

**The Sunflower Community Project**  
**Citizen Science Handbook**

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## **Introduction**

Hello! If you are reading this, you are likely already well on your way to being a part of The Sunflower Community Project, and we could not be more excited about it! This handbook is designed as a how-to guide for your participation. In our collaboration, your goal will be caring for and measuring the sunflowers you have adopted. We hope this will not feel like a chore, but rather an opportunity to take part in exciting new research, of which no one knows the results of yet!

This handbook is focused on describing how to properly care for and measure your sunflowers, with some details about what we hope to gain from your efforts. Throughout the season we will regularly post to the blog on our website about the progress that yourself and others are making toward better understanding the sunflowers that thrive in urban environments. The blog will focus much more on the science behind the project, describing details about hypothesis-based and experimental science, as well as details about evolution, native plant ecology, and of course, sunflowers! In addition to posting to the blog, we will send out reminder emails about when to take your measurements, and when there are educational workshops you can attend to learn more about this project, along with ecology and evolutionary biology more generally. Please check your email regularly to ensure you receive these reminders on time.

If you have this handbook we assume you have attended one of our orientations, and that you have some familiarity with project and your role already. If anything in this workshop seems unfamiliar or unclear, or you are just learning about the project, please contact us. We are eager to assist you however we can!

## **Why Am I Doing This?**

As humans change our landscape and cities grow, the diversity of native plants and animals in urban areas decreases. Loss of native diversity often accompanies more pollution, habitat loss, higher temperature, and more invasive, nonnative species. However, some native plants – such as the Common Sunflower (*Helianthus annuus* L.) – are able to survive and thrive in cities despite these difficulties. How do sunflowers survive in cities? Do they help other animals survive by providing food and shelter? By studying sunflowers in urban environments like Boulder, CO, we aim to explore these questions with your help!

## **What If I Have Questions?: Consulting with Project Facilitators**

Science can be hard sometimes, and we do not expect you to do it all on your own! We are here to help. If you have any questions or concerns about anything related to the project, feel free to contact us. Below we have listed our contact information, which is also available at our website.

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## **Sunflower Care**

One of the great things about sunflowers (*Helianthus annuus*) is how hardy they are. As a native plant – one that has been naturally growing in an area for many years – they have no problem with our hot, dry Colorado climate. If you have experience gardening, we suspect you will have no problem keeping your sunflowers healthy, but we want to give you a few tips to be sure we are all on the same page.

1. Treat all your sunflowers equally. As best as you can, try to treat all your sunflowers the same. This means watering them the same amount, that no plants are receiving any more or less shade or sunlight, and that you are not giving any extra help to one sunflower even if it is smaller or looks like it needs more help. We hope that all the sunflowers will survive the whole season, but do not worry if any sunflowers die. If any of your plants do not survive, please make a note of this when you submit your observations (see below). Knowing which sunflowers live and die is great data too!
2. Water often. When sunflower are young they will need lots of water. We recommend watering once every 24 to 48 hours if possible. As your sunflowers mature, they will not be so thirsty, and you can water less often. Try to water consistently in regular intervals (for example, water every Wednesday and Saturday), and use your judgment as to how much to water and how often is necessary. It is hard to say exactly how much you should water, because this will depend on the soil, weather, and amount of sun your garden gets. You will have to use your best judgement, using how healthy the plants look as your guide. And remember, treat all your sunflowers equally!
3. Check for wilting. If any of your sunflowers seem to be sagging from their own weight, or you notice wrinkling of the leaves, this means the plant needs more water. Remember, all your sunflowers should be treated equally, so even if only one plant is wilting, water the others ones too! If one of your plants seems to be struggling the whole season, take note of this in your observations, but do not give this plant more attention than the others.
4. Water in the morning or afternoon. If the sun is high in the sky water can act like a magnifying glass and burn your plants leaves. To avoid burning your plants, water them in the morning or evening. By watering your sunflower in the morning or evening, you also use less water. If you water in the middle of the day, a lot of the water may evaporate before your sunflowers can use it.

## **Taking Measurements: How**

Measurement is an essential part of every science discipline. Measurements are scientists' way to simplify and summarize observations, including simple observations we are all familiar with like height, weight, and time, to more complex ones such as energy, velocity, or gravity. Measurements make it possible to compare and contrast observations to each other in a standardized way. Good measurements can reveal something about reality we may not have been able to learn by simply looking at the plants alone.

In our case, we are interested in measuring physical traits of sunflower plants. As a citizen scientist, you will take and record measurements of the sunflowers you are caring for. After those measurements are recorded by you and citizen scientists like you, we can make comparisons between sunflowers from different environments to ask if and how the plants differ. Perhaps sunflowers from urban environments will tend to have larger flower disks than those in rural environments. If that is the case, we can then ask why this might be true and design further experiments to test out our new ideas. This process is at the core of scientific discovery, and you will be playing a major role!

Below we have listed the measurement we would like to record from each sunflower and a brief explanation of how to take the measurement most accurately. Please ask us questions if you are unsure how to do any part of the process.

