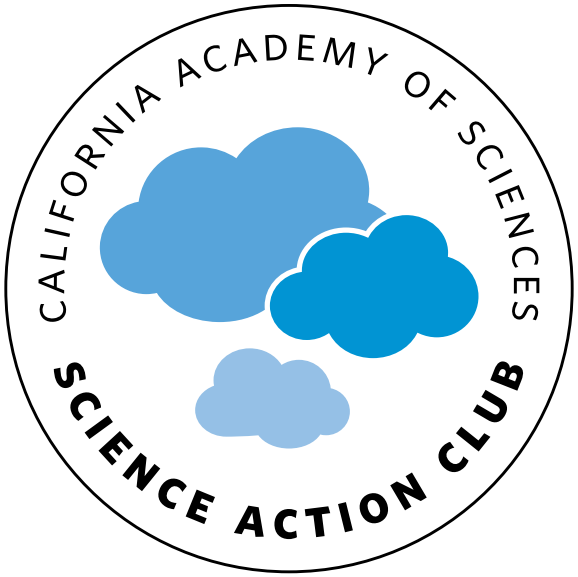



Activity Leader Guidebook

# Cloud Quest

CALIFORNIA ACADEMY OF SCIENCES

SCIENCE

ACTION CLUB

*This guidebook belongs to: _____*
*GLOBE Observer username: _____*
*GLOBE Observer password:* **Jellyfish123**

*Fall 2017*

# CONTENTS

# WHAT IS SCIENCE ACTION CLUB?

Science Action Club (SAC) is a nationwide STEM program for middle school youth in out-of-school time. We provide afterschool staff with in-depth training, teaching kits, and best practices for informal STEM education. Our goal is to get middle school youth outside, connected to nature, and contributing to citizen science research.

## What is Citizen Science?

Citizen science is a global movement in which scientists and the general public collaborate to answer some of the most pressing questions about our planet. Many big scientific questions require more data than one single scientist, or even a team of scientists, could collect. In SAC, youth will collaborate with NASA and contribute to the GLOBE database of observations. Through citizen science, anyone can learn the process of science and make valuable contributions.

## What is GLOBE Observer?

GLOBE Observer is an international network of scientists and students working together to study how clouds affect Earth's environment. By observing the sky from the ground and reporting what you see, citizen scientists like you can help NASA researchers track changes in sky and cloud conditions to support Earth science research. Clouds affect weather and climate by controlling the flow of energy through Earth's atmosphere. Since clouds can change rapidly, scientists need frequent observations from citizen scientists to better understand cloud cover over Earth's surface.

## School-day Standards

The activities in this guidebook support the Next Generation Science Standards (NGSS).

## No Experience Necessary!

Just like citizen science, this guidebook is designed to be accessible to everyone, even those with little-to-no science background. Each activity plan includes step-by-step instructions and techniques for engaging youth in fun science exploration. The focus is on curiosity, investigation, and community. Through these experiences, youth and activity leaders learn and discover together.

## Educator Portal

Visit sacportal.calacademy.org to access the *Clouds* online training and other helpful resources.

A NASA CloudSat satellite

# SAC TERMS AND DEFINITIONS

| Term | Definition | Notes and Examples |
|---|---|---|
| activity leader (AL) | Person responsible for leading SAC activities with youth | SAC activity leaders have many titles. Some are afterschool instructors, camp counselors, school teachers, and librarians. Throughout SAC materials, the term activity leader refers to anyone who leads Science Action Club with youth. |
| trainer | Person responsible for training and supporting SAC activity leaders | Your trainer is your main contact for support. Keep your trainer informed of any changes that come up or questions you may have about Science Action Club. |
| agency | Name of the organization that oversees your program | The agency might be an afterschool provider, a library system, a school district, parks and recreation, or any other organization through which Science Action Club is offered. |
| location | Name of the specific program or location that offers SAC | Many agencies have multiple locations. The Oakland Public Library system may offer SAC at several branches and the local YMCA may support several schools. The club location is the specific school, library, or site where SAC meets. |
| club | Group of youth participating in SAC | Sometimes there is more than one Science Action Club offered at a single location. For example, the Berkeley YMCA at Roosevelt Middle School may run one club with grades 5-6 and another with grades 7-8. In this case, the agency is Berkeley YMCA, the location is Roosevelt Middle School, and there are two clubs at that location. |
| online training | Required training accessible through the SAC Educator Portal | This interactive training covers all 12 SAC activities, important science concepts, and teaching strategies for the informal STEM learning environment. |
| activity leader training (ALT) | Required in-person training led by a SAC trainer | This workshop provides hands-on practice for leading the *Cloud Quest* curriculum with youth. |

