RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

Soils & Site Selection

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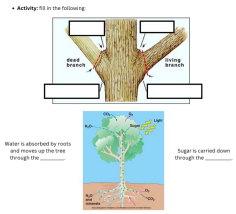
How to Use the Worksheets

- Answer questions as we go along to put what you're hearing on paper
- Answer the questions after listening to the lecture to practice using what you just heard
- Come back to the worksheet later to review what you've learned



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We find trees in many environments in nature

DIFFERENT TREE SPECIES ARE ADAPTED TO GROW IN DIFFERENT CONDITIONS

https://outforia.com/types-of-biomes/

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Towns and cities are different growing environments

https://outforia.com/types-of-biomes/

https://en.wikipedia.org/wiki/Urban_canyon;
https://www.cnu.org/publicsquare/2019/07/12/street-trees-planetary-prescription

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Some conditions in towns and cities make it difficult to grow trees

In this lesson, we're going to learn

- Soil basics
- Why some trees have trouble growing in the built environment
- How to identify tough growing spots
- How we can pick out tough tree species for tough spots

How do I know the tree in this photo is dead?

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Soil is the foundation of a forest

PROBLEMS WITH SOIL CAN BE ONE OF THE BIGGEST ISSUES FOR URBAN TREES

https://en.wikipedia.org/wiki/Forest_floor

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Soil is a mixture of…

Very small rock fragments (minerals)

Parts of once living things (organic matter)

Living things (roots, insects, fungi, microbes)

Water

Air

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There are many different types of soil across the world

Soils are affected by:

- The type of rocks in a place
- Seasonal temperature and rainfall
- The shape of the landscape
- The type of plants and animals
- The amount of time it has developed
- The impact of humans

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Soils have many features we can use to describe them

TODAY WE WILL FOCUS ON A FEW BASICS THAT ARE VERY IMPORTANT TO TREES

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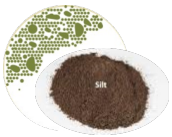
Texture describes that amounts of sand, silt, and clay pieces in a soil

MINERAL COMPONENT - VERY TINY ROCK FRAGMENTS

Sand = Largest Particle

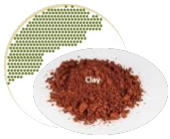
0.05 mm to 2 mm wide (thickness of paper to thickness of a nickel)

Silt = Medium Size



0.002 mm to 0.05 mm (thickness of human hair to paper)

Clay = Very Small



Less than 0.002 mm (thinner than human hair)

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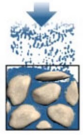
Soil contain different amounts of each particle size

Soil with a lot of **sand** feels gritty

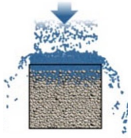


Water moves through easily, good drainage

Soils with a lot of **silt** feel like flour

Moderate drainage

Soils with a lot of **clay** feel sticky



Can hold water for a very long time, poor drainage

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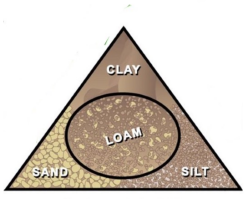
Soils with a mix of sand, silt, and some clay is called a loam



Loam is a combination of all these

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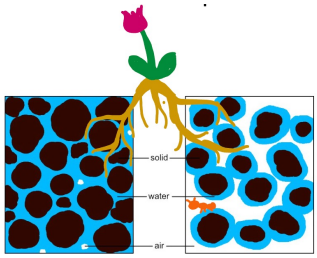
Pores are spaces between solid soil pieces

- Pores help soil act like a sponge
- Water and air move in and out of soil
- Critical for living things in the soil



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Organic matter comes from the breakdown of things that used to be alive

DECOMPOSITION

At first, it looks like the original living thing

Over time, it changes into generic dark brown material

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Soil organic matter is very important

- Adds nutrients to the soil (sort of like vitamins)
- Acts like a sponge to keep soil moist
- Is food for the microbes and insects that live in the soil

Very little organic matter, lighter color

More organic matter, darker colors

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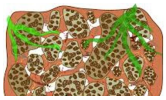
Mineral particles and organic matter can stick together to form aggregates

- Aggregates = clumps of soil
- Aggregates make bigger pores that connect together
- Water and air move more easily through the soil
- Easier for roots to grow



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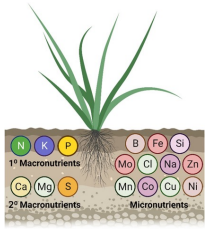
Nutrients are chemical elements that plants need to survive and grow

- Nitrogen, phosphorus, and potassium are nutrients that plants need from soil in pretty large quantities
- There are 14 other elements plants need from soil as well
- Plants get nutrients from both the mineral and organic parts of soil
- Fertilizers are also a source of nutrients



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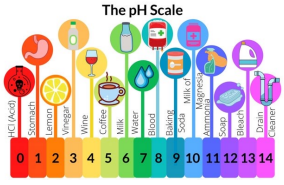
Soil pH affects how easy it is for plants to get nutrients out of soil

- pH measures how acidic or how basic the soil is



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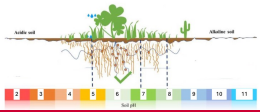
Soil pH affects how easy it is for plants to get nutrients out of soil

- pH measures how acidic or how basic the soil is
- Most garden plants prefer a pH to be between 5 and 6.5
- If pH is too low or too high, some plants can be stressed
- Though other plants are adapted to low and high pH



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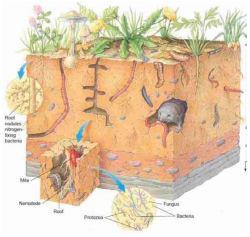
Living things in the soil create a good growing environment for plants

- Living things can:
  - Make nutrients more available for plants
  - Eat harmful pests and diseases
  - Create more pore spaces for air and water



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Now that we know a bit about what makes good soil for trees…

WHAT CAN GO WRONG?

