SCIENCE AT HOME: SUPPORTING FAMILIES THROUGH INFORMAL EDUCATION PROVIDERS

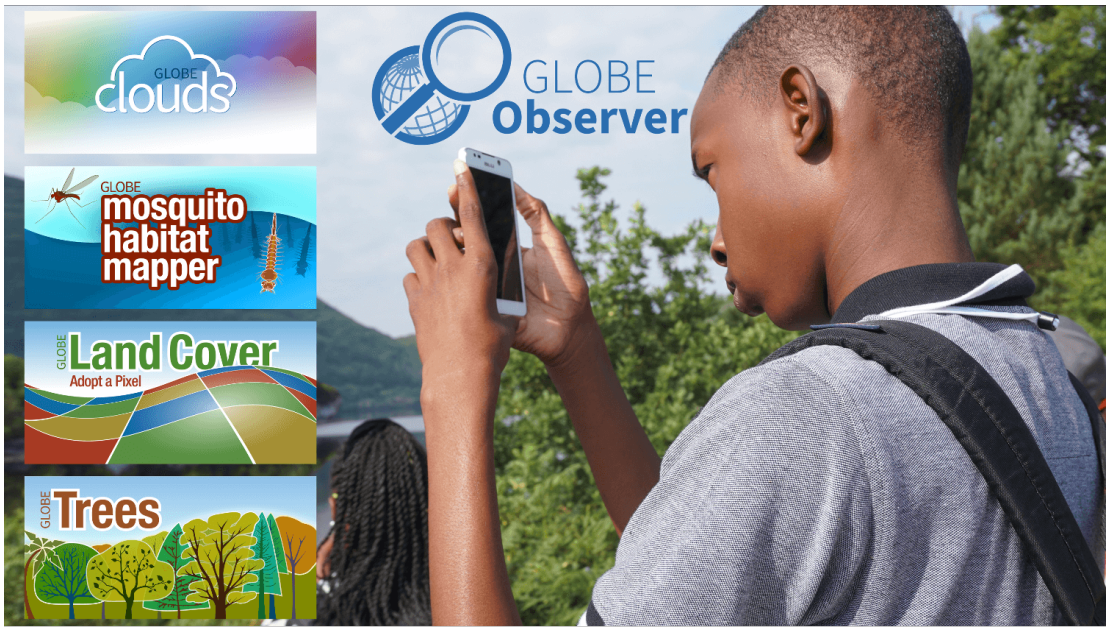
Theresa Schwerin, Vivienne Byrd, Heather A Fischer, Brian Campbell, Marilé Colon-Robles,
Russanne Low, Peder Nelson, and Heather Mortimer

Institute for Global Environmental Strategies, Los Angeles Public Library, Oregon State University, NASA Goddard Space Flight Center, and NASA Langley Research Center

PRESENTED AT:

AGU FALL MEETING
Online Everywhere | 1–17 December 2020

FOSTER SCIENCE AT HOME THROUGH GLOBE OBSERVER CITIZEN SCIENCE



As part of the international **GLOBE Program (http://www.globe.gov),** GLOBE Observer focuses efforts on out-of-school audiences with the objective of engaging new citizen scientists worldwide.

Using a free mobile app, volunteers in 120+ GLOBE countries contribute to monitoring clouds, water (especially as a habitat for mosquitoes), plants (trees and other land cover), and help to identify change over time. These data can be used to help interpret and augment NASA satellite data and are openly available to view and explore.

Community building through partnerships with informal science education organizations has been a significant focus for **GLOBE Observer (http://observer.globe.gov)**, including libraries, camps, museums, parks, scouts. In 2020, many of our partners were closed to the public and pivoted to virtual programs and supporting their visitors with online resources.

The team equipped partners with electronic content - **toolkits for informal educators (https://observer.globe.gov/toolkit)** developed in 2019, as well as new and adapted resources - to enable their online outreach to their audiences.

FIELD TEST WITH FAMILIES AND INFORMAL EDUCATION PARTNERS

Photo Credit: Laura Robinson

During summer 2020, 14 families field tested 4 GLOBE Observer activities, with supplemental resources:

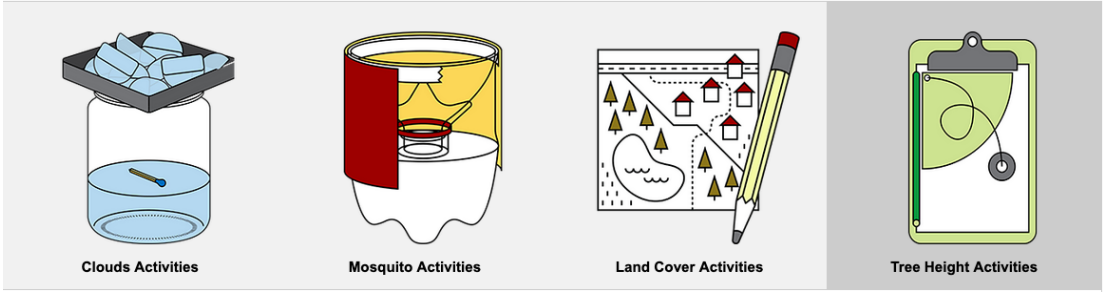
1. Cloud in a Jar
2. Build a Mosquito Larvae Trap
3. Build a Clinometer
4. Making a Map

Parents responded to questions related to:

- Availability of the materials at home,
- Enjoyability,
- Questions that were sparked,
- If the activity worked as expected,
- If there were any difficulties, modifications or substitutions that were needed,
- Usefulness of the supplemental resources, and
- Suggestions for improvement.

