Resources:

Why Trees Matter

OVERVIEW

Trees matter for a wide variety of reasons. They provide us with many ecosystem services, meaning the things that the natural world provides for our use and benefit as humans. Maintaining healthy ecosystems is crucial to increasing availability and access to ecosystem services. Increasing tree canopy in cities helps to maintain our urban forest. This document will give an in depth look at reasons for why trees matter in all cities but especially in the Phoenix valley.

ECOSYSTEM SERVICES

- Energy Savings
- Combating the Urban Heat Island
- Carbon Sequestration
- Air Pollution Reduction
- Water Conservation
- Storm Water Retention
- Soil Conservation
- Nutrient Cycling
- Wildlife Habitat Protection
- Community Development
- Enhance Property Values
- Food Forest
- Increase Happiness
- Help Students Learn Better

TREES MATTER

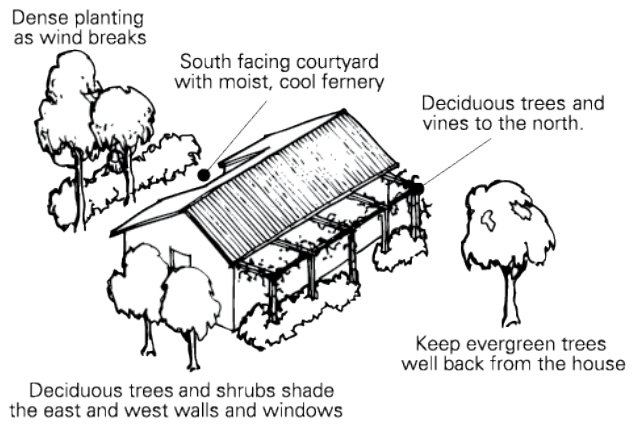
PHOENIX GOALS

The City of Phoenix is working towards a goal of 25% tree cover by 2030 which means roughly 5,636,000 new trees must be planted over the next 14 years, or 376,000 new trees each year. This amount of newly planted trees in less than 20 years, is a very hefty goal considering that Phoenix's current budget allows for the planting of 3,000 trees per year but the city also removes about 2,000 trees each year due to disease and damage. The Forestry Division is hoping to receive enough money allotted to plant 5,000 trees a year and, therefore, achieve 75,000 newly planted trees by 2040. In order to reach this goal of 20% urban tree canopy cover in 25 years, we stress the need for *everyone* to plant trees on private property as well as public land.

trees are nature's air conditioners!

ENERGY SAVINGS

Planting trees can save the average household $100 to $250 per year on utility bills. Three trees placed strategically around a home can save consumption for cooling and heating by about 25% and its summer air conditioning demands by as much as 50%. In Arizona where our highest utility bills are often caused by running the air-conditioner, that is substantial energy cost savings. Because cool air travels downward, standing under a tree alone can drop the temperature by 25°F; imagine the energy savings from surrounding a home with several trees. Check out the website listed below to see the best place to plant trees on your yard to optimize energy savings!

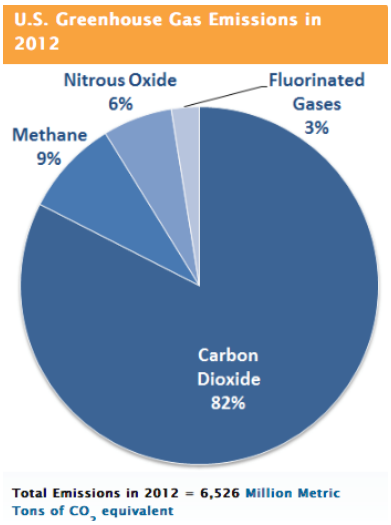


COMBATING THE URBAN HEAT ISLAND

The Urban Heat Island (UHI) Effect is a growing concern in many metropolitan areas, however, is extremely prominent here in the Phoenix valley. UHI happens because of how much concrete and asphalt is used for streets, sidewalks, buildings, etc.; these materials absorb and hold heat, releasing the heat at night. Night time temperatures have increased by about 5-10%. Along with cooling homes, trees can also cool a city nearly 10°F by providing shade and breaking up the heat released from concrete.

