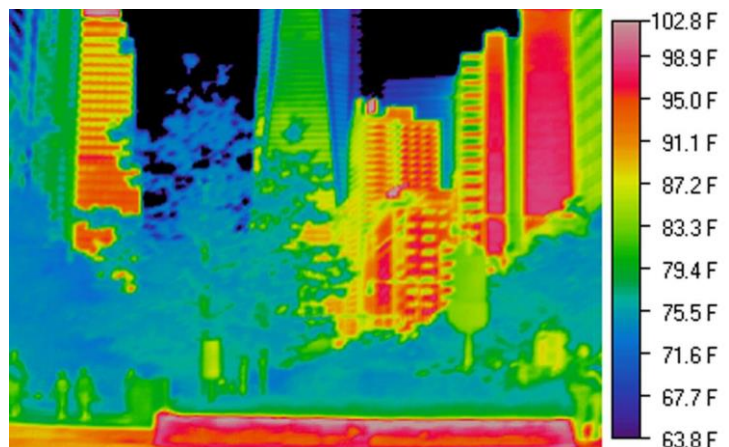


ART + SCIENCE AT HOME

Hara Woltz and Shelly Forster

EXAMINING MICROCLIMATES + TRACKING TREE SHADOWS

A [microclimate](#) is a set of climate conditions such as sunlight, temperature, wind, and moisture levels in a defined area of study. Microclimates can range in size from several centimeters to hundreds of kilometers and influence ecological processes including plant growth, nutrient cycling, soil respiration, and habitat selection. Some plants, like sunflowers, will grow larger in a sunny microclimate, while ferns prosper in the shade. To better understand microclimate, think about where you like to rest when you're outside on a boiling hot day. Where would you prefer to be: on hot asphalt or in the cool shade of a tree? In addition to absorbing and blocking the sun's rays, trees also keep their nearby microclimate cool in the summer by releasing cooling water vapor through the stomata (remember these leaf structures from Day 2?) in their leaves. A few years ago artist Nickolay Lamm walked around New York City with a thermal camera [documenting temperature differences](#) in an urban microclimate. Do you notice the stark difference between the tree and metal skyscraper temperatures?



Nickolay's photos illustrate a phenomenon called the **urban heat island effect**. [According to the EPA](#), cities can be 2-5°F warmer during the day and 22°F warmer at night than the surrounding countryside! This happens in part because cities have a lot of surfaces like asphalt that absorb heat during the day and slowly release it at night and have fewer trees that absorb sunlight and release cooling water vapor.

Recent research from a group of scientists found that the urban heat island effect may still [disproportionately affect low-income neighborhoods](#) that were subjected to discriminatory, racist housing policies nearly 100 years ago. In a study of 108 urban areas, the scientists found that neighborhoods that were formerly redlined to block people of color from getting housing loans have fewer trees and more hot concrete surfaces and are an average of 5 degrees hotter than non-redlined neighborhoods. Cary scientist Dr. Steward Pickett and his collaborators saw a similar phenomenon in a Baltimore study where they found that redlining influenced the distribution of urban trees and parks in favor of white, U.S.-born homeowners at the expense of immigrants and people of color. Baltimore neighborhoods affected by discriminatory housing policies in the 1930s [still have half the tree canopy](#) than their privileged counterparts and are therefore far more vulnerable to the urban heat effect.

If you think the urban heat effect is as fascinating as we do, we recommend reading up on research by Cary Research Fellow [Dr. Timon McPhearson](#), who studies urban ecology, including the ecosystem services provided by urban green infrastructure.

Ready to head outside with your field notebook? Your mission today is to observe the impact of a tree on its nearby microclimate by investigating shade. We'll leave the other key component of tree microclimate (cooling water vapor) for another day.

STEP ONE: Gather your materials and head outside.

- Today we will construct a quadrat (AKA a "study square"), so you will need your fieldbook, drawing supplies, and these extra materials:
 - **tape measure or ruler, four pencils, twine or string, thermometer** (optional). If you don't have a tape measure or ruler, you can estimate the length.

