



Schoolyard Investigation



Fall Color Change

Third Grade



PEI PACIFIC
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Overview

These lessons are specific to the fall season as students will explore the phenomenon of the changing colors of leaves. Through observations, readings, and videos, students will be able to explain why some leaves change color in the fall and some do not, and which environmental factors cause the change in leaf color. Students will use evidence collected by investigating the various pigments in leaves to support their explanation. An optional investigation is included in which students can submit leaf color and leaf drop data to www.budburst.org.

Overview Statement

Use **observations and investigations to explain** that **temperature and decreasing sunlight cause some leaves to change color** in the fall.

Next Generation Science Standards

3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment.		
Science and Engineering Practices Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. <ul style="list-style-type: none"> Use evidence (e.g., observations, patterns) to support an explanation. 	Disciplinary Core Ideas LS3.A: Inheritance of Traits <ul style="list-style-type: none"> Other characteristics result from individuals’ interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. LS3.B: Variation of Traits <ul style="list-style-type: none"> The environment also affects the traits that an organism develops 	Crosscutting Concepts Cause and Effect <ul style="list-style-type: none"> Cause and effect relationships are routinely identified and used to explain change
<i>Common Core State Standards Connections:</i> <i>ELA/Literacy –</i> RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS3-2) RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea. (3-LS3-2) RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS3-2) W.3.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (3-LS3-2) SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. (3-LS3-2) <i>Mathematics –</i>		

MP.2	Reason abstractly and quantitatively. (3-LS3-2)
MP.4	Model with mathematics. (3-LS3-2)
3.MD.B.4	Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. (3-LS3-2)

English Language Proficiency Standard

ELP.2-3.2 Participate in grade appropriate oral and written exchanges of information, ideas, and analyses, responding to peer, audience, or reader comments and questions.

Background

There are two investigations to explore. The first investigation explores the difference between evergreen and deciduous tree leaves to highlight the differences in inheritable traits. The second investigation explores how light (or lack of light) can change leaf color emphasizing how the environment can change traits. Without light, the chlorophyll will degrade. The lack of chlorophyll reveals yellow and orange pigments that were already in the leaves but masked during the warmer months. The reason that no red pigment will be observed is that the red pigment in some leaves is the result of a chemical change: Sugars that can get trapped in the leaves produce new pigments (called anthocyanins) that weren't part of the leaf in the growing season. Cool nights contribute to the formation of the anthocyanins. You may want to consider completing both the Explore and Explain for the first investigation before you begin the Explore of the second investigation.

Fall into Phenology from www.budburst.org

What autumn changes do you notice in the plants in your neighborhood, schoolyard, or community? At Budburst, we are interested in what plants are doing throughout the year so we can understand how plants respond to changes in their environment. *Fall into Phenology* is a fun way for everyone to get outside to observe fall phenological changes around the country. Join us, observe a plant near you, and learn more about the stories plants are telling this fall!

No need to limit your *Fall into Phenology* observations to leaf color and drop. Watch for fall flowers, such as asters, and record first flower, or full flower. Seeds and fruiting abound in the fall months. Report all your phenology observations to your [Budburst Account](#).

Why Fall into Phenology?

One of the most frequent requests we get from scientists is for enhanced geographic coverage of observations. The more people we have participating across the country, the better geographic coverage we have, and the more useful the data is to scientists and researchers. Your data can and will be used to look for general trends, or they might be used to double-check and better understand remotely sensed data such as that taken by satellites, or they might be used by high school students tracking relationships between leaf color change and precipitation.

Objectives

Students:

- Use reasoning to connect the evidence and support an explanation about environmental influences on expressed traits in organisms. In their chain of reasoning, students describe a cause-and-effect relationship between the changing temperature and sunlight in fall and its effect on leaf color.

Materials:

- collection of leaves of various colors (or photos of leaves) including deciduous and evergreen
- compass
- markers or crayons in greens, yellow, oranges, reds; paint chips (optional)

- journals/science notebooks
- reading material: *Why Do Leaves Change Color?* by Betsy Maestro; *How Leaves Change* by Sylvia Johnson, *Sky Tree* by Thomas Locker.
- painter's tape
- optional - potted plants such as chrysanthemums; and aluminum foil if you do "hidden colors" in classroom instead of outdoors.

Timing: Minimum three 30-minute learning sessions.

Learning Experience

For this project students may work as individuals, in pairs or small teams. Each student should document their individual and group thinking throughout the design process, utilizing either the generated student pages or in a science notebook.

