WATER in the World! (and in the School Garden)
3rd Grade Science Unit

Objective: Students will understand the role water plays in the life cycle of plants and the role plants play in the water cycle. Students will also understand the role humans play in both these cycles by exploring ideas for water conservation.

Materials
cooler with ice cubes
rain gauges placed in garden
clear plastic bag/twist tie to attach to branch night before
watermelon and cutting knife (or other fruit/veggie with high water content!)
5 large buckets of water filled to different levels, 1 empty bucket
plastic gallon jug filled with water, 5 drinking cups, chalk for notes

5-10 min: Water as Element and the Water Cycle
see notes below part I
**Garden Parents help pass out one ice cube per student to hold in hands ;-)

15 min: Plants and Water – 2 interrelated cycles
see notes below part III (tour the garden…)

10-15 min: Conserving Water in the Garden and in our Homes
see notes below part III (gardens) and part II (homes)
**Garden Parents feel free to jump in and lead discussion about general water conservation – prompt/ask kids what THEY can do at school/home to conserve etc.

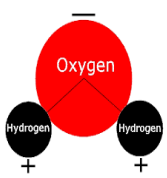
10-15 min: Water Rationing Group Activity (part II)
**Garden Parents please help by checking in on groups and guiding student brainstorming as needed, some will have harder time than others with this!

5-10 min: Water in our Food!
While cutting up watermelon to enjoy have student groups tell what country/bucket they were assigned to and how they decided to use the water etc. Talk about fairness – why did some groups have more water than others? Clean vs. dirty water?

If time students can also guess water content of other fruits/veggies they eat…
cucumber and lettuce: 96% water
zucchini, radish and celery: 95%
tomato: 94%
green cabbage: 93%
Watermelon and strawberries: 92% water
Grapefruit: 91%
Cantaloupe: 90%
**60% of human body is water !!

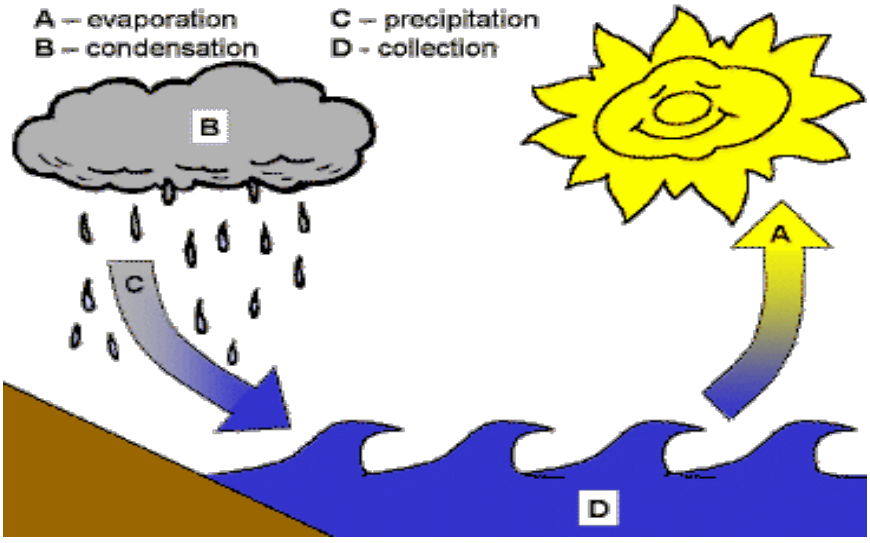
Part I All About Water http://idahoptv.org/sciencetrek/topics/matter/facts.cfm
Water **molecules** are made up of two **elements**: oxygen and hydrogen.
Water has 2 hydrogen molecules, 1 oxygen molecule

Matter makes up everything, **water has 3 states**: solid – liquid – gas. Each a different state of matter, but still always water molecules! What are 3 states of water depending on temperature? Liquid, Ice (freezing 32 F), steam (212 F boiling point) (give each kid a solid ice cube to hold in their hands – see how long they can hold it – what is making it melt into a liquid? What will make the liquid evaporate/dry from their hands?) *Other matter changes too, but often only exists in two states or requires the help of humans and technology to move through all three phases. Water is the only matter on earth that can be found naturally in all three - solid, liquid and a gas. Carbon Dioxide (the stuff we breathe out) is generally found as a gas but dry ice (that spooky ice that fogs) is actually carbon dioxide (CO_2) in its solid state. CO_2 is one of the few things that do not have a liquid state though. It turns out that nearly everything can exist in 3 states; it is just a question of finding the right temperatures. For instance, oxygen, a gas, becomes a liquid if you cool it down to - 297 degrees Fahrenheit (really, REALLY cold) and if you cool it down further to -362 degrees Fahrenheit it becomes a solid.*
http://scienceline.ucsb.edu/getkey.php?key=3556

