

## CURRICULUM GUIDE: LEAVES



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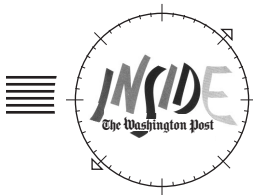
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## Learn About Leaves

*KidsPost Article: "Fall Guys: Colorful Show Signals The Approach of Winter"*

**Lesson:** An introduction to photosynthesis and the life cycle of a leaf.

**Level:** Grades 3-6

**Subjects:** Science, English Language Arts

**Related Activity:** Art

**Procedure**

**Read**

Read the KidsPost articles.

**Examine and Discuss**

Ask students to answer the following questions. Discuss the answers with particular attention to their understanding of photosynthesis.

1. What is the most visible change to leaves of deciduous trees in the fall?
2. What does chlorophyll do to help photosynthesis take place?
3. What are nutrients?
4. Photosynthesis is a process. What happens during photosynthesis?
5. It is helpful that leaves fall off tree branches before winter arrives. Explain why.
6. Which is the dominant pigment in most leaves?
7. What gives fall leaves their yellow color?
8. List three vegetables that have the carotenoid dominant pigment.
9. What gives fall leaves their red color?
10. How do anthocyanins and carotenoids protect trees?

**Read For Information**

Give students copies of "Three Pigments." Read to learn more about chlorophyll, anthocyanins and carotenoids. Be sure students understand that the three pigments are found in flowers, plants, fruits and vegetables as well as leaves. Distinguish the three pigments from one another.

**Observe and Write**

Ask students to observe a tree or a group of trees for five days. They are to record their observations in a journal. While observing they may write phrases, make lists, record dialogue, sketch the scene and

## Leaves Resources

*On the Web and in Print*

### ON THE WEB

#### Shedding Light on Photosynthesis

If you want to do more than collect fall's leaves, place them between sheets of wax paper and iron them to preserve them, check these sites for ideas.

<http://photoscience.la.asu.edu/photosyn/education/colorchange.html>

#### Why Do Leaves Change Color in Fall?

Science Made Simple provides this site for children. Includes an elementary, large type version to download for the youngest readers. This site includes three projects that adults can do with children: Separate Colors in a Green Leaf Using Chromatography, Separate Colors in a Fall Leaf Using Chromatography and Observe How Light Affects Color Development.

<http://www.pbs.org/ktca/newtons/9/phytosy.html>

#### Photosynthesis: How Do Plants Make Food?

To accompany Newton's Apple show number 907, you will find a short lesson, questions, activities and vocabulary. You need not have seen the show to use this material.

<http://photoscience.la.asu.edu/photosyn/education/photointro.html>

#### An Introduction to Photosynthesis and Its Applications

A resource from the Arizona State University Center for the Study of Early Events in Photosynthesis for teachers who want to review the basics. Illustrations are helpful.

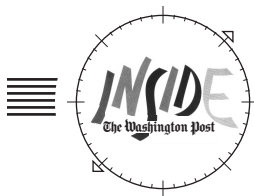
[http://www.accessexcellence.org/AE/AEC/AEF/1996/morishita\\_pictures.html](http://www.accessexcellence.org/AE/AEC/AEF/1996/morishita_pictures.html)

#### Photosynthetic Pictures Are Worth More Than a Thousand Words

In this Access Excellence Activities Exchange, C. Ford Morishita provides background, materials and all steps to follow in this experiment. This is one for older students or one for teachers to demonstrate for (and amaze) their students.

#### IN PRINT

Gardiner, John Reynolds. *Top Secret*. Education World recommends this fourth-grade level book. In it, a science fair project inspires a boy to solve the mystery of photosynthesis.



## Learn About Leaves

*Continued*

write in complete sentences. Ask that each day they view the tree from different perspectives. For example, they might sit at a distance south of the tree one day, under the tree on another day. Tell students that they are not to climb the tree.

They may include people in their descriptions, especially if the individuals are raking leaves.

Either as homework or an in-class activity, students are to use their observation notes to write one to three paragraphs in which they describe the tree. They are to include enough sensory details and descriptions so that others can picture the scene. On one of the five days, they should include information from the KidsPost article and "Three Pigments" handout. They may also research to learn more about the species they are observing.

At the end of five days, students are to review their journal entries and descriptive paragraphs. Select one of the five days' descriptive paragraphs to revise. Tell them this will be shared with their classmates.

### Share and Evaluate

Pair students to share their revised descriptive paragraphs. Ask each student to evaluate the work of his or her partner's descriptive writing. You may wish to use the "Descriptive Writing Evaluation" reproducible.