Engage

1. Begin this activity by taking students outside for a walk around their schoolyard. There is no need at this point to observe any trees specifically. This first outside activity is to **notice** the **changes in the environment** more than just leaf color change. Pose the questions: "What changes do you notice in the fall?" (Optional question: "What do you like best about fall?") Things to notice might include:
 - a. Are any flowers blooming right now?
 - b. Are there any other things falling from trees other than leaves (cones, nuts)?
 - c. Are there trees that are staying green and don't lose their leaves?
 - d. How does the air feel? Is it warmer or cooler than before school started?
 Have students record what they are **noticing** in their journals.
2. Next, either point out the **changing leaf colors** in the schoolyard or, in the classroom, show a beautiful colored leaf or a photo of amazing fall color. Ask students what questions they have about the leaves changing colors. Start the questions with "I wonder....." Record these questions for the class to reference. Have some prepared probing questions such as "Do all leaves change color?" "Are all leaves the same color?" "Why are leaves changing color now?"
3. Tell the students they will be **investigating** what **causes** some **leaves to change color**.

Explore

Teacher Notes: There are two investigations to explore in this section. The first investigation is exploring the difference between evergreen and deciduous tree leaves to highlight the differences in inheritable traits. The second investigation explores how light (or lack of light) can change leaf color emphasizing how the environment can change traits. You may want to consider completing both the Explore and Explain for the first investigation before you begin the Explore of the second investigation.

1. Students use the Leaf Worksheet from the National Wildlife Federation's *Tree Detective* activity (in student pages of this investigation) to explore the different shapes that leaves come in. The whole activity is valuable given enough time. However, using just the leaf worksheet will prepare students for being able to **observe** both deciduous and evergreen leaves.

2. Students go outside again – this time to *observe* a tree that is changing color and respond to the questions:
 - a. Is the tree all one color?
 - b. If not, where are the *different colors on the tree?*
 - c. If there is still green on the tree, is it all the same shade of green?
3. Students *observe* another deciduous tree if possible and answer the same questions.
4. Students draw either of the trees accurately capturing where the color is found on the **What does a deciduous tree look like in the fall?** student page. Option: have students draw and then label the colors to fill in back in the classroom. Students could also use paint chips to match colors they observe.
5. Students collect leaves that are a variety of colors – including green –from as many different trees as possible. Be sure to include evergreen leaves (needles) as well.

Art Extension

Lois Ehlert's *Red Leaf*, *Yellow Leaf* and *Leaf Man* are beautifully illustrated children's books celebrating the colors and shapes of leaves in fall. In *Leaf Man*, Ehlert uses real leaves to construct pictures. Use the reading of this book to invite students to make their own pictures and collages with collected leaves.

Set aside some time for students to do leaf rubbings using a soft crayon and some paper. If you're feeling very ambitious, place the leaf on a hard surface (like a concrete floor) and lay a piece of paper on top. Then have students use a rubber mallet to pound the leaf – colors from the leaf will color the paper!

6. In the classroom place all the leaves on a table and separate according to color and shape (this should result in a separate pile of evergreen leaves).
7. Students respond to the questions:
 - a. Are ALL the leaves changing color?
 - b. Which trees have leaves that are NOT changing color?
8. Students draw, color, and label an evergreen leaf on the **What does an evergreen leaf look like?** student page.
9. Students study a colorful leaf and answer these questions:
 - a. Is the leaf all one color?
 - b. If not, where does the color change on the leaf?
 - c. Is the leaf the same color top and bottom?
10. Students draw, color, and label their leaf on the **What does a deciduous tree leaf look like in the fall?** student page.
11. To explore the *cause and effect* of light and leaf color change, pose the question to the students, "What happens to the *color of a leaf when it doesn't get light?*". Record their responses and save to revisit at the end of the investigation.
12. Students go outside and put painter's tape on deciduous green leaves to prevent light from reaching the leaves. Find low-hanging leaves in the schoolyard where students can place their tape. This investigation works best when choosing leaves that are in the sun.
13. Students draw and record in their journals/notebooks what they did along with the date, time, and weather.

14. After 5–7 days remove the tape and *observe* and record what has happened to the color. Pose the question again: “What happens to the *color of a leaf when it doesn’t get light?*”
 - a. Teacher notes: Without light, the chlorophyll will degrade. The lack of chlorophyll reveals yellow and orange pigments that were already in the leaves but masked during the warmer months. The reason that no red pigment will be observed is that the red pigment in some leaves is the result of a chemical change: Sugars that can get trapped in the leaves produce new pigments (called anthocyanins) that weren’t part of the leaf in the growing season. Revisit the initial responses of the students from #10 and note any changes in thinking. The explanation of this phenomenon is under Explain.
15. If it is necessary to conduct the investigation of hidden leaf color in the classroom: Students record the color of leaves of a potted chrysanthemum (paint chips work well). Pose the question, “What happens to the color of a leaf when it doesn’t get light?” Students place aluminum on 3–5 leaves of a chrysanthemum, wait a week and record observations in their journal/notebooks.

