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Finding the Nano in Trees

Overview/Annotation:

Science Content Standard(s):

	7th grade ALCOS #2: Identify functions of organelles found in eukaryotic cells, including the nucleus, cell membrane, cell wall, mitochondria, chloroplasts, and vacuoles.
	8th grade ALCOS #12: Classify waves as mechanical or electromagnetic.
NGSS:	MS-PS1-3: Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
	MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
	MS-LS1-1: Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
	MS-LS1-2: Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

Primary Learning Objectives:

1. The students will be able to identify and label the structures of a plant cell on their pre and post assessments
2. The students will be able to follow the instructions and materials provided to create a piece of homemade paper from plant cell fibers
3. The students will use proper technique to prep a microscope slide and view the appearance of cellulose on polarized film
4. The students will be able to observe and explain how the different wavelengths of light produce different colors
5. The students will be able to visualize the link scale and properly differentiate between all measurements on their post assessments from kilometers to nanometers

Total Duration: 60 minutes

Materials and Equipment: (For 8 groups of 3)

1. Arnold Grummer Medium Dip Handmold Class Pack (size 5.5x8.5 found at http://arnoldgrummer.com/medium-dip-handmold-class-pack.html)
2. Storage containers (14 gallon) (4)
3. Sponges (16)
4. Dish towels or blotting paper (12)
5. Dipping pans/buckets (8)
6. Drip pans (14 gallon storage container lids) (8)
7. Pulp storage bins with airtight lid (4 gallon) (8)
8. Blenders (1)
9. Iron (1)
10. Portable Ironing Board (2)
11. Papertowels (1 package)
12. Gloves (1 box)
13. Safety glasses 1 per student
14. Colored Pencils (6 boxes)
15. Microscopes (ideally 1 per group)
16. Vials containing concentrated aqueous suspension of cellulose nanocrystals
    *See below for ordering information
17. Disposable plastic pipettes (1 box)

18. Microscope slides (1 box)
19. Coverslips 1 box
20. Polarized film (12 pieces)
21. Handouts
22. A/V equipment for Powerpoint and video presentation (optional)

Technology Resources Needed:

1. SmartBoard or projector for presenting the PowerPoint
2. Computer with PowerPoint
3. Microscopes

Background/Preparation:

1. The teacher should have already covered the basics of plant cell structure and photosynthesis in previous lessons. This module only acts as a basic review for these topics. Things students should already be familiar with:
    a. Major parts of the plant cell
    b. Functions of each component
    c. The steps in photosynthesis
    d. The photosynthesis equation
2. The teacher should be prepared to print approximately 100 pages before teaching this lesson. These things include: the pre and post assessments, the papermaking worksheet, and the nanocrystal worksheet.
3. The teacher should be prepared to make pulp ahead of time (2 days max). Directions for making the pulp are as follows:
    a. Put one loose handful of shredded paper in a blender
    b. Add 6 cups of warm water (this helps break down the fibers).
    c. Blend until it is the consistency of water. *Note, there should be no chunks.
    d. Dump the mixture into a pulp storage bin (#7 on materials list)
    e. Repeat steps a-d 3 times to allow for 3 students to be able to make one piece of paper. *Note, it's one blender full of the mixture per one student. So, 24 blender fulls total would suffice for a 24 student class.

Procedure/Activities:

1. First, administer the pre-assessments to the students.
2. Begin the PowerPoint presentation that begins with "Plant Structure" and briefly review the parts of the plant and photosynthesis, which will lead into the common uses of plants.
    - **Be sure to connect fibers, which contain cellulose, to papermaking**
3. Students should now the papermaking activity while looking at the guided questions.
4. After each student has made a piece of paper, they should individually complete the papermaking questions to turn in.
    - **The teacher or assistant will be responsible for ironing each piece of paper**
5. Continue with the PowerPoint section that begins with "How Small is the Nano in Trees?"
    - This section is an in-depth look into cellulose, the molecule found in fiber.
    - Connect the fiber and papermaking activity to this next section.
6. Show the TAPPI video embedded in the PowerPoint
7. Now, begin the Nano Cellulose Activity. The students will remain in their same groups as the papermaking activity.
8. After the students complete the activity and answer the Nano Cellulose lab questions the teacher should continue with the PowerPoint showing what the crystals should look like and explain why they see the colors they do.
    - Be sure to explain that we see these colors because things act different under the nanoscale and size and shape determine properties such as color.
9. Have the students complete the post-assessments

Assessment Strategies:

1. The students will be assessed by their ability to label the parts of the plant cell on their pre and post assessments.