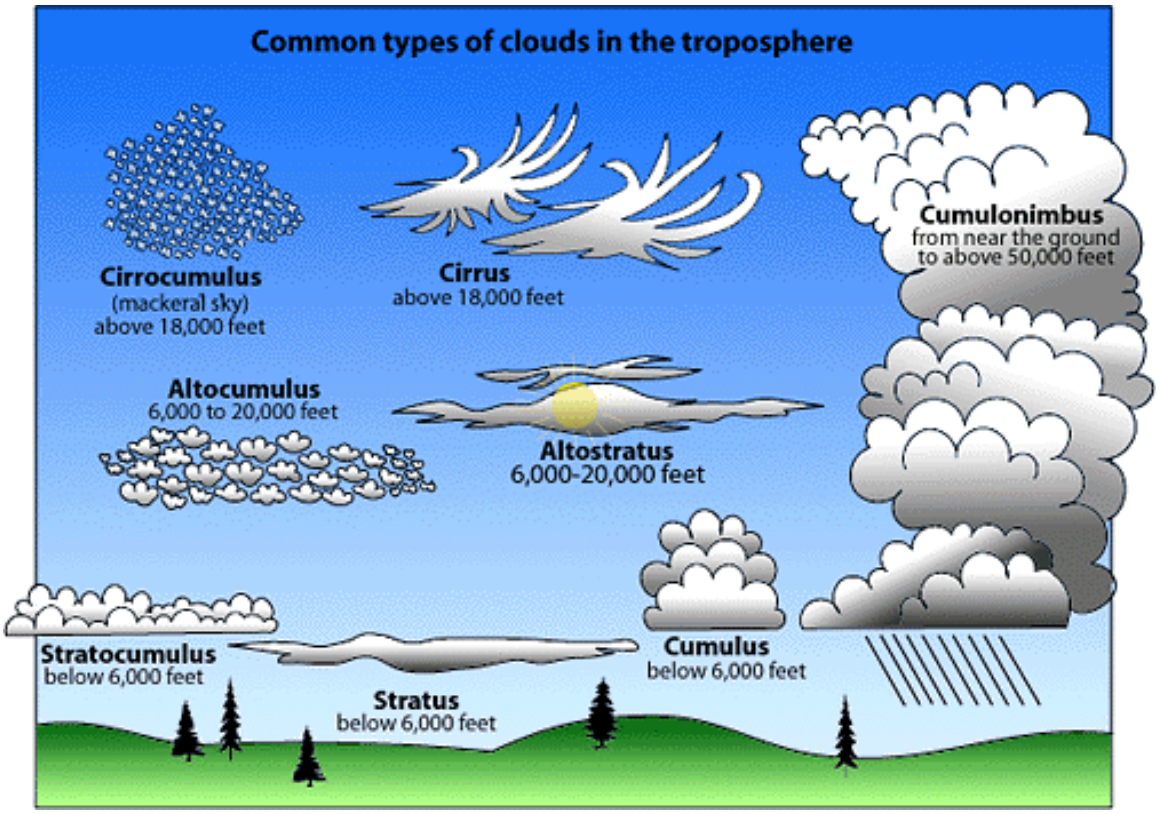


FACTS: ¾ of earth's surface covered in water, 97% (most of it!) in oceans and salty, only a very small amount is fresh water on land that comes from rain collection – 2% is frozen in Antarctica and Greenland, only 1% is fresh drinking water, which ALL the people and animals on earth have to share!

Water Cycle: http://www.kidzone.ws/water/
Water never vanishes – it is always here – same amount that's always been on the planet is still here! just takes on different forms in the cycle! (mention dinosaurs)
A) **evaporation** (transpiration in plants! perspiration in animals!) from sun's heat
B) **condensation** (clouds form as water collects in atmosphere) look up at sky!
C) **precipitation** (rain, sleet, snow, hail falls from clouds when they get too heavy)
D) **collection** (anywhere water collects on earth's surface: oceans, rivers, lakes, etc.)



Weather http://scied.ucar.edu/webweather/clouds/cloud-types
Clouds are made of condensed water vapor in the form of drops of liquid or crystals of ice. Rain falls from clouds when the drops of water become too heavy to stay suspended in the sky and are pulled toward the earth by gravity.



Part II: Water Conservation https://water.usgs.gov/edu/qa-home-percapita.html

*** AT this point have an open-topped gallon jug of water, which a student has to walk around the area with for next 15 minutes (let them pass it off to another child as they tire). They can't spill any of it!

Did you know: average American uses 80-100 gallons of water per day! More than people in any other countries. Show them how many gallons are in one home depot bucket – how many of these would equal 100? That's what you use in one day!