Explain

1. Give students information about the terms deciduous and evergreen. Students write the definition of deciduous and evergreen in their journals.
2. Students *observe* other differences between evergreen and deciduous leaves such as shape and size. Respond to the questions:
 - a. Are the traits of the trees the same or different?
 - b. Is the environment the same or different for these trees?
3. Post the before and after responses to the question “What happens to the *color of a leaf when it doesn’t get light?* Students construct an explanation that “*Without light, the leaf changes color.*” Connect the students’ *observations* back to the changes they observed during the Engage part of this investigation (the amount of daylight is less, and the temperatures are cooler). Students respond the questions:
 - a. How does the amount of light affect leaf color?
 - b. How does the amount of light affect other traits of the tree?

Optional Investigation

Citizen Science: Observations of Tree Color and/or Leaf Drop for Budburst.org

Collect one-time data to submit to www.budburst.org. You will need to know the name of the tree and its location (latitude and longitude from your phone). These questions will need to be answered online. You might want to choose several trees.

Leaves changing color:

- No leaves have changed color
- Early: Only a few leaves have changed color (less than 5%)
- Middle: Many leaves have changed color
- Late: Most leaves have changed color (over 95%)

Leaves dropping:

- No leaves have dropped
- Early: Only a few leaves have dropped (less than 5%)
- Middle: Many leaves have dropped
- Late: Most leaves have dropped (over 95%) fallen

Students construct an explanation from their observations that the *environment affects some traits in the trees but not all traits.*

4. Read *How Leaves Change* by Sylvia Johnson to gain knowledge about how and *why leaves change color.*

5. Students place their tree drawings around the room or share them in groups. Students to discuss the following questions doing a pair - share:
 - a. Is the tree all one color?
 - b. If not, where are the different colors on the tree?
6. Students brainstorm reasons they think the tree is not all one color and have them record their ideas in their journals/notebooks.
7. Read *Why Do Leaves Change Color?* by Betsy Maestro or have students read it themselves if there are enough copies.
8. Students watch a video about why leaves change color. Here are some suggestions:
 - a. [Why Do Leaves Change Color?](#)¹
 - b. [Why Do Autumn Leaves Change Color?](#)²
9. Students *explain* the *environmental changes that cause the change in leaf color* in the fall using their *observations as evidence*. Pose the following questions to support the student explanations:
 - a. *What environmental changes occur in the fall to signal changes* in deciduous trees' leaves? (There is less light to make chlorophyll and the temperatures become cooler).
 - b. Some types of trees develop red color in their leaves in the fall. *What causes the bright red/purple color to form in the leaves of some trees?* (Sunny days and cool nights)

Elaborate

1. Students answer the investigative question, "What happens to *leaf color* when the leaf doesn't get light?" making a claim with evidence and reasoning using the assessment and reflection page **Leaf Color Change CER**.
2. Students find the name of the tree of one of the leaves using tree ID books or the internet. Leafsnap is an app for tree and shrub ID. The website <https://www.pltwa.com/forest-resources.html> provides a bibliography of books.
3. Optional: Read *My Favorite Tree: Terrific Trees of North America* by Diane Iverson or *Meeting Trees* by Scott Russell and/or *Sky Tree* by Thomas Locker
4. Students write a poem using words describing the tree.
5. Students press leaves or do another leaf art project.

Evaluate

1. Give each student 2 different leaves (one from an deciduous tree and one from an evergreen tree) to compare and contrast using a Venn diagram or a box and T chart (see student pages:

¹ Video retrieved from YouTube user Free School, "Why Do Leaves Change Color? What Makes the Leaves Fall?", <https://youtu.be/UuTrDnzmMxY>

² Video retrieved from Scientific American, "Why Do Autumn Leaves Change Color?," <https://www.scientificamerican.com/video/why-do-autumn-leaves-change-color-2013-10-03/>

Comparing and Contrasting 2 Types of Leaves). Ask them to answer the question, "How are these leaves alike and different?"

2. Give students the **3,2,1 Reflection** page from the reflection and assessment section. Have students write three ideas they have learned, two ideas they are wondering about and one question that they have.
3. Evaluate student drawings for details and accuracy.
4. Evaluate student answers to questions particularly to what causes leaf changes to occur using the student page **Questions to Evaluate**.
5. Evaluate students' drawings/descriptions of the color changes after removing the tape.
6. Evaluate students' constructed explanations answering the question, "*What happened to the leaf's color when the leaf doesn't get light?*"