2. The students will also be assessed by their ability to follow directions and create their own piece of paper using plant cell fibers
3. The students will be assessed on how well they prep a microscope slide with the nanocellulose before viewing
4. The students will be given questions after each activity in which they will be assessed on thoroughness and completeness. They will explain how the wavelengths of light produce different colors under the microscope.
5. The students will complete their post-assessments and identify the structures on the link-scale

Extension: Have the students get in their groups again and complete The Nanoscale activity. They should be given that 1 foot=0.3048 meters.

Remediation: The teacher will pair at-risk learners with proficient students during the group activities. If at risk learners still need additional assistance, the teacher or proficient class peer may repeat the activity one-on-one and step-by-step with the student.

*Cellulose Nanocrystal Ordering:

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davisva@auburn.edu

PAPERMAKING:
THINGS TO THINK ABOUT

1. What do you observe when you look into the container?

2. Touch the liquid mixture. How does it feel? Can you feel the fibers or does it feel like a homogenous liquid?

3. After you take the papermaking mold out, what do you observe?

4. Why would you need to press the paper? What would happen if you didn't press the paper?

5. What does the finished product look like? How is this different from what you buy in the store? Why?

PAPERMAKING QUESTIONS

Name: _____
Date: _____
Class: _____

1. What do you observe when you look into the container?

2. Touch the liquid mixture. How does it feel? Can you feel the fibers or does it feel like a homogenous liquid?

3. After you take the papermaking mold out, what do you observe?

4. Why would you need to press the paper? What would happen if you didn't press the paper?

5. What does the finished product look like? How is this different from what you buy in the store? Why?

6. Paper is made of fibers, but what are the fibers made of?

Do You See the Nanocrystals in Trees?

Materials per Group:

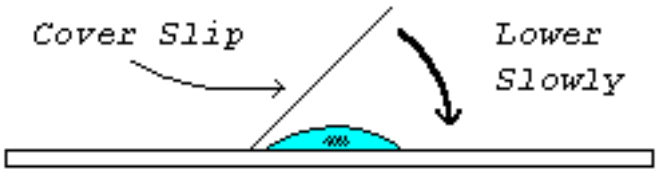
1 Dropper
1 Glass slide
1 Coverslip
2 Polarized Lenses
1 Microscope
Colored Pencils

Procedure:

1. Obtain a sample of cellulose from the vial from the front of the classroom using your dropper.

2. Place one drop of cellulose on your glass slide. Apply the coverslip to the stop of the sample using the proper technique.

Figure 3



3. Place your glass slide in between two polarized lenses and place it under the microscope.

4. Begin your microscope at the 10x objective and observe.

5. Repeat on each objective.

Name: _____
Date: _____
Class: _____

Do you see the Nanocrystals in Trees?

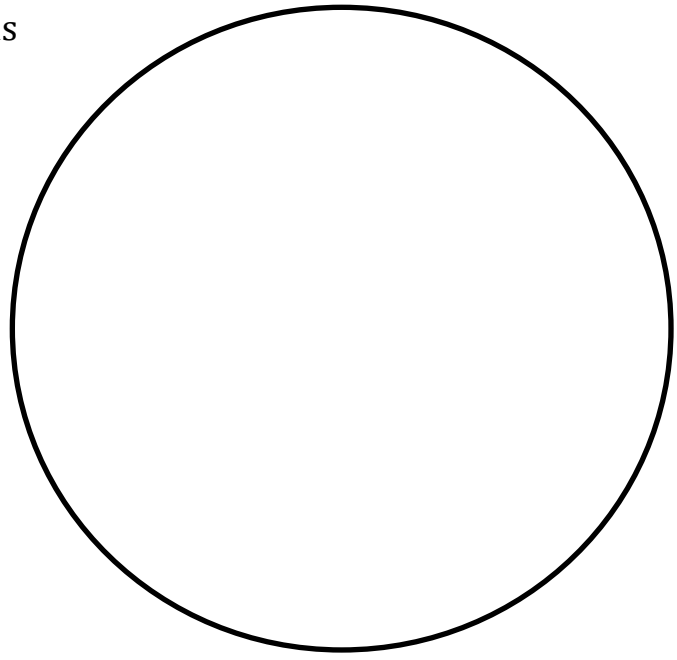
1. Observe the cellulose. What does the cellulose look like? Does it look how you imagined? Why or why not?