What do we use all that water for?
Uses of water: drinking, cleaning, flushing toilets, washing our bodies etc. Have students brainstorm what they use water for before they even come to school. Toilet flushing, tooth brushing, and hand washing are pretty clear. With prompting think about dishes getting cleaned, cooking (boiling eggs in water or making oatmeal!), the fact their clothes had been washed, etc.

Where does that water come from?

Sources of/Access to water: wells (underground water), springs (bubble up from ground), rivers, lakes, ponds, reservoirs (man-made lakes we dig to collect water or we dam up rivers to form lakes – rivers, streams feed into lakes and oceans from higher points like hills, mountains etc.). At Haldane where does water come from? Drinking fountains, faucets, in garden from hose – underground pipes. Water treatment plant in Cold Spring purifies/cleans water.

How could we **conserve (or use less) water** in our daily lives?

http://www.americanwater.com/49ways.php

http://environment.nationalgeographic.com/environment/freshwater/water-conservation-tips/

Ask students ways they save water at school and home… some more obvious than others (turning off faucet while brushing teeth, taking shorter showers, not running dishwasher unless full) also (not washing clothes as often if not really dirty, not running through sprinkler unless lawn needs watering, eating more veggies than meat (!less obvious but more water is used to produce meat than veggies – water needed to grow the corn/grains that feed the cows that you eat….)

What about people who live in **other countries**? How do they get water?

**In many countries there is no tap to turn on with clean water, people have to fetch it. Elaine's mom Carolyn Llewellyn lived in Niger, a country in Africa that is mainly Saharan desert, for 2 years and had to walk 15-20 min every day to fetch her own water. In Niger, many families had to walk that long to reach clean water, and then carry it back home. Quite an incentive not to waste water! Now check in with kids… How did we do? Did we carry it for 15 min and not spill any?

GROUP ACTIVITY

Have students form **5 groups** which will be their extended families (roughly 3-4 kids in each group). Each group pulls a slip that assigns them to where they live. They have to find a bucket of water in the garden labeled with the name of their "home" and read the directions next to that bucket. Each bucket comes with some plastic cups so they can gauge 'drinking water' portions for themselves.

5 bucket groups (use home depot buckets in shed)

A) U.S. – NYS (Cold Spring) – full bucket of clean water
B) Africa – Niger – clean water but only ¼ full
C) South Asia – Nepal – full bucket but of very dirty water (post earthquake)
D) U.S. – CA – half bucket of clean water (water rationing given severe droughts)
E) U.S.- Flint, MI – full bucket of lead contaminated water

Directions to cut out and leave for students next to each bucket:

A) You are a family that lives in Cold Spring, NY, USA and because of street repairs on the water line this is all the clean water that will come out of your faucet today; it's all you have for the next 24 hours.

-- How would you share it? Would everyone get equal amounts?
-- What would you use the water for? What are your priorities?

B) You are a family that lives in Niger, Africa and this is all the water you managed to pump from a well and carry back home with you today; it's all you have to use for the next 24 hours. FYI the average daily temperature in Niger ranges from 88 to 106 F.
-- How would you share it? Would everyone get equal amounts?
-- What would you use the water for? What are your priorities?

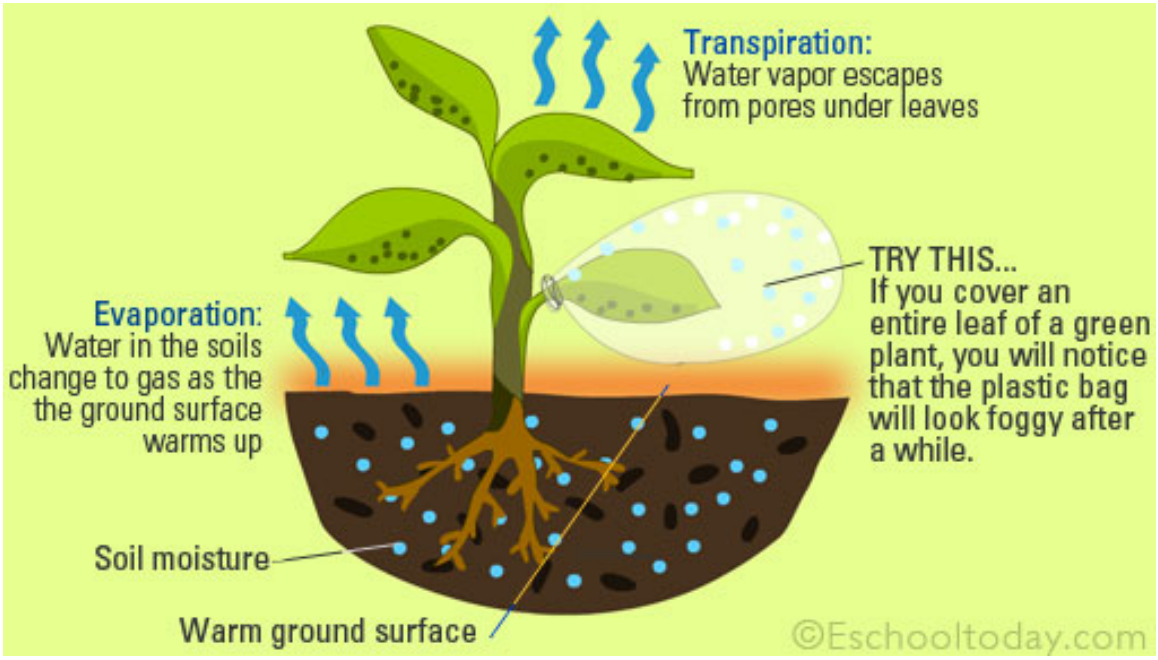
C) You are a family that lives in Nepal, South Asia. Your country just suffered a terrible earthquake and your home was destroyed. You are living in a makeshift tent and struggle to find any clean water anywhere. This is all the water you could find today and all you have to use for at least the next 24 hours, maybe longer.
-- How would you share it? Would everyone get equal amounts?
-- What would you use the water for? What are your priorities?

