



Celebrating Chemistry

CHEMISTS CELEBRATE EARTH WEEK AMERICAN CHEMICAL SOCIETY

Into the Woods with Chemistry



Into the Woods with Chemistry: Woody Chemis-tree

By Weslene Tallmadge

Imagine a world with no trees—no shade on hot days, no birds singing in the branches, and no clean air to breathe. Trees are everyday heroes that work quietly all around us, helping the planet and the people who live on it.

Trees are important because they have so much to give. We couldn't live on Earth without them. They provide food, building materials, and beautiful forests. Can you think of five incredible things about trees? Read on and add to that list!



About the cover:

Birds, bringing in the banner, are celebrating the 150th anniversary of ACS in 2026!

The cover has many kinds of trees from various parts of the world. How they look and behave depends on the season. In late winter and early spring, tapping the *sugar maple tree* gives you sap. Upon boiling down, this becomes maple syrup (page 4). Come spring, blooming *cherry blossoms* are being planted. In summer and in warmer regions through the world, you see others like the *banyan* (Indian subcontinent) and the *flamboyant trees* (many warm parts). In fall, *stewartia tree* has turned into a beautiful color as cool temperature breaks down green chlorophyll. In the same season, apples are aplenty. During late fall/winter is a great time to build the treehouse for the backyard on the *mulberry tree*. The *Australian bottle tree* (Australia), *sequoia* (California), and *apple tree* (many countries) are all found in different regions in the world. Of course, you have scientists studying the tree rings (read on page 9) and leaf structure to learn more about them.

Weslene Tallmadge is a professor at Gannon University in Erie, Pennsylvania.

Trees are providers

We need oxygen to breathe for our survival. Trees make *oxygen* for us when they make their food. They also absorb carbon dioxide, a **greenhouse gas**, in the process (read more on page 3). Trees provide *food* like nuts, fruit, seeds, and syrups for us and animals (find out if your syrup is real maple syrup on page 5). Trees offer *shelter* to birds and animals, and we use their wood to build houses. Trees are also the source of *firewood, lumber, paper, rubber*, and more. Trees are part of the system that *supports* us and other life forms.

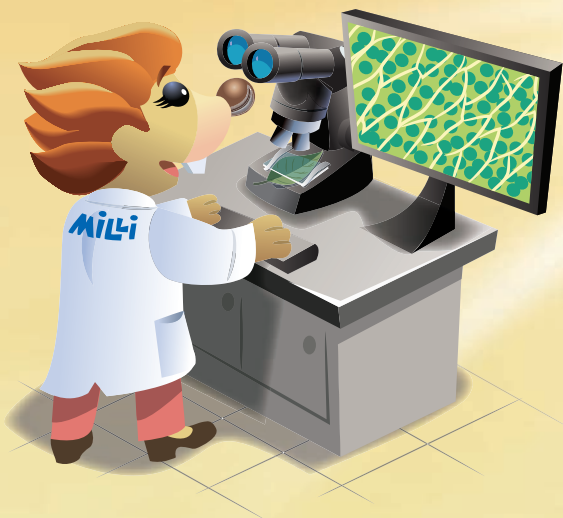
Trees protect the Earth

Trees help our climate (learn how on page 8). Earth can sometimes get too cold or too hot for different reasons. Trees help *maintain* the balance that keeps us be more comfortable. Trees add *humidity* (water content) to the air through water vapor. Trees *purify* air. They remove unhealthy particles and gases so we can breathe cleaner air. Tree roots absorb and *store* water. They hold on to soil around them and can *prevent erosion* or (soil washing away).

Trees add beauty, nutrients, peace

Trees can make the spaces we live in more beautiful. Green spaces in cities can have a calming effect and reduce stress in humans. Have you noticed that tree shade helps you feel cooler on hot days? You may save money on air conditioning if you have trees where you live. In the fall, many trees have leaves that change color to beautiful shades of red, yellow, and orange. The fallen leaves decay and add nutrients back to the soil making it fertile.

Trees protect our soil, clean our air, filter our water, make the oxygen we breathe, regulate Earth's temperature and humidity, and are even said to help relieve stress and anxiety, lower blood pressure, and boost our mood. Enjoy learning about some of the amazing chemistry of trees in this issue!



The Secret Recipe: Making Food While the Sun Shines

By **Betty Jo Chitester**

Did you know plants don't "eat" like we do? Plants don't grow by getting food through their roots. They are like chefs: they make their food by combining what they find in the air with water from their roots and sun's energy.

All green plants, including trees, shrubs, herbs, and algae make their own food by a process called **photosynthesis**. Without this, other living beings couldn't exist on Earth. Photosynthesis comes from Greek. "Photo" means light and "synthesis" means to "put together." This process happens only when there are light, carbon dioxide (from air), and water (taken up by roots). Through photosynthesis, plants make a simple food called glucose (a sugar) and oxygen.

Fun Fact: Did you know plants can grow without sunlight? So, where sunlight may not be available, office lights or special grow lights could work.

What does a tree need for photosynthesis?

Sunlight (photons) – Sun has packets of energy called "**photons**." Each photon contains a certain amount of energy. When the sun (or light) is shining, leaves use this energy for making their food.

Chloroplasts and **Chlorophyll** – Chloroplasts are tiny "kitchens" in plants, where photosynthesis takes place. They are specialized small structures in leaves. They contain chlorophyll. Chlorophyll is the pigment (a pigment gives color to things) that gives leaves their

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green color. It is what helps trap the sunlight and convert sun's energy into food.

Carbon dioxide (CO₂) – CO₂ is easily available and in plenty in the air. Many activities release CO₂ such as living things breathing out or human activities such as burning fuel.

Water (H₂O) – For plants, water is as important as CO₂. Water absorbed by the tree roots travels up to the leaves for photosynthesis.

Fun Fact: All the energy you gain by eating food really started out as the sun's energy!

What is the tree's recipe for making food? Six parts CO₂ and six parts water are needed to make one part glucose (a sugar) and six parts oxygen. The equation used by scientists is:



The glucose is used by the plant to grow: for making more leaves, roots, fruits, bark, etc.

We need to thank trees and plants for the oxygen, wood, fruit, seeds, leaves, nuts, rubber, paper, firewood, and all the other things we have because of them. As a thank you, consider planting and nurturing trees every chance you get. Thanks to them, we are alive!



Milli's Safety Tips: Safety First!



- Ask an adult for permission to do the activity and for help when necessary.
- Read and follow all directions and safety recommendations before starting the activity.
- Wear appropriate personal protective equipment (safety glasses, at a minimum), including during preparation and clean up.
- Tie back long hair and secure loose clothing, such as long sleeves and drawstrings.
- Do not eat or drink food when conducting the activity.
- Clean up and dispose of materials properly when you are finished with the activity.
- Thoroughly wash hands after conducting the activity.

Tap the Sap: Maple Sweet Chemis-tree

By David Heroux

Boiling – Sap collected this way contains only very little sugar. Syrup needs to be thicker and denser, sweeter, with a deeper flavor, and increased shelf life. Boiling removes water, kills germs, and makes the syrup dense and sweet. Boiling also triggers a chemical process that caramelizes the syrup. This adds components that make maple syrup even more delicious.

Filtering – Maple syrup may contain impurities such as dust, tree bark, or particles from the processing of the sap. Filtering removes most of the big impurities.

Packaging – Once filtered, the maple syrup is now ready to be bottled and sold! The heavenly syrup is ready to add to your warm pancakes.

Fun Fact: Did you know that maple syrup is older than the United States itself?

The color and the flavor of maple syrup depend on many factors: what time of the year the sap was collected, the kind of tree, and the processes used. Maple syrup starts light. It gets darker and stronger flavored as the weather gets warmer. Common colors for syrup are golden, amber, dark, and very dark.

Did you know there are other types of syrup from trees? Some European countries tap birch trees. Gorosoe (Korea), butternut, and alder trees are other trees whose saps are also delicious. Syrups from these trees have sweet green tea, toffee, caramel, butterscotch, and other such flavors.

If you love your maple syrup, make sure you are eating the real syrup. Many common pancake syrups (that usually come in large containers and say “syrup”) tend to be artificial syrups. They are made from corn syrup, sugar, water, artificial flavors, and colors. If you want the real syrup, check the label for ingredients. Real maple syrup should only say “100% pure maple syrup.” Remember all the sweet chemis-tree that goes into your maple syrup as you enjoy your breakfast waffles and pancakes!



What do maple syrup and rubber have in common? They are both made from tree sap (kind of like tree blood)! However, only maple syrup is an edible, sweet treat. Maple syrup is a natural sweetener with nutritional value, like honey. It is rich in some metals (manganese and copper) and riboflavin (vitamin B2).

Maple syrup was first discovered by the Native American population in North America by accident. Legend goes that a chief threw a sharp tool that struck a maple tree trunk. When it warmed up the next day as the sun shone, sap started to flow. This was then collected and used in cooking, and it made food taste delicious. Hence, maple syrup was born!

Since the sap is low in sugar, it is boiled to increase the concentration of sugar. Today, producers typically need 40 to 50 cups of sap to make one cup of pure maple syrup that is sold in stores. Generally, sugar maples, black maples, and red and silver maples are used for this purpose.

Maple Syrup in the Making

Tapping – Late winter to early spring every year, in northern United States and Canada, small holes are drilled into maple tree trunks. Small taps are placed in them (without hurting the tree).

Sapping – When weather is warmer in spring, trees wake up from their winter nap, and they start to ooze sap. The sap is collected in buckets or through tubes. Buckets need to be emptied often, usually daily. If tubed, the sap goes to a collection point. Sometimes vacuum suction is used to pull the sap from the tree trunks to make collection faster.

David S. Heroux is Leavy Family Professor of Chemistry at Saint Michael's College in Colchester, Vermont.

Syrup Detective

By Regina Malczewski



Safety Suggestions

- ✓ Eat/Taste the materials used in this activity only as directed
- ✓ Wash hands after this activity

Question to investigate

Can we identify different sweet syrups just by using our senses?

Introduction

Sweet syrups are everywhere. They are used in cooking, especially for sweet treats, ice cream toppings, breakfast food, and more. Native Americans originally made maple syrup. The iconic “Log Cabin Syrup” was first sold over 100 years ago! Are there differences in the flavor of each type of syrup? Does maple syrup taste sweeter or less sweet than others? Try this test to check your ability to distinguish these gooey staples.

Materials

- 8 small cups
- 8 spoons
- 1 permanent marker
- Four different types of syrups:
 - Regular pancake syrup (Log Cabin, for example)
 - 100% pure maple syrup
 - Butter-flavored pancake syrup
 - Dark corn syrup (Karo, for example)

Procedure

1. Use the permanent marker to label the sides of 4 cups with “Regular,” “100% Maple,” “Butter-flavored,” and “Corn Syrup.” These are the known samples.
2. Label the remaining cups with #1, #2, #3, and #4. These will be the unknown samples.
3. Make sure all chosen syrups are at room temperature before you start. Pour about ½ inch of each syrup (about 2-3 tbsp) into the labeled sample cups.
4. Repeat step 3 with the unknown cups. Then, have an adult mix up the order of cups and record it in secret.
5. Line up all the known sample cups.
6. Sample each known syrup with a clean spoon. Observe the color, smell, texture, and taste. Note on the table how sweet, buttery, nutty each one is. Compare them. Think about their aftertaste, thickness, and stickiness. Record them on the table.
7. After you have tasted the four syrups and recorded your thoughts, have an adult pass you one of the unknown cups. Taste each unknown syrup using a fresh spoon. Based on your judgement, place it next to the marked cup that it resembles most.
8. Repeat matching the remaining unknown syrups with the labeled ones. Finally, check with the adult if you matched them all correctly.

Observations

	Sweetness (mild to very)	Color (shades of brown)	Odor/Flavor (nutty, buttery)	Stickiness	Other
Regular Syrup					
100% Maple Syrup					
Butter-flavored Syrup					
Corn Syrup					

Unknowns	Which kind of syrup is this? What is your evidence?
#1	
#2	
#3	
#4	

Where’s the chemistry?

All of the syrups are sweet and shades of brown! But did you notice how different the syrups taste and smell? The differences are because of the different ingredients and sugars they contain! Some are thicker and more fragrant. Each syrup sticks differently to the spoon.

All except 100% maple syrup typically contain corn syrup. Corn syrup tastes sweeter than maple syrup because of the kind of sugar in it. True maple syrup has only one ingredient – 100% maple syrup. In other syrups, you will see additives such as water, preservatives, colors, and maybe other sweeteners. These are added to imitate the flavor and taste profile of the real maple syrup. Did you know “buttery” syrups contain no butter at all? Reading food labels is always interesting and you can investigate further!

Regina Malczewski is a retired biochemist from Dow Corning Corporation in Midland, Michigan.

Match the Name to the Leaf

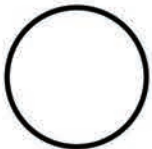
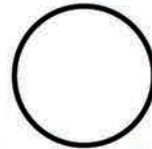
1. Ash
2. Birch
3. Horse Chestnut
4. Maple Leaf
5. Northern Red Oak
6. Oak
7. Pin Oak
8. Sequoia
9. Sycamore



Acorns grow on this tree.
Sounds like you will be okay finding this one!



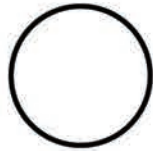
This leaf is found on the flag of Canada.



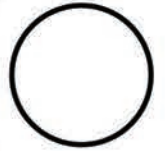
This leaf is more common in cooler climates, but fewer in the South.



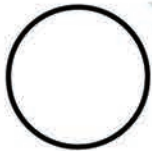
This leaf is a farm animal, then something you can eat.



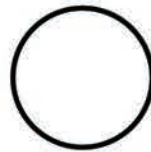
Native American canoes were made from this tree.



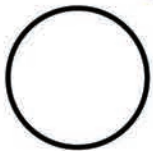
The name reads a little like the sound made by dogs. Its "helicopter" seeds spin as they fall.



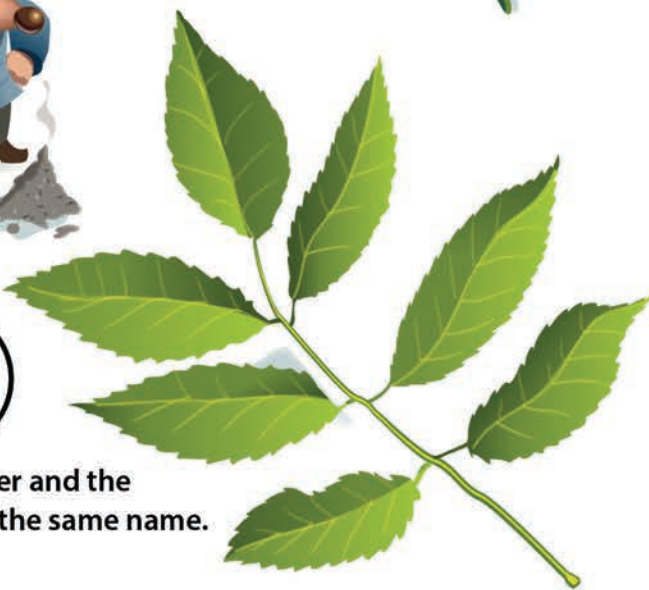
This leaf is from one of the tallest trees in the US.



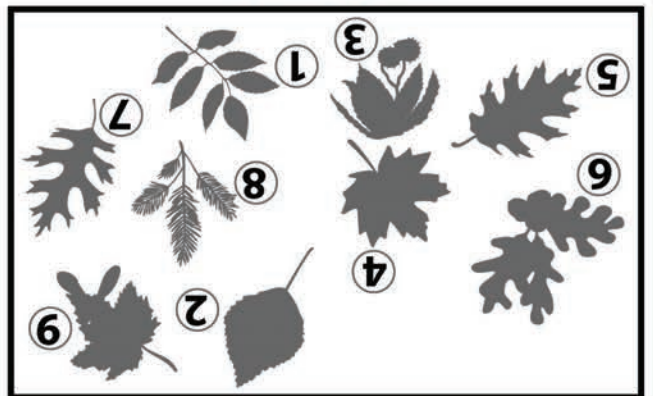
If you listen carefully, you might hear this leaf drop.

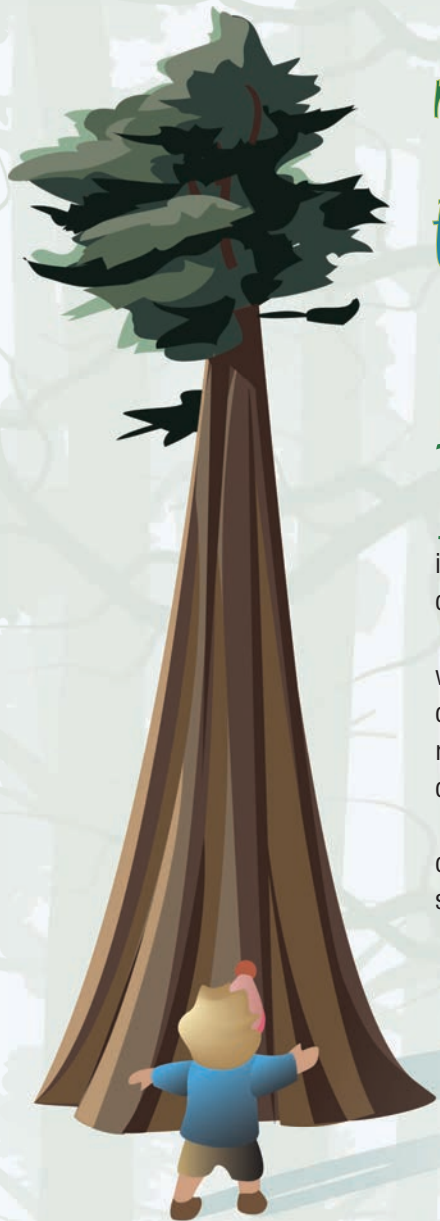


Burnt paper and the leaf share the same name.



ANSWERS





Trees are the Keys – to Climate

By Regina Malczewski

How can trees tell you stories about the past? Trees started to live on Earth many thousands of years ago. They adjust so well to their environment and “talk” to each other through the “wood wide web.” Tiny fungal threads connect roots of different trees in proximity. They share resources and information. Given how closely affected trees are by climatic conditions and human behaviors, they can tell us secrets of the past.

Trees have a system of tiny tubes called **xylem**. Trees use these tubes like straws to “drink” water from the ground through their roots. Xylem also feed the rest of the tree. The climatic conditions decide how much water a tree gets. This in turn will decide which trees grow in a region. Trees and climates are hence interconnected. Because of the many types of weather conditions, there are a variety of trees.

Trees also adapt well to their environment. They make seeds that are different. Trees have certain types of leaves and root systems to store water (or not store too much water). They also show specific properties (adapted to low light conditions, to survive different temperatures).

Seeds – Seeds of desert trees have thick outer coatings. This keeps them from dying in the heat. Some seeds like those of “helicopters” or dandelions are lightweight. Wind can blow them far away, where they can then grow into trees/plants. Some seeds have “hooks” that can attach to surfaces. These seeds can attach to your socks or clothing, Velcro style. Where they get discarded, they grow.

Leaves – Some trees have needle-like leaves. This is so snow can easily fall off them. Loss of water through vapor from trees (from leaves, soil, tree surfaces) is called **evaporation**. Some trees that see plenty of rain have large leaves. This helps water run off quickly. Large leaves lose more water to evaporation, too. Leaves in desert climates have a waxy coating to keep the water in. **Stomata** are small pores present on the leaf. They allow CO₂ and oxygen in and out. They also control how much water a plant loses depending on weather conditions.

Bark – Tree bark is thicker in colder climates. Where wildfires are common, tree bark can have fire retardant. Hot and dry regions have light-colored bark to reduce heating up of the trees. Some barks even have chemicals that can kill insects.

Tree Rings – Tree rings from coffins, wooden houses, and even firewood can tell secrets of the Earth’s past! The study of tree rings is also known as **dendrochronology**. Trees adapt to various climates on the inside too. Their rings (yearly xylem growth) can tell us all about the forest fires, lack of water, volcanic eruptions, and insect attacks they lived through. This information is used by scientists studying trees, climate researchers, and specialists that study the past.

Wide, fat rings signal good times. Wide rings mean a year with plenty of rain. Narrow rings indicate dry growing seasons. Thin ones often indicate more environmental challenges. “Scars” or misshapen rings correspond to disasters such as forest fires and lack of rain or water.

Trees don’t just provide shade and clean the air. They also tell us so much about climate in the past. Their adaptations have enriched our lives in SO many ways! They continue to do so long after they are gone.

Regina Malczewski is a retired biochemist from Dow Corning Corporation in Midland, Michigan.



Reading Between the Circles

By Sherri Rukes



Safety Suggestions

- ✓ Thoroughly wash hands after this activity

Question to investigate

How can you use a tree cookie (a natural wood slice from a tree) to learn about a tree's life?

Materials

- Tree cookie (you may look for "unfinished natural wood slices" online or try to get one from a local tree service or arborist)
- Magnifying glass
- Ruler

Introduction

Have you ever wondered how old a tree is? What if you could also learn about the weather years ago? A tree can tell us a lot about how old it is and at the same time, the climate history of our planet. You can do this by studying tree rings. This study is known as dendrochronology (dendro = tree, chrono = time). Scientists (and you) can use tree rings to measure the age of a tree. They are also able to learn about the local climatic conditions the tree experienced during its lifetime.

Procedure

1. Examine your tree cookie. Notice the concentric rings (like a bullseye pattern).
2. Use a magnifying glass to look more closely at the sets of rings. Can you see that each ring has a light part and a dark part? The light part and dark part together count as one ring.
3. Find the innermost ring. This is the first year's growth of the tree.
4. Find the outermost ring. This is the last year's growth of the tree.
5. Choose to count either the dark rings or the light rings. The number you get gives you the rough age of the tree!
6. Find the widest ring. Use a ruler to measure the width of this ring. Record it on the table.
7. Find the narrowest ring. Using a ruler, measure the width of this ring. Note it on the table.
8. Are the rings on your tree cookie mostly wide or mostly narrow?
9. Do the rings tend to be wider near the center or near the edge of the tree cookie?



Observations

Detail about the Tree Cookie	My Observations
Number of Rings (tree age)	
Widest Ring	
Narrowest Ring	

Where's the chemistry?

When a tree is cut down, scientists can take a slice of the trunk known as a tree cookie. This cookie holds a lot of information. Each ring represents a year of the tree's life. The rings serve as a record of its growth and the conditions it experienced. The number of rings provides us with the age of the tree.

Trees add a new layer of growth between the bark and the trunk each growing season. The lighter colored rings are formed in spring and early summer. The darker ring growth occurs in late summer and autumn. The ring width reveals how much the tree grew in that year. Climate (plenty of rain, sun, etc.) that the tree benefits from makes the tree ring to grow wider. Narrow rings signal stress factors such as forest fires, lack of water, or extreme cold or heat. A young tree grows fast. Mature trees grow more slowly. And so, the rings become more narrow as the tree gets older.

How old was the tree in your sample? Did your tree grow in mostly wet, good years (wide rings)? Or was it mostly dry, hard years (narrow rings)? Or a mix of good and hard years?

Sherri Rukes is a chemistry teacher at Libertyville High School in Libertyville, Illinois.



The Adventures of Meg A. Mole, Future Chemist

Mr. Doug Loose



In honor of this year's Chemists Celebrate Earth Week (CCEW) theme, "Into the Woods with Chemistry," I traveled all the way to Midland, Michigan, to meet Mr. Doug Loose. Mr. Loose has worked with trees for many years in different ways!

"When did you first get interested in trees?" I asked. "Starting in grade school, as a scout, we collected sap from the maple trees in Gladwin County, Michigan." Later during college, this interest continued. "When I attended college at Michigan Tech, I was able to get permission to tap trees on a friend's property and make syrup." He used special tools "to measure the amount of sugar in the sap, as well as the sugar concentration as the sap boiled down. We learned those techniques while in chemistry class." He became interested in this work because it gave him "the ability to get outside during winter and do something productive."

I was very interested in learning more about the chemistry that went into his syrup making. He explained that chemistry taught him "how solutions work, how light reflects differently as the syrup concentrates, and how to use the syrup to replace sugar in baking and cooking. As a chef, I always say that chemistry is the most important knowledge to be able to cook great meals. Reactions between sugar and yeast give off gas to make bubbles in bread. Pancakes, bread, and many others rely on this type of chemical reaction."

Fun Facts

- **Favorite pastime/hobby:** Fishing
- **Birth date?** July 26th

Throughout his career, Mr. Loose worked in other areas of chemistry as well. He shared, "I have had many jobs in my life,

from milking cows and baling hay to being a chef, an engineer, a manager." He added, "When I left the specialty chemical industry I went to work as a global reliability expert." He became interested in chemistry at an early age. "Early in life I was very good at math and fixing things around the farms I worked on." He continued, "My grandfather was a genius and a very skilled artist, who worked with sheet metal his whole life. He taught me a lot about how math and science are everywhere and in everything." His grandfather made his own machines when they were too expensive to buy. "I got a lot of my curiosity from him," he said.

And the project involving trees that he is most proud of today? He explained "Midland MI experienced a catastrophic flood. A very nice neighborhood was damaged so badly that the people living there could not rebuild with their own means." He and his wife bought the 46 houses there with help from a local bank. "We rebuilt them in 18 months," and provided homes for all the families. I exclaimed, "So many trees were used for the wood to build homes for all of those people!" That is a thing to be proud of!

I really enjoyed visiting and learning from Mr. Loose. It was exciting to discover all the ways he has based his career on trees. From building homes to making his own maple syrup, his journey was inspiring. Chemistry can take you places, too!

Word Search

Try to find the words listed below – they can be horizontal, vertical or diagonal, and read forward or backward!

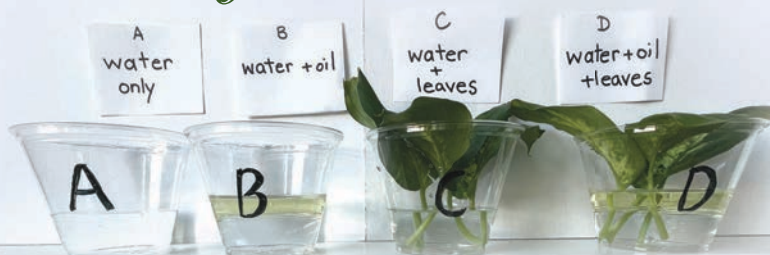
E	P	H	O	T	O	S	Y	N	T	H	E	S	I	S	Y
L	C	R	S	E	E	D	E	S	U	G	A	R	I	G	S
X	A	A	E	K	X	N	E	O	S	E	Q	U	O	I	T
Y	T	W	R	V	S	T	V	E	N	N	D	L	B	A	R
R	I	A	O	B	A	S	T	I	R	Y	O	O	G	U	A
C	B	A	U	M	O	P	E	D	R	N	H	E	M	T	N
M	H	V	I	T	E	N	O	N	O	O	E	N	A	E	S
I	E	L	A	L	F	E	D	R	T	N	N	M	Q	M	P
N	C	R	O	S	U	X	H	I	A	I	O	M	U	C	I
G	O	H	K	R	E	C	Y	R	O	T	A	S	E	H	R
S	Y	R	U	P	O	E	B	L	S	X	I	L	D	N	A
A	T	O	L	R	B	P	C	R	E	A	I	O	O	M	T
P	E	N	D	P	E	P	H	E	R	M	A	D	N	I	I
H	R	N	M	M	N	M	C	Y	E	M	D	E	E	C	O
M	E	S	E	Q	U	O	I	A	L	R	E	P	F	A	N
D	X	T	R	E	E	R	I	N	G	L	T	L	E	A	F

- | | | | |
|------------------|----------------|---------|---------------|
| BARK | ENVIRONMENT | SEED | TRANSPIRATION |
| CARBON DIOXIDE | EVAPORATION | SEQUOIA | TREE RING |
| CHLOROPHYLL | LEAF | STOMATA | XYLEM |
| CLIMATE | PHOTOSYNTHESIS | SUGAR | |
| DENDROCHRONOLOGY | SAP | SYRUP | |

For answers to the word search, please visit
www.acs.org/celebratingchemistry

From Roots to Leaves: Journey of Water in Plants

By Regina Malczewski



Safety Suggestions

- ✓ Do not eat or drink any of the materials used in this activity
- ✓ Handle sharp objects (like scissors) carefully
- ✓ Wear gloves when handling the plants in the activity. Some plants can be toxic when ingested or touched. Keep away from pets.

Question to investigate

Can we see evidence for the movement of water that is being pulled by plant leaves?

Introduction

Plants obtain the water they need from the ground through their root systems. From there it travels to leaves, flowers, and fruits through a system of tubes. These tubes are called xylem. From the leaves, water is released into the atmosphere by a process called **transpiration**. It is a specialized form of evaporation (water loss from any surface).

Materials

- 4 9-ounce clear plastic cups
- 1 1/3 cups room temperature water
- 1/3 cup measuring cup
- 1 tablespoon measuring spoon
- 4 tablespoons vegetable oil
- 1 permanent marker
- 8 plant leaves – from magnolia or houseplants such as pothos.
- 1 weighing scale that shows weight in grams (should measure to 1 decimal place)
- 1 pair of scissors

Procedure

1. Use the permanent marker to label 4 cups as follows:
A – Water B – Water + Oil
C – Water + Leaves D – Water + Oil + Leaves
2. Measure and place 1/3 cup water in each of the four cups.
3. Add about 2 tablespoons of vegetable oil only to cups B and D. Ensure that the oil layer is approximately 1/2 inch thick. If not, add some more oil.
4. Use the scissors carefully to snip off four plant leaves for Cup C and four leaves for Cup D. Cut them in a way that the stem is long (longer stems work best). Place the leaves in their respective cups, ensuring the stems are well dipped in water.
5. Weigh each cup (water, leaves, oil included) in grams. Record this as the “Start Weight” on the table. Record also the time and date on the data table.
6. Place the cups in a well-lit area but without direct sunlight.
7. Wait for at least 2 days and weigh the cups one by one again. Record the results in the data table. This is the “End Weight.”
8. For each cup, subtract the “End Weight” from the “Start Weight” to find the water weight loss for each cup. Note this on the table.

Observations		Cup A (water)	Cup B (water + oil)	Cup C (water + leaves)	Cup D (water + oil + leaves)
Start Time & Date: _____	Start Weight				
End Time & Date: _____	End Weight				
	<i>Amount of water lost (start weight – end weight) (in grams)</i>				

How does it work?

In Cup A (water), all water lost is from evaporation. In Cup B (water + oil), no evaporation or transpiration occurs: The start and end weight should be about the same. The oil layer on top prevented all water loss. In Cup C (water + leaves), the water loss should be the maximum. Water is lost through transpiration (from the leaves) as well as evaporation (from the water surface). In Cup D (water + oil + leaves), all the water lost is only through transpiration. Oil layer on top prevents any loss through evaporation from the water surface..

Transpiration in the leaves happens through stomata (tiny pores in leaves). Special cells called **guard cells** control the opening and closing of stomata. Guard cells are the gatekeepers. With xylem, stomata, and guard cells working together to actively pull water from the ground, water can move up to even the tallest trees! And that is amazing journey of how water moves from roots to shoots and leaves.

Regina Malczewski is a retired biochemist from Dow Corning Corporation in Midland, Michigan.

Words to Know

Chlorophyll – the green pigment that gives leaves their green color. They help the plant use sun’s light to make their “food” when the sun is shining.

Chloroplasts – the tiny “kitchens” in leaves where plants make their food through photosynthesis. They contain chlorophyll that captures the sun’s energy for the process.

Dendrochronology – study of tree rings that can tell us about past climate, weather, and environmental changes the trees grew in.

Evaporation – is the general term for the process where liquid water becomes a gas (water vapor) and can happen from any surface. Water is lost as water vapor into the air.

Greenhouse gas – a gas that “traps” the sun’s energy and warms Earth. CO₂ is an example. Too much can kill life on Earth.

Guard cells – the gatekeeper cells that control the opening/closing of stomata (the very tiny pores on leaves). Each stoma (singular form of stomata) has two guard cells.

Photon – a very tiny packet carrying light energy. Photons are so tiny that they aren’t visible to our eyes. Energy of sunlight carried by photons is used by plants for making food and growing.

Photosynthesis – the process plants (and other bacteria) use to turn carbon dioxide, light, and water into energy in the form sugar and oxygen. The sugar is the food plants use to grow, and oxygen is released into the air we can then breathe.

Sap – sap is a sticky, watery liquid that comes from trees. It is like tree “blood” that takes food and water to all parts of the tree. It seals the tree trunk when there’s a cut and helps it heal.

Stomata – small holes or pores that can open and close to gases like carbon dioxide and oxygen. They also allow or prevent water loss depending on the environmental conditions.

Transpiration – a special type of evaporation specific to plants and trees. Plant and tree leaves have stomata (pores) that release water vapor into the air. This is an essential part of their growth and survival.

Xylem – the tiny tube system with “straws” through which water travels from root to the rest of the tree/ plant.

About Celebrating Chemistry

Celebrating Chemistry is a publication of the ACS Office of Science Outreach in conjunction with the Committee on Community Activities (CCA). The Office of Science Outreach is part of the ACS Division of Education. Chemists Celebrate Earth Week (CCEW) edition of *Celebrating Chemistry* is published annually and is available free of charge online or in print through your local CCEW Coordinator. Visit www.acs.org/ccew to learn more.

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The activities described in this publication are intended for children under the direct supervision of adults. The American Chemical Society cannot be responsible for any accidents or injuries that may result from conducting the activities without proper supervision, from not specifically following directions, or from ignoring the cautions contained in the text.

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