CARBON SEQUESTRATION

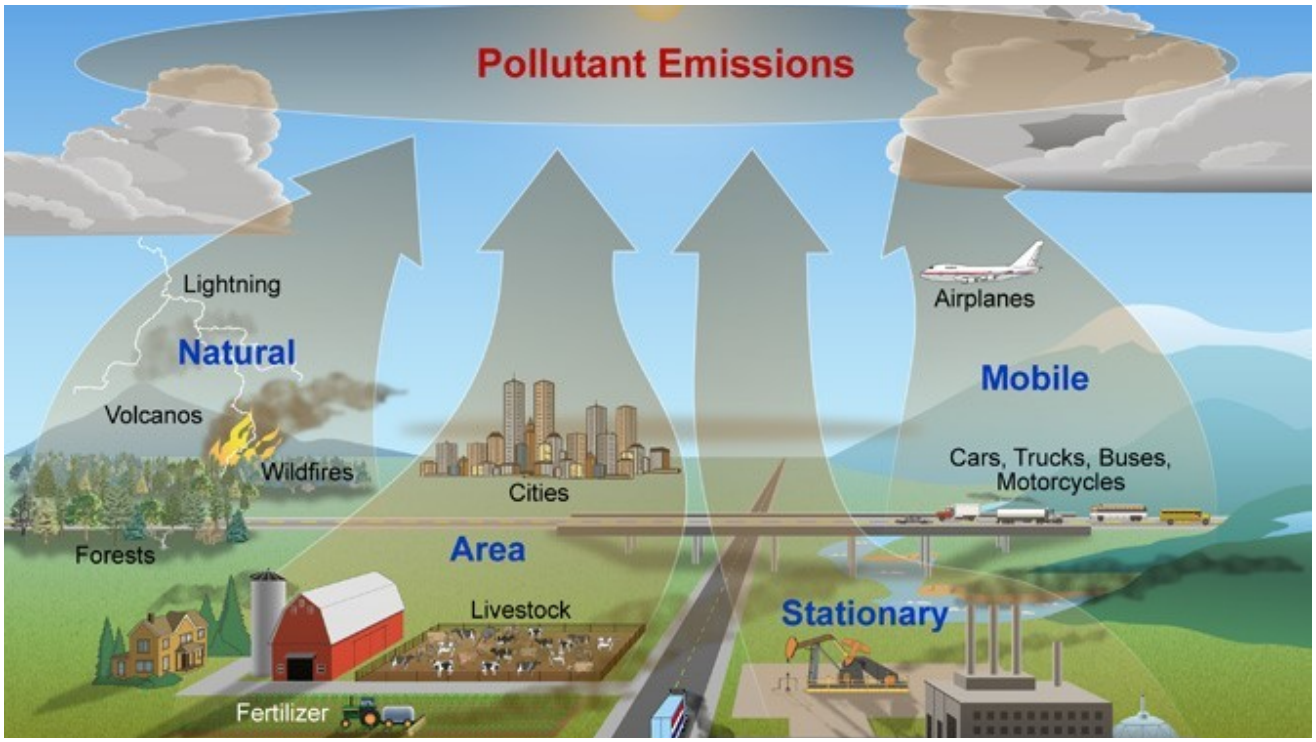
Carbon dioxide comprises 82% of greenhouse gases emitted in the US according to a 2012 report by the US Environmental Protection Agency. Trees are able to remove carbon dioxide from the atmosphere and store it(sequestration) in their roots, trunk, leaves, and undisturbed surrounding soil.As trees grow, they increasingly absorb more carbon dioxide from the atmosphere. Because trees store more than they release, forests are referred to as carbon “sinks.” Forests store more carbon compared to other land-based ecosystems; one tree can absorb nearly 48 pounds of carbon dioxide a year and sequester 1 ton of carbon dioxide in 40 years. One acre of grown trees is able to capture the amount of carbon dioxide released when one car drives 26,000 miles(that’s over 6 round trips by car from Arizona to New York). Trees use carbon dioxide as part of their food cycle. Through photosynthesis, carbon dioxide is converted into sugar, cellulose, and other carbohydrates needed to feed the tree. The rate at which a tree is able to store carbon depends largely on the tree type, age, and size.Younger, larger, and faster growing trees, on average, absorb more carbon. Nearly half of the dried wood weight of a grown tree is carbon.Forests are great resources for carbon sequestration and a natural way to slow and even reverse the trapping of heat in the Earth’s atmosphere. As we debate the best ways to favorably alter climate change, perhaps, one of the best ways is to plant trees. The greatest potential for adding the type of forest cover, and its benefits, afforded by trees is in urban areas.Urban forestry can play a large role in reducing greenhouse gases by reducing the energy used for air conditioning, particularly, in places like Arizona. Electricity such as that used for air conditioners accounts for over 30% of carbon dioxide emission in the US.Planting more trees in urban areas not only reduces electricity usage by providing shade and other energy saving benefits, but trees also help sequester the carbon released from urban activities.