D) You are a family that lives in Fresno, California, USA and your Governor just declared a statewide drought emergency. Every family in Fresno is only allowed this much water per day as part of a new water rationing system; it's all you have to use for the next 24 hours.
-- How would you share it? Would everyone get equal amounts?
-- What would you use the water for? What are your priorities?

E) You are a family that lives in Flint, Michigan, USA and your Governor just said your tap water is unsafe to drink because of lead contamination. You can travel to one of the city's drop off points to collect free bottled drinking water but the nearest one is 2 miles away and you have no car. This is a bucket of contaminated water from your tap; it's all you have for the next 24 hours unless you can get to the drop off point for clean bottled water.
-- Would you use this water? If so, how would you share it?
-- What would you use the water for? What are your priorities?

Part III: Plants and Water

--plants are mostly water, water in their cells gives them their shape/form. Without water they droop and shrivel (yank a plant out of the garden and watch it shrivel!)
--water is also necessary for process of photosynthesis: plants use sunlight (energy) to change water and carbon dioxide into simple sugars (food) that feed the plant. Water then carries this food throughout the plant
--during photosynthesis plants release water vapor into air through process called **transpiration** – stem is like a water pipe moving water to the leaves which release it back into the atmosphere – which adds to the water cycle (forming clouds, rains, collects, evaporates/transpires etc.) (in morning cover a section of forsythia branch in garden with a plastic bag so it can transpire before this lesson!)
-- Trees also transpire – how do they move that much water up their super tall trunks (point to the large Elm trees in garden) show students a piece of wood from a tree with the rings – these are layers of **xylem** which show how much water was absorbed in a year – this tells us if a given year was rainy or dry, and tells us how old the tree is (1 ring = 1 year of growth). Have students count the rings – how old was this tree when it was cut? Which years were rainier than others? How do you know?
* xylem/phloem transport system: http://www.biology4kids.com/files/plants_xylemphloem.html
http://www.differencebetween.info/difference-between-xylem-and-phloem



--plants also help water – trees shade the ground which keeps soil moist, plants anchor the soil and keep it from eroding or blowing away and washing into rivers and lakes, leaves and branches trap rainwater so it slowly seeps into soil instead of flowing away too quickly (i.e. the dripline which mimics the rootline below ground!)
--some plants disperse seeds through water (devil's heads! Coconuts!)
--plants you eat are mostly water: tomatoes are 95% water, apples 85%
(bring in a sample of these for kids to taste if it's a hot day!)

--without water there'd be no plants and without plants no animals/people so ALL life on earth depends on water!
FACTS: An average-sized birch tree in summer can 'drink' about 80 gal water which is enough to fill two large bathtubs!

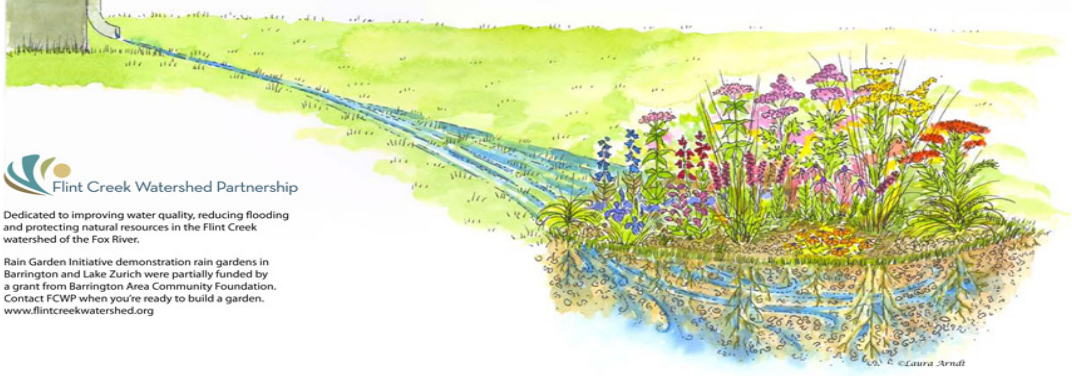
How do we conserve water in the school garden?

