Trees Challenge 2020: Make Every Tree Count

Facilitator's Guide for Informal Educators

The Challenge

To celebrate the 50th anniversary of Earth Day and the 25th anniversary of the GLOBE Program, GLOBE Observer is hosting a month-long citizen science challenge in April 2020. Volunteers are invited to measure the height of as many different trees as possible throughout the month using the Trees tool in the GLOBE Observer app. The individuals, schools, and registered teams that measure the most trees will be recognized as top observers in the challenge.

Download the app here: observer.globe.gov/get-the-app

This document contains information relevant to informal educators who are interested in participating in the challenge, including an overview of the science, steps for taking observations and creating teams, and resources that are useful for developing and promoting Trees Challenge 2020 programming. Find more information here: observer.globe.gov/trees-2020

Timeline and Important Dates

February 19 - Webinar for Educators at 2:00 - 3:30 pm EST (19:00 to 20:30 UTC)
March 30 - Facebook Live at 1:00 pm EST (17:00 UTC)
April 1 - Start of challenge
April 1 - National Go on a Walk day
April 7 - World Health Day (see Science Connections to Public Health)
April 22 - 50th Earth Day
April 22 - GLOBE's 25th anniversary
April 24 - Arbor Day
April 30 - End of challenge
May 3 - Last day to submit data
May TBD - Winners Announced

A planning timeline is included in the appendix of this guide.

Communications

Follow the GLOBE Program on social media for updates on the challenge:
Facebook - www.facebook.com/TheGLOBEProgram
Twitter - twitter.com/GLOBEProgram

The Science

Trees are one of Earth's largest banks for storing the carbon that is emitted by natural processes and human activities. Forests cover many parts of the planet's land area, and as much as 45 percent of the carbon stored on land is in the forests. Trees cool and moisten our air and fill it with oxygen which can help balance our carbon budget. Trees undergo photosynthesis. Photosynthesis is a complicated process where carbon dioxide and water are converted to glucose (a simple sugar) and oxygen.

The GLOBE Observer application's Trees Tool allows citizen scientists to measure tree height for as many trees as the observer wants. You can track the growth of trees over time and can compare your measurements with tree height measurements from the NASA Ice, Clouds, and land Elevation Satellite-2 (ICESat-2, icesat-2.gsfc.nasa.gov), and the Global Ecosystem Dynamics Investigation (GEDI, gedi.umd.edu), instrument. Scientists from both of these missions might just use your tree height observations in their professional research.

ICESat-2, although its primary objectives are to monitor the sea ice, ice sheets, and glaciers around the globe, it is also surveying the heights of the world's trees and forests. The laser altimeter instrument onboard ICESat-2 is sensitive enough to detect both the forest floor and the tops of trees in all but the densest woods and jungles.

From the International Space Station and using a different type of laser altimeter, the GEDI instrument makes precise measurements of tree and forest canopy height, canopy vertical structure, and surface elevation to greatly advance our ability to characterize important carbon and water cycling processes, biodiversity, and habitat.

With the combination of citizen scientist observations from the Trees tool and satellite data from ICESat-2 and GEDI, we will be able to get a view of Earth's tree height from the sky and the ground, thus creating a robust database for researchers to showcase how something as simple as tree height can help us understand something as complex as our ever-changing planet.

A few facts about tree height:

1. Tree height is the number one indicator of how well an ecosystem can grow trees.
2. Tree height allows you to track the growth of trees over time.
3. Tree heights over time allows NASA scientists to understand the gain or loss of above-ground biomass. This can inform calculations of the amount of carbon that trees and forests take in or release into the atmosphere.

Making Observations

The app does the calculations for you, all you need to do is to point your cell phone at the top of the tree, then the bottom of the tree, then count how many steps it takes to reach the tree. You can also measure the circumference of the tree, if you wish.