# TIMELINE OF EXPECTATIONS

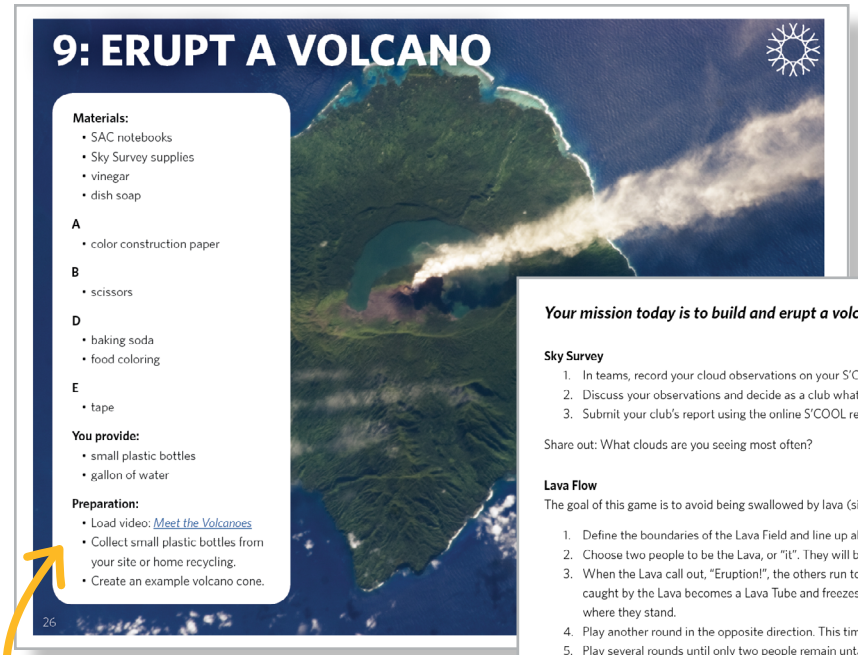
| Expectation | Description | Due Date |
|---|---|---|
| Complete the online training | This required online training will help you succeed as an activity leader. Use the SAC guidebook to follow along. You must complete this training in order to be eligible to receive the SAC activity guidebook and kit.<br><br>To learn how to navigate the SAC Educator Portal, see the Guide to the SAC Educator Portal (written guide or video). | Before the ALT |
| Attend the ALT | Practice leading activities, test out the kit materials, and trade teaching tips with other SAC activity leaders at this required in-person workshop. | Dates vary |
| Identify an outdoor location | You are responsible for finding an outdoor space where youth can look at clouds. Ideally, the space should not be more than a five-minute walk from where your club meets. Ask your program supervisor for support, if needed. | Two weeks after the ALT |
| Secure technology equipment | In order to participate in citizen science, your club will need at least one mobile device and a working internet connection. A projector and speakers are also highly recommended. Check with your supervisor to make sure you have access to technology during Science Action Club. | Two weeks after the ALT |
| Recruit youth | SAC is more fun when the club is full. You are responsible for recruiting 15-20 youth and maintaining strong attendance. Use the *Youth Program Flyer* template to help with publicity. | Two weeks after the ALT |
| Connect with families | Once youth are enrolled, send home a letter introducing Science Action Club. Use the *SAC Letter to Families* template. Download and edit the template to fit your audience and include your own details. | Two weeks after the ALT |
| Lead Science Action Club activities | There are 12 *Cloud Quest* activities. To prepare for each activity in advance:<br>• Read activity instructions in the guidebook.<br>• Gather the materials needed.<br>• Revisit the online training, if necessary. | After your kit arrives<br><br>Complete all activities by __/__/____ |