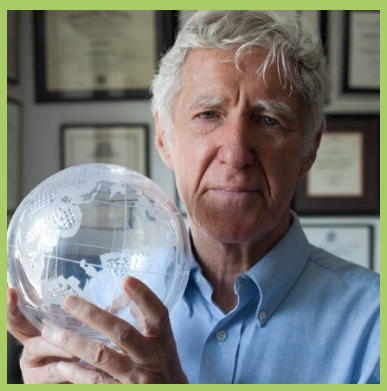


AIR POLLUTION REDUCTION

One aptly worded description for the role that trees play is that trees are the earth's lungs. Trees filter the air of contaminates (such as nitrogen oxides, ammonia, sulfur dioxide, and ozone) by ingesting gaseous air pollution through tiny leaf openings called stomata (pictured right). Trees breathe in pollutants and then breathe out oxygen.One mature tree provides a day's worth of oxygen for 4 people.The main sources of air pollution come from transportation (mobile), industry (stationary), agriculture (area), and nature (natural).In 2014, US Forest Service scientists and fellow researchers published a report detailing the largest study of air pollution removal by trees. The report concluded that trees save over 850 human lives a year and prevent 670,000 cases of acute respiratory symptoms--statistics based on air quality improvement of a mere 1 percent. In 2005, approximately 134,700 deaths in the US were attributed to air pollution.In a related study published in the journal *Environmental Pollution*, researchers estimated the value of human health benefits from air pollution reduction by trees to be almost $7 billion a year. The report noted that although most of the air pollution reduction occurred in rural areas (which have a higher concentration of trees), most of the health benefits were experienced in urban areas. One of the researchers concluded that because over 80 percent of Americans live in urban areas, the study reveals the crucial role that urban forestry plays in public health.

Trees emit gases themselves, called biogenic volatile organic compounds (BVOCs). Urban planners, however, can select low-emitting BVOCs trees since different species emit different amounts. Additionally, the amount of BVOCs is dependent on temperature—less emission occurs at lower temperatures—and since trees tend to lower temperatures,increasing tree coverage can reduce BVOCs.



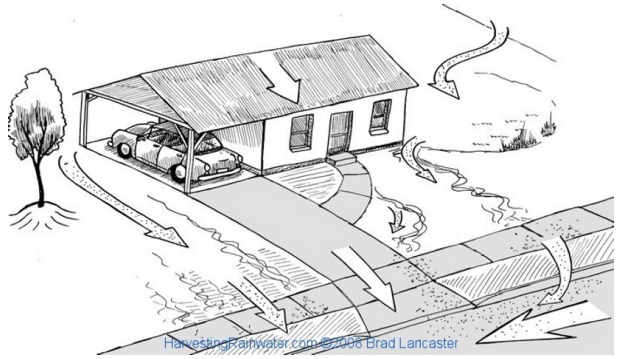


"If I had had more time, I would have talked about planting trees. I think the idea of planting a trillion trees is a great one. It's sort of a win-win-win. Among other things, it would help with soil conservation, certainly. It would reduce rainfall runoff and increase the amount of replenishment of underground water tables. And it obviously would fix huge amounts of carbon and help to reestablish the balance that we need to be stabilize climate. So I couldn't be more enthusiastic about the idea of planting trees, not by the millions, but by the trillions... What I think we need to do is to do some sort of cost-benefit analysis of planting trees so we can see all the benefits associated with trees. It's not just lumber or firewood. It's soil conservation, it's climate stabilization. It's a lot of things. But we don't have much in the way of full cost accounting on planting trees, which is one of the things I think would greatly strengthen the argument for planting a lot more trees than we do."

