
  - resistant to modern washing soaps
  - Reliable in always looking the same
  - strength and variety
  - (what else)

Exercise – Student research: Enviro Impact of Dye in Fashion **2.30 - 3.00 pm**

Young researchers are **split up into three groups** (these will be the groups the work in throughout the workshop). They will conduct background research on three key aspects of the workshop and prepare mini-ppt-presentations. Mini-ppt presentations throughout the workshop will be the basis for the final presentations on the last day of the workshop. This first presentation represents the “background” section of their final presentation.

Hand out worksheet [worksheet no. 1: “Background research”] for this exercise to the groups.

[Mentors make rounds and help students in the exercise. In the beginning it is important that each group has a mentor to help them understand the task, and where/how they can find the resources for their research]

Each group will read one or two short articles, and get some short overview information material (info sheets, short video clips, images), provided through google drive. Students will work through the material and compile ppt-presentation for a share out.

Group 1: Health and Synthetic Dyes.
The group will research the labor conditions in the fashion industry and the ways it produces its products, specifically focussing on dyeing and dye making, in an general overview.
Group 2: Environmental Problems and Synthetic Dyes.
This group will research various dimensions regarding health and the environment in the use and production of industrial dye chemicals.
Group 3: Alternative Resources for Dyeing.
This group will research the alternative pathways provided through natural, local dyestuff and traditional cultural practice of dyeing, the advantages these alternative avenues provide.

These themes are intertwined, and in the concluding discussion of the student's presentations we will bring these themes together to point out the promises and potentials of natural dye, making them aware of some shortcoming and challenges that need science to figure out. **talk about globalization and alienation**

Mini Lesson – Presentations and Share out 3.00 - 3.30pm
Students give short (5 minute) presentations. We will discuss together briefly key aspects of the respective themes, highlighting those aspects by picking up what students presented and praising them for their insights ("That is very cool that how you articulated that - this is super important bc --- bring in additional aspects"). In the discussion we will tie the different aspects the students researched together, to foreground the importance of interdisciplinary research programs. **Concept: interdisciplinary knowledge production, diversity**

Through this we articulate the task and aims of the workshop and set the theme. We project again the properties of synthetic dyes we discussed in the beginning of this exercise, and add on negative and positive aspects

- Discuss how these aspects also are embedded in the problems synthetic dyes create
    - e.g. resistance to modern washing soaps goes hand in hand with the huge environmental harm the chemicals they use produces
    - Some things are great and have a huge advantage, some things are highly problematic
    - Make the kids realize that in order to strengthen natural dyes for their environmental and social advantages, we need to come up with ways to enhance certain properties the synthetic dyes are really good at achieving (durability, eveness, etc.)

We discuss the issues of synthetic dyes and its varying aspects, and foreground how alienation is a key factor in this –-– we also will discuss the advantages of synthetic dyes that made them so successful – and the ways these advantages come about, with all the invisible negative consequences that enable them in the first place. We will associate this with the chemistry (foreshadowing how in turn we want to do the same with natural dyes, while making sure they are not alienating and extractive).

Mini-Demonstration on Dye Basics (10 min):
We make briefly, with two young researchers as assistants, a mordants to illustrate how science can help improve natural dyes.

- **Mordant:** show how Alum Mordant is made (with the help of two “assistants” and the other kids standing around us watching) and explain what it does
  - I will use small fiber test stripes in this demonstration, and make explicit to them that you can test multiple things simultaneously by using test stripes (important for the experiment design - see next exercise). E.g. tell them that you could leave multiple test stripes in the solution and take them out at different times to test how the fiber changes with varying exposure to the substance.

