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| Lesson Objectives: SWBAT and PLO’s* Students will propose ideas as to how the blue dye might be obtained from natural plant sources and understand that there is a trial and error aspect to discovery.
* The students will understand the processes of fermentation, reduction and oxidation, which are important chemical reactions causing the color production of indigo blue.
* The students will investigate a vat dye solution and observe reactions and results and interpret and evaluate the evidence.

Preparation:* Create a indigo stock solution as per directions of the Maiwa handprints Indigo and Woad Pamphlet (20 mins; can be prepared up to a week in advance)
* 19 Liters of water in a Large bucket kept at a temperature of 45-60 degrees Celsius (10 mins)
* Indigo Vat Instructions Booklet for each student

Supplies Needed:* Natural Indigo Powder
* Thiourea dioxide or sodium hydrosulphite
* Lye (sodium or potassium hydroxide)
* Synthrapol soap and soda ash (for cotton)
* Orvus paste and vinegar (for wool and silk).

Natural Indigo Dye VatGrade 11/12 ChemistryPrepared by: Ms. BarberDate of Lesson: TBA | Teacher Guide | Class Narrative | EquipmentNeeded |
| Introduce Indigo*0:00-0:015* | ~As a hook, teacher adds the stock solution to the indigo vat, students can watch the indigo turn blue as it is oxidized, and then back to yellow as it is reduced. ~During this lesson students will review the history of the Indigo plant and it’s influence around the world.~Students will also learn how to obtain, harvest and ferment the plant. In this class, we will be reviewing the chemical reaction that happens during the fermentation process.~Later in the class, students will observe an indigo vat at work and watch the de-oxidization and oxidization process. ~Students are asked the question: “There are records of dyes being used to color fabrics dating to before 2500 B.C. If you were assigned the task of making material more colorful, how would you find a good dye? Keep in mind the point in time (3,000 to 4,000 years ago!) and the resources you have available.” Students will write down their answers, and think-pair-share. | ~[Indigofera](https://en.wikipedia.org/wiki/Indigofera)~Why do we use indigo?~How much indigo does it take to dye a pair of jeans? (3-12g)~Where does indigo come from?~Why do we use chemicals in a vat and what are the alternatives? | • a large bucket or plastic garbage can• quart wide mouth mason jar• quart pot (stainless steel, enamel, or pyrex),• measuring spoons• wooden rod or stick for stirring• rubber gloves. |
| Reviewing the History*0:15-0:20* | ~ Teacher shows a powerpoint of the following: * What is Indigo?
* Where does it come from?
* How long has it been used and in what cultures?
* The ancient method of extracting the blue dye-Vat dye process.
* The economic value of indigo and value of blue to the world.
* Explain the process of fermentation, the reduction and oxidation process that eventually reveals the blue color.

  | ~How log does it take for the indigo vat to reduce?~Can we speed up the indigo dyeing process?~Why do we need to keep the indigo vat warm and de-oxidized? |
| Fermentation and Oxidization*0:20-0:30* | ~ Teacher lectures on the chemical process of fermentation.~Teacher lectures on the chemical process of oxidization and what is going on within the indigo vat when we dye a textile. ~Explain the role of heat in an indigo vat.  |    |
| Demonstration of Indigo*0:30-0:37* | * Review safety procedures.
* Review reduction/oxidation process.
* Identify the materials needed to complete the lab.
* In lab groups students will create a vat dye bath using indigo and dye fabric or yarn.
* Students will make observations and answer questions.

~Teacher will first demonstrate how to dip the textile into the indigo vat will every correct measure taken into account.~Teacher will show the lowering and raising of a textile at least three times. | ~~ |
| Students Try*0:37-0:55* | ~Students will then try to dip their own textile (using rubber gloves and extra safety precautions) so they can watch the oxidization process themselves. ~Fabric must be fully immersed.~Students dip once and keep their textile in the vat for a minimum of 10 mins. They then oxidize their textile outside of their vat for a minimum of 10 mins. ~Students may dip as many times as they like, time permitting.  | ~ |
| Clean-up | ~Students must let their textile dry for 24 hours before rinsing it with cold water and a vinegar solution. ~Students must wipe up all indigo drippings and wash their rubber gloves.  | ~ |
| Assessment | ~Exit Slip: 3-2-1. 3 Things they learned today, 2 questions they have about the chemistry of indigo, and 1 thing they will take forward into future classes.~Formative Assessment: what were the students attitude in trying something new to them?~How did the student answer the question? Give them a mark for completion.~In a later class, you can dive deeper into the oxidization process with a class and assess them on that. | ~ |