A few helpful and crucial hints:

- In the Introduction section on the app, you will need to input your height. The app will then estimate your eye level.
- Make sure you always keep your smartphone (or other device) camera at eye level when aligning it to the base and top of the tree.
- When walking to the tree on a flat surface, always take normal steps.
- If you are walking downhill or uphill to the tree, please measure the actual distance to the tree with your tape measure and enter it in the Review section before submitting.
- If someone else will be using your cell phone to take a tree height observation, please visit the Help section of the app to change the user's height.

A video showing how to take an observation is available to download at svs.gsfc.nasa.gov/13211.

Creating a Team

A GLOBE Team is a group of citizen scientists working together as an organization. Teams can be used to set up a competition, coordinate a community's citizen science efforts, support an educational or corporate initiative, or simply enable a group of people to work together. Teams may include GLOBE schools and GLOBE Observer volunteer scientists. Anyone can form or join a GLOBE team. You can create and join as many teams as you like.

What do teams look like for this challenge? You might create multiple teams (teens vs. adults or different branches of your organization) and run a small internal competition. For example, during a GLOBE Observer challenge in 2019, Scouts in Australia created a team for every troop and held a smaller competition. The Scout troop that won their competition was also placed among GLOBE Observer's top observers.

You could create a single team for your organization so that your community's efforts are counted together. This approach allows you to gauge participation as a result of your programming.

If you create a team for the Trees Challenge 2020, please register with us so that we know to count your team when we tally the results. To register, visit the Trees Challenge page on our website, observer.globe.gov/trees-2020, scroll to the end of the page, and fill out the short form.

Every team has a team page on the GLOBE website. To see your team's page, go to GLOBE Teams, www.globe.gov/globe-community/globe-teams, then select "Join a Team." You can search for your team's name or scroll through the list. Click on your team's name.

The team page includes a summary of how many members are on the team, how much data the team has collected, and links to the data collected. The team manager (initially the person who set up the team, but that role can be transferred to another team member) will also see options for changing the team name or location, changing the team type (private vs. open), and managing members. Only the team manager can see the list of members.

Anyone can create a GLOBE team, and you can create and manage as many teams as you like. To create a team in the GLOBE Observer app:

1. Click on the gray bar or gear icon along the top of the app to open the settings page
2. Select Create a GLOBE Team
3. Enter a team name in English. All team names are screened. If potentially offensive terms are used, the team name will be rejected. Please try again with a different name.
4. Select your country and, if you choose, your city and zip code. This information will be public on the GLOBE Teams page.
5. You will receive an email confirming that you successfully created a team. Your confirmation email will include information about how to manage your team

To create a team on the GLOBE website:

1. Sign in to the GLOBE website using your GLOBE Observer username and password
2. Go to the GLOBE Teams page
3. Click "Create a GLOBE Team"
4. Enter a team name in English. All team names are screened. If potentially offensive terms are used, the team name will be rejected. Please try again with a different name.
5. Select your country and, if you choose, your city and zip code. This information will be public on the GLOBE Teams page.
6. You will receive an email confirming that you successfully created a team. Your confirmation email will include information about how to manage your team.

Teams can be open or private. Anyone can join an open team. The team manager must invite participants to join a private team. Your team will initially be private. If you are using the team to track the impact of your programming, we recommend keeping it private. To invite people to join a private team, the team manager must provide the team's referral code. Log in to the GLOBE website. Click on "Go to" in the top white bar. You will see a list of My Organizations that will include the team you manage. Select the team. The team's referral code will be below the team name. Provide that code to anyone you wish to invite to join your team.

The Teams page of our website, observer.globe.gov/do-globe-observer/do-more/teams, includes more information about how to join a team and how to manage a team. Please contact us, observer.globe.gov/about/contact-us, if you would like help setting up your team.

Using the Toolkit

The toolkit is organized by protocol and contains tips for integrating GLOBE Observer into your programs; activities, books, videos, presentations, and printables to build your program; and materials to promote your program.