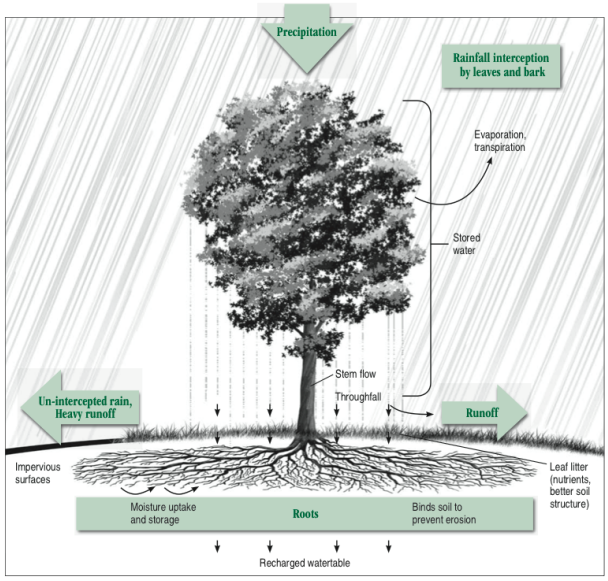
-Lester Brown, President of the Earth Policy Institute

STORM WATER RETENTION

Trees help redistribute and clean water by retaining storm water runoff (refer to the diagram below). Trees prevent flooding from storms by trapping water in their leaves, trunks, and roots.One mature tree can potentially intercept 1,000 gallons of water a year.Some studies estimate that urban forests can reduce annual runoff by2-7 percent and with strategic tree landscaping, nearly 65% of storm runoff can be reduced in residential areas. Additionally, trees improve water quality by trapping water that would normally run-off into waterways, carrying with it soil that contains sediments and nutrients. While nutrient-carrying soil may sound beneficial, excessive nutrients like nitrogen or phosphorus can lead to an overgrowth of aquatic plants that reduce oxygen content and disrupt fish life. Finally, trees help collect and filter water for local aquifers and watersheds that replenish the groundwater needed to supply drinking water for much of the world's population.



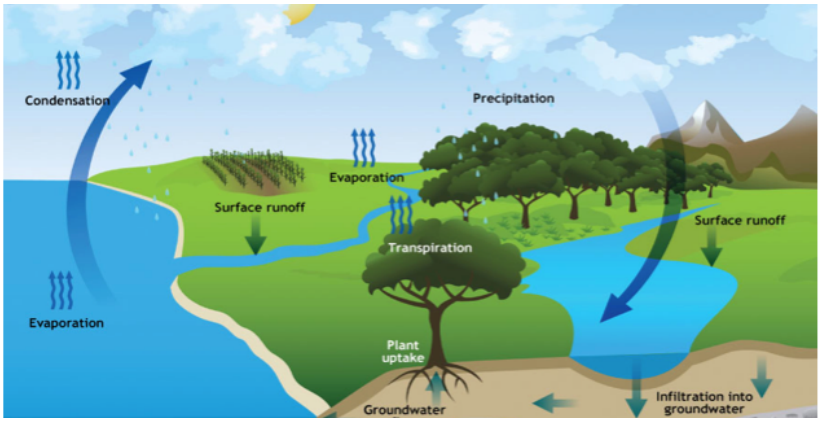
Important Ways a Tree Helps with Stormwater Management