### Decide and Revise

Students decide which of the suggestions to include in their descriptive paragraphs. They make spelling, punctuation and grammar corrections.

### Publish

Students may print their descriptive piece on large sheets of paper in the shape of a leaf, print on paper which is the color of fall or word process and print out. Teachers may wish to "publish" the descriptive paragraphs on a display board with leaves that students have preserved.

"Fall Guys: Colorful Show Signals The Approach of Winter" can be found at <http://www.washingtonpost.com/>

### Enrichment

1. Conduct one of the experiments that are described in the Web resources.
2. Ask students to make a leaf collection in which they must collect 6-10 leaves from different trees and identify the leaves. Explain ways to preserve and present the leaf collections.

## ON THE WEB

<http://www.state.me.us/doc/foilage/kids/index.html>

### Maine Foliage Kids' Page

Maine was the first state to post weekly foliage reports on the Web. "Maine Tree Guide" provides a list of native conifers and broadleaf trees and a guide to foliage species that you can download for students to color. Glossary and Forest facts are good resources. Do take time to view "How the Leaves Change Color."

<http://www.ces.ncsu.edu/nreos/forest/topics/leafco~1.html>

### Why Leaves Change Color

A useful graphic and overview provided by North Carolina Cooperative Extension Service.

<http://virtual.clemson.edu/groups/FieldOps/Cgs/leaves.htm>

### Why Do Leaves Change Color?

In addition to basics of leaf chemistry and trees by dominant coloring, the Clemson site provides methods for collecting and preserving leaves.

<http://scifun.chem.wisc.edu/chemweek/fallcolr/fallcolr.html>

### The Chemistry of Autumn Colors

Scifun gives the scientific perspective as seen by a chemist.

[http://nl4.newsbank.com/nl-search/we/Archives?p\\_action=doc&p\\_docid=0EF25A916E90BA84&p\\_docnum=75&s\\_subterm=Subscription%20until%3A%2012%2F31%2F2010%2023%3A59%3A59&s\\_subexpires=12%2F31%2F2010%2023%3A59%3A59](http://nl4.newsbank.com/nl-search/we/Archives?p_action=doc&p_docid=0EF25A916E90BA84&p_docnum=75&s_subterm=Subscription%20until%3A%2012%2F31%2F2010%2023%3A59%3A59&s_subexpires=12%2F31%2F2010%2023%3A59%3A59)

### It's the Maine Attraction for Woodcock and Grouse

A very different take on Maine's foliage, forests and hunting. For older students.

# Descriptive Writing Evaluation

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NAME \_\_\_\_\_

1. I think your central idea is:

2. Strengths of your descriptive writing

a. I can see:

b. I can hear:

c. I can almost feel:

d. The best sensory detail is:

3. Recommendations for improvement

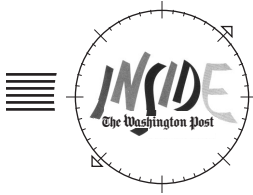
a. Your description of \_\_\_\_\_ could be stronger if you:

b. I think your description would be stronger if you:

4. I have circled mistakes in spelling, punctuation and grammar

Signature of student evaluator

\_\_\_\_\_



## Word Study: A look at photosynthesis

Think of leaves as the kitchen of the tree, the place where food is prepared. The food is sugar and starch that's produced by taking a gas called carbon dioxide out of the air, combining it with water from the ground and using a special process to create exactly what the tree needs to survive and grow. That special process is called photosynthesis, and it depends on two things: sunlight and chlorophyll.

Sunlight provides the "heat" to make "cooking" possible. Without light, plants cannot make food. If food is not made, cells of the plant can die.

Chlorophyll [pronounced CLOR-o-fill] is a chemical that takes energy from sunlight and turns it into tree food. It's not surprising that chlorophyll is green. The Greek word for the color green is *chloro*.

Let's take a closer look at "photosynthesis." It is composed of three Greek words: *Phot* and *phos*, meaning light + *syn*, meaning with + *thesis*, meaning position. So "photosynthesis" conveys the idea of being in a place with light.

Here's another way of looking at photosynthesis.

Photosynthesis is a process. During this action, plants use the energy from sunlight to produce sugar. Cellular respiration converts the sugar into ATP, the "fuel" used by all living things. The conversion of unusable sunlight energy into usable chemical energy receives the actions of the green pigment chlorophyll. You need photosynthesis to stay alive. Don't forget you need those green vegetables, too.

Here is the way a chemist describes photosynthesis:



This expression explains what happens when six molecules of water are added to six molecules of carbon dioxide. Together they produce one molecule of sugar and have six molecules of oxygen left over. So, you can have your sweets and breathe too.