| Expectation | Description | Due Date |
|---|---|---|
| Submit citizen science observations | Citizen science is an essential part of Science Action Club. Please submit club lists to GLOBE Observer regularly. Your trainer and the SAC Team will periodically check for your club's observations on GLOBE Observer.<br><br>If you need access to your GLOBE Observer account, contact your trainer for the username and password. Never change the username or password of your GLOBE Observer account, as both your trainer and the SAC team need access to your account.<br><br>If you need help navigating GLOBE Observer, check out the How to Do a *Sky Survey* video. | During Activities 5-12 |
| Provide feedback | You are responsible for submitting Attendance and Feedback after each *Cloud Quest* activity.<br><br>You can do this using the hyperlinks or QR codes in the guidebook, or by accessing Activity Leader Resources on the SAC Educator Portal. | After completing each activity |
| Administer the SAC Youth Survey | You are responsible for administering the *SAC Youth Survey* during Activities 9, 10, or 11. Let your trainer know when this is complete.<br><br>All clubs that complete the survey will be entered into a raffle for special prizes. | During Activities 9 - 11<br><br>Completed surveys are due by __/__/____ |
| Host a site visit or complete a phone interview | You may be asked to participate in a SAC site visit or phone interview.<br><br>If you are selected to participate in a site visit, please help arrange the visit with your trainer. Contact your supervisor for help.<br><br>If you are selected to participate in a phone interview, please help arrange the call with your trainer. Contact your supervisor for support. Ensure you have a quiet space to make the call. | As needed |
| Celebrate! | Invite your trainer to stop by your last SAC session and celebrate with your club. Remember to print and sign SAC certificates of success. | |

# ACTIVITY SUMMARIES

| Title | Activity Mission | Materials You Provide |
|---|---|---|
| Activity 1: Get to Know a Cloud | Construct a cloud and compare cloud types. | - |
| Activity 2: Build a Satellite | Design and build a model satellite. | recyclable materials |
| Activity 3: Ground Truthing | Ground truth your surroundings. | printed satellite image of your site |
| Activity 4: A Closer Look at the Sky | Hone your cloud observation skills. | - |
| Activity 5: Connect to NASA | Collect data about clouds to help NASA conduct Earth science research. | - |
| Activity 6: Rocket Science | Build and launch a model rocket. | large bottle of tap water |
| Activity 7: Drain to Rain | Trace a drop of water through the water cycle. | ice cubes, bowls, measuring cup |
| Activity 8: Measure the Wind | Test the wind speed. | - |
| Activity 9: Erupt a Volcano | Create and erupt a volcano. | small plastic bottles, gallon of water |
| Activity 10: Fly a Kite | Build a kite that can fly. | - |
| Activity 11: Green Design | Design an eco-friendly building. | recyclable materials |
| Activity 12: Cloud Conclusions | Summarize the data from your sky surveys. | - |

# HOW TO USE THIS GUIDEBOOK



## 9: ERUPT A VOLCANO

**Materials:**
- SAC notebooks
- Sky Survey supplies
- vinegar
- dish soap

**A**
- color construction paper

**B**
- scissors

**D**
- baking soda
- food coloring

**E**
- tape

**You provide:**
- small plastic bottles
- gallon of water

**Preparation:**
- Load video: *Meet the Volcanoes*
- Collect small plastic bottles from your site or home recycling.
- Create an example volcano cone.

26

Check the activity title page before your club meets for a list of all materials and preparation.

"A" indicates materials found in bag A of the kit.

Some activities require additional materials that you need to provide.

Share each activity's mission statement with youth.

***Your mission today is to build and erupt a volcano.***

**Sky Survey** — 20 min. | outside

1. In teams, record your cloud observations on your S'COOL report forms.
2. Discuss your observations and decide as a club what to report online.
3. Submit your club's report using the online S'COOL report. Use a wet paper towel to clean your forms for next time.

Share out: What clouds are you seeing most often?

**Lava Flow** — 15 min. | outside

The goal of this game is to avoid being swallowed by lava (similar to Sharks and Minnows).

1. Define the boundaries of the Lava Field and line up along one edge.
2. Choose two people to be the Lava, or "it". They will begin in the center of the field and try to tag the others.
3. When the Lava call out, "Eruption!", the others run to the other side of the field and try to avoid being tagged. Anyone caught by the Lava becomes a Lava Tube and freezes in place. Lava Tubes cannot move, but can reach out and tag from where they stand.
4. Play another round in the opposite direction. This time look out for both Lava and Lava Tubes.
5. Play several rounds until only two people remain untagged. They win!