WATER CONSERVATION

Trees help preserve and manage water in several ways. First, their leaves and bark intercept and store an amazing amount of water. Although the quantity varies with tree type and size, one tree can store 100 gallons or more of water after 1-2 inches of rainfall. Part of this intercepted water will slowly be released to the soil below, requiring less additional water needed for trees and crops, and part will evaporate into the air. Tree roots also store water which will eventually be released into the atmosphere through transpiration.*Transpiration* is the process by which stored water in tree roots travel to the leaves and then evaporate into the air through stomata, or leaf pores. An average tree can release 250-400 gallons of water in one day. Through water evaporation and transpiration, trees play a critical role in the water cycle. Much of the water that travels inland does not come from oceans, which also release moisture into the air that forms rain clouds.Oceanic moisture accounts for rain that reaches only 150 miles from the coast. Through tree evaporation and transpiration, air is remoistened as it travels farther inland from oceans and this accounts for much of the rainfall away from coastal areas.Trees and other small vegetation return nearly 70% of rain back into the air which then maintains the water, or rain, cycle and recharges rivers and lakes. Without trees the interior parts of continents would become deserts, such as in Australia and Africa were deforestation has led to minimal rainfall.

"trees are the Earth's lungs."

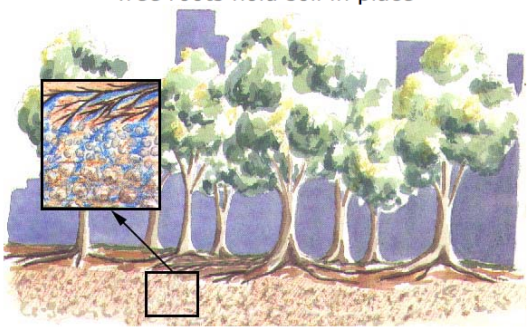


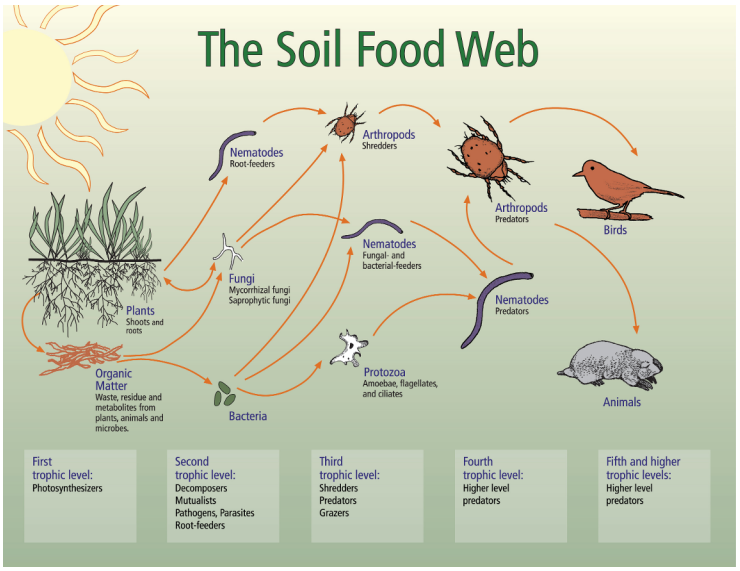
SOIL CONSERVATION

Soil conservation deals with methods or processes used to prevent soil erosion and maintain soil health and productivity. Trees help conserve soil by reducing soil erosion, increasing soil organic matter, enhancing soil structure, and aiding in nutrient cycling.As a third of the world's land surface is threaten by desertification, planting and caring for trees to help retain fertile soil is crucial not only to the health of the land but to over 850 million people who rely on agriculture as their livelihood.

The most fertile part of soil is found in its first couple centimeters, or topsoil.It is vital that topsoil is maintained and prevented from being washed away as it is necessary for crop and pasture growth. The more topsoil removed, the more fertilizer will be needed and the quicker desertification occurs. Trees help conserve soil by holding it in place with tree roots (pictured below) and by creating a rougher soil surface with tree stumps, fallen branches, and foliage litter. A rougher surface area slows the rate of water flow that erodes soil and a rougher surface improves water infiltration into the soil which increases soil fertility and decreases the need to provide additional watering, something important as water becomes scarcer. Moist soil also prevents it from being eroded by wind. Another way trees conserve soil is by creating soil organic matter from their leaf litter and decaying roots. Trees and plants perform the first trophic, or nutritional, level of organic matter needed in the soil food web(refer to the diagram below). Soil organic matter increases the activity of microorganisms found in the soil which help increase soil fertility. As organisms decompose various organic matter or consume other organisms, nutrients are converted from one form to another and made available to plants and other soil organisms. All plants depend on the food web for their nutrition and soil plays a vital role in the process. Trees also strengthen soil structure by providing **biopores**—pores left behind from decayed roots.These openings help water and nutrients travel through compacted soils to crops. While benefits from biopores may not be seen for several years, their effects remain important as crops in compacted soils can use biopore pathways left by trees many years after that area has been cleared of trees.