## Root Words

We have studied photosynthesis. What other word is formed from the Greek word for light?

Want to make a collection of this fall's leaves? You could gather leaves and place them between paper towels with stacks of books on top of them to dry them out. You could draw them with crayons or paint them with watercolors. You could take a color photograph.

What is a photograph? You know what photo means. Light.

What does graph mean?

Graph comes from the Greek word *graphikos* that means writing and the verb *graphein* that means to write. So when you take a picture you are writing with light.

Maybe you could prepare a photo essay.



AP PHOTO/HUNTSVILLE TIMES, GLENN BAESKE

**Vivid fall colors of maple tree leaves brighten the walk home from school for a high school student in Huntsville, Ala.**



## More than a Pretty Color: Three Pigments

### 1. Anthocyanins

**What is the etymology of anthocyanin?** Two Greek words: *antho*, meaning plant + *cyan*, meaning blue

**What color do anthocyanins provide?** Anthocyanins give plants their color. The colors have a wide range: salmon-pink, red, crimson, blue, purple

**Where can I find anthocyanins?**

*Fruits:* blueberry, cherry, Concord grape, cranberry, raspberry

*Leaves:* red maple, red oak, sumac

*Plants:* bromeliads, carnivorous plants

*Vegetables:* carrot, red cabbage

**What do anthocyanins do?**

■ *Anthocyanins are pigments that provide color.* Anthocyanins are natural colorants that are found in many flowers, fruits and vegetables. They belong to a group of compounds called the flavonoids.

■ *Anthocyanins help plants.*

Anthocyanins attract insects for the purpose of pollination. These pigments also play a major role in predation in carnivorous plants by

attracting insects into the trap apparatus. Anthocyanin-related pigments are produced in response to exposure of the plant to UV radiation. They become a screen to protect the plant's DNA from damage by sunlight. In a less significant role, anthocyanins serve as anti-feedents. Animals don't like their taste so they don't eat the plants.

■ *Anthocyanins are antioxidants.*

You should eat fruits and vegetables high in anthocyanins against cardiovascular and other diseases.

**What are scientists asking?**

Are anthocyanins able to inhibit LDL (the "bad") cholesterol, prevent blood clotting and defend cells against dangerous carcinogens?

Learn more about anthocyanins

<http://www.nal.usda.gov/ttic/tektran/data/000007/19/0000071970.html>

Anthocyanins: Natural Colorants with Potent Antioxidant Properties

<http://www.pittstate.edu/chem/courses/chem326b/cromo.html>

Anthocyanins and Thin-layered Chromatography

Lab procedure to chromatograph plant extracts is provided. Advanced level, but provides teachers with background information.

### 2. Carotenoids

**What is the etymology of carotenoid?**

The Greek word *karoton* and Latin word *carota*, meaning carrot + the Greek suffix *eidos*, shape or form. The emphasis is on the color of the pigment.

**What color do carotenoids provide?**

Carotenoids give color to plants and animals. These pigments give foods their orange-red colors and flowers their yellow colors. The colors have a wide range: yellow, orange, orange-red