**Erupt a Volcano**

What comes to mind when you think of volcanoes? Inside the Earth are layers of solid and melted rock. Vol
pressure builds enough to push gases or some of the melted rock, called **magma**, through the Earth's surface. Some volcanoes release long steam plumes that can be seen from space.

Watch the *Meet the Volcanoes* video to see more about how they form and erupt before you build your own volcano.

1. Divide into teams of 3-4. Each group will need a bottle, two sheets of paper, tape, markers, and scis
2. Fold the sheets of paper into cones around the bottle and cut the corners off. The point of th
tightly around the opening of the bottle.

Time estimates and location suggestions are provided for each part of the activity.

Additional tips for activity leaders are included to the right of the dotted line.

2. Hold a grid over a photo and count how many boxes are full of clouds. If a box is partially full, estimate to the nearest percent. Thin clouds do count, but blue sky in between does not.
3. Each box is 5% of the photo. Calculate cloud cover by multiplying the number of boxes you counted by five.
4. Spread out the *Cloud Cover* categories (Clear, Isolated, Scattered, etc.) and sort all of the photos into the correct categories. When you think you are done, step back and shout, "Done!"
5. If you misidentified cards, rearrange them and explain your thinking to your teammates. If you got all of your images right, compare estimates with another group.

- **Percentage can also be estimated by dividing the number of boxes counted by the total number of boxes.**
- **When a group shouts, "Done!", check their answers using the diagram on the next page. If they have images in the wrong categories, tell them how many they need to change, but not which ones they need to change.**

Share out: What made it easier or more challenging to determine the cloud coverage? Were some types of clouds easier to categorize than others? If so, why?

10 min. | outside

**Sky Color**

In addition to making observations about clouds, it's also important to look at what is behind them.

1. Estimate what the sky color is by using the *Sky Color* strips (one per pair). Hold the strips up next to the sky and try to decide which color matches best. Hint: squinting can make it easier.
2. Collect the *Sky Color* strips for use again later. You can record today's observations in your notebooks.

**Explore more:** Why Do Clouds Stay Up?

**Explore more:** Watch Why Do Clouds Stay Up? (6 min.) to learn more about how clouds float above Earth's surface.

**Call to action:** Challenge your friends and family to figure out cloud coverage and altitude. Notice if the clouds look the same or different at home. Remember to add these notes to your cloud journal.

12 Activity 4: A Closer Look at the Sky

This icon indicates a media link. Scan the QR code to access videos and other digital content. In the digital guidebook, you can also click the hyperlink.

# KIT MATERIALS

## A

| | |
|---|---|
| 1 | *Altitude Axis* |
| 10 | *Build an Anemometer* handouts |
| 4 sets | *Cloud Cover Categories* cards |
| 10 | *Cloud Cover* grids |
| 4 sets | *Cloud Cover* photos |
| 2 sets | *Cloud Identification* cards |
| 1 | *Cloud Quiz Show* scorecard |
| 2 packs | color construction paper |
| 5 sets | *Design a Satellite* cards |
| 5 | *Design a Satellite* handouts |
| 20 | *Drain to Rain* maps |
| 1 set | *Drain to Rain* signs |
| 1 set | *Drain to Rain* stations |
| 4 sets | *Fly a Kite* instructions |
| 10 sheets | gray construction paper |
| 10 sheets | gray tissue paper |
| 1 set | *Green Building Challenge* cards |
| 20 sheets | kite paper |
| 20 | SAC certificates |
| 20 | SAC stickers |
| 1 set | *SatCom Relay* images |
| 10 | *Sky Color* strips |
| 5 | *Sky Survey* charts |
| 50 | *Sky Survey* stickers |
| 20 | *Which Cloud Am I?* grids |
| 10 sheets | white construction paper |
| 10 sheets | white tissue paper |

## B

| | |
|---|---|
| 5 | graduated cylinders |
| 4 | hole punchers |
| 2 packs | markers |
| 5 | scissors |

## C

| | |
|---|---|
| 1 | blindfold |
| 100 | cotton balls |
| 40 | effervescent tablets |
| 20 sheets | foil |
| 5 | glue sticks |
| 40 | pipe cleaners |
| 100 | popsicle sticks |
| 40 | skewers |
| 50 | straws (narrow) |
| 10 | straws (wide) |
| 2 spools | string |
| 10 | tape |
| 11 | t-pins |