Feedback from these families and library partners that offer STEM programs for families also reinforced the overall approach and informed recommendations for refining and strengthening the activities.

START WITH SIMPLE AND FUN ACTIVITIES



Our objective is to begin building curiosity and exploration with activities using simple materials that typically can be found at home, and not require going outdoors.

- Parents noted these activities were easy for them to replicate at home and made science concrete for their children.
- The also noted than even in cases where they didn't have the exact materials, they were able to find substitutions that worked.
- Informal educators noted the activities were flexible and could be easily incorporated into a variety of programs and audiences.

Download the following activities and supporting resources at: **Our Favorite GLOBE Observer Family Activities (https://observer.globe.gov/family-science)**

Cloud in a Jar

Materials

- ☐ clear glass jar
- ☐ metal tray or plate
- ☐ ice cubes
- ☐ hot water
- ☐ matches (optional)

Creating Your Cloud

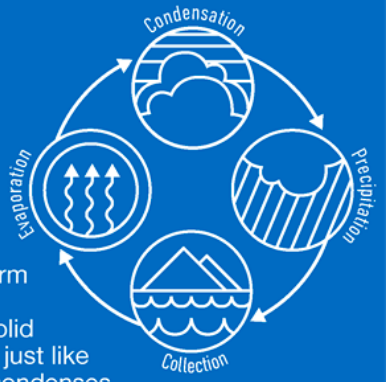
1. Fill the jar with about 2 inches of hot water and stir.
2. Light a match, blow it out, and drop it into the jar (optional).
3. Once the smoke clears, place the ice tray on top.
4. Watch a cloud form!

What's Happening?

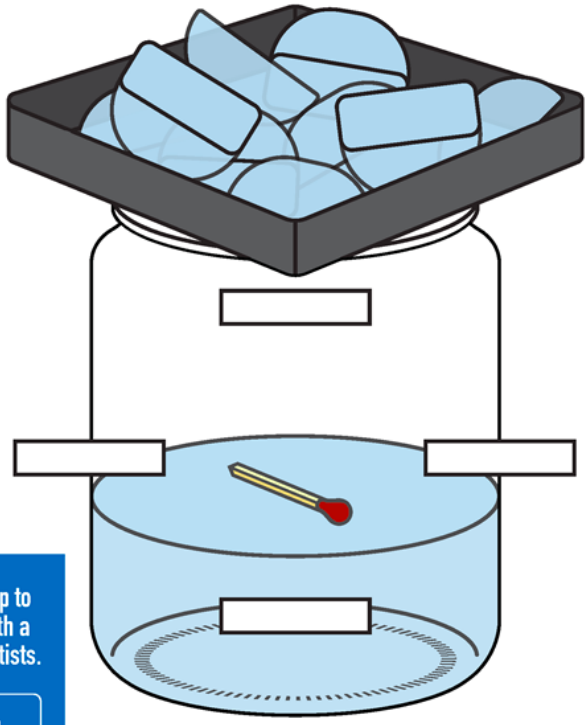
In this activity, stirring the water increases the amount of water vapor in the jar. As the water vapor rises towards the cool tray, it condenses onto particles in the air. If you used a match, this effect will be even more dramatic because of the smoke particles.

Sketch what you see happening inside of the jar and label the parts of the water cycle.

How do clouds form?



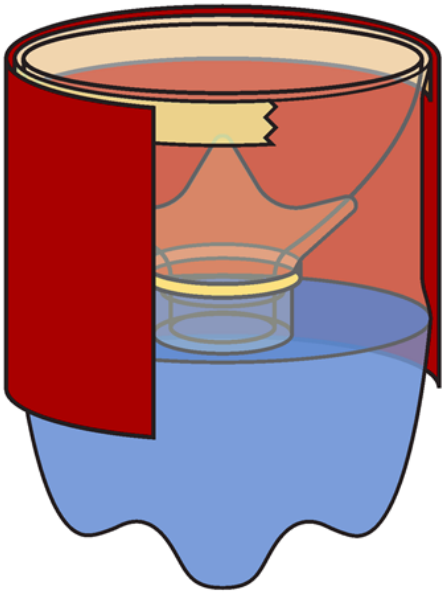
Our atmosphere is full of water vapor, but we can't see it. So why can we see clouds? Clouds form when water vapor condenses onto solid particles in the air, just like how water vapor condenses onto the side of a cool glass on a warm day.



Build a Mosquito Larvae Trap

Materials

- ☐ clear plastic bottle
- ☐ netting
- ☐ rubber band
- ☐ tape
- ☐ scissors or craft knife
- ☐ dark paper or fabric
- ☐ water



What does the trap do?

Container-breeding mosquitoes lay their eggs in standing water that collects in puddles, buckets, and even trash! This trap tricks mosquitoes into laying their eggs in a container that the larvae can't escape. You can then report the larvae using the GLOBE Observer app.

Remember, this trap isn't for trapping adults. You should still protect yourself from bites by wearing long sleeves and applying effective insect repellant.