STEP TWO: Find a tree or large shrub that casts a shadow.

- Try to find a grassy area where you can set up a quadrat, but don't worry if you don't have access to a grassy area.
- You could also set up a quadrat on pavement with some sidewalk chalk. Any tree will do.

STEP THREE: Observe the Weather.

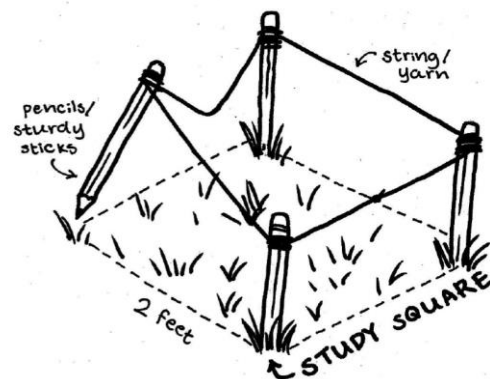
- Take note of the same weather factors you observed yesterday.
- Look back to yesterday's notes if you need a reminder.

STEP FOUR: Observe the Shadow.

- Take some time to look at the shadow cast by the tree. Walk around. How solid is the shadow? Are there gaps?
- What does the edge of the shadow look like?
- Do you notice any differences in the area around the tree that might help you predict where the shadow travels or how it might affect the nearby microclimate and ecosystem?
- How big is the shadow relative to the tree? Shadows are long in the morning and evening, and shorter midday.
- NOTE: If you are doing this activity on a cloudy day and there is no shadow, focus instead on the second half of Step Four and make predictions of where you think the shadow's path may travel throughout the day.

STEP FIVE: Set up a quadrat.

- Find a space at the edge of your tree's shadow.
- Ideally about 50-65% of your quadrat will be covered in shadow.
- Measure out a square that is four feet by four feet, or your best estimate if you don't have a tape measure. If you don't have enough space for a 4x4 square you can make it as small as necessary.
- Push a pencil into the ground at each corner of the square. Make sure that they are inserted securely enough to support the string.
- Wrap string around each pencil so that you create an observational square.
- We borrowed this great quadrat illustration from the [Cary EcoQuest](#) program.
- NOTE: if you don't have a grassy area, you can draw a quadrat with sidewalk chalk. The most important thing is having a stationary square so you can observe changes throughout the day.



STEP SIX: Draw a square to represent your quadrat. Jot down the time.

- Imagine you are a hummingbird hovering above the quadrat. Draw the view looking down from above. Include the string lines and the shadow within them.
- Observe for a few minutes and sketch any insects that move through the square. Draw any plants of interest within your quadrat and take note of their position in relation to the shadow.
- If you have a thermometer you may want to take the temperature in the middle of the space. Do you notice any differences between shaded and unshaded areas? Touch the shaded grass and unshaded grass. Do they feel different?

STEP SEVEN: Second quadrat observation

- 10 to 15 minutes later, return and repeat Step Six.

STEP EIGHT: Third quadrat observation

- 10 to 15 minutes later, return and repeat Step Six.

QUADRAT PHOTOS (HUMMINGBIRD'S EYE VIEW):



11:52 AM



12:07 PM



12:22 PM

STEP NINE: Write a few quick notes about your observations.

- Did you notice any differences in your study square as the sun moved through the sky?
- Would you need an extended timeframe to notice any differences?
- What would you do differently if you made these observations again?

STEP TEN: Finish up your day by doing one of the following drawings:

- Be a hummingbird again! Imagine hovering above the canopy of your tree and looking down. Draw an aerial view of your tree and map out its shadow's imagined path throughout the day.
- Think more specifically about microclimate within your tree. Imagine you are a [tired squirrel](#) and make a sketch of where you would want to hide on your tree in the hottest part of the day.



(NBC Dallas Fort Worth)



(Richard Smart)



(James Marvin Phelps)



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