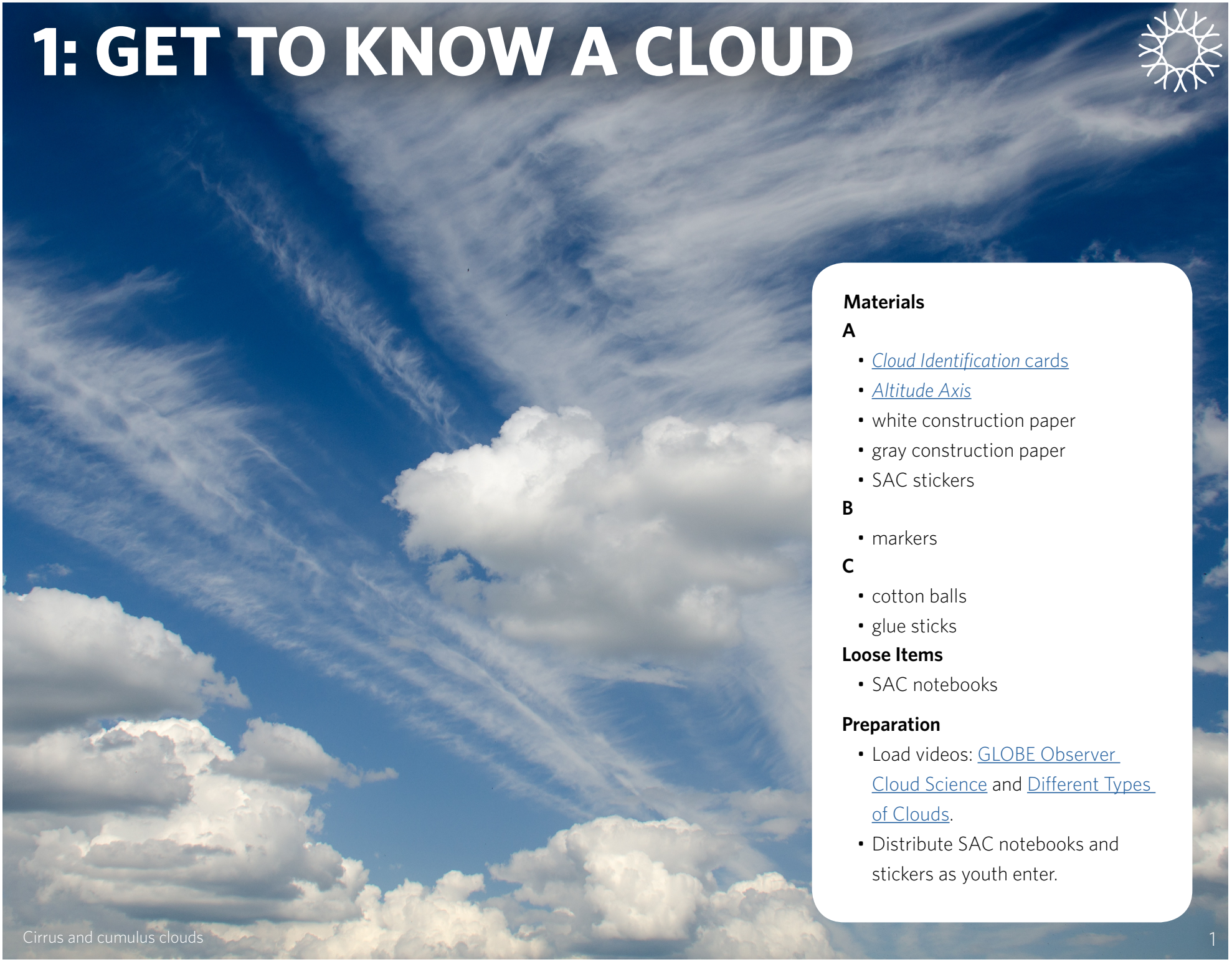
## D

| | |
|---|---|
| 1 bag | baking soda |
| 55 | cups |
| 1 box | food coloring |
| 10 | plastic vials |

## Loose Items

| | |
|---|---|
| 20 | SAC notebooks |
| 1 | *Clouds* guidebook |
| 20 | *Clouds* buttons |
| 1 bottle | dish soap |
| 1 bottle | vinegar |

# 1: GET TO KNOW A CLOUD



**Materials**

**A**

- *Cloud Identification* cards
- *Altitude Axis*
- white construction paper
- gray construction paper
- SAC stickers

**B**

- markers

**C**

- cotton balls
- glue sticks

**Loose Items**

- SAC notebooks

**Preparation**

- Load videos: GLOBE Observer Cloud Science and Different Types of Clouds.
- Distribute SAC notebooks and stickers as youth enter.