Extension

1. Students participate in the leaf [Chromatography Activity](#) to see *the pigments in a leaf*.



Fall Color

Student Pages

Name: _____

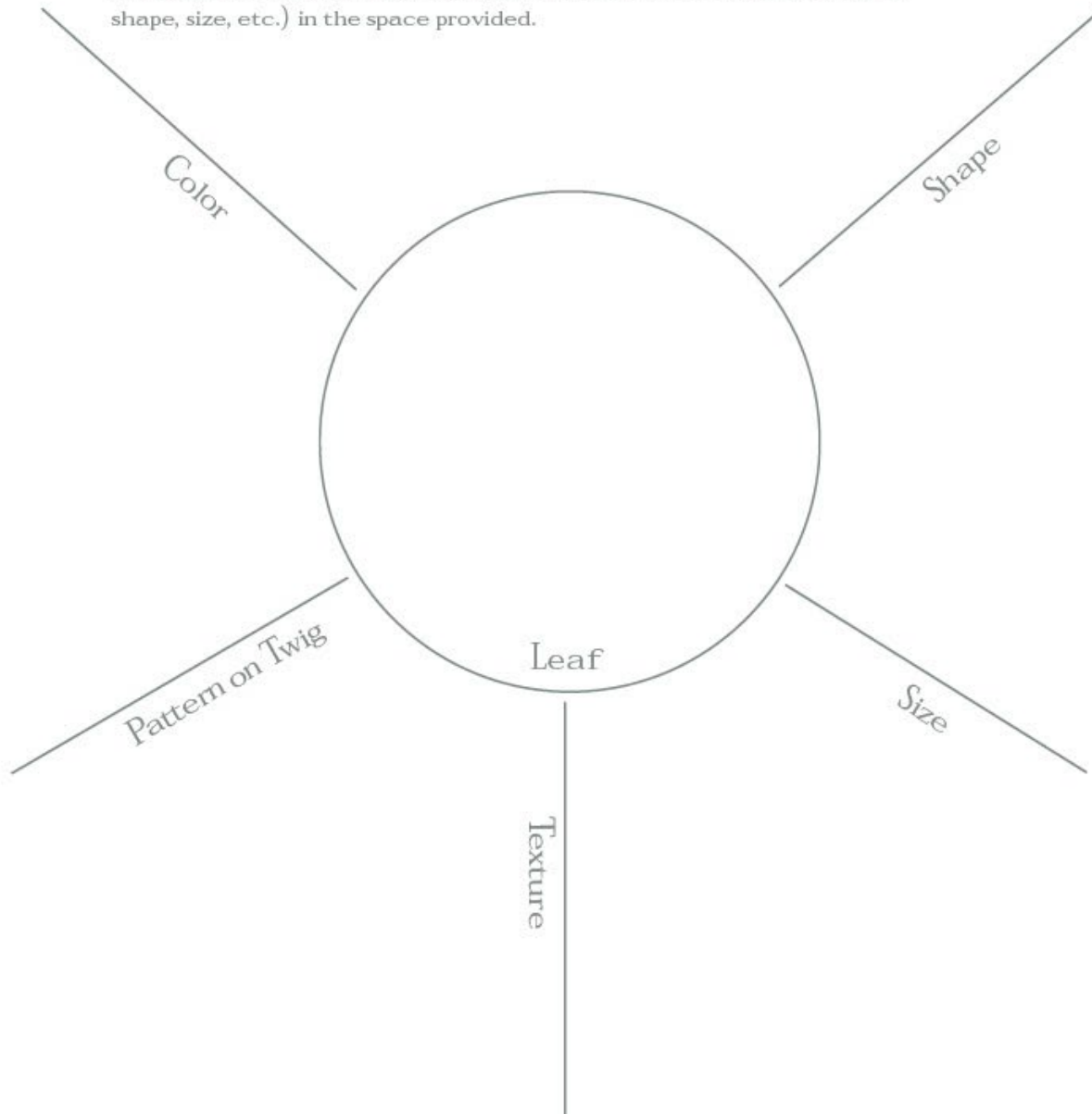


Tree Detectives!

WORKSHEET

LEAF CLUE SHEET

DIRECTIONS: Draw a picture of your leaf in the middle, where it says "Leaf," and briefly describe or draw each characteristic of the leaf (e.g., color, shape, size, etc.) in the space provided.



Compare and Contrasting 2 types of leaves

Are these leaves more alike or different? Find the tree/shrub your leaves came from.