Building the Trap

1. Cut the top off of the bottle using scissors or a craft knife.
2. Use the rubber band to attach the netting to the mouth of the bottle.
3. Invert the top and tape it to the bottom.
4. Fill the trap with water until the water is right below the netting.
5. Wrap with dark paper or fabric.

Using the Trap

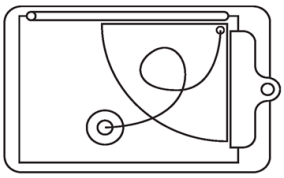
1. Put the trap in a protected place outside.
2. Check the trap every few days.
3. If there are adult mosquitoes in the trap, shake gently to drown them.
4. Share your observations using the GLOBE Observer app. Select OVITRAP as the habitat type.

observer.globe.gov

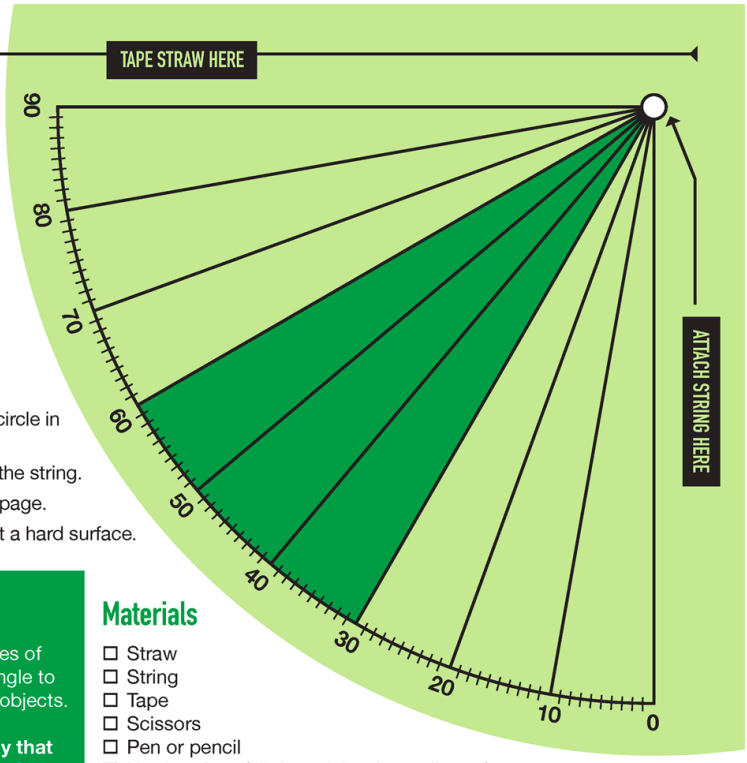
Download the GLOBE Observer app to share your observations with a global community of citizen scientists.

Download on the App Store | GET IT ON Google Play

Build a Clinometer



1. Pull a knotted string through the circle in the upper right corner.
2. Attach a weight to the bottom of the string.
3. Tape your straw to the top of the page.
4. Clip to a clipboard or hold against a hard surface.



What is a clinometer?

A clinometer is tool for measuring angles of slope or elevation. You will need this angle to calculate the height of trees and other objects.

Measuring tree height is just one way that scientists study the health of forests. Give it a try using this paper clinometer.

Materials

- ☐ Straw
- ☐ String
- ☐ Tape
- ☐ Scissors
- ☐ Pen or pencil
- ☐ Hard surface (clipboard, book, cardboard)
- ☐ Weight (beads, paper clip, metal washer)

observer.globe.gov

Calculate the Height of a Tree

1. Find a tree on level ground that is at least 15 ft (5 m) tall. Stand where you can clearly see the base and the top.
2. Look at the top of the tree through the drinking straw.
3. Use the clinometer to measure the angle at which you are looking at the tree. It helps to have a friend tell you where the string crosses the arc.
4. Measure the distance to the tree using a tape measure or your pace length.

You can also measure trees with the GLOBE Observer app – no tape measure or clinometer required!

Download on the App Store GET IT ON Google Play

What is a tangent?

The tangent (tan) of an angle is a trigonomic function used to calculate the legs of a right triangle. When measuring a straight tree on level ground, the tree trunk and ground form a right triangle.

If your calculator doesn't have the tan function, find a tree that can be viewed from a 45 degree angle when looking at the top. The tangent of 45 is 1, so the height of the tree above your eye height is equal to the distance from the tree.

Which measurement system do you prefer?

Imperial (Feet and Inches) *or* Metric (Meters and Centimeters)

Circle or highlight the units you plan on using. Remember, you can use either system, but it's important to only use one.

Your Height (in. / cm) − 4 in. = / − 10 cm = Eye Height (in. / cm)

This is an estimate. You can also measure your eye height with the tape measure.

Distance from Tree (in. / cm) x tan Clinometer Angle = Vertical Leg (in. / cm)

Vertical Leg (in. / cm) + Eye Height (in. / cm) = Tree Height (in. / cm)

Tree Height (in. / cm) ÷ 12 = / ÷ 10 = Tree Height (ft / m)

You can use the same process to measure anything taller than you on level ground.

Making a Map

Getting Started

When you think of a map, you might think of different elements, like a grid, a compass, a scale, a key, symbols, and labels that show how different things relate to each other. However, the most important part of a map is its purpose. The purpose of a map drives choices such as the scale and what information to include.