Cirrus and cumulus clouds

## *Your mission today is to construct a cloud.*

15 min. | inside

**Welcome to Science Action Club!**

SAC is a partnership between your out-of-school time program and the California Academy of Sciences in San Francisco, California. There are Science Action Clubs all across the United States.

GLOBE Observer Cloud Science

NASA needs you! Starting today, you will build the scientific skills you need to report cloud observations to NASA, helping professional scientists learn how clouds affect climate on Earth. Over the coming weeks, you will become expert citizen scientists. Through games and experiments, you will investigate the sky and learn to ground truth satellite images. Each day, you will get a new mission to help focus your adventure. Your mission today is to design and build a model cloud. To get started:

- Watch the GLOBE Observer Cloud Science (3 min.) to learn more about your mission as a NASA citizen scientist.
- Create club agreements and expectations and write them on the board. Explain and practice an attention-getting signal.

15 min. | inside or outside

**Eye of the Storm**

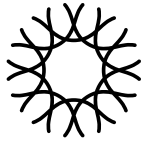
The goal of this game is to make a storm of sounds and pay attention to small changes in the beat. Like scientists, all players have to closely observe what is going on.

1. Form a circle with the group. Choose one person who will be the Guesser. The Guesser either steps outside the room or is blindfolded.
2. Choose another person to be the Motion Leader. Make sure the Guesser doesn't know who the Motion Leader is.
3. Have everyone around the circle start with clapping. Place the Guesser at the middle of the circle, or eye of the storm. If the Guesser was blindfolded, take the blindfold off.
4. The Motion Leader's job is to start new motions (snapping, tapping the ground, stomping, etc.) for the group to copy without the Guesser noticing; the Guesser's goal is to identify the Motion Leader in three guesses or less.
5. If the Motion Leader is caught, he or she becomes the next Guesser. If not, he or she can choose the next Guesser. Play for ten minutes.

30 min. | inside

**Construct a Cloud**

What is a cloud? **Clouds** are made up of tiny water droplets and small particles floating in the air, such as dust and sea salt. As air cools, water vapor (water in the gas state) condenses into liquid water droplets that grab onto the floating particles. When large amounts of these droplets join together, they form a visible cloud. Depending on factors like temperature, altitude, and moisture, different kinds of clouds can form.



Watch Why are There Different Types of Clouds? (2 min.) to learn more about the clouds you see in the sky.

Why are There Different Types of Clouds?

Share out: What kinds of clouds have you seen in different weather conditions?

You are going to become cloud experts to help NASA scientists:

1. Break into pairs and distribute one *Cloud Identification* card to each pair.
2. Each pair will focus on one type of cloud: work together to read the description of the cloud and describe what your cloud looks like in your own words. You can record your ideas in your notebooks.
3. Create your own version of the cloud on your card using construction paper, cotton balls, glue, and markers.

Hang the *Altitude Axis* on the board or wall. Ask each group to introduce their cloud to the club and then hang their cloud at the appropriate height next to the *Altitude Axis*.

Share out: What similarities do you notice about the shapes and colors of clouds at different altitudes?

**Explore more:** Watch The Making of a Cloud video (3 min.) and talk about where else you have noticed condensation.

Explore more: The Making of a Cloud

**Call to action:** Start a cloud journal to sketch the clouds you notice in the sky. Note important details such as the date, time, location, and type of cloud. See how quickly you can become an expert!

**Attendance & feedback:** How many youth attended? How did it go? Record notes here, then click or scan the link to let us know.

How did it go? Let us know!

# 2: BUILD A SATELLITE

**Materials**

**A**

- construction paper
- *SatCom Relay* images
- *Design a Satellite* cards
- *Design a Satellite* handouts

**B**

- markers

**C**

- pipe cleaners
- popsicle sticks
- foil
- tape

**Loose Items**