You can find the full Trees Toolkit at www.observer.globe.gov/toolkit/trees-toolkit

Featured Resources:

- Paper Clinometer
- Tree Height Comparisons: A Hand-Held Clinometer vs. the NASA GO Trees Tool
- Seeing Trees in 2D vs. 3D: A Demonstration of Forest Extent and Tree Height
- Promotional Flyers

Community Connections

Science Topics

NASA studies trees from a global perspective--for example, the role that trees play in Earth's carbon cycle. However, trees are also connected to local issues, from invasive species to public health. People are often concerned about these topics, because the impacts are more tangible; and when people are concerned about an issue, they often want to know what they can do about it. You can engage your audiences in science that doesn't just help NASA with our global research, but also with a local or regional issue that they're concerned about. Start by listening. What are your visitors asking about? If you're in a library, are they asking about books on a certain topic?

Here are a few examples:

- Invasive Species
    - Spruce Beetle
    - Emerald Ash Borer
    - Hemlock Wooly Adelgid
- Disease
- Wildfires
    - Burn Intensity
    - Burn Recovery
- Habitats
    - Monarchs and Eucalyptus Trees
    - Habitat Restoration
- Public Health
    - Urban Heat Island Effect
    - Air Pollution
- Drought

Finding Local Experts

- Colleagues
    - Are there researchers or resource managers that are a part of your organization or system?
- Government
    - Which local and state government organizations might be interested in your topic? Park Service, Dept. of the Environment, Forestry Service, etc.
- Universities
    - Are there universities nearby? Do they have an environmental science department or other related department?

Connecting to Other Projects

We ask for tree height measurements because this data can help us study the health and mass of forests at a global scale. For local and regional topics, you may wish to collect additional data through another project. For example, we recently worked with the Akron Zoo FrogWatch chapter to train volunteers to take concurrent observations with the Mosquito Habitat Mapper tools to better understand the relationship between frogs and mosquitoes.

- iNaturalist - tree identification / wildlife
- eBird - wildlife
- Leafsnap - tree identification

Find more at www.scistarter.org

Add what you find to your field notes within the app, or simply note that you took a concurrent observation. Researchers can pull data based on the field notes, so if you're working with a local expert, ask how they would like the notes formatted.

Appendix

FAQs

Why measure tree height?

Tracking how trees are changing over time can help us estimate the number of trees that make up an area. Tree height is the most widely used indicator of an ecosystem's ability to grow trees. Observing tree height allows NASA scientists to understand the gain or loss of biomass which can inform calculations of the carbon that trees and forests either take in from or release into the atmosphere.

What do trees have to do with Earth's carbon budget?

Trees cool and moisten our air and fill it with oxygen and can help balance our carbon budget. Forests are considered one of the world's largest banks for all of the carbon emitted into the atmosphere through natural processes and human activities. They cover about 30 percent of Earth's land surface, while accounting for 50 percent of plant productivity. As much as 45 percent of the carbon stored on land is tied up in forests. Trees undergo photosynthesis. Photosynthesis is a complicated process where carbon dioxide and water are converted to glucose (a simple sugar) and oxygen.

What is ICESat-2?

In addition to measuring the height of Earth's ice sheet, sea ice, and glaciers, the NASA Ice, Clouds, and land Elevation Satellite-2 (ICESat-2, icesat-2.gsfc.nasa.gov) will also survey heights of the world's forests, lakes, urban areas, cloud cover and more, adding a third dimension of Earth from space.

What can I use to compare the tree height data I collected to the data from ICESat-2?

ICESat-2 (and ICESat) elevation data can now be visualized on the National Snow and Ice Data Center's (NSIDC) OpenAltimetry tool, openaltimetry.org. Data for the new ICESat-2 mission were released to the public on May 28, 2019. OpenAltimetry provides access to all ICESat-2 data for which there is a complete set of data products, including canopy (tree) height. If the ICESat-2 satellite collected data over your observed tree location, you can view ICESat-2 elevation data corresponding to your tree's latitude and longitude. This ICESat-2 dataset will continue to expand as ICESat-2 collects new data in the years to come.

What is GEDI?