Use this page to plan your map and then draw it on the back.

Purpose

How will your map be used?

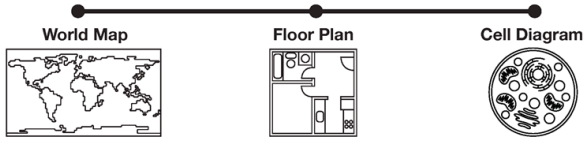
It might help to start with one of these verbs:

find navigate study document teach

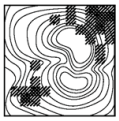
Extent and Scale

Map extent is the area that your map shows, and that area must be scaled to the size of your map.

What will the extent of your map be? _____



Scale describes the size that real-life objects appear on a map. It is often written as a ratio, but can also be descriptive—like *one square equals a city block*.



Map Data

Map data is the information that your map includes, like points of interest, boundaries, physical features, and statistics.

What information will you include in your map?

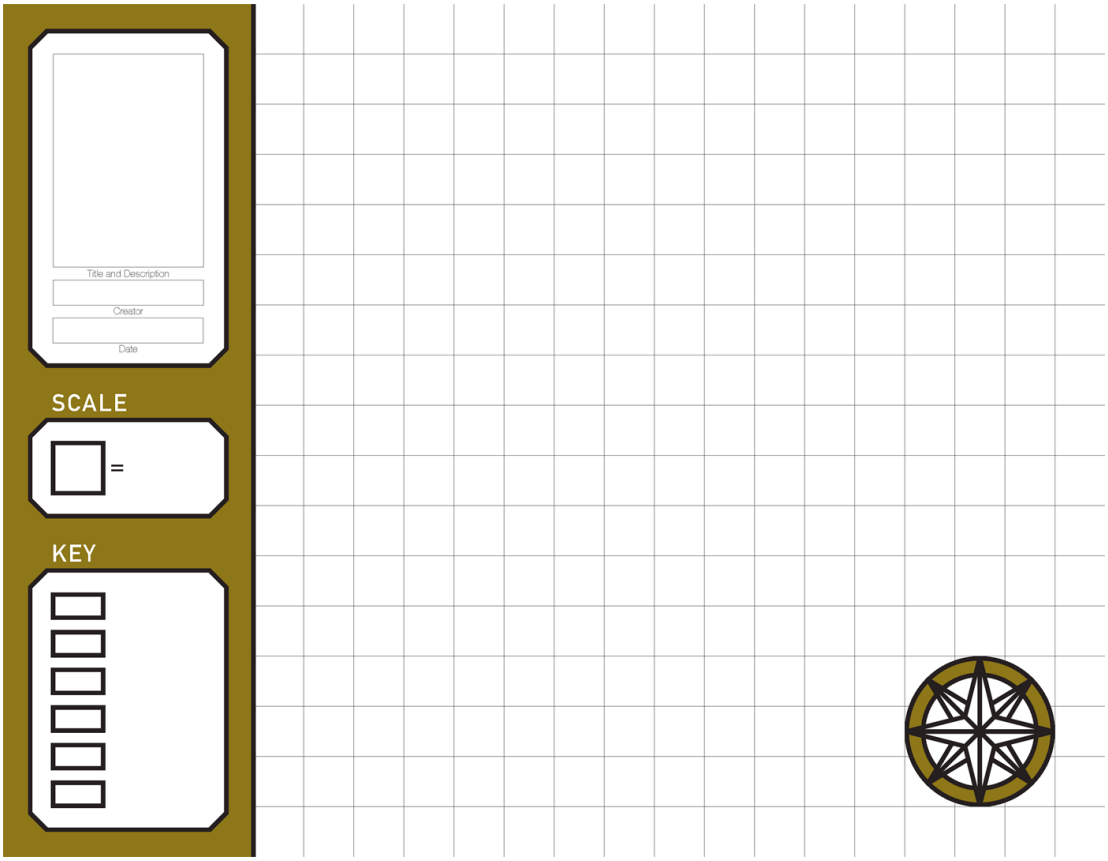
_____

_____

_____

Want to do more? Place a piece of clear plastic over your map and assign a color to each type of surface. Now try coloring the squares of the grid with just one color each. These squares are similar to the pixels that make up satellite imagery.

observer.globe.gov



PROVIDE SUPPORT FOR INFORMAL EDUCATORS, PARENTS AND CAREGIVERS

[VIDEO] https://www.youtube.com/embed/Ky6KhGLw1AU?rel=0&fs=1&modestbranding=1&rel=0&showinfo=0

Each activity is presented in a consistet format and includes supporting information, including:

- Short video demonstrations
- Adaptations and suggestions for different ages
- Questions to prompt discussion
- Information about how these citizen science observations connects to NASA science
- Resources for going further

The video at the top shows a demonstration of how to build and use a paper clinometer. Following are additional video demonstrations for Builda Mosquito Larvae Trap, Cloud in a Jar, and Making a Map.

