

1st Place Winner
Scientific Inquiry
Karen M. Skophammer
Manson Northwest Webster Schools
Fort Dodge, IA

Pigment Plucking

Grade Level(s): Grades 4-8

Subject(s): Science, Math, Technology, Art, and Language Arts

OBJECTIVE:

1. Students will discover which pigments are found in different fruits and vegetables.
2. Students will practice processes for extracting pigments from fruits and vegetables.
3. Students will use extracted pigments to create artwork on the subject “falling leaves.”
4. Students will find out which pigments are fat-soluble.
5. Students will classify fruits and vegetable pigments into the four basic types of plant pigments.
6. Students will chart their results of pigment classifying and fat-soluble pigments/non-fat soluble pigments.
7. Students will create a Power-Point capturing what they’ve experienced during the unit of study.

PURPOSE:

This lesson will emphasize that colors are caused by substances called pigments. The students will see that plant (natural) pigments can be easily extracted and used to SAFELY color foods, cloth, beverages, and to paint with etc.,

OVERVIEW:

Through hands-on activities, the students will gather fruits and vegetables and classify them (science), extract pigments (chemistry and physical science), and use these “safe and natural pigments” to paint a work of art (visual arts). The students will interpret the pigments (science) and chart the results (math). The students will write a “rap” or poem about the natural art

which they have created or about pigment extraction in general (language arts).

MATERIALS NEEDED:

- Various fruits and vegetables (leaves can also be used)
- Melted butter
- White tissue paper or blotting paper
- Grater
- Teaspoon/Tablesppoon
- Strainer/funnel
- Jars/beakers
- Cutting board or surface
- Oil pastels or crayons
- Nail polish remover
- Q-Tips
- Mineral oil

ACTIVITIES:

A few days before this unit is to begin, I ask the students to bring fruits and vegetables that are brightly colored (such as carrots) to school. We also go on a scavenger hunt around the neighborhood for leaves and berries.

We discuss the fact that the world has gorgeous and varying colors, but where do they come from? In the case of fruits and vegetables, they come from molecules inside the food that are called pigments.

For instance, spinach and other green veggies get their color from the pigment chlorophyll. Carrots get their color from pigments called carotenoids. Other odd colored veggies get their colors by a combination of different pigments.

There are four (4) basic types of plant pigments, which are:

1. Anthoxanthins: can make white, yellow, and orange colors
2. Carotenoids: can make red, reddish-orange, and brownish colors
3. Anthocyanins: can make purple, blue, black, and reds
4. Chlorophyll: greens

I write the above types of plant pigments on the board, large enough for the students to easily read and refer to.

*Pigments in color do more than just give plants their color. They do the following:

- They help manufacture substance that plants and animals feed on. For example, beta carotene, (in orange carrots) can be changed into vitamin A.
- They help capture and use light.
- They help fruits and flowers stand out so insects and birds are attracted to them and they can pollinate them and spread the seeds.

*Most plants and algae contain chlorophyll even if you don't see it. It can be hidden by other pigments.

After a discussion and background information on color, we're ready to extract some colors.

Steps:

(I demonstrated a carrot, and then the students worked in pairs of two to do the extraction of color on the fruits and vegetables they had brought, keeping a record in the journals.)

1. Grate a small amount (about 5 tablespoons) of the vegetable or fruit, such as a carrot, and put it into a glass cup (2 cup size is best) or a beaker.
2. Put $\frac{1}{2}$ of the grated vegetable into the cup and mix it with two teaspoons of mineral oil
3. Place a strainer over the mouth of the jar or beaker-lined with a coffee filter or thick white tissue paper. Pour $\frac{1}{2}$ the mineral oil/vegetable mixture through the filter. Pretty soon the solution with the pigment will have dripped through into the beaker. Put this aside.
4. Mix the other $\frac{1}{2}$ grated vegetable with 1 teaspoon of melted butter and 2 teaspoons of mineral oil.
5. Place a funnel lined with a coffee filter or tissue paper over a second jar or beaker. Pour the vegetable/butter/mineral oil mixture through it. Pretty soon this pigment will drip through too. Set this aside.
6. Hold the two jars or beakers containing the pigments up to the light and compare. What results did you see? Why? Record this in your journal. (Some pigments are fat-soluble so they will dissolve in fats. Not ALL pigments are fat-soluble, however.)

7. Repeat this with other vegetables/fruits for a variety of results and colors.

Art Activity:

Use the colors (pigments) you've extracted to paint a design/picture on white tissue paper or sheets of blotting paper. When dry, outline with oil pastels. Gorgeous!

Part II:

Other fruits and vegetables are NOT fat-soluble. So, you can use this experiment with TEACHER GUIDANCE (because of the nail polish remover) to separate the pigments of these. Some good examples are: tomatoes, spinach, radicchio, lettuce, or any other red lettuce.

1. Use the top of three or four radicchio leaves and blend them in a blender until mushy. Put the mush in a bowl with an equal amount of nail polish remover. Strain the vegetable mush into a glass beaker...the liquid will be colored. Cut some strips from a white coffee filter. Put the strips in the beaker vertically. Watch the colors run up the filter.
2. Dip a cotton swab into the liquid and touch it to the coffee filter. What do you see this time? Record your results.
3. Mix $\frac{1}{4}$ cup nail polish remover with $\frac{1}{4}$ cup of water and put three tablespoons of the mush with the solution. The coffee filter strip is hanging on the inside of the beaker. The colors should work their way up the coffee filter separating them!

Art Activity:

Use the colors (pigments) you've extracted to paint a design. Also, the strips that the color has crawled up onto and separated itself onto can be cut and glued down into a type of collage. These turn out wonderfully!

****Other ideas:**

- Study how color additives in processed foods help their appearance and help to sell a product.
- Study the antioxidant activities of total pigment extract from vegetables and fruits such as blackberries. Blackberries contain large amounts of anthocyanins-pigments that give blackberries their characteristic red to blue color. Anthocyanin is also an antioxidant.

Math:

Graph results of fruits and vegetables as to which ones were fat-soluble and which were not. Also graph and keep records of colors extracted from vegetables and fruits.

Language Arts and Music:

Rap about veggies/color extraction:

Isn't Mine Mighty Fine

By Jade

My name is Jade and I'm here to say,
Those veggies are colorful in a major way!
From carrots being orange and bright as the sun,
When we grated them, our fun had just begun!
We plucked the pigments from veggies and fruits,
It made a brightly colored juice.
From those juicy colors we painted designs,
Don't you think mine is mighty fine?

Rap song about Pigments being fat-soluble:

What's Up with That?

By Cameron

Yo, people, what's up with that...
Pigments are soluble in fat?
My teacher had a fabulous idea,
If you don't believe me, just come and see-a!
From our fruits and veggies, we did us some art,
Now, don't you think that's really smart?
We combined science, math, and language arts too,
And don't forget, we used the color blue.
'Cause we extracted pigments, ya, ya.
We extracted pigments.

Reflection about painting done with extracted pigments:

By Amber

Leaves of many colors are falling gently through the sky. They don't land; they just drift, gently by me. All the colors seem to separate, yet blend together perfectly in my painting. Who would have thought that science and art would fit so perfectly together? I guess science is an art and art is a science according to my teacher. You know what? She proved she was right with this lesson! I love both science and art because of her.

Technology:

We created a PowerPoint presentation featuring claymation figures that the students made along with sayings and wording showing their understandings of “Pigment Plucking” or color extraction and what they learned from it.

MODIFICATIONS OR EXTENSIONS:

Study how color additives in processed food help their appearance and help sell the product.

Study the antioxidant activities of total pigment extracted from vegetables and fruits, such as blackberries.

Graph results of fruits and vegetables as to which ones were fat-soluble and which were not. Also, graph and keep records of color extracted from vegetables and fruits.