Similarities

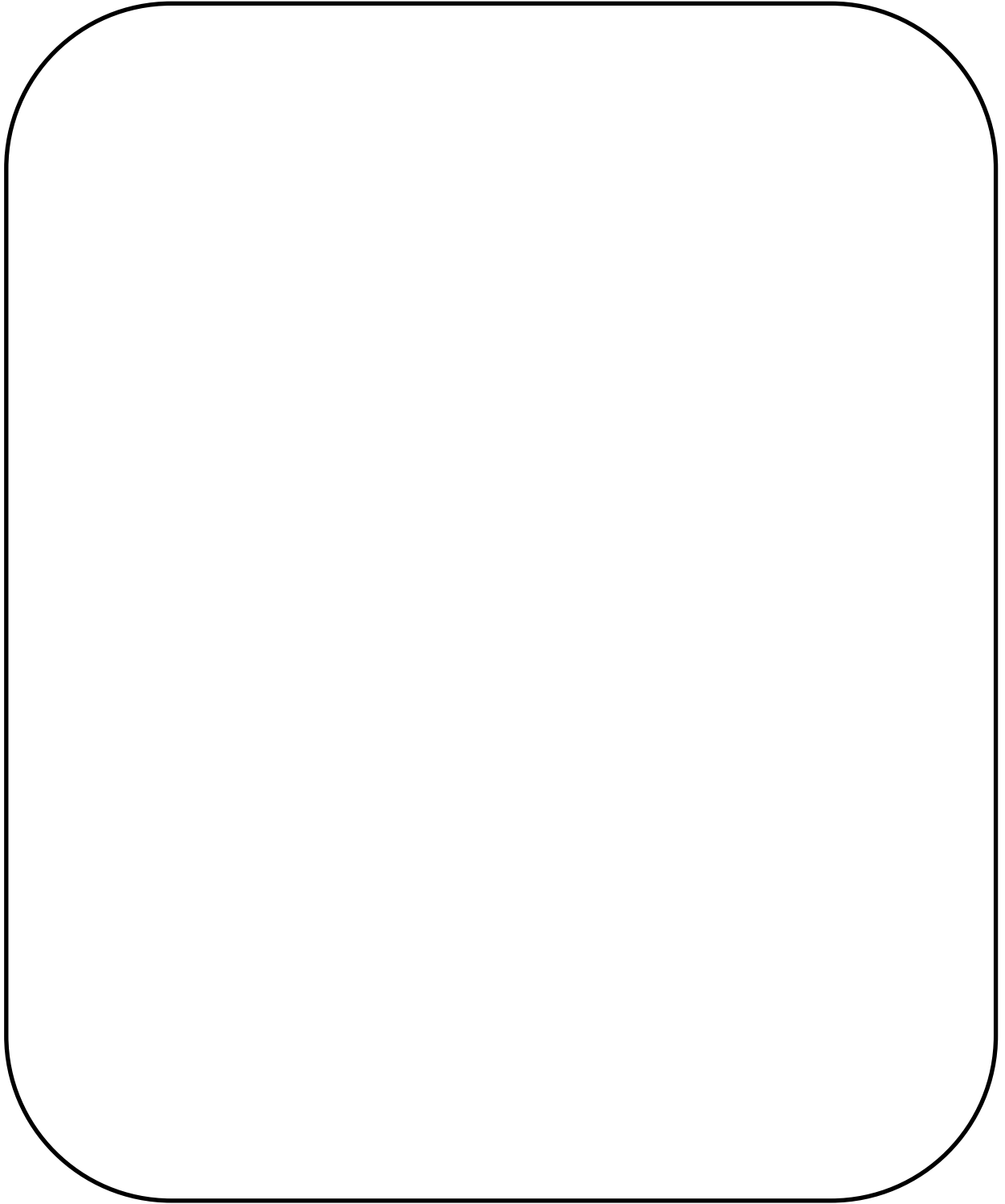
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Differences

Leaf 1	Leaf 2

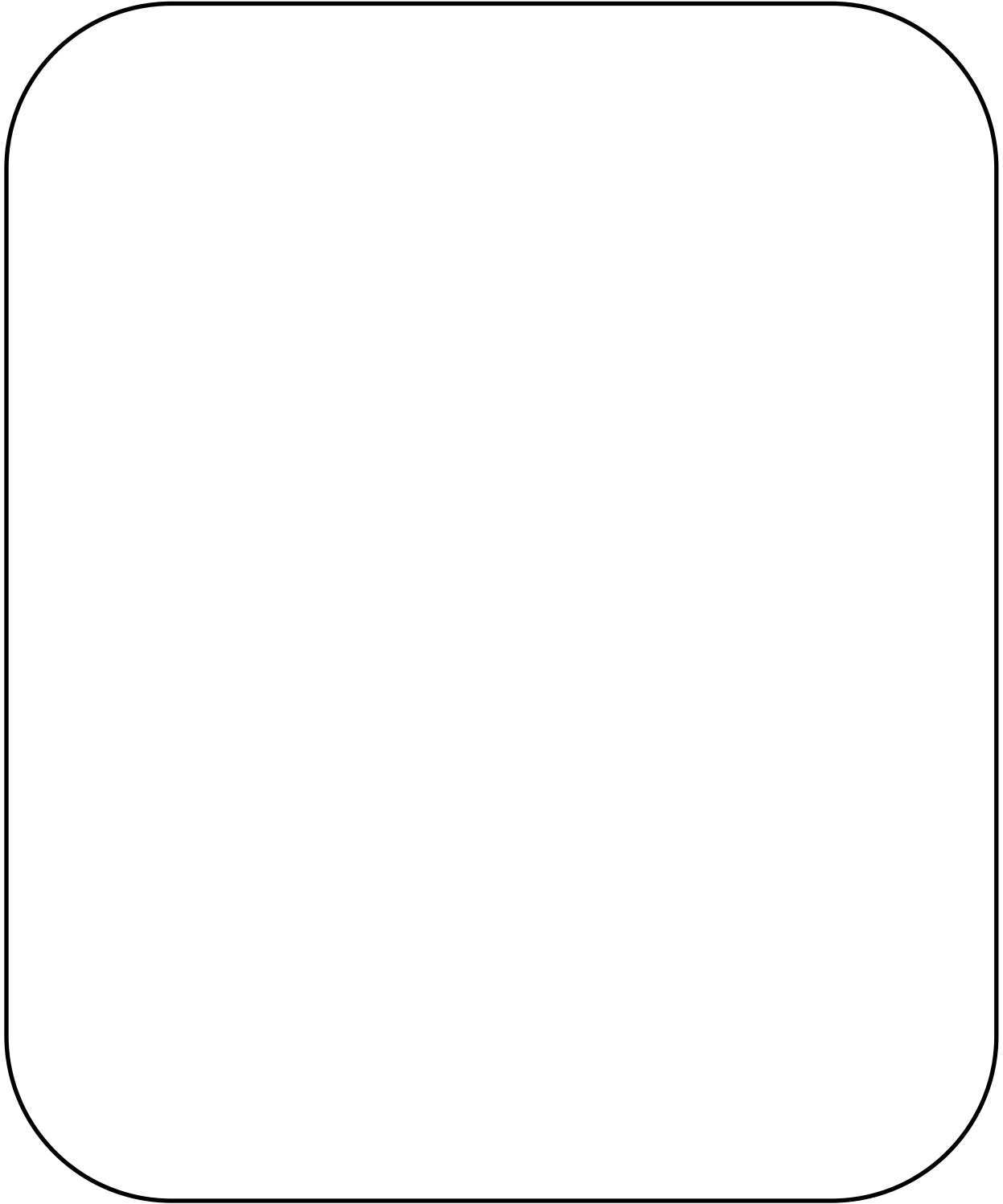
What does a deciduous tree look like in fall?

Draw and color your tree



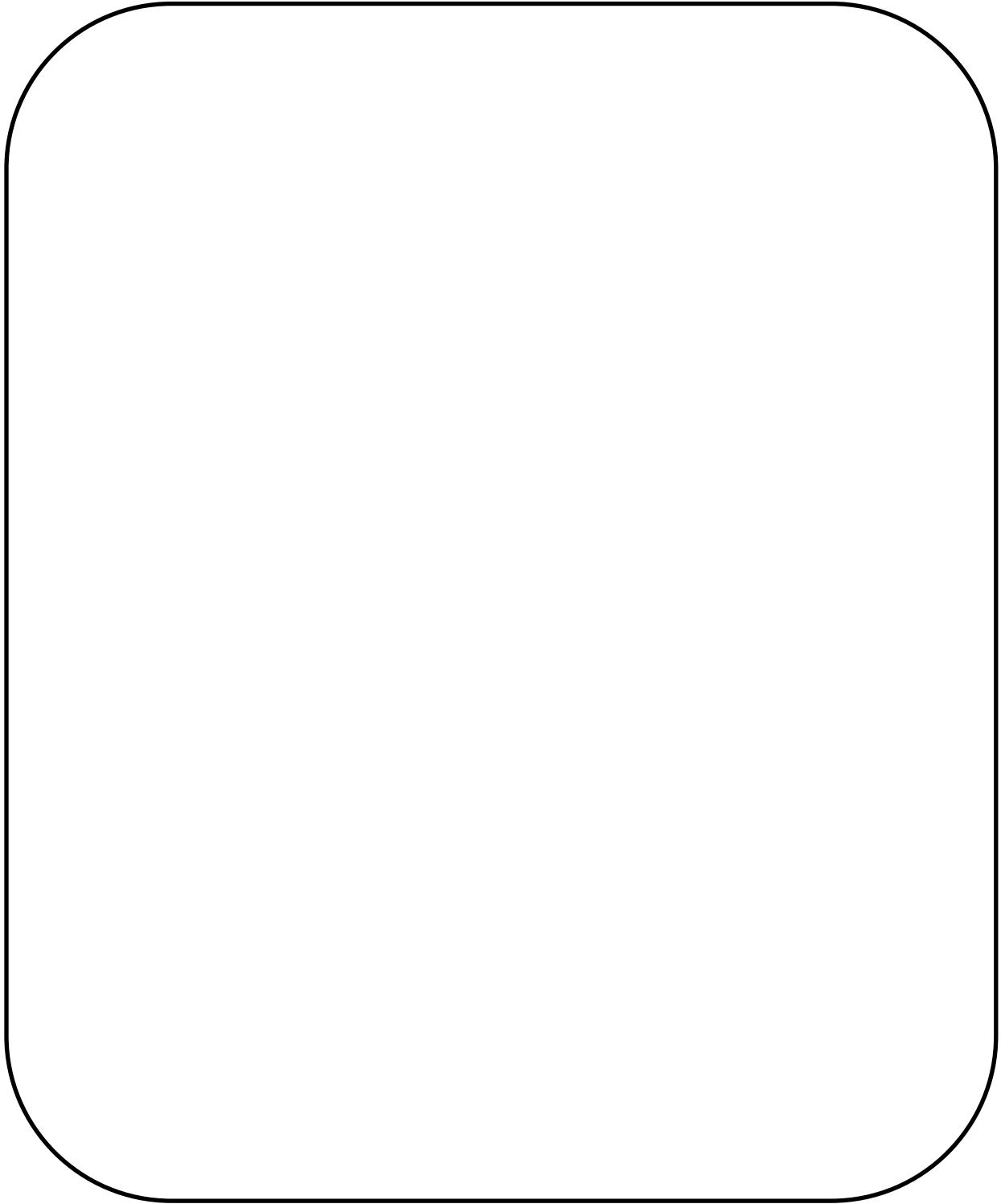
What does a deciduous tree leaf look like in fall?

Draw and color your tree



What does an evergreen tree leaf look like in fall?

Draw and color your tree



Fall Color Change

What do deciduous trees look like in fall?

Questions to Evaluate:

1. Describe the terms deciduous and evergreen.
2. What environmental changes occur in the fall to signal changes in deciduous trees' leaves?

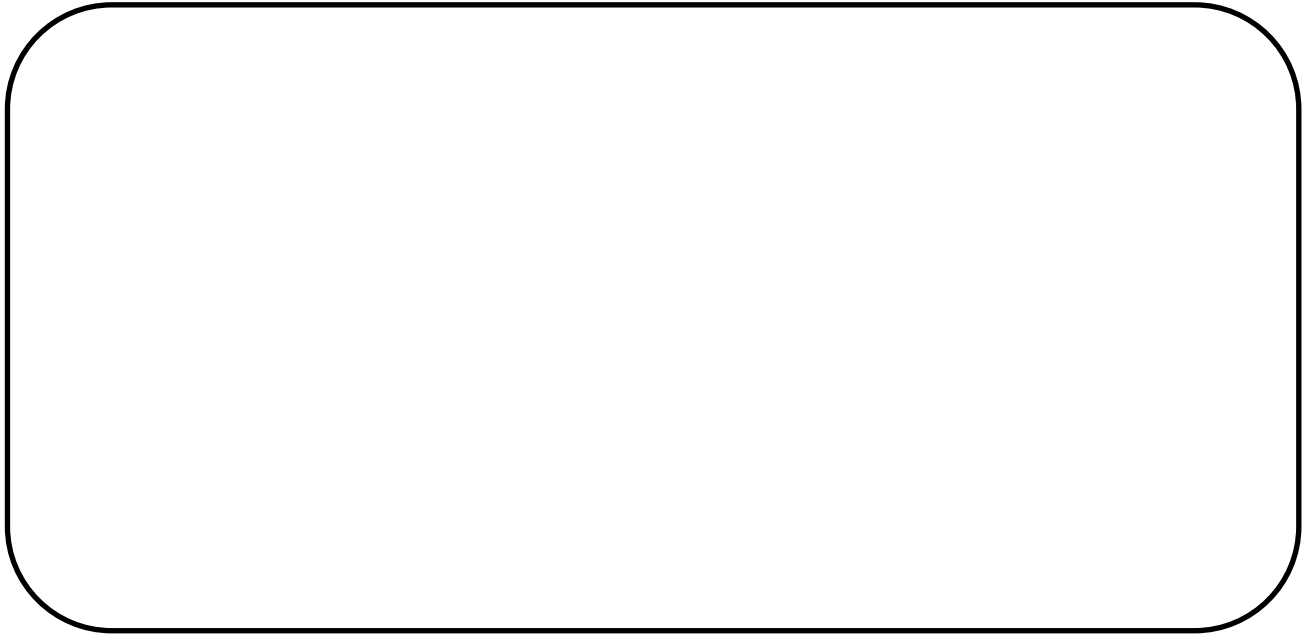
Reflection and Assessment

3, 2, 1 Reflection

- Write three ideas you have learned
- Write two ideas you are still wondering about
- Write one question you still have

What happens to the color of a leaf when it doesn't get light?

Draw or describe leaf color change:



Claim:

Evidence:

Reasoning:

Rubric for Color of a Leaf Claim, Evidence, Reasoning (CER)

Standard: 3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment.

	Score of 4	Score of 3	Score of 2	Score of 1
Explanation of Phenomena	The student consistently identifies the explanation of leaf color change, clearly articulating a statement that relates the phenomenon to a scientific idea, including the understanding that inherited traits can be influenced by the environment.	The student mostly identifies the consistently identifies the explanation of leaf color change, adequately articulating a statement that relates the phenomenon to a scientific idea, including the understanding that inherited traits can be influenced by the environment.	The student attempts to identify the explanation of leaf color change, but may have some difficulty articulating a statement that relates the phenomenon to a scientific idea and understanding that inherited traits can be influenced by the environment.	The student needs substantial support and guidance to identify the explanation of leaf color change and struggles to articulate a statement that relates the phenomenon to a scientific idea and understanding that inherited traits can be influenced by the environment.
Evidence	The student effectively describes the given evidence that supports the explanation, providing comprehensive descriptions of environmental factors that vary for organisms of the same type, inherited traits that vary between organisms of the same type, and observable inherited traits of organisms in varied environmental conditions.	The student mostly describes the given evidence that supports the explanation, providing adequate descriptions of environmental factors that vary for organisms of the same type, inherited traits that vary between organisms of the same type, and observable inherited traits of organisms in varied environmental conditions.	The student attempts to describe the given evidence that supports the explanation, but may have some difficulty providing accurate descriptions of environmental factors that vary for organisms of the same type, inherited traits that vary between organisms of the same type, and observable inherited traits of organisms in varied environmental conditions.	The student needs substantial support and guidance to describe the given evidence that supports the explanation and struggles to provide accurate descriptions of environmental factors that vary for organisms of the same type, inherited traits that vary between organisms of the same type, and observable inherited traits of organisms in varied environmental conditions.
Reasoning**	The student effectively uses reasoning to connect the evidence and support an explanation about the influences of light and temperature on inherited traits in trees. They clearly describe a cause-and-effect relationship between the causal environmental factor and its effect on a given leaf color variation, providing a logical and coherent chain of reasoning.	The student mostly uses reasoning to connect the evidence and support an explanation about the influences of light and temperature on inherited traits in trees. They adequately describe a cause-and-effect relationship between the causal environmental factor and its effect on leaf color variation, providing a mostly logical and coherent chain of reasoning.	The student attempts to use reasoning to connect the evidence and support an explanation about influences of light and temperature on inherited traits in trees, but may have some difficulty describing a cause-and-effect relationship between the causal environmental factor and its effect on leaf color variation, resulting in a somewhat disjointed or incomplete chain of reasoning.	The student needs substantial support and guidance to use reasoning to connect the evidence and support an explanation about influences of light and temperature on inherited traits in trees, struggling to describe a cause-and-effect relationship between the specific causal environmental factor and its effect on leaf color variation.

***This assessment is working towards meeting the full standard.**

****At the third-grade level, some students may struggle with scientific reasoning. Students are not expected to fully explain using scientific reasoning until 4th grade.**

Teacher Resources

Fall into Phenology from www.budburst.org

What autumn changes do you notice in the plants in your neighborhood, schoolyard, or community? At Budburst, we are interested in what plants are doing throughout the year so we can understand how plants respond to changes in their environment. *Fall into Phenology* is a fun way for everyone to get outside to observe fall phenological changes around the country. Join us, observe a plant near you, and learn more about the stories plants are telling this fall!

No need to limit your *Fall into Phenology* observations to leaf color and drop. Watch for fall flowers, such as asters, and record first flower, or full flower. Seeds and fruiting abound in the fall months. Report all your phenology observations to your [Budburst Account](#).

Why Fall into Phenology?

One of the most frequent requests we get from scientists is for enhanced geographic coverage of observations. The more people we have participating across the country, the better geographic coverage we have, and the more useful the data is to scientists and researchers. Your data can and will be used to look for general trends, or they might be used to double-check and better understand remotely sensed data such as that taken by satellites, or they might be used by high school students tracking relationships between leaf color change and precipitation.

How to Report your *Fall into Phenology* Observations

Fall into Phenology was developed with your busy schedule in mind. It takes about ten minutes to report an observation. This campaign welcomes both types of observation reports:

- A one-time report, or status-based observation -- For example: early, middle, or late stage of leaf color or leaf drop for a Sweet gum tree you see while driving through a state park.
- A life-cycle report, or event-based observation -- For example: for 50% leaf color *and* 50% leaf drop of the red maple in your backyard.

To make your observation report follow these simple steps:

- Log into your [Budburst Account](#) - submit your [One-time or Life-cycle Report](#) using your handheld device or record your observations on a field report form (downloadable from your plant's webpage) and post your findings later.
- Track your data - check your Sugar Maple data from previous years in your [Budburst Account](#), or view data from other observers using the [Data menu](#). Is this year's leaf color or leaf drop earlier or later than previous years?

All observation reports - whether Life-cycle or One-time - are helpful in understanding how plants respond to changes in climate and atmosphere over time.

The goal of this campaign is to collect at least 500 observations from around the country (that's only 10 per state!). Watch for updates and track observations as they are reported.