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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 Vat  Grade 11/12 Chemistry  Prepared by: Ms. Barber  Date of Lesson: TBA | Teacher Guide | Class Narrative | Equipment  Needed |
| 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. | ~ | |