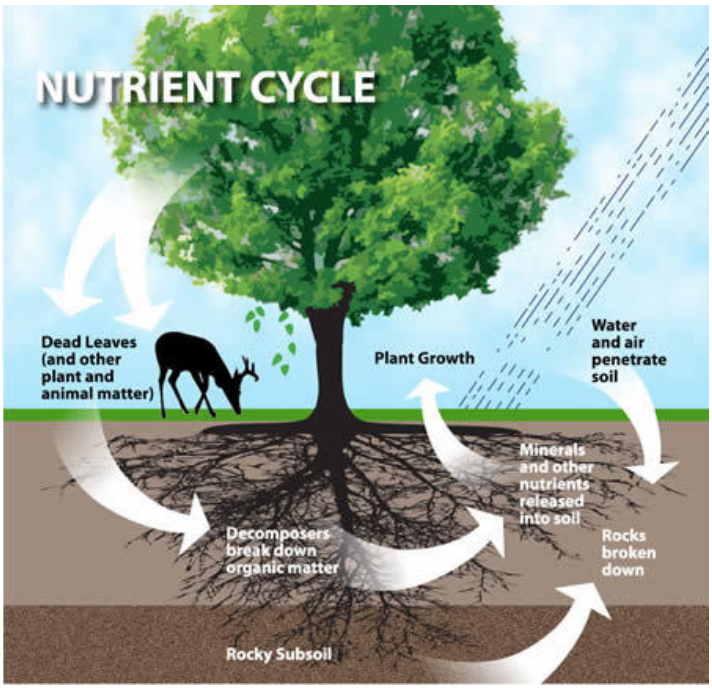
Tree roots hold soil in place





NUTRIENT CYCLING

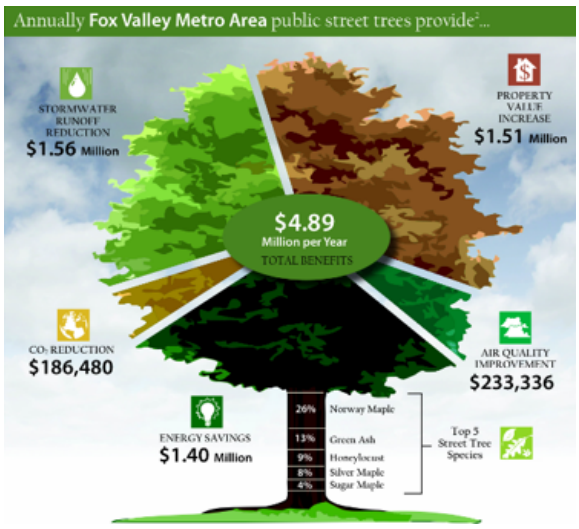
Trees also conserve soil by aiding in nutrient cycling. Trees recycle nutrients by moving them from underground to the soil surface, where they decompose to form soil organic matter. Tree litter such as leaves then decompose on the ground, releasing nutrients back to the soil for the tree to take back up (refer to the diagram below). Thick tree canopies are great sources of free, natural fertilizer not only by shedding leaves but also by capturing nutrients on leaf surfaces which are then washed from the leaves to the soil by rain.



WILDLIFE HABITAT PROTECTION

If climate change--particularly the earth's warming--and deforestation trends continue, nearly one million species will become endangered in the next 50 years.Forests shelter over two-thirds of Earth's land-based animals, including the largest portion of threatened species. Wildlife relies on trees for survival. Forests supply food, housing, migration and breeding resting spots, and a safe and natural habitat for wildlife. The symbiotic relationship between wildlife and forests plays a crucial role in ecosystems. For example,bees work as pollinators,birds become seed dispersers, and bears are food-chain regulators while their waste serves as natural forest fertilizer.Forest wildlife is nature's ecosystem engineers and maintenance workers.