The Global Ecosystem Dynamics Investigation (GEDI, gedi.umd.edu) instrument measures precise height measurements of surface water, ice, vegetation, and the land surface can improve estimates of flood risk from storms, fresh-water supplies, forest resources, and can help identify priorities for biodiversity conservation.

What is the purpose of comparing my GLOBE tree height data with the data from NASA missions?

NASA GLOBE Observer tree height data can serve as a source of data comparison for the ICESat-2 satellite. ICESat-2 utilizes an onboard laser altimeter system to measure the height of our planet, one photon at a time. The technology of ICESat-2 can measure the height of trees all around our planet. NASA GLOBE observers can share their data with NASA scientists and can be part of vital missions that make NASA science even better.

How can scientists and researchers use my tree height and tree circumference observations?

Tracking how trees are changing over time can help estimate the amount of trees that make up an area's biomass – the total mass of organisms in a given area or volume. Taking these observations can serve as a step to help scientists and researchers understand how trees help us balance Earth's carbon budget.

How many tree heights should I measure?

Record the height of trees in as many places as you would like. Also, you can measure the same tree many times, in order to see potential changes to tree heights over time.

What defines the top of a tree and the base of a tree?

Top of a tree: also known as the canopy or crown of a tree, it is the uppermost part of the tree.
Base of a tree: the lowest part of the tree trunk that is still above ground

Why are we also measuring tree circumference?

Tree circumference measurements can be used to estimate the volume, biomass, and carbon storage of trees.

What if I can't reach all the way around the tree, how do I measure circumference?

If you don't have another person to help you, try making a small mark with your fingernail as far as you can reach, and measure the circumference in two stages.

Why do I need to report on surface conditions?

Surface conditions are an important part of tree observations. Knowing the local environmental conditions will allow for a much more robust dataset that can be used in defining the local ecosystem. By reporting surface conditions, you are also providing additional data to assist during analysis and satellite validation.

How do I change from metric to English units or vice versa, or change my height?

While in the Trees tool, tap on the question mark at the lower right, and select "Introduction." Walk through the screens and change any settings you wish to modify.

I'm getting an error message "Invalid Angles: Please step further away from the tree to better measure the top and bottom," but it doesn't go away when I walk further away from the tree. What should I do?

If following the directions and moving further away doesn't clear the error message, your device may not have the gyroscope needed to measure the angles and calculate tree height using the app. You can check your device specifications to be sure. The other tools in the app will not be affected.

Will citizen scientists' personal information be made public?

An email address is needed to register for a GLOBE Observer account, as well as country affiliation (the user must be in one of the 120+ GLOBE countries), but we do not ask for a name or any other identifying information. The email address is not publicly visible. However, if a participant joins a team, the team manager will be able to see their email address. A unique numeric user ID is assigned to each user, and can be retrieved from the database along with the details of an observation, including latitude and longitude.

Who can participate in the challenge?

To sign up for a GLOBE account, a user must be in one of the 120+ GLOBE countries, www.globe.gov/globe-community/community-map. The GLOBE Observer app is intended for ages 13 and up. Younger children can participate under the supervision of an adult.

Can two people measure the same tree?

We encourage multiple observations of the same tree. If two observers start pacing toward the tree from different directions, the location of the tree (measured at the base of the tree trunk) should be similar enough to be matched. The photographs of the tree can also help match observations. Any variation in location will be due to differences in GPS measurements, and should be minimal. Comparing the calculated height of the same tree from multiple observers can help us assess the accuracy of the data.

Are any of the challenge resources available in Spanish?

As of February 2020, parts of the app have been translated, and other sections are expected to be complete before the challenge begins on April 1st. To change the language, go into settings by tapping on the white bar at the top of the screen (with the wheel icon), then tap "Change Language" and choose Spanish from the dropdown. Other languages are available for some parts of the app as well. In addition, the promotional poster and flyers will be available in Spanish on our website, in the resources section for the challenge.