[VIDEO] https://www.youtube.com/embed/bPBomfbLpWY?rel=0&fs=1&modestbranding=1&rel=0&showinfo=0

[VIDEO] https://www.youtube.com/embed/s33puplDwf0?rel=0&fs=1&modestbranding=1&rel=0&showinfo=0

[VIDEO] https://www.youtube.com/embed/4a-FIRYzmMA?rel=0&fs=1&modestbranding=1&rel=0&showinfo=0

OFFER MULTIPLE AND CONNECTED OPPORTUNITIES AND RESOURCES FOR ENGAGEMENT

Building engagement and interest in science is a process that goes beyond a single activity.

Insights from research suggest that “building and supporting ecosystems with multiple, varied, and connected opportunities for exposure and engagement are key for STEM interest to take hold” (Bell, 2019).

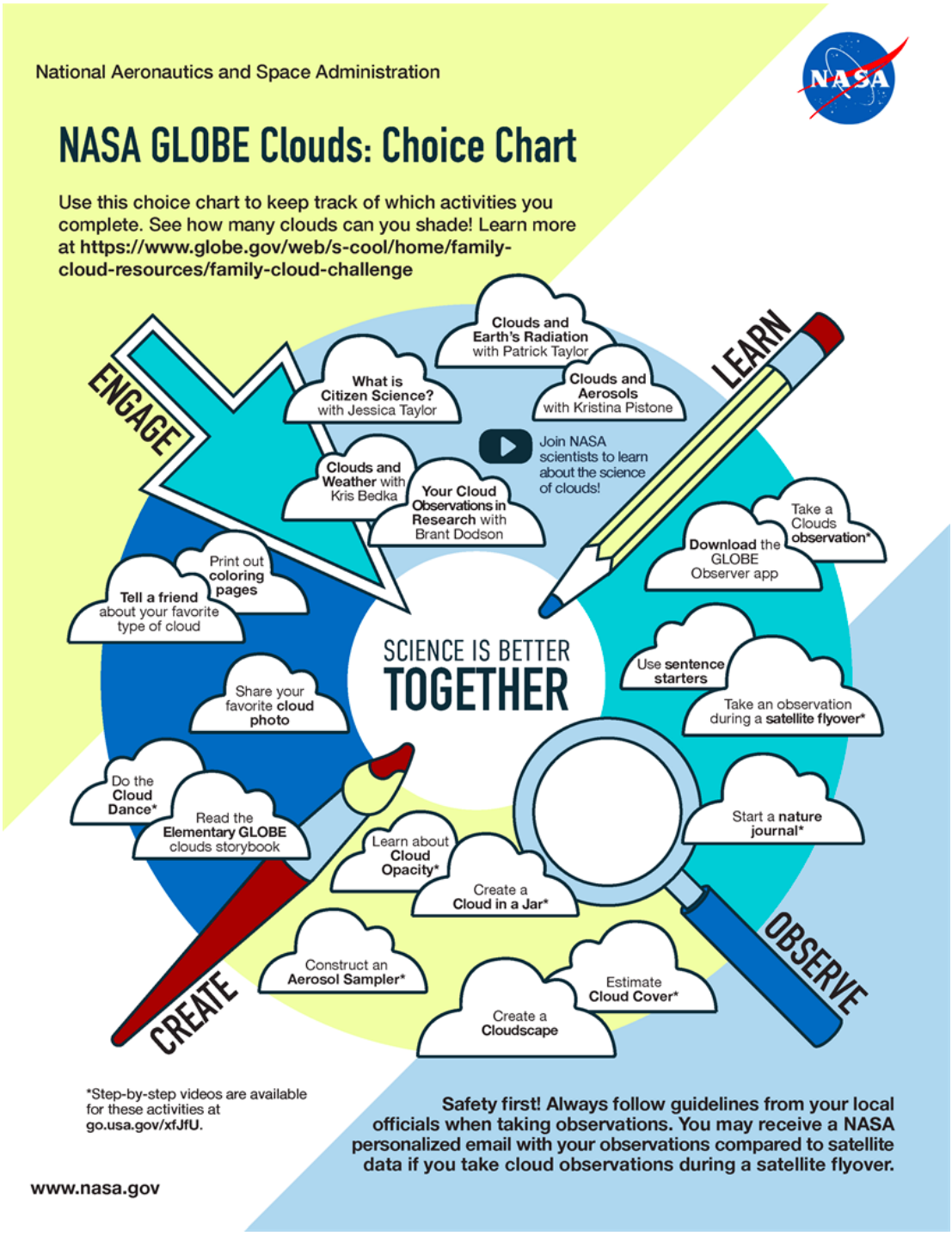
Connections are provided to multiple means for families and learners to engage, increase interest, and—if they wish—contribute their data through NASA's GLOBE Observer free mobile app.

Following are examples of two collections of connected resources: ***GLOBE Clouds Family Guide*** and ***Mission Mosquito Science Notebook***.

In development is a GLOBE Trees Family Guide, which is planned for release in spring 2021.

GLOBE Clouds Family Guide

Go to the Clouds Family Guide (https://www.globe.gov/web/s-cool/home/family-cloud-resources)



The family guide includes several hands-on activities that promote science and art; science videos provide "on-demand" access to NASA subject matter experts. See examples below.

[VIDEO] https://www.youtube.com/embed/FNmjBD52DC4?rel=0&fs=1&modestbranding=1&rel=0&showinfo=0
Above: Marilé Colón Robles and Tina Rogerson (NASA LaRC), and Heather Mortimer (NASA GSFC) share why satellite matches to GLOBE cloud observations are important and how to read a satellite match table.