Trees, themselves are also important ecosystem regulators. As part of the tree life-cycle (refer to the below diagram), a mature tree provide fruits, nuts, and seeds for wildlife and a percentage of tree seeds will grow to form new trees. In a properly functioning ecosystem, dead and decaying trees serve as nests, nurseries, and housing for animals and preserve moisture and nutrients that help with new plant growth and soil organisms. Trees heavily regulate the type and amount of wildlife in an area. By providing a livable environment for a species,trees largely determine their survival. Restoring forests is an important step in maintaining wildlife. Planting and caring for trees not only protects wildlife habitat, but it also reduces the possibility of having to say goodbye to a million unique species of our forest community.

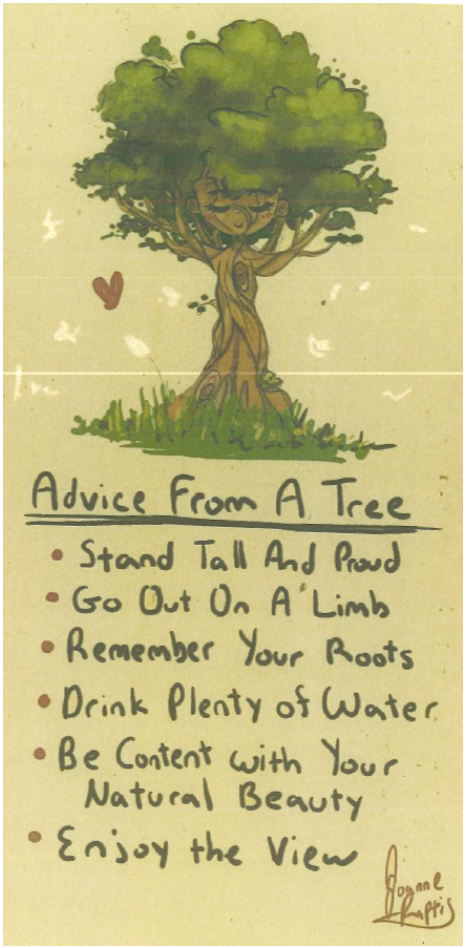


"trees improve the quality of life within a community by reducing the chronic stress

COMMUNITY DEVELOPMENT

As more people worldwide live in cities, trees improve the quality of life within a community by reducing the chronic stress linked to urban living by providing access to nature and green spaces. Green spaces are areas with trees, plants, and other vegetation. One UK study showed that areas with higher tree density had lower levels of antidepressant prescriptions.Research also shows that the more green space an urban area has, the more healthy social interactions between adults and children and the lowering of graffiti, property crime, and violent crime. Programs like Trees for Integration help reintegrate street children with their local community and encourage them to play alongside other local school children. Studies show that children learn faster and ADHD symptoms appear less when children have access to nature.

Increasing the number of trees in a neighborhood helps develop a community's economy by attracting more business and tourism and by improving the productivity of workers through better concentration and less mental fatigue. Trees also develop a sense of communal ownership (and appreciation) of common spaces. One study conducted by Furman University revealed that neighborhoods which didn't regularly interact through block parties or crime watches did, however,start organizing other community events together once they started caring for their local communal trees.



ENHANCE PROPERTY VALUE

According to an online posting by the Arbor Day Foundation (ADF), a mature tree can hold an appraised value of anywhere from $1,000-$10,000. One study cited by ADF showed that 83% of realtors believe that mature trees have "a strong or moderate impact" on the sell-ability of houses listed for under $150,000 and for homes listed over $250,000,98% of realtors agree with that statement.Strategic landscaping, particularly with trees, can increase property values as much as 20 percent.Pictured right is a local Phoenix home that is a great example of strategic landscaping. Below are various property price increase estimates from an article published in *Arborist News*. Depending on the location, size, and number of trees, property prices can potentially increase by 15%. The article also cited that homes near naturalistic parks are usually worth 8 to 20 percent more than comparable properties. Understanding the real estate benefits of trees is becoming increasingly important, and the Sacramento Tree Foundation has dubbed the benefits analysis as “Treelestate.”Trees can be so economically valuable that some homeowners insure their trees because the loss of a landmark tree during a storm, for instance, can depreciate the property value anywhere from 10-20 percent. Although it can take years of growth and care for a tree to reach a size that adds substantial *economic* value to a property, it’s worth the investment.