BREAK

3| ADIRE ADINKRA AND XHOSA PATTERN SIMULATION **3.30 - 5pm**

- Intro/Aim of the mini-lecture (Ron)
- Pattern simulation
  - Assign kids to work station
  - Kids, with guidance of mentors (Leo, Amelia, Ehtan, …?), complete tutorial (20-30 min)
  - Kids make their own patterns (30 - 40 min)
  - Share-out: Kids present their patterns, vote on the best ones to be printed
  - The others will be printed on paper and handed out (or can we make them on stamps, etc.? For smaller fabric dyeing, as we have the alternative means?)

- Kids conclude the day by writing documentation of their work --- importance of documenting, we discuss how key that will be during the whole next day, Mentors have to remind them throughout the day that kids need to keep protocols of what they do.

NIGHT PRINTING FUN

Day 2: Thursday June 10

9am; Location: PDI studio
Materials: Laptops for research; printer; notebooks for documentation; thumb drive;

Experiment Material: see extra checklist (“Checklist 1”).
Worksheets: 2-7

Mini -Lesson: Exploring the Laboratory, Intro to natural dyes 9.00-09.15am

We set up the workstations prior to their arrival and assign them to their work stations. Workstations are setup and students come in.

We give an brief intro to the day, telling them that we start exploring natural dyes.
Ask students, in context of the day before, why natural dyes are better, and what we try to achieve?

1) Ask students what the advantages of natural dyes are
2) Ask students what the advantages of synthetic dyes are
3) So what do we try to achieve through experimentation:

→ based on what we learned in the student research the day before. Remind them that we try to utilize and strengthen the advantages of natural dyes by improving some key aspects of them (what are they -- they should by now be able to list: color fastness, constance of colors, variety, etc.)

1| EXPLORING NATURAL DYES 9.15 - 11.30

Exercise: Learning about Hypothesis by making an Indigo vat 9.15-10.45am

Students already learned the general aspects of experimentation and its importance on the first day. We come back to that and tell the students about dependent and independent variable, as well as controlled variable as we set up the indigo vat.
This is a casual informal starting off of things. Students are quasi-dropped into the cold water. We just start off with things (yay)!

Hand out the Indigo recipe (Worksheet No. 4). Students read them.
Lead instructor walks everyone through the experiments, students follow the instructions on their workstations.

1. Mentors: set up the experiment with students (this will take about 20 minutes):
    a. Turn on hot plates (make sure students know not to touch them, be attentive to that)
    b. Put beakers with water on there
    c. Set up the sensors (Amelia, Ethan!)-- start measuring temperature and ph level. Bring water to 40C. While students are waiting for the water to reach that temperature: intermission on PH values and controlled for variables

INTERMISSION: Ask why we are measuring this. Explain to them that we learned that we will kill the yeast bacteria if we go over 50C, but at the same time they don't really are active under 40C. So we have to make sure the temperature is right. At the same time [reason for the alcine level]. So we measure that.
Mini exercise on measuring and explaining PH
→ Make them see that the chemistry in optimizing natural dyes can be very complex and needs careful experimentation. This requires controlling for variables in order to understand relationships. Tell them that in order to understand how yeast works, there have been experiments necessary. You can use such sensors, like ph and temperature to control for variables to make sure they don't interfere with your experiment
Then talk about the reason why we want to

d. Once at 40C: Put in Yeast and Sugar -- wait for it to make bubbles and froth; explain why that happens
e. Simultaneously make paste, stir in, let sit.
f. Explain them the science behind that
g. Put the experiments aside (MENTORS) -- carry the containers to the supply desk and leave them on the hot plate there (we will look at them again on Friday, maybe something happened by then

Taking a step back, we talk about the laboratory and experimentation, explaining them hypothesis formulation and the value of experiments. Talk with them about how science can help optimizing dyes, by experimentation through hypothesis testing as scientific method. Use the wax example to convey testing A-B relationships and how controlling for variables is important in that process. Explain to them how the sensors did that in our exercise with the vat. And how testing and experimentation enabled us to learn what these optimal values we used are, as we started to understand the chemistry that stands behind the indigo.