**Where can I find carotenoids?**

*Animals:* cardinal, flamingo, goldfish

*Fruits:* orange, peach

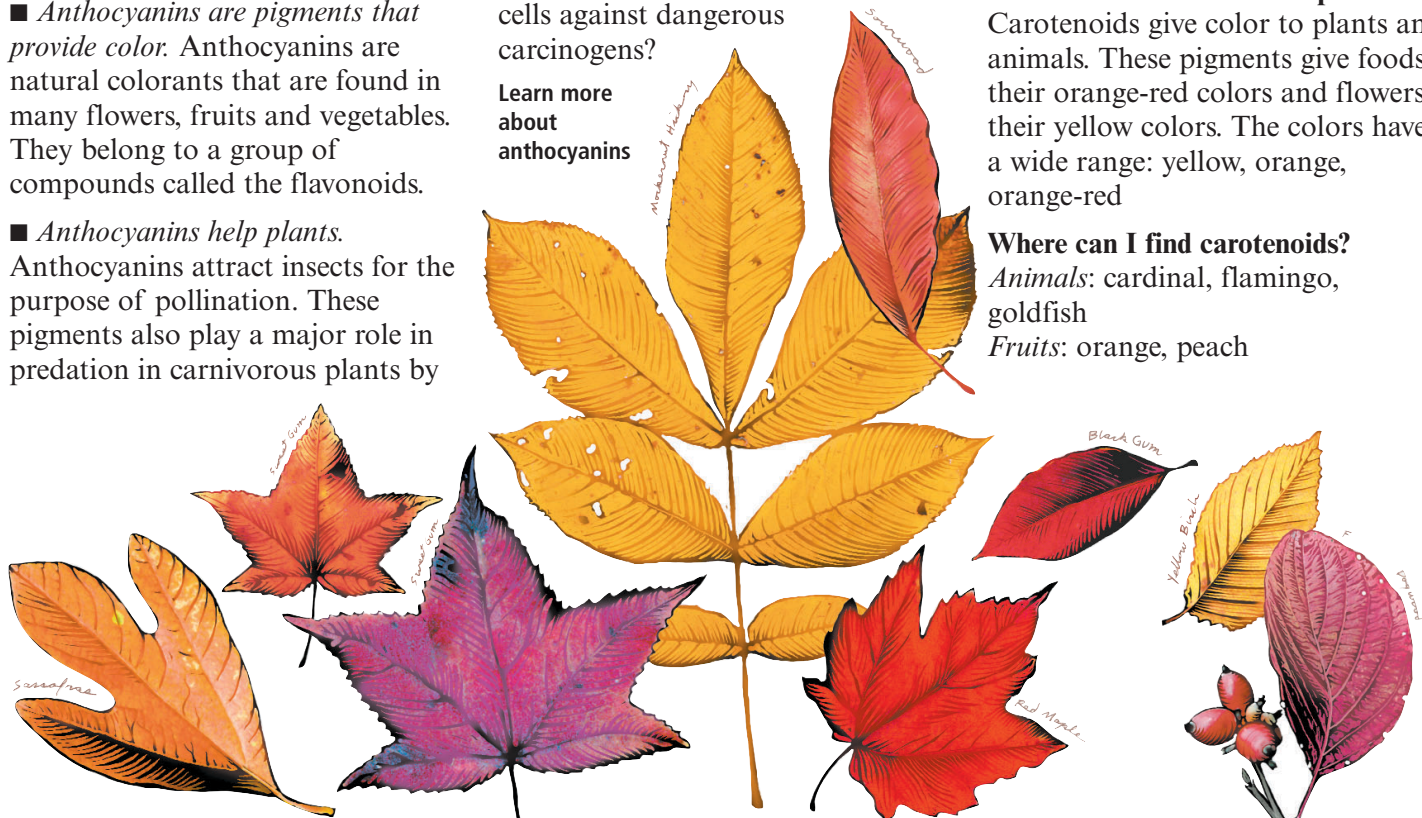


ILLUSTRATION BY PATTERSON CLARK—THE WASHINGTON POST

*Leaves:* birch, cottonwood  
*Vegetables:* corn, carrot, kale, spinach, turnip

### What do carotenoids do?

■ *Carotenoids are pigments that provide color.*

A scientist named Berzelius in 1837 named the yellow pigments of autumn leaves xanthophylls. They are carotenoids.

■ *Carotenoids are antioxidants.*

Oxidation is a kind of theft. The chemical thieves are called agents, oxidizing agents. They rob atoms, molecules and ions of one or more electrons. When oxygen is an oxidizing agent, you can see it. The apple turns brown, the iron nail rusts and your blue jeans fade.

In humans, carotenoids protect cells and tissues by acting as biological police to stop the theft. For example, xanthophylls found in corn and spinach are believed to protect the macular region of the retina.

■ *Carotenoids are essential in photosynthesis.*

Carotenoids provide vitamin A.

**Have you heard of beta-carotene?** It is a main source of vitamin A that you need to remain healthy. If you don't have enough vitamin A when you are young, you can become

sick. Some children in very poor countries (developing nations) do not receive necessary vitamin A so they die young.

### What are scientists asking?

Do carotenoids help in the fight against cancer, heart disease and degenerative eye disease? See what you can find out about recent research. The USDA even has a Carotenoids Research Unit at its Beltsville Human Nutrition Research Center (<http://www.barc.usda.gov/bhnrc/bhnrc.html>).

#### Learn more about carotenoids

<http://dcb-carot.unibe.ch/carot-intro.htm>  
The Carotenoids Page

<http://www.cc.nih.gov/cc/supplements/vita.html>  
Vitamin A and Carotenoids

## 3. Chlorophyll

**What is the etymology of chlorophyll?** Two Greek words: *chloro*, meaning green + *phyll*, from *phyllon*, meaning leaf.

### What color does chlorophyll provide?

Chlorophyll provides the green color of leaves.

### Where can I find chlorophyll?

In green leaves. The chlorophyll in leaves decays in autumn. The green color fades so that the anthocyanins and carotenoids can be seen.