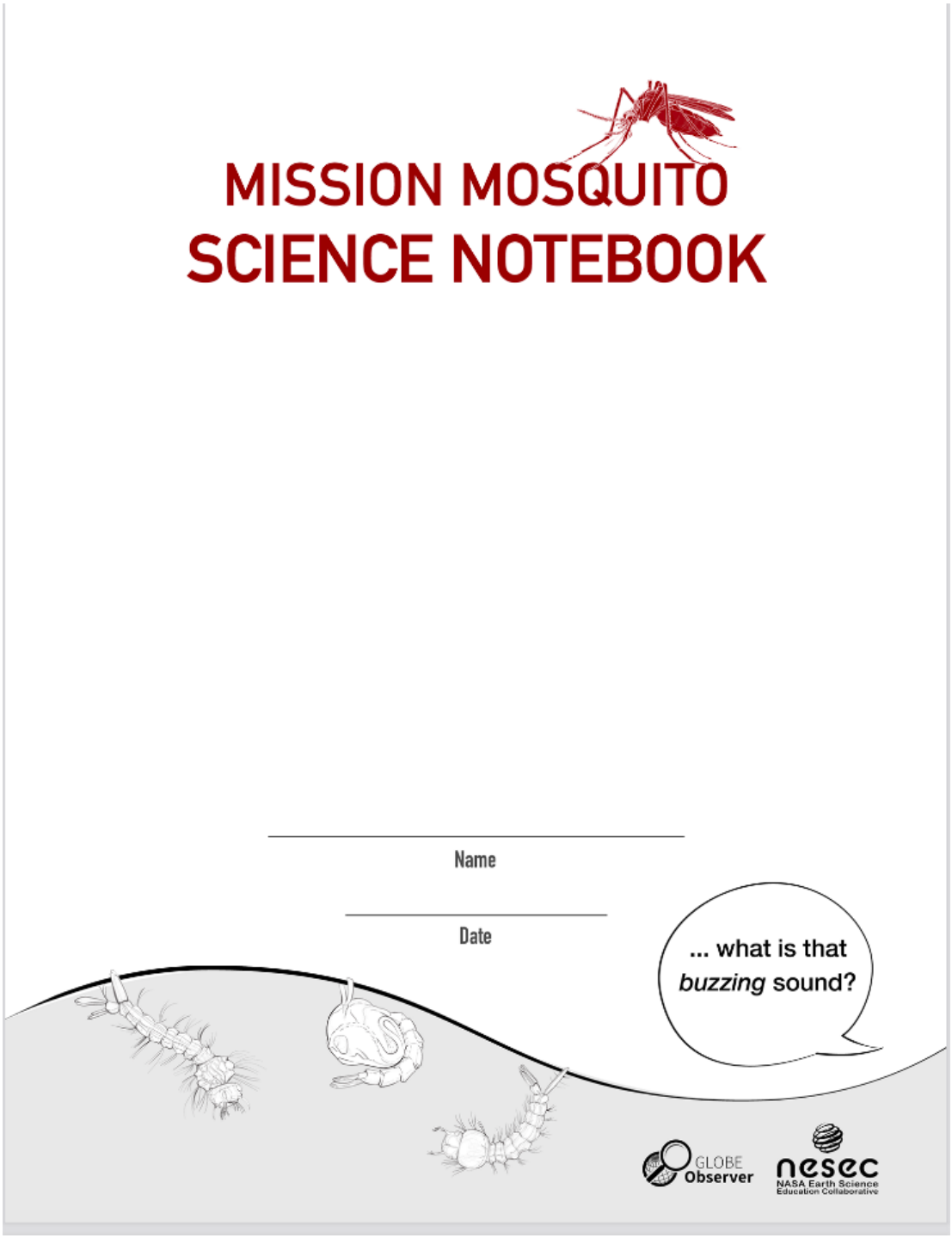
[VIDEO] https://www.youtube.com/embed/epV69N-CNfU?rel=0&fs=1&modestbranding=1&rel=0&showinfo=0
Above: J. Brant Dodson (Atmospheric Scientist, NASA Langley Research Center) explains the power of citizen science observations and how GLOBE and GLOBE Observer cloud observations are being used in his research.

Mission Mosquito Science Notebook

Go to Mission Mosquito Science Notebook (https://strategies.org/products/mission-mosquito-science-notebook)

The ***Mission Mosuito Science Notebook*** is designed to reflect basic aspects of a science notebook while also incorporating information and activities that build relevant background knowledge, confidence in independent learning and research, and engagement in science, particularly citizen science through GLOBE Observer Mosquito Habitat Mapper.

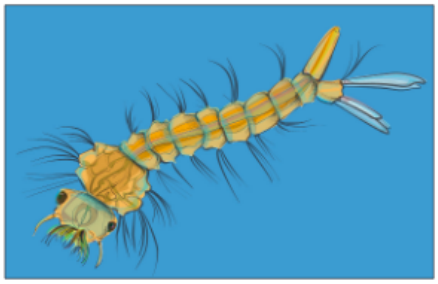
The notebook inlcudes a *Companion Guide for Parents and Caregivers*.