Connections to Boy Scouts

Forestry merit badge

- Requirement 1 includes preparing a field notebook, making a collection, and identifying 15 species of trees, wild shrubs, or vines in a local forested area
- Requirement 5a includes visiting a managed public or private forest area with the manager or forester who is familiar with it, writing a brief report describing the type of forest, the management objectives, and the forestry techniques used to achieve the objectives
- Requirement 5c includes taking part in a forest-fire prevention campaign in cooperation with your local fire warden, state wildlife agency, forester, or counselor, and writing a brief report describing the campaign, how it will help prevent wildfires, and your part in it.
- Requirement 6 includes taking an inventory of the trees that may be a hazard to structures or people in a camp, local recreation area, or neighborhood. Note the species and hazardous condition, and suggest a remedy (removal or trimming), and make your list available to the proper authority or agency.
- Requirement 8 includes visiting one or more local foresters and writing a brief report about the person, or writing about a forester's occupation including the education, qualifications, career opportunities, and duties related to forestry.

Connections to Girl Scouts

Girl Scouts have a "Think Like a Citizen Scientist" Journey where girls observe, analyze, collect data, participate in a citizen science program and take action. This in-depth journey is a great opportunity to engage girl scouts in the Trees tool in GLOBE Observer.

For information on how to start the journey visit scistarter.com/girlscouts/info. Once you get started choose GLOBE Observer Tree Heights as your citizen science opportunity. Troops or councils can join the challenge as teams.

Resources for programming are also available through GLOBE Observer. For more information and access to these resources, please contact us: observer.globe.gov/about/contact-us.

Connections to Libraries

Trees provide one of the most versatile themes for library programs. Whether your audience is families, adults, children or classrooms/youth groups, "Trees" can provide a foundation for affordable and useful programs for libraries of all sizes — uniting art and community with citizen science.

United States 2020 Census

Libraries are playing a key role in the next Decennial Census in 2020 by delivering information, hosting outreach about the importance of participating, and providing Internet access for patrons to complete the Census.

As trusted messengers in the community, libraries will play a unique role to engage hard-to-reach individuals and groups (bit.ly/325xMcQ), including families with young children, people without Internet access, households with blended families and multi-generations, young mobile people such as college students, and English language learners.

Consider promoting the trees challenge and related programming to patrons, including those who use library computers to respond to the Census. Create signage and displays using promotional resources provided for the trees challenge, together with messages connecting to the census (e.g., “People aren't the only thing America counts...NASA needs YOU to count trees”). Offer family-friendly programming and programming for different ages and abilities, including families, teens, young adults, and seniors.

Library Groups

Libraries host meetings and provide services to a range of community groups. Consider partnering with groups that are already meeting at the library, such as gardening, photography, hiking, and running groups, scouts (see section on Boy and Girl Scout connections), neighborhood associations, seniors, and book clubs.

Tree-themed Story Time and Books

Check out the Trees section of the GLOBE Observer Toolkit for Informal Educators, observer.globe.gov/toolkit/trees-toolkit, for starter lists in WorldCat of books for children, youth, and adults. Host multigenerational story time. Grandparents or seniors in the community can talk about trees when they were growing up.

Host a Community Tree Walk

Partner with a near-by park or nature center, who might also be able to offer an expert to talk about trees. Or map a walking route in the neighborhood that will take the group to at least two trees for the group to measure. Observations can be made offline and submitted when WiFi is available.

Tree walks can be recurring events (weekly, monthly, seasonally, annually). This popular programming could also incorporate planting seedlings or providing seedlings to take home. Seedlings are often available at no/low cost from the state conservation department or local non-profit groups.

Build a Paper Clinometer

Compare with tree height observations made with the GLOBE Observer app. Download the template and activity that uses simple materials like a straw and a weight (e.g., paperclip or a washer) from the Toolkit for Informal Educators.

Bring Trees Indoors

One thing that librarians can't control is the weather. It is best to have a "plan B" for an outdoor event, so plan for a rainy day. Ensure participant satisfaction by also offering an indoor alternative. Don't have a local tree expert available for your program? A program of recorded TED Talks (bit.ly/2HD3jcN) can provide a fascinating (and indoor) look at trees.