2. Observe the cellulose underneath the microscope **WITHOUT** the polarized films on each objective. What does it look like?

3. Observe the cellulose **WITH** the Polarized films on each objective. What does it look like now?

4. Why do you think you observed this phenomenon?

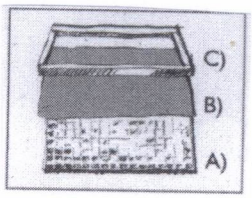
5. Now, sketch what you see on the highest objective using colored pencils.



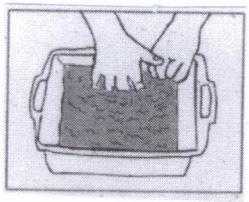
Materials
Mold and Deckle
Coarse mesh screen
Fine mesh screen (blue)
Pulp mixture
Blotting paper (3)
Drip tray
Sponges

Papermaking Procedure:

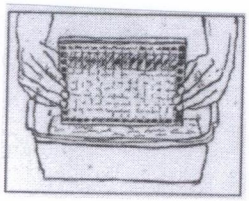
1. Make sure your wooden hand mold is assembled properly.
    a. Wooden Frame (Top)
    b. Coarse Mesh Screen (Middle)
    c. Plastic Grid (Bottom)



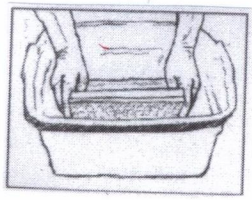
2. Using your hands, stir around the pulp in the bin. (Don't be afraid to get your hands dirty!)



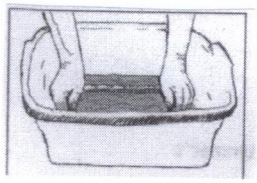
3. Take your mold and place it inside the pulp bin, stirring it around to agitate the pulp a little more.



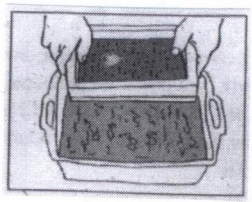
4. Keeping the mold inside the pulp bin, move the pulp around to make sure it becomes evenly distributed over the screen.



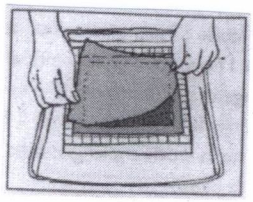
5. Pick your mold straight up from the pulp bin, keeping everything level. Be careful not to touch the screen at this point.



6. After 10 seconds, tilt the mold to let more water drain off into the bin.

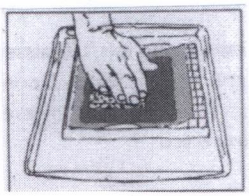


7. Set the mold down on your tray and lift off the wooden frame.

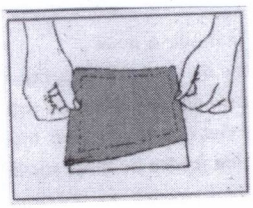


8. Now, place the fine blue mesh screen over the pulp sheet that you just made.

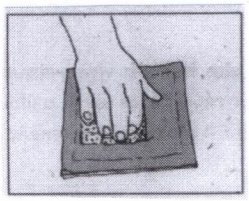
9. Using your sponge, press down on the screen to absorb more water, wring sponge and repeat as many times as necessary.



10. Carefully peel off cover screen, and lay down 2 pieces of blotting paper beside your mold.

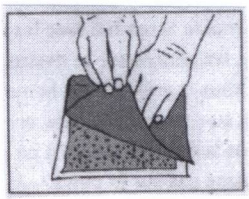


11. Pick up the papermaking screen and turn it upside down on top of the blotting paper.

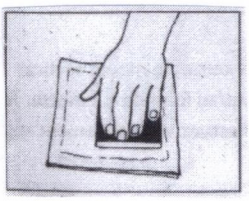


12. Use your sponge to press it down over the back of the papermaking screen to absorb more water.

13. Carefully peel away the mesh screen leaving the homemade paper on the blotting paper.



14. Place another piece of blotting paper over your paper and press with a textbook 3 times.



15. Carefully peel your piece of paper away from the blotting paper and follow teacher instructions for the drying procedure.