2| Student Research: The Dye Stuff **10.45 - 11.15 am**
Students start encountering how dyeing works. They will stepwise learn about the dyestuff they work with and the ways in which we actually extract the color from the dyestuff.

Group 1: Indigo + Turmeric ------ Stamping; Ron, Anegi
Group 2: Indigo + Onion Skins ------ Robot; Amelia; Dagen
Group 3: Indigo + Blackberries ----- Folding; Ethan, Kwaku

a) Intro to Dyeing
Students receive three worksheets: **Hand out dyestuff with info cards (Worksheet No. 5 – Dyestuff), the intro to dyeing sheet (Worksheet No. 6 - Dyeing 101) and the questions sheet (Worksheet No. 7 - Reflection Sheet).**

We also distribute the dye stuff to the respective groups. The young researchers will recognize the substances from their research the day before, and they will discuss the background of the dyestuff. Have them read through worksheet No. 6, and have them identify and note down the independent and dependent variables. **[Mentors: remind them**

in the process - by asking them – what this means]. The bold terms signify the independent variables, their effects are not explicitly mentioned but there are hints throughout the document on what dependent variables may be (and they should recognize them from earlier discussions).

Students then read through the info sheets for their dyestuff and answer questions on worksheet No. 7. Through that they articulate again the purpose of their experiments and the aims of the workshop.

b) Articulate the research hypothesis

Now the students get worksheet No. 8 (Hypothesis formulation). and start articulating their hypothesis, based on the aims they formulated in worksheet 7. For that they have to combine information given in the different worksheets. Mentors guide them through that process: They have to figure out what they want to do, by putting dependent and independent variables in a relationship. Once they articulated that they will define their experiments.

Finally, hand out worksheet No. 9 (experimental setup) where they fill in the concrete things they will do with the dyes in their experiments. Students can design multiple experiment by using different test stripes and the two beakers they have, revolving around what variables to control and how to dye. At then end they should have clear hypothesis to work with and an experimental setup.

[For Mentors/Instructors - Specific aspects of indigo:]

A) Indigo: Indigo is tricky with its chemistry. There is a risk with getting the vat working, as it is every time a gamble and things can go easily wrong and the vat is ruined. We will have to make the kids aware of that aspect, and can convey that even a failed experiment is a valuable one, as it makes us revisit our findings and find out what needs to be adjusted, granting a better understanding of how things work.
There is little wiggle room for experimentation with the recipe itself for that reason. But they will learn a lot in experimental setup.
Mentors should help them define experiments around what they need to measure in order to get the vat right (especially temperature, duration of rest, ph value).
Furthermore, kinds can design experiments involving how long the dye soaks in the vat and how they measure their success with the colors they produce.
Very likely, the colors will come out unevenly. Make them aware about how this can be something great (reference to denim). Make them think about how they could increase the “evenness” of the color.

3| Setting up the experiments -- Making the dyes **11.15 - noon**

It is time to get to work! The young researchers, under guidance of the mentors, will start setting up their dyes! Here the help of **mentors** will be crucial, especially in handling the indigo, and the instruments in general.

Revisit the notes. Follow the recipes as provided and adjust them according to the experimental setup. Mentors should play an active assistive role in all of this, but let the students take the lead and make the decisions – have them own this!

Mentors, some additional information:

- if they use hot dyeing methods, they go over with their mentors to the hot-dye-room (we need a cool acronym!) and carefully set everything up, we won't let them operate directly with boiling stuff, but they can prep quantities in the lab and then bring that over, put things in the water and then we heat it up
- if they use cold dyeing methods, they follow their self-formulated recipes with the help of the mentors
- have them document their work!

LUNCH BREAK

During lunch break - bring in the prepared indigo vat, set up the colors for dyeing. **Mentors should meet with me briefly to give me details on the students' experiments and so I can help providing the means for the experimental setups necessary, and how to test the results.**

4| Documentation
2-2.30pm

Students return from lunch at 2 pm. We start the session by completing the documentation in their notebooks (about 10-15 minutes).