Help patrons take practice observations indoors or nearby using the app to measure the height of an object in or around the library, for example a bookshelf, flagpole, the library building, or other tall object – at least 15 feet/5 meters tall. Make sure you have a clear path of at least 25 feet away that allows you to see the bottom and top of the object. Don't forget to delete any practice observations.

Observation Stations and Displays

Continue to engage your community through displays and station activities throughout the month.

- Posters, flyers, and other promotional materials that you can customize for your library are available in the challenge resource library, go.usa.gov/xddRc. Invite patrons to join your library team so that their observations will count towards the challenge (a poster is available among the downloadable resources with a place to customize with your team and referral code).
- The GLOBE Observer app will calculate average step length based on the height information provided. Make observations as accurate as possible by setting up a station activity where patrons measure their average stride length.
    1. Measure out and mark a known distance (e.g., 10 feet or 20 feet).
    2. Starting with the heel of the right foot in line with the starting point, count how many steps it takes to walk from one end to the other, then divide by the number of steps.
    3. Take the average of 3 times, and enter this information into the app.

- Build interest in tree programming by borrowing and displaying tree-themed traveling trunks from your local Department of Natural Resources or nature center. Using online resources, make a pictures/captions display about the oldest, tallest, etc. trees in your state, North America, and the world and use it to showcase your tree book collection; don't forget to dust off biographies and poetry that fit the theme.

Planning Timeline

Following is a sample timeline for planning your April programming for the Trees Challenge. Remember: NASA needs tree height observations from citizen scientists throughout the year; both ongoing observation programs or organizing observations around specific events (like Earth Day and the Trees Challenge 2020) are valuable.

Two Months

Make a Plan (and update as you get closer to your events)

- Identify goals and target audience(s)
- List tasks and who is responsible for each and deadlines
- Identify and contact community partners (e.g., local tree experts)
- Select date(s)
- Develop promotional strategy and begin promoting

Three Weeks Before

- Download the app: observer.globe.gov/get-the-app
- When you first open the app, you will need to register and create a login by entering an email address.
  Tip: you can share a login to use across devices during your programs.
  - The app and use are completely free.
  - An email is sent immediately with a password. Login with the password and you're ready to start observing.
- Begin taking observations. Use the app to measure trees around your site and neighborhood, or planned event location (e.g., if your event will be held at a park or other location).
- Set up a friendly team competition among staff or organizations (e.g., library branches)
- Run a "Name our Team" activity to engage the community in the challenge (e.g., through social media).

One-Two Weeks Before

- Set up your team(s) on the GLOBE site. Participants can join multiple teams and their observations will count towards all of their team totals.
- Consider whether participants will have or need Internet access to download the app during your program or event. Observations can be made offline and uploaded later.
- Select a site outside for making observations and plan your logistics for a safe event. (How will you get patrons there? Will you start outside at this location? Or begin inside?)
- Send out announcements to local media and through social media accounts.
- If possible, send out directions to registered participants or post on your event or program page so they can download the GLOBE Observer app, register, and are ready to go!
- Display promotional materials for your program (e.g., book displays and flyers).

Two Days Before

- Make sure your GLOBE Observer app is up-to-date on any devices you plan to use and that you can login easily (logging in to the app will automatically install any updates).
- Send final reminders to participants if registration is required for your program.
- Print out and copy any handouts needed.
- Do a dry run of your planned program with staff and volunteers.
- Check the weather forecast; if needed, have your rainy day back up plan ready.

Day of Program

- Gather all the resources you will use in your program.
- Charge your smartphone(s) or tablet(s).
- Login and test out the app to be sure everything is working.

Keep It Going

Some ideas for keeping the Trees Challenge going throughout April:

- Schedule live programming throughout the month for different groups (families, teens, adults, seniors).
- Post/display updated team maps throughout the month (e.g., weekly) showing where and how many observations your team has made.
- Send out reminders through local media and on social media to remind your team to keep taking observations