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What are soil-related problems that we can encounter in the built environment?

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Soil Compaction

- Soil can become compacted from increased urbanization
  - Heavy foot traffic from humans in the environment
  - Site traffic during construction of sites
  - Heavy machinery
  - Soil management
  - Pavement and road implementation
- Increased compaction can increase soil bulk density, which indicates reduced poor space in the soil for air and water.
- This can cause impacts such as reduced infiltration and drainage, plant decline, and soil structure degradation.

https://www.advancedturf.com/resources/soil-compaction-symptoms-problems-and-best-practices/

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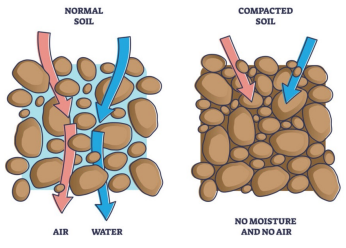
Soil Compaction



https://www.georgiaturfsolutions.com/what-is-soil-compaction-and-how-can-i-fix-it/?post_type=blog_post

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Soil Volume

- Related to previously discussed soil compaction
- Compacted soils can be denser, which indicates that they require more soil on average to fill a space
- Urban based engineered or structural soil
  - i.e. Rooflite for green roofs
- Soils that are less compacted, at a high volume, can help rainwater management, for instance.

https://www.greenroofs.com/2024/05/02/green-roof-soil-systems-by-rooflite/

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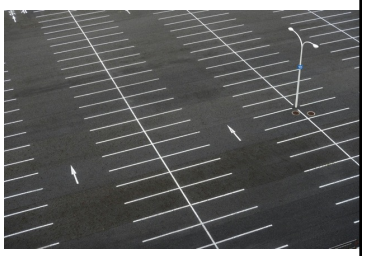
Altered Hydrology

- Hydrology can become altered due to soil compaction and the increase in impervious surfaces in urban environments
- Urbanization can reduce groundwater infiltration and increases surface runoff
- Harming soil biodiversity due to a limit of oxygen and water exchange



https://frontiergroup.org/resources/good-intentions-bad-outcomes-six-ways-impervious-surfaces-harm-our-cities-and-the-environment/

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Road Salt

- Implementation of road salt in urban areas can introduce sodium chloride (NaCl) into the environment
- NaCl can increase....
  - Salinity
  - pH
  - Density
    - Compaction caused by dispersing clay particles and destroying soil structure
- This, in turn, can decrease nutrient availability and harm the surrounding plant and mico-organism community.

https://www.scenichudson.org/viewfinder/this-winter-slash-the-salt/

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What is infrastructure that can limit tree growth?

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Below-Ground

- It is extremely important to call before you dig (i.e. 811)
  - Underground utility lines
- Myths of tree breaking pipes!
  - If roots are often found inside a pipe, the pipe was often damaged first.
  - Roots want to grow toward moisture found in a leaking pipe

811®

Know what's **below.**
Call before you dig.

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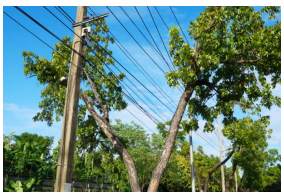
Above-Ground

It is also important to think about electric and telecommunication lines as a source of danger when selecting a site ideal for tree planting



https://johnsonopstreecare.com/blog/dont-touch-trees-in-wires/
https://www.thetreecenter.com/look-up-when-you-plant-trees-and-utility-lines/?srsltid=AfmBOoqX7v61DC6-5-WNvS7JLRmPkAF_rmnq3AKCM1SHhKfgKpvWLnOK

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Sources of Shade

- Key to thinking about sources of shade for potential new trees.
- Sources of shade can be in the form of…
  - Other trees and vegetation sources
  - Buildings and structures in the urban environment
- Trees can become extremely stressed without proper light, harming key processes such as photosynthesis

https://www.americanforests.org/article/capturing-the-beauty-of-trees-in-our-cities/

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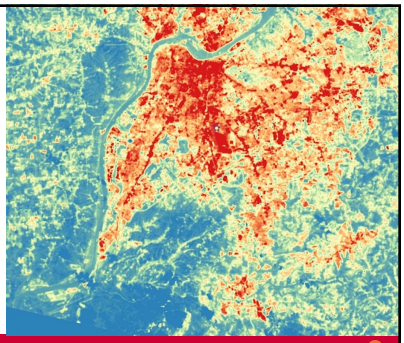
Hard Surfaces

- When conducting site selection, we want to thinking critically about nearby hard surface
- Some of these hard surfaces can reflect heat and ultimately lead to drought stress
  - Urban Heat Island effect



https://earth.org/data_visualization/urban-heat-islands/

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There are a lot of tough challenges for a tree

- Sometimes we can improve problems, such as compaction
- Some trees are more tolerant of difficult growing conditions than others

https://www.nwf.org/Magazines/National-Wildlife/2019/April-May/Gardening/Urban-Forests

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Before we plant a tree, we should…

- First, look at general growing conditions and potential problems at the planting site
- Then, find out which tree species can tolerate those conditions
- Next … we'll step outside to practice checking a planting site

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