MISSION MOSQUITO
SCIENCE NOTEBOOK
Name
Date
... what is that *buzzing* sound?
GLOBE Observer
nesec
NASA Earth Science Education Collaborative

Make some scientific observations

After a few days, the eggs hatch into larvae - the second stage. You have already seen that stage in the first picture in this notebook (**Page 2**). Depending on the species and air/water temperatures, the larvae will soon (within days) turn into pupae, the third stage.

Below is a drawing of a larva (second stage); on the right is a drawing of a pupa (third stage).



Larva

Pupa

List two ways the larva and pupa look alike	List two ways the larva and pupa look different
1.	1.
2.	2.

A larva needs food to eat and air to breathe. A larva has a mouth; it eats microorganisms that live in the water around it. Most species, or kinds, of mosquitoes have a special tube called a siphon located at the other end of its wormlike body. The siphon looks like a straw; it must be at the surface of the water for the larva to get air.

VOCABULARY ALERT

Siphon: *The siphon is a breathing tube. Because mosquito larvae spend their time underwater, the siphon breaks the surface of the water and allows them to breathe air.*

Trumpet: *The breathing tube used by the pupa. They occur in pairs and are found near the head.*

Photo courtesy Otrell Edwards, Esq.

LEVERAGE COMMUNITY PARTNERSHIPS: EXAMPLES FROM LOS ANGELES PUBLIC LIBRARY

Los Angeles Public Library (LAPL) is a GLOBE Partner, and a key collaborator with the NESEC project. Following are examples from the LAPL Neighborhood Science (NeiSci) and what citizen science programming looked before COVID-19 and adaptations to continue to engage the community virtually.

LOS ANGELES PUBLIC LIBRARY

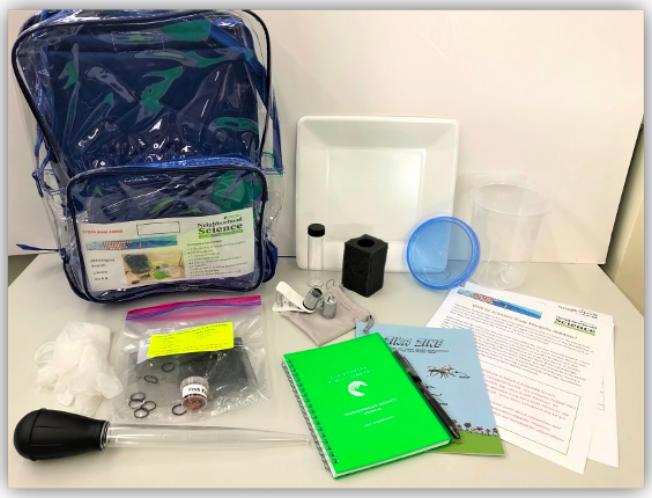
Neighborhood Science

Investigate • Share • Transform

Pre-covid programs typically looked like this

LAPL developed circulating kits that patrons could check out to continue citizen science at home. The library has suspended circulating these kits until it is safe to do so.

Top: GLOBE Clouds kit, Bottom: GLOBE Mosquito Habitat Mapper Kit.



Adaptations for Virtual Programs

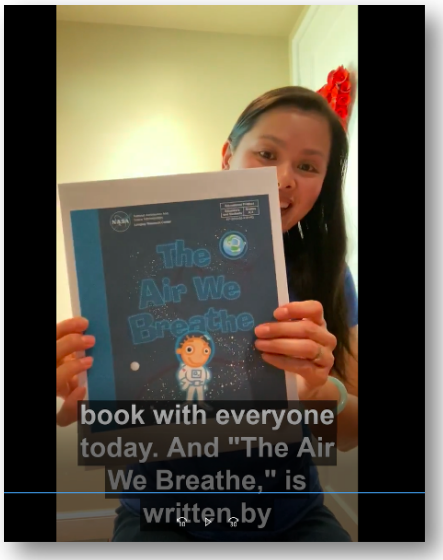
Going virtual enabled the following opportunities:

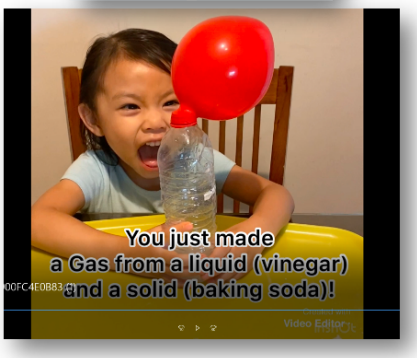
- Broadened audience beyond local communities
- Connected with subject matter experts also beyond the local community
- Increased parent/intergenerational participation
- Enhanced school's curriculum (LAPL works with Los Angeles Unified School District)
- Increased willingness to search for and try out other citizen science projects
- Willingness of patrons to turn their smart device into a convenient and effective scientific device