**NOTE: Each sunflower you receive from us will have a unique ID written on a tag that will be placed in front of the plant in the soil. Be careful to record the ID of the plant that you are measuring so that you do not confuse which measurements came from which plant. Be sure to record the date you take your measurements, and that all your sunflowers are measured on the same day that you have written. Use the tables at the end of this handbook to record all your measurements.**

## **Tricks and Tips for Taking Excellent Measurements**

1. *Be confident in your measurements by taking them multiple times before writing them down.* There is an old carpentry saying, "measure twice and cut once." We will not be cutting anything, but this is still good advice. *Be confident in your measurements by taking them multiple times before writing them down.*
2. *Once you feel good about your measurements write them down immediately - don't wait!* It is far too easy to forget the exact measurements, and we want to be as accurate and precise as possible.
3. *Estimate the smallest digit of your measurement.* This sounds funny — didn't we just say be as accurate as possible? Imagine you measure leaf width in centimeters like the one shown below, how many centimeters should you record? The tape measure should have a number for each whole centimeter (1 cm, 2 cm, 3 cm, etc.). In addition there should be 9 small tick marks in between each whole centimeter. Each tick is 1/10 of a centimeter. So the measurement below could be written as 2.1cm. However, when you look very closely you can see there is a little extra space after the red tick mark for 2.1cm. How much extra? This is what we mean by guess the smallest digit of the measurement. Measuring this way ensures your measurements are as precise possible. To be clear, we would record this measurement as 2.13cm by guessing how much space is left after the 2.1cm mark. Your guess might be slightly different. That's okay. **The last digit is your best guess.** This may be too difficult for some measurements like plant height. Be as accurate and precise as possible, but don't worry if you need to make a more coarse estimate (like 2.5cm instead of 2.57cm). Measurements are never perfect.



If you look closely, the width of the leaf is slightly more than 2.1 cm.  
We would guess the width to be 2.13 cm.

## **Types of Measurement You'll Take**

### **Date of First Flowering (month, day, year)**

Flowering time is a very important measurement for plant evolution. Flowering means a plant is ready to reproduce. When a plant flowers during the season can differ from plant to plant and this suggests something about the environment the plant is expecting to grow in. If the environment the plant is from is low in water, plants might flower earlier in the season to produce seeds quickly, before it dies. If their environment is high in water, a plant might produce flowers later, investing more in its own growth, which can lead to making more seeds, or bigger and healthier ones. Unlike the other measurements being recorded twice per month, flowering time will only be recorded one time for each plant. **If possible, try to record the exact day each of your plants produce its first flower and transfer this to the comments section of the online data entry form. We encourage you to email us pictures if you are unsure whether you should count a disk as flowering or not – we are happy to help!** You will know when each of your plants has made its first flower by the yellow petals on the flower disk. Make sure all the petals have unfolded from the center. Once all the petals have unfolded – even if the flower disk is not completely

### **Number of Flower Disks (count)**

Flower disks are where seeds are made. A mature flower disk should have nice yellow petals. Please be sure to only count flower disks that have produced yellow petals. The more flower disks a sunflower has, the more seeds (and offspring) that plant will be able to produce. For the first several months, your sunflowers will not have flower disks, so this measurement will be zero. As time goes on your sunflowers will start producing flower disks. Only count flower disks with yellow petals (also called ray corollas) that are completely unfolded. If at any point a flower disk is eaten, please take note of it in your observations.

### **Flower Disk Diameter (cm)**

Flower disk diameter suggest something about the seeds a sunflower can produce. The bigger the disk, the more seeds or bigger seeds the plant can produce. The flower disk diameter should be measured in centimeters. Be sure not to include the yellow petals in the measurements, only the dark core part of the flower should be measured.

For consistency, please measure the same flower disk throughout the season. This should be the first mature flower disk that signaled the plant's flowering time. We recommend **loosely** tying a ribbon or string around the plant near this flower disk to keep track of it (do not tie it too tight as you could constrict the plant's tissue as it grows).

If the flower disk becomes damaged or eaten, please take note of this in your observations log and continue measuring a different disk from the rest of the season.



When measuring flower disk diameter, be sure to only include the disk and not the petals in your measurement.

### Leaf Width & Length (cm)

Leaves are a plant's way of photosynthesizing. Photosynthesis is the process of turning sunlight into usable energy. The size of a leaf suggests something about how much light the plant expects to get. If the plant expects shade it might produce large leaves to collect more light. If it expects lots of sun, its leaves might be small to protect itself from getting too much light.

Leaf width and length should be measured in centimeters. For consistency, please measure the leaf nearest to the ground early in the season. We recommend marking this leaf in some way to easier keep track of it as the sunflower grows; for example, you could tie a string or ribbon loosely around the leaf stem. Like measuring a flower disk, if the leaf you measure becomes damaged or eaten at some point in the experiment, take note and choose another leaf to measure for the rest of the time. Try to choose a leaf that is similar in size to the previous one if possible. Please see pictures for visual aid. To measure width, try to measure the widest part of the leaf. When measuring length, try to start your measurement where the leaf blade first splits from the stalk (see pictures for visual aid) and go to the point of the leaf tip. **Please do not measure the cotyledon leaves. Cotyledons are the plant's initial leaves that form early in development. Cotyledons are small round leaves that will shrivel and fall off the plant after a few weeks into the season. Be sure to measure the first true leaf that forms. You will know a true leaf because it will be have a pointed shape – longer than it is wide.**



Choose a true leaf to measure that is nearest to the ground. There will likely be two different leaves at this same height. Choose either one.



