



Science Unit: *Plants and Ecosystems*

Lesson 6: *Fun with Plants that We Use Des Plantes Bien Utiles*

School Year: 2006/2007

Developed for: Queen Elizabeth Annex Elementary School, Vancouver School District

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Grade level: Presented to grades 2-3; appropriate for grades 1 – 7 with age appropriate modifications ; Présenté au niveau de la 2^e et 3^e année; approprié aux niveaux de la 1^{re} à la 7^e année en y apportant les modifications nécessaires.

Duration of lesson: 1 hour and 20 minutes

Objectives

1. Learn about the varying ways that humans use plants.
2. Learn what a plant pigment is and how to extract it.

Background

Plants are important to humans because they provide us with the oxygen that we breathe and are an essential food source. We use plants for a surprising number of things besides food. Lumber, fuel, medicine, latex, perfumes and fibers for clothing are all examples of things that people use plants for. Plants are also a source of natural dyes. It has only been in the last hundred years that synthetic dyes have been used. Before that, all dyes were extracted from things in the environment. Think about the beautiful colours that we see in nature. These are caused by pigments, which are chemical compounds that reflect a certain colour because they absorb all the other colours of visible light. Plant pigments do a variety of different jobs for the plant. For example, chlorophyll, a plant pigment that makes plants green, is necessary for photosynthesis, the process of making sugar from sunlight, water and carbon dioxide from the air. Two other common plant pigments are carotenoids, which reflect yellow, orange, and brown and anthocyanins, which reflect darker reds and purple.

Vocabulary

<u>Word:</u>	Brief definition.
<u>Pigment</u>	Any material in a plant or an animal cell that results in a colour.
<u>Chlorophyll</u>	A photosynthetic pigment in most plants that causes the green colour of plants.
<u>Dye</u>	A substance used to colour materials.
<u>Synthetic</u>	A substance that is made using a chemical process rather than occurring naturally.

Vocabulaire

<u>Mot:</u>	Brève définition.
<u>Pigment</u>	Tout matériel provenant d'une cellule végétale ou animale qui crée une couleur
<u>Chlorophylle</u>	Un pigment provenant de la photosynthèse qui crée la couleur vert des plantes.
<u>Teinture</u>	Une matière colorante.



Synthétique

Une matière réalisée artificiellement à partir d'éléments chimiques simples.

Materials

For Activity 2

- Natural, undyed wool [such as from Birkland Bros. LTD (3573 Main Street, Vancouver BC V5V 3N4, Tel :604 874-4734)]
- natural dyes [for example, from Maiwa Handprints LTD (see ref.)]
- Orvus paste soap or shampoo (to scour the wool – see instructions)
- Materials for home-made dyes: dried yellow onion skins, 4 cups of fresh spinach
- Alum (for bonding the dye to the wool)

Matériaux

Pour Activité 2

- Laine naturelle non-traitée
- Teintures naturelles provenant de Maiwa Handprints LTD
- Savon orvus ou shampooing
- Matériaux pour créer des teintures : pelures d'oignons jaunes séchées, 4 tasses d'épinards frais
- Alum (pour faciliter l'adhésion de la teinture à la laine)

In the Classroom

Introductory Discussion

1. HOOK: *Activity 1 will be done as a hook.*
2. TO REVIEW:
 - a. Natural vs. synthetic
 - b. The definition of a pigment and what humans use pigments for.

3. SCIENCE ACTIVITY:

Activity 1: Plant Scavenger Hunt. Scavenger hunt for things in the classroom that are made from plants.

Activity 2: Dyeing Wool with Natural Dyes. Dye wool with natural dyes (store bought natural dyes from Maiwa Handprints LTD and dyes made in the classroom from onion skins and spinach).

Science Activity/Experiment

Activity 1: Plant Scavenger Hunt.

Purpose of Experiment: For the students to grasp how many things that we use daily are made of plants.

Methods:

Instructions

1. Put students into groups of three. Give the students 15 minutes to write down everything they can find in the classroom that is made of plants.



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2. As a group make a list of all of the things that the students have come up with.

Some things the students might not think of:

Corkboard (Cork is one layer of the bark of certain trees)

Rubber balls, bicycle tire, some erasers (Natural rubber is made from the sap of the Rubber tree, but synthetic rubber exists too)

Paper

Some clothing (cotton, linen, hemp)

Certain medicine (aspirin from willow bark)

Furniture

Building materials

Elements of their lunch (bread, sugar, vegetables, fruits)

Activity 2: Dyeing wool using Natural Dyes

Purpose of Experiment: To see how pigments can be extracted from plant material and to see one way that plants can be used.

Methods:

NOTE: This activity requires a lot of set-up before starting in the classroom. Be sure to begin at least three days before the class.