Price increase	Condition
2%	mature yard trees (greater than 9-inch dbh)
3-5%	trees in front yard landscaping
6-9%	good tree cover in a neighborhood
10-15%	mature trees in high-income neighborhoods

TREES MATTER

INCREASE HAPPINESS

A recent study shows how even looking at pictures of trees and other green spaces make us calmer. Participants of the study were given pictures of either trees and green places or pictures of concrete and buildings after they had completed a strenuous math problem. Researchers then tested the participants' sympathetic and parasympathetic nervous systems. The sympathetic system responds to stress by triggering the fight-or-flight reaction and raises our heart rate and makes us anxious. The second system, the parasympathetic, brings feelings of calmness and well-being. When participants saw pictures of greenery after the math stressor, their parasympathetic system kicked-in and lowered heart rates, something that failed to happen with the group of participants who viewed pictures of concrete and man-made objects. The study suggests that viewing green spaces, such as trees, can help lower feelings of anxiety and stress and that actually visiting or seeing nature can create even greater feelings of relief and happiness.

"even looking at pictures of trees and other green spaces make us calmer"

HELP STUDENTS LEARN BETTER

A recent study shows that a view of trees outside a classroom window helps students retain information better and recover from stress quicker. Although previous research has shown positive associations between green landscapes (trees, grass, plants) and student academic performance, this is the first study to support causal relationships between exposure to green campus landscapes and improved student performance

In the randomized controlled experiment, 94 students at five different high schools were assigned to classrooms without windows, windows that opened up to a barren space (and no natural greenery) or windows with views of green space (trees, grass). All students participated in a 30 minute activity and were then given a 10 minute break. It was specifically the 10 minute break that allowed (or didn't allow) access to nature that led to marked improvement in a student's attention capability and stress recovery (refer to the diagrams above.) The study reveals the important—but often overlooked--impact that school designs and green landscapes have on student academic performance.

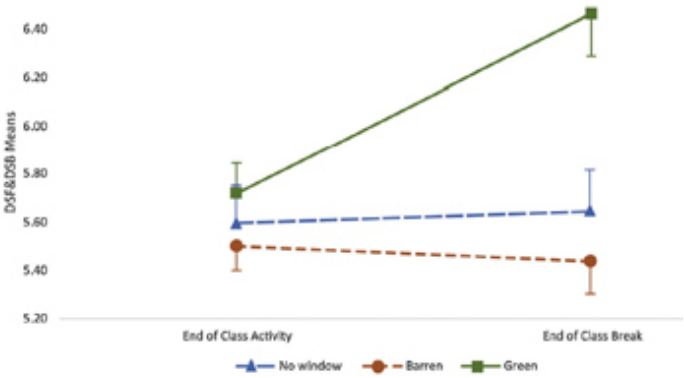


Fig. 2. Attention scores at the end of class activity and break (Means and SE).

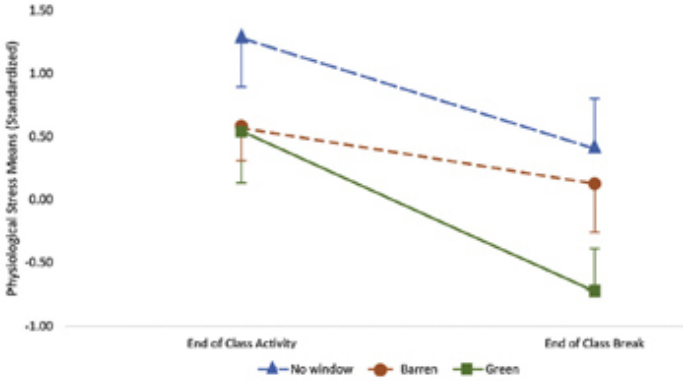


Fig. 3. Physiological stress at the end of class activity and break (Mean and SE).

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TREES MATTER

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