### What does chlorophyll do?

Chlorophyll is a hard worker that is essential for photosynthesis to take place. Chlorophyll collects sunlight. It changes the energy of sunlight into an energy that can combine carbon dioxide (something that is not good for humans to breathe) and water. The result is a good product, a carbohydrate. Photosynthesis keeps plants alive. Since we eat plants and animals eat plants, chlorophyll is very important to our life.

#### Learn more about chlorophyll

<http://scifun.chem.wisc.edu/chemweek/chlorophyll/chlorophyll.html>

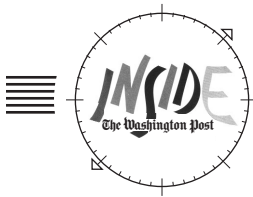
Chemical of the Week: Chlorophyll

A quick overview of the chemical properties of chlorophyll; for teachers.

[http://www.chm.bris.ac.uk/motm/chlorophyll/chlorophyll\\_h.htm](http://www.chm.bris.ac.uk/motm/chlorophyll/chlorophyll_h.htm)  
Chlorophyll



ILLUSTRATION BY PATTERSON CLARK—THE WASHINGTON POST



## Academic Content Standards

*This lesson addresses academic content standards of Maryland, Virginia and the District of Columbia. Among those that apply are:*

**The main lesson addresses these academic content standards of:**

### Maryland

#### Science

Life Science (3.0): Students will use scientific skills and processes to explain the dynamic nature of living things, their interactions and the results from the interactions that occur over time. Biochemistry: By the end of grade 3, students know and are able to: 3.3.12 explain that habitats provide basic needs, (i.e., food, water, shelter, energy) for the organisms living in them. Ecology: By the end of grade 3, students know and are able to: 3.3.12 explain that habitats provide basic needs, (i.e., food, water, shelter, energy) for the organisms living in them. By the end of grade 5, students know and are able to: 3.5.12 cite evidence that individuals and groups of organisms interact with each other and their environment.

Environmental Science (6.0): Students use scientific skills and processes to investigate the interrelationships of the natural world and to analyze environmental issues and their solutions.

Interdependence of Organisms: By the end of grade 8, students know and are able to: 6.8.2 identify and explain the interdependency of organisms within the environment in a given ecosystem (i.e., producer/consumer, predator/prey, host/parasite).

#### Language Arts

Writing (3.0): Students produce informational, practical, persuasive and narrative writing that demonstrates an awareness of audience, purpose and form using stages of the writing process as needed (i.e., pre-writing, drafting, revising, editing and publishing).

A complete list of State Content Standards of Maryland can be found at <http://www.mdk12.org/mspp/standards/>.

### Virginia

#### Science

Life Processes, Grade 4, 4.4: The student will investigate and understand basic plant anatomy and life processes. Key concepts include photosynthesis (chlorophyll, carbon dioxide) and dormancy. Grade 7, LS.6: The student will investigate and understand the basic physical and chemical processes of photosynthesis and its importance to plant and animal life. Key concepts include

- energy transfer between sunlight and chlorophyll;
- transformation of water and carbon dioxide into sugar, water and oxygen; and
- photosynthesis as the foundation of food webs.

#### English

Writing, Grade 3, 3.7: The student will write descriptive paragraphs.

- Develop a plan for writing
- Focus on a central idea
- Group related ideas
- Include descriptive details that elaborate the central idea

Grade 6, 6.7: The student will write narratives, descriptions and explanations.

- Use a variety of planning strategies to generate and organize ideas.
- Establish central idea, organization, elaboration and unity.
- Select vocabulary and information to enhance the central idea, tone and voice.

A complete list of Standards of Learning of Virginia can be found on the Web at <http://www.pen.k12.va.us/>.

### Washington, D.C.

#### Science

Life Science, Content Standard 2: Observe, investigate, describe and classify living things; explain life cycles, diversity, adaptations, structure and function of cells and systems reproduction, heredity, interdependence, behavior, flow of energy and matter and changes over time. By the end of grade 3, the student will describe life cycles of familiar organisms; produce evidence to explain that some source of energy is needed for all organisms to stay alive and grow.

#### English

Language as Literature, Content Standard 2: Students respond in many ways to a rich variety of literary texts and relate texts to life. Grade 3: The student connects facts, incidents and details as appropriate; writes topic sentences, supporting details and concluding sentences; excludes extraneous details and inconsistencies; evaluates writing against specific criteria and revises text to meet the standard; writes responses in at least three paragraphs.

A complete list of Standards for Teaching and Learning of the District of Columbia Public Schools can be found at <http://www.k12.dc.us/>.