1) collect rainwater in a rain barrel – some plants (carnivorous and water plants) can only use fresh rainwater not tapwater, which has chlorine to disinfect so we use the rain barrel to collect water for these special, sensitive plants
2) in the summer we water in the morning or evening when not so hot so water does not evaporate as quickly; someday we might put irrigation hoses in the garden so water trickles out slowly over time (show them a gator tree bag?!)
3) we water plants less often but for a longer period of time to encourage deep root growth. If we watered too often and just a little we'd encourage shallow roots to form which if a drought happened or we couldn't water would hurt the plant's ability to access water deeper in the soil
4) we mulch around plants to keep moisture in and weeds down, by weeding out competing plants we give the plants that need water more access to it since weeds will also drink water away from the plants we are growing
5) we add compost/organic matter to the soil so the soil can hold more water in it. Super sandy/rocky soil lets water flow through too quickly, organic matter holds water in longer
6) we turn off the water spigot when not watering so leaks don't happen in hoses/pipes to waste water.
7) We could grow plants especially adapted to dry climates that don't need much water – this is a special kind of landscape design called **xeriscape gardening** which designs landscapes that don't use much water. From *xeric* ("dry") + *-scape* ("type of space"). http://en.wikipedia.org/wiki/Xeriscaping
8) **RAIN GARDENS** – http://www.lowimpactdevelopment.org/raingarden_design/whatisaraingarden.htm
http://raingardenalliance.org/what
On the surface, a rain garden is the same wild flowers and other native plants you'd expect to see in any garden. But the difference runs deep. During a storm or shower, the rain garden soaks up a few inches of water runoff from a roof, driveway, or other paved surface. That water slowly seeps into the ground instead of heading for the nearest storm drain.

Why does that matter? It's all about runoff. As our region's forests, farmland and other green spaces are paved over for highways, housing developments and shopping centers, the amount of impervious surface continues to grow. All this "progress" paves over the ground's natural ability to absorb rainwater. In many local communities, sewage and storm water systems are still connected underground. It takes as little as a tenth of an inch of rainfall to overload them, causing sewage to overflow into streams, yards and rivers. And even where storm water doesn't enter the sewage system, runoff follows storm drains and surface paths, picking up pollutants that contaminate our rivers. The result is a wastewater treatment nightmare as the cost of improving local water quality to meet EPA standards will run in the billions of dollars--thousands of dollars per homeowner. Add to that the financial, environmental and health impacts of flash flooding along our rivers and streams, and you begin to see the breadth of the dangers that unmanaged storm water pose to our communities.

Rain Gardens Conserve Water

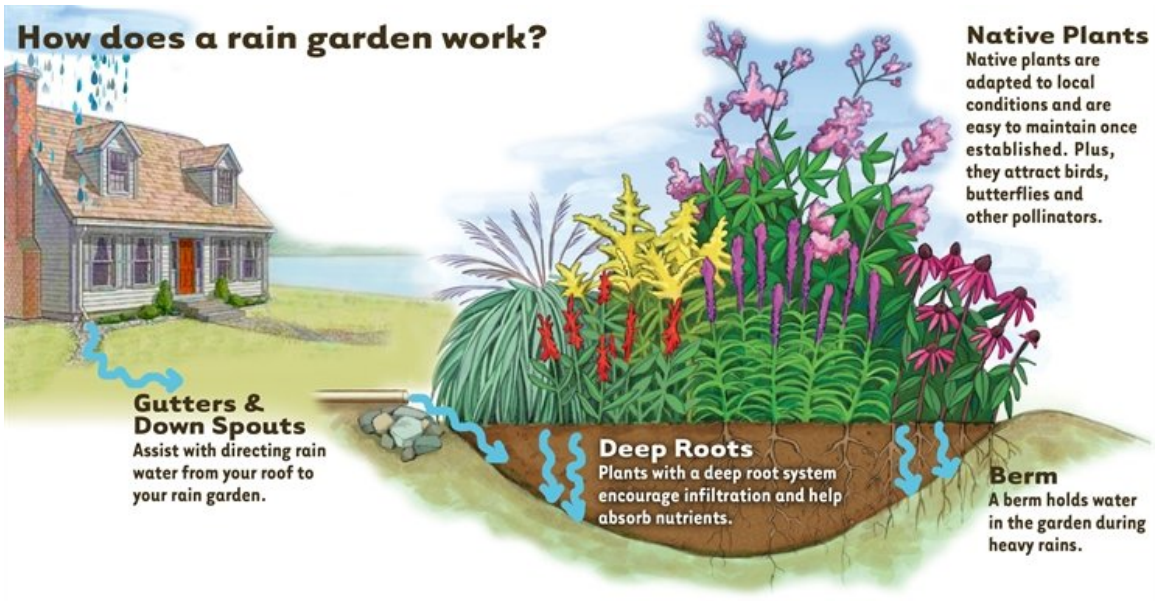
Rain gardens keep rainwater where it falls by capturing runoff from impervious surfaces – roofs and driveways – and allowing it to seep slowly into the ground. This recharges groundwater supplies. They protect nearby streams and lakes by reducing the amount of runoff and pollutants. Most feature native plants that provide bird and butterfly habitat and require less maintenance than lawns – and no chemicals.