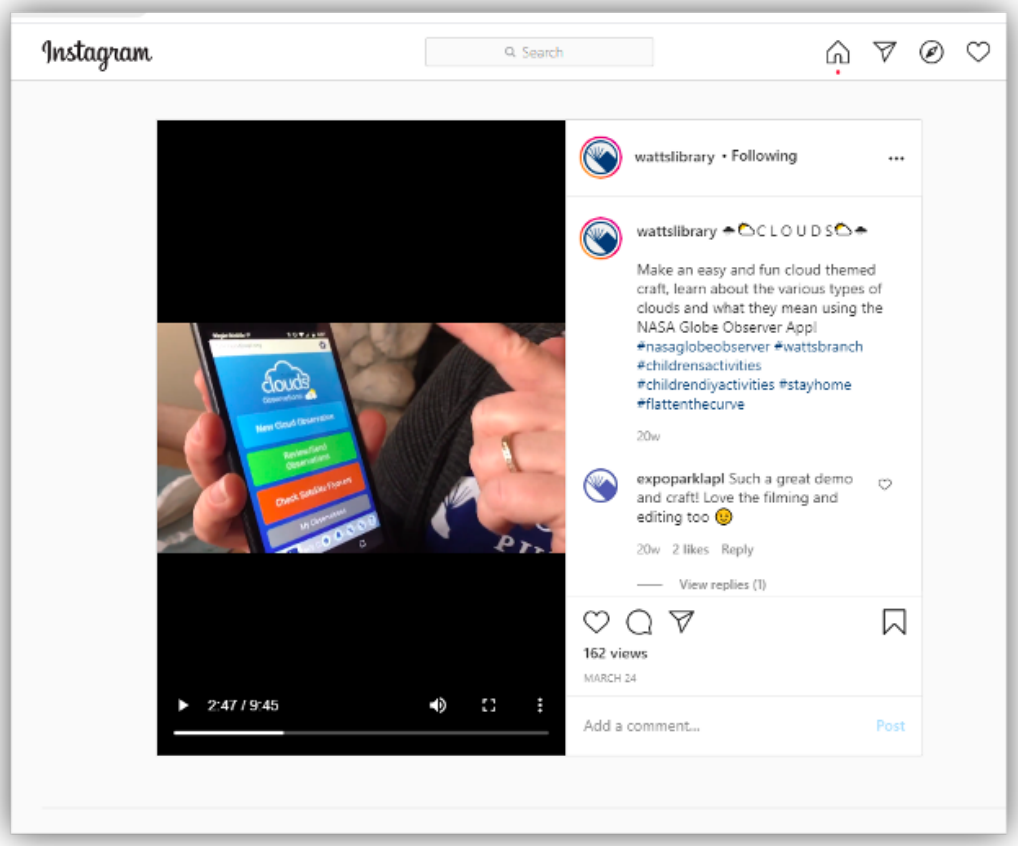
[VIDEO] https://www.youtube.com/embed/s33puplDwf0?rel=0&fs=1&modestbranding=1&rel=0&showinfo=0

Above: The North Hollywood Branch of the Los Angeles Public Library created a video demonstrating the Cloud in a Jar activity that was posted on the library social media. LAPL also printed copies of the activity, which were distributed in 4,000 created "grab and go" science kits for curbside pickup. Printed materials are particularly important to households with limited access to internet and printers.

Virtual storytime with hands-on activity







LEARN MORE ABOUT THIS PROJECT

This activity is part of the NASA Earth Science Education Collaborative (NESEC).

NESEC is a partnership among four organizations: led by the Institute for Global Environmental Strategies in strong partnership with the Earth Sciences Divisions at three NASA Centers: Goddard Space Flight Center, Langley Research Center, and Jet Propulsion Laboratory. External evaluation is conducted by Oregon State University.

NESEC is supported by the NASA Science Mission Directorate under IGES award No. NNX16AE28A.

The goal is to enable broad participation in authentic NASA Earth STEM experiences for lifelong learners. We do this by creating engaging, meaningful, and authentic STEM experiences and resources that are:

- Based on NASA Earth science
- Tailored to specific audiences' needs
- Supportive of diverse learners throughout their lifetimes
- Delivered broadly through strategic partnerships

Learn more at: **nesec.strategies.org (https://nesec.strategies.org/)**

ABSTRACT

The NASA Earth Science Education Collaborative (NESEC) project has the goal to enable broad participation in authentic NASA Earth Science STEM experiences for lifelong learners. These experiences include citizen science through GLOBE Observer (part of the international GLOBE Program), student investigations and research projects, field campaigns, and internships, including both virtual and in-person participation by participants. NESEC works with informal science education providers who are strategic partners, including public libraries such as Los Angeles Public Library to develop, deliver, and strengthen these experiences for learners. The 2020 pandemic required the project to adapt and emphasize ways to participate that did not require going outdoors and could be undertaken from home and create resources to support family science. This presentation will discuss results of field testing science activities and resources with families and emerging evidence of best practices for partnerships and resources to support remote learning and science at home.

REFERENCES

Bell, J. et al (2019). Defining and Measuring STEM Identity and Interest in STEM Learning, in Connected Science Learning, Issue 12. Retrieved Oct. 5, 2020 from: http://csl.nsta.org/2019/11/stem-identity-and-interest/

Promising Practices for Engaging Families in STEM: Quick tips from experts who listen, learn and welcome families in STEM. Retrieved Oct. 5, 2020 from https://stemnext.org/promising-practices/

NASA Earth Science Education Collaborative (NESEC) - https://nesec.strategies.org/

Our Favorite GLOBE Observer Activities for Families - https://observer.globe.gov/family-science

The GLOBE Program - https://www.globe.gov

GLOBE Observer - https://observer.globe.gov/