Set-up prior to activity:

1. **Scour the wool.** The purpose of scouring is to ensure that the dye penetrates well and coats evenly. Place the wool in a large pot and add 6 gallons of water for 450 grams of wool. Add 1 tsp of Orvus Paste Soap (available at Maiwa LTD, see Reference) or shampoo. Heat gently for one hour. Turn very gently. Allow to cool down slowly and then rinse with warm water.
2. **Mordant the wool.** Dissolve alum in very hot water in a large pot. For the amount of alum necessary you will need 15% of the weight of your dry wool. Add enough water to cover the wool and stir well. Wet the wool before adding to the pot. Bring the temperature of the wool up slowly (over 30-45 minutes) until 195 F (just under simmering). Keep it at this temperature for 1 hour. Let cool in the pot for 20 minutes. Remove the wool from the mordant bath and hang it over a steel or plastic rod until it stops dripping. Rotate the wool frequently. Store in a damp white cloth or 24-48 hours and keep it damp the whole time.

Instructions

Bought Natural Dyes:

1. **Madder** (extract from the root of the madder plant, makes red colours): Add 35% of the weight of the wool of the madder dye to the dye pot with a small amount of hot water. Add enough water to allow the wool to move around freely and the wet, mordanted wool. Simmer for 1 hour, without allowing the water to get hotter than a simmer. Cool the wool down in the dye bath. Remove the wool from the pot and rinse the wool until the water runs clear. Wash the wool with Orvus paste or with shampoo and rinse again. Dry the wool before use.
2. **Logwood** (extract from wood of the Hematoxylon Campechianum tree, makes purple/blue colours): Add 3-5% of the weight of the wool of the logwood dye to the dye pot. Same directions as above.

Homemade Natural Dyes:

1. **Onion** (extract from the onion skins of yellow onions, makes yellow colours): Peel the outer skins from the onions and lay them on a cookie sheet to dry for several days. Place the skins in a nylon stocking and tie shut. Heat in a large pot with enough water to cover the wool and boil until the water is brightly coloured (around 10 minutes). Let the dye cool for 20 minutes. Add the wool and simmer for around one hour.
2. **Spinach** (extract from spinach leaves, makes green colours): Cook 4 cups of spinach (to release the chlorophyll from the cells). Place in a nylon stocking and tie shut. Heat in a large pot with enough water to cover the wool and boil until the water is brightly coloured (around 10 minutes). Let the dye cool for 20 minutes. Add the wool and simmer for around one hour.



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Note: Wear rubber gloves when handling the dyes.

Once the wools are dyed and dried, the wool can be used for making bracelets or weaving into squares using hard cardboard slotted on the edges.

Safety Instructions:

1. Keep pots of hot dyes out of reach of students. You may wish to make a “safety zone” around the dye pots with tape. Instruct students that they need to be with an adult if they go inside the tape border.
2. Don't taste plant pigments.
3. If you are making dyes from scratch remember that some plant pigment extracts are toxic. Be VERY careful when you choose the plants to extract from. If you are unsure about a plant, check with poison control first.
4. If you are buying natural dyes remember that they might not be non-toxic or they may need harsh chemicals for fixatives. Be careful where you purchase your dyes. Maiwa LTD only sells safe dyes and fixatives.

Optional Questions:

1. Name two things besides food that people use plants for (rubber, dyes, paper, construction, spices, clothing, medicine)
2. What is the name of the pigment that makes plants green? (chlorophyll)
3. The green pigment in plants is important for what plant process that happens in the leaves? (photosynthesis)
4. What is a dye? (something used to colour)
5. What does synthetic mean? (made by a chemical process)
6. What pigment colour comes from onion skins? (yellow/orange)

Closure Discussion

Review the many uses of plants. Review what a plant pigment is and how it is used by the plant.

References

1. Burnie, David. 1991. How Nature Works: 100 Ways Parents and Kids Can Share the Secrets of Nature. Pages 40-41, The World of Plants and Fungi. Reader's Digest Association Inc. ISBN: 0895773910 .
2. Zwinenberg, A.J. and Van Gelder, J. 1983. Encyclopédie de la nature alphabétique et systématique. Pages 22-23. Chantecler.
3. http://en.wikipedia.org/wiki/Biological_Pigment Wikipedia, the free encyclopedia [Information about biological pigments]
4. Natural Dyeing. Pamphlet about natural dyeing put out by Maiwa Handprints LTD. (see www.maiwa.com) **Address:** 6-1666 Johnston Street, Granville Island, Vancouver, BC Canada V6H 3S2 Tel 604 669 3939)
5. http://www.ourcanadiangirl.ca/fun/fun_ellen.php Our Canadian Girl, website with stories and activities for children [onion skin dye recipe].
6. See another Scientist in Residence Program lesson plan on plant pigments and natural dyes: Plants science unit, Lesson 8, *Using Plant Pigments as Natural Dyes*. <http://www.scientistinresidence.ca>



Extension of Lesson Plan

1. (Before the lesson): Extract plant pigments from leaves and separate them on a strip of coffee filter paper. Grind leaves with a mortar and pestle and add 4 tsps of nail polish remover (acetone). Pour mixture in a glass and place the coffee filter strip attached to a pencil into the glass. The plant pigments will climb the coffee filter and separate out into bands.

NOTE: Acetone is extremely flammable and an eye irritant. Use only in a well-ventilated area and only allow adults to handle it.

2. Experiment by leaving different pieces of wool in the dye for varying amounts of time.
3. Experiment by putting wool into different pots of dye to make new colour combinations.
4. Experiment with different types of materials to see which ones absorb the dye best.