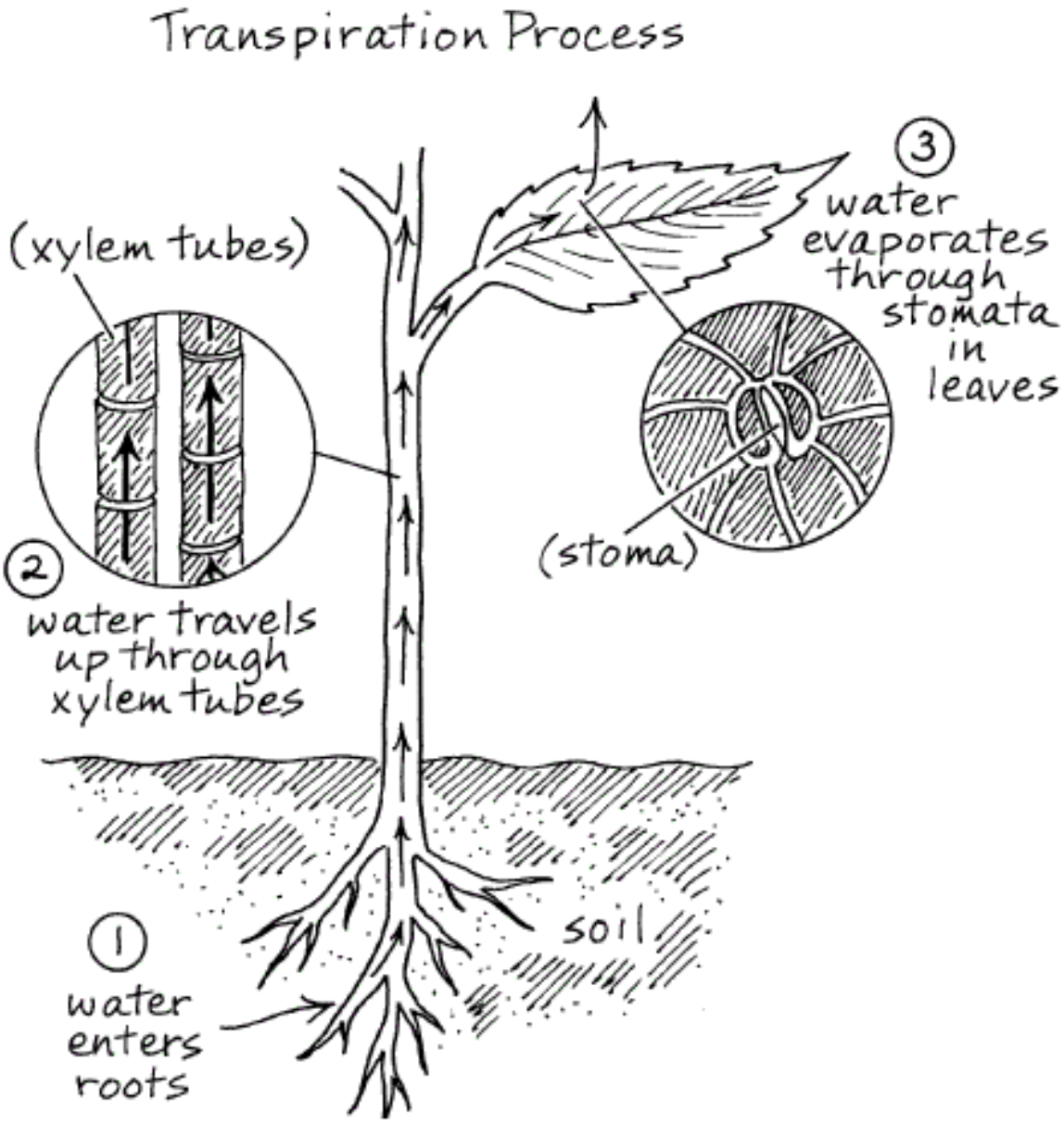


Flint Creek Watershed Partnership

Dedicated to improving water quality, reducing flooding and protecting natural resources in the Flint Creek watershed of the Fox River.