5| Experiments, Testing, Documentation (Dyeing) 2.20-4.30pm

After that, the students will start dyeing: They will prepare test strips (they get mordanted and non-mordanted fabric and will cut **[with the help of the mentors]** the appropriate amount of test strips and conduct their pre-defined experiments.

[Mentors: help them in handling their fabric. For the indigo it is crucial to dye it correctly (follow the instructions). It will be key that students have a clear understanding of the process: how long will they keep the fiber in the pot? At what temperature? Do they need to stir it, etc.?
Make them document what they do, and label their test stripes when they take them out.]

This is hard to predict how it exactly plays out, as some fabric needs to soak for 20 minutes, some for an hour. We want to keep them busy during that. But the inital set-up will keep the occupied – including appropriate documentation – for about until 3pm.

After that, we have to be flexible, with the following activities that students have to accomplish until 4.30pm.

[Mentors: Play an active guiding role for your group in regards to what tasks the students should take on once they are done with starting the dye process.]

Tasks to complete between 2.30 and 4pm

1. Dyeing (see above)
2. Results testing and documentation
3. Dye the wall hangings
4. Start working on the PPT

AD 2)

While the colors soak students should prepare the setup for **testing their results and documenting them**. This will look different for each group, and I will prepare some guidelines for mentors during lunch break, based on what the students produced.

This can involve for example

- testing color fastness (Amelia, Ethan and I will help students set the sensors up)
- testing if colors match what was expected (this will mostly involve the students making "thick descriptions" of the results. Mentors should help them finding good ways to express their results in efficient ways)
- Color change with duration of exposure, changing amounts of dye stuff, etc. This will involve visual documentation of the results.

Once they start testing, students should use the general checklist (**Handout Worksheet No. 10**) for testing some general parameters. After that they test if their hypotheses were confirmed, and revise/adjust their hypothesis (**Worksheet No. 7a**) -- see also ad 3).

AD 3)

Once students have revised their hypothesis and adjusted their experiment (this should be done rather quickly, given the time constraints), they will have to make a decision on how they want to dye their wall hanging based on the results

(my expectation is that everyone will go for turmeric, given how well it works and the color it produces - if we have time at the end, we can suggest them to go wild and overdye their hanging with another color "to see what happens". We can also do that with some of the test stripes, if we have the time, but I doubt that any of that will be the case)

AD 4)

Whenever there is downtime, have the students start working on their presentations. Use the mini-ppt from the day before, and start by adding on their hypothesis and documentation to illustrate what the problem was, they addressed and how they tried to test the hypothesis they formulated. By that time I will have uploaded documentation material to the drive for the students to access photos from their work during the day.

7| Wrap up and Work on PPT. **4.30-5pm**

At 4.30 we have to stop whatever we are doing (and finish it for the students over night). Most of the things should be done, but the wallhangings might still need to soak and finish. We will tell the students to instruct us as their “quasi lab assistants” and will present them with the final results the next morning.
Then we tell them to start working on the ppts and that they will present them tomorrow - they will have an hour the next morning to complete whatever did not get done.

Day 3: Friday June 11

9am; Location: PDI studio
Materials: Laptops for research; thumb drive, projector

1| Finalizing Presentations **8.30 - 9.20**
Students come in, we will have a lax and excited atmosphere as we are coming close to an end now! This will be a mostly easy day for all of us:
Students finalize their presentations, especially focussing on their final results – the wall hangings. **Take pictures of the groups with their results!** Students should again document the results of their dyeing of the hangings, and make some final conclusions on their experiments (and maybe include suggestions on what the next experiment could look like based on these new results).

2| Setting up presentations **9.20-9.30**
Collect all presentations via thumb drive and set them up ready to go for folks coming. Students can decompress for a moment.

3| Final presentations **9.30**
Students give their presentations

Everything good must come to an end, so also this – we’ll go for lunch and celebrate (hopefully)!