When measuring leaf width (left), try to do so at the very widest part of the leaf.

When measuring leaf length (right), try to get all of the leaf blade, but do not include the plant's stem in the measurement.

### Total plant height (cm)

Plant height suggests something about how a plant uses resources (water and nutrients). Some sunflowers may grow very tall before flowering to get more sunlight than other plants. Others might stay small so they do not need as much water and nutrients to stay alive.

Plant height should be measured in centimeters by stretching a measuring tape from where the plant enters the soil to the top of the plant stem. When the plant is mature, the topmost part of the sunflower should be a flower disk. Do not include the top flower disk in your measurement, instead, end your measurement just below. Try to bend the plant to be straight up and down if at all possible.

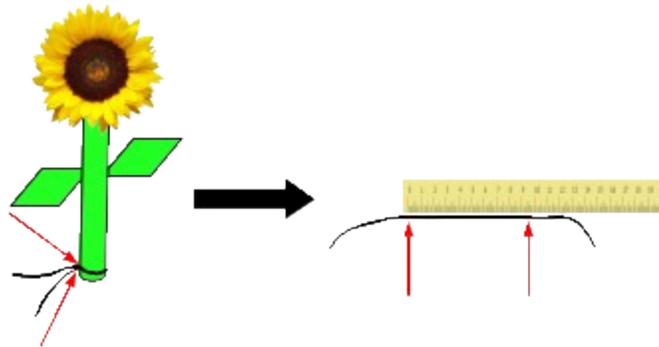
The plant might be taller than your measuring tape. If this is the case, carefully mark where on the plant the measuring tape reaches, move the beginning of the tape to this mark and measure from this point to the top of the plant. Do this a third time if needed. Finally add the lengths you measured together for the total plant height.



When measuring plant height, start measuring as near to the ground as possible, and end at the top of the stem.  
When plants get much larger, try to straighten the stem to be completely vertical without any bend.

### Plant Base Circumference

Plant base circumference (the length of a circular object when straight) suggests something about the overall size of the plant. Big plants need a larger base to support their own weight. Plant base circumference should be measured in centimeters. To measure plant base circumference use string or yarn and carefully wrap it around the bottom most part of the plant as close to the soil as possible. Use your fingers to pinch how much of the string you needed to wrap around the base once. Unwrap the yarn from the sunflower stalk keeping your fingers pinched in the same place. Use a measuring tape to measure how many centimeters of yarn you needed to wrap the base.



When measuring base circumference, wrap string around base of the sunflower once.  
Pinch where the string touches itself and measure the length of the string that was needed to wrap around the sunflower's base.

## **Taking Measurements: When**

Please measure each of your sunflowers twice per month, always during the first and third weeks. We will send out a reminder email a few days before it is time to measure your sunflowers. You do not have to measure your sunflowers on an exact schedule, but please try to measure them within the week we send out the reminder, and also try to measure them all at same approximate time. In other words, do not measure half of your plants one day and the other half three days later.

## **Collecting Data**

We have provided several pages of tables to record your measurements. Please be careful to record the measurement in the correct row and column of the table and that every column of the table is filled out for each sunflower. We highly recommend writing down your measurements immediately after taking them. Once you have written the measurements down they can be transferred to the pooled spreadsheet explained below.

## **Uploading Data**

Once you have taken measurements for all plants, you can transfer these data to our online database. We ask that you transfer measurements to the online database as you go rather than waiting until the end of the season. By transferring your measurements online as you go, we will be able to share our findings with all our participants on our website throughout the summer.

The link below is where you can transfer your measurements. You will see that the online data table should look very similar to your collection table except there is only one row. Please submit each plant you are measuring separately. Each time you click the link, a new blank row should appear where you can type your recorded measurements.

Link

<http://tinyurl.com/kbbr3o2>

## **Data Collection Forms**

We have included three pages of measurement collection tables. This should be more than enough for the season, but if you find you need more, please go to the resources page of our website:

When recording measurements, make sure all information for a given plant is recorded in the same row of the table. Once you have transferred your measurements online, check the box in the very last column (“Data Online?”), so you do not accidentally record the same measurements twice.

In addition to recording these measurements, we ask you to keep a running journal of observations. Your observations should include anything you feel is important or worth noting. For example, if the leaf or flower disk you were monitoring becomes damaged or eaten, please record this in your observations. There is space provided in the electronic database (linked above). You can write notes and observation directly on your collection forms just below where you recorded your measurements, or write them separate in a notebook or something like that. Record any and all observations you think appropriate to the online data base, including animals and insects you might see interacting with a particular sunflower, or if you notice anything strange or different about one of the plants. **Please try to relate your observations to a particular sunflower plant if possible.**





