

Cloverbud Investigators: STEM for Every Season**Fall Leaf Color Change**

November

Background:

Spring and summer are always a great time to go play and explore outside! On those extra warm days, we seek some relief from the rays of the sun in the shade provided by the trees. Here in Ohio, we are lucky to have deciduous trees. Deciduous means that the trees shed their leaves each fall and grow new ones each spring. If our weather conditions are good, this process can give us a beautiful color show in the fall. Let's look at the leaves; in the summer you will notice that the leaves on the trees have a green color or pigment. The green pigment is called chlorophyll, which helps the trees produce their food through a process called photosynthesis. Photosynthesis means plants use energy from sunlight to convert water and carbon dioxide into sugars which help them grow.

In the fall when the weather in Ohio starts to change and we start having cooler temperatures, the trees know they need to take a break from working and go into a kind of a resting period during our cold Ohio winter. This is when we notice the color changing in the leaves of our deciduous trees. The interesting thing about the leaves changing color is that the yellow and the orange colors we see in the fall are already in the leaves, we just cannot see them because the green chlorophyll hides them from us. The leaves contain several pigments besides the green colored chlorophyll. They also contain pigments called carotenoid which make up the orange colors and xanthophyll which make up the yellow colors. So these colors are present in the leaves all year even though we cannot see them.

So how do we see these beautiful fall colors? When the trees begin to go into their resting or dormant state they begin to seal off the stems of their leaves, kind of like shutting down their food factory. When that happens, the water and sugar flow from root to leaf and leaf to root, a slowdown which causes the tree to stop producing chlorophyll. The green coloring of the leaves then begins to breakdown and we start to see the vibrant yellows and orange colors shine through.

But wait, aren't we missing a color...what about RED? The red and purple colors come from another pigment called anthocyanin. This pigment is a little different because it is not present in the leaves all year but is made as the chlorophyll starts to break down and the sugars build up in the leaves. The amount of red and purple coloring we see in the fall leaves can be affected by the temperature, the amount of rainfall, and even cloud cover. If we have a number of cool nights and warm days for a period of time in the fall, the trees will more than likely produce a sea of red

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leaves. This is because the warm days cause the leaves to produce large amounts of sugar which gets trapped in the leaves, turning them the bright reds and dark purples we see.

As we learned already, tree leaves have orange and yellow in them even in the summer! In this investigation we are going to talk about how the pigments in the leaves are masked by the other colors and what processes allow these hidden pigments time to shine.



November's Mystery: How do trees' leaves change colors?

Supplies:

- 🍃 Green Tree Leaves
- 🍃 Small Jar and Plastic Wrap
- 🍃 Hot Water & Shallow Pan
- 🍃 Rubbing Alcohol
- 🍃 Paper towels
- 🍃 Paper Coffee Filter and Tape
- 🍃 Scissors and a Spoon



Science Behind Fall Leaf Color Change:

In Ohio, we have trees that shed their leaves each fall. They are called **deciduous** trees. These trees have leaves that appear green in the spring and summer due to a pigment called **chlorophyll**. The leaves also have two other pigments, called carotenoids (the orange colors) and Xanthophyll (the yellow colors,) in them year round, but the chlorophyll is stronger and masks the other colors. However, in the fall as the days get shorter and the weather gets cooler, the trees begin their dormant period and begin a process of sealing off the leaf stems. When this happens less, chlorophyll is produced and the chlorophyll present begins to break down. It is at this point we can see the other colors begin to show through. Also at this point the trees begin to produce another pigment called **anthocyanin**, which is dependent on the sugar levels of the leaves. The sugar levels can be based on a number of environmental factors including amounts of rainfall, sunshine and temperature. The more trapped sugar in the leaves, the more reds you will see. A good example of this is the leaves of the sugar maple. The sugar maple is a very high sugar producing tree and the primary provider for maple syrup. The leaves of the sugar maple often have a blaze of fiery reds and oranges in the fall.



Sugar Maple Tree



Sugar Maple Syrup

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What to Do:

Step 1: Collect 2-3 large green leaves from the same tree type. Carefully tear or chop the leaves into very small pieces and put them into a small jar.

Step 2: Add rubbing alcohol, one tablespoon at a time, to the jar. Use just enough liquid to cover the leaves. Using a plastic spoon, carefully smash and grind the leaves in the alcohol. **SAFETY NOTE:** rubbing alcohol can be harmful if misused. Avoid contact with skin and eyes. Younger children should wear eye protection.

Step 3: Cover the jar very loosely with a lid or plastic wrap. Place the jar carefully into a shallow tray containing 1 inch of hot tap water (warm water bath).

Step 4: Allow the mixture in the jar to warm up in the water bath for at least a half-hour, longer if needed. Carefully swirl the liquid in the jar gently about every five minutes. Reheat the water bath if needed. The alcohol should become a dark color (the darker the color the better).

Step 5: Cut a long thin strip of coffee filter paper. Remove the jar from the water bath and remove the lid or covering. Place the strip of filter paper into the jar so that one end is just touching the alcohol solution and secure the other end of the paper with tape to the outside of the jar.

Step 6: The alcohol should travel up the paper, bringing the colors with it. After 30-90 minutes the colors will have traveled different distances up the paper as the alcohol evaporates. You should be able to see different shades of green, and possibly some yellow, orange or red, depending on the type of leaf selected.

Go Over Findings:

What kind of trees drop their leaves each year in the fall? (Deciduous)

Do all trees lose their leaves in the fall? (No)

Do all trees change color in the fall? (No)

What are the 4 color pigments of leaves? (Chlorophyll, Carotenoid, Xanthophyll and Anthocyanin)

Which pigment gives us a red color? (Anthocyanin)

Which pigment gives us a yellow color (Xanthophyll)

Which pigment gives us an orange color? (Carotenoid)

Which pigment gives us a green color? (Chlorophyll)



Can you think of a career where you might work with or around a lot of trees?

What color do we see most of the time when we look at the leaves?

Investigate, Create, & Take: Investigators can take with them:

- ✓ Leaf Rubs
- ✓ Leaf scratch offs that change colors

Sources:

Why leaves change color by USDA Forest Service, Northeastern Area:

<http://na.fs.fed.us/fhp/pubs/leaves/leaves.shtm>

Additional Links:

<https://www.youtube.com/watch?v=s7qTx2l7bvo>

Find Out Why Leaves Change Color Activity-by Mike Calhoun and Michael Calhoun, Updated on Sep 18, 2014; http://www.education.com/activity/article/Leaves_Change_fifth/

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