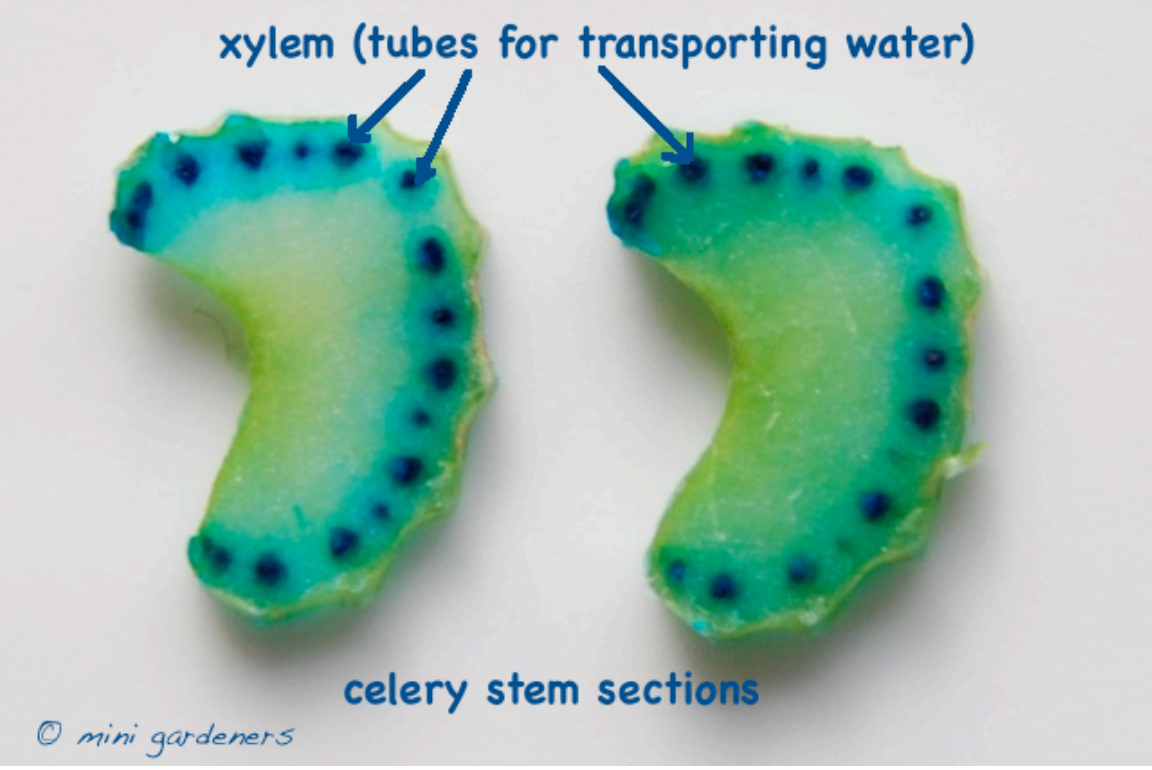
Rain Garden Initiative demonstration rain gardens in Barrington and Lake Zurich were partially funded by a grant from Barrington Area Community Foundation. Contact FCWP when you're ready to build a garden.
www.flintcreekwatershed.org





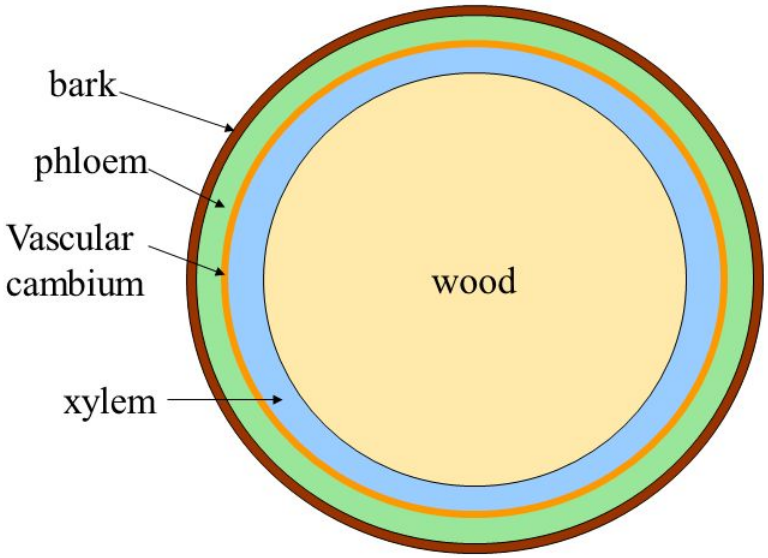
http://blog-yard-garden-news.extension.umn.edu/2009/04/the-mystery-of-maple-sap-flow.html

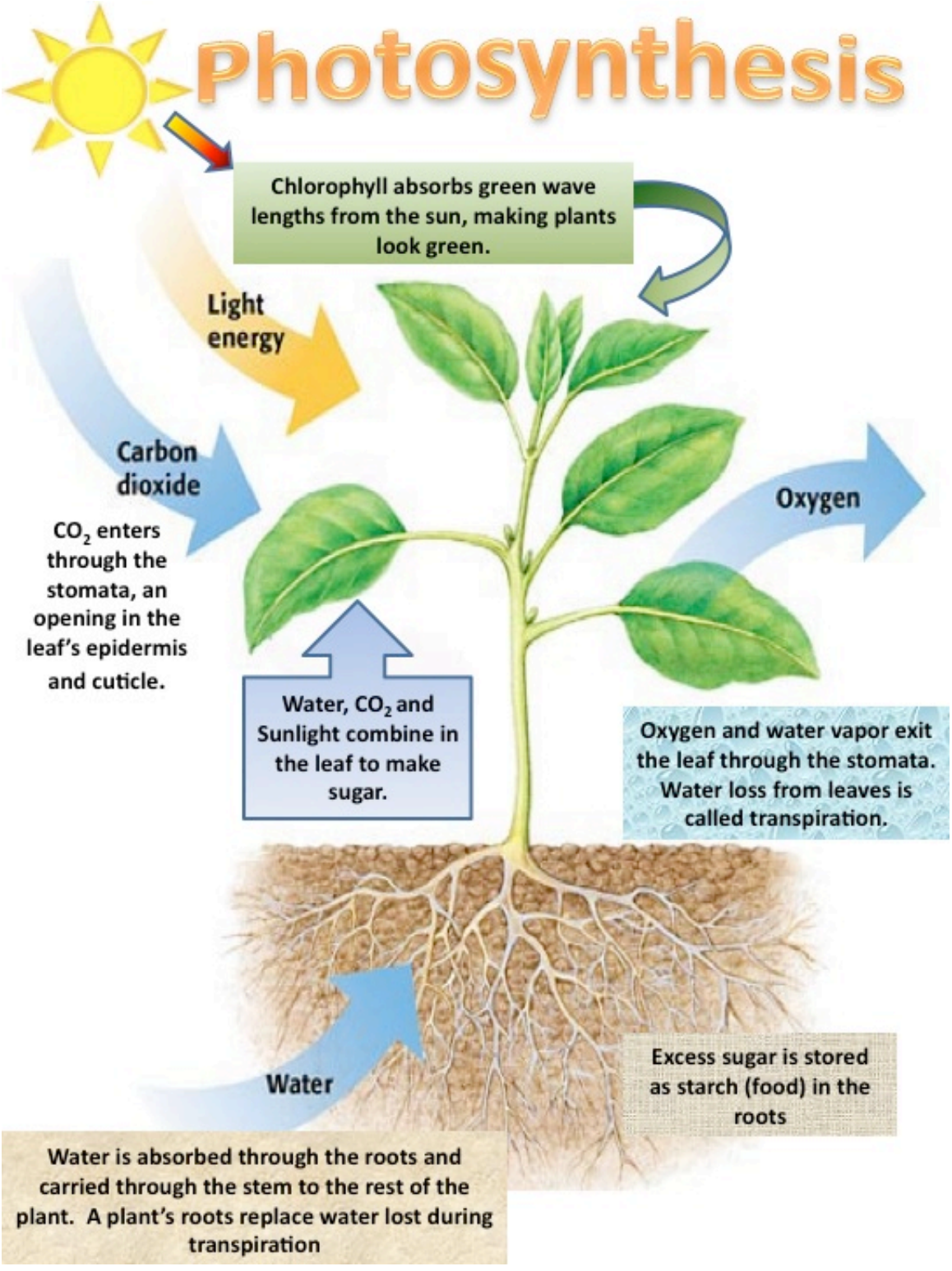
maple sap tapped for syrup is actually the XYLEM, not the ploem – read above for details!



Vascular tissue: Trees

- Vascular tissue is located on the outer layers of the tree.





Expansion activity: **spittlebugs!** suck liquid from xylem! Very cool…. Immature nymphs cover selves with spit-adults are leaf/froghopper insects. http://crawford.tardigrade.net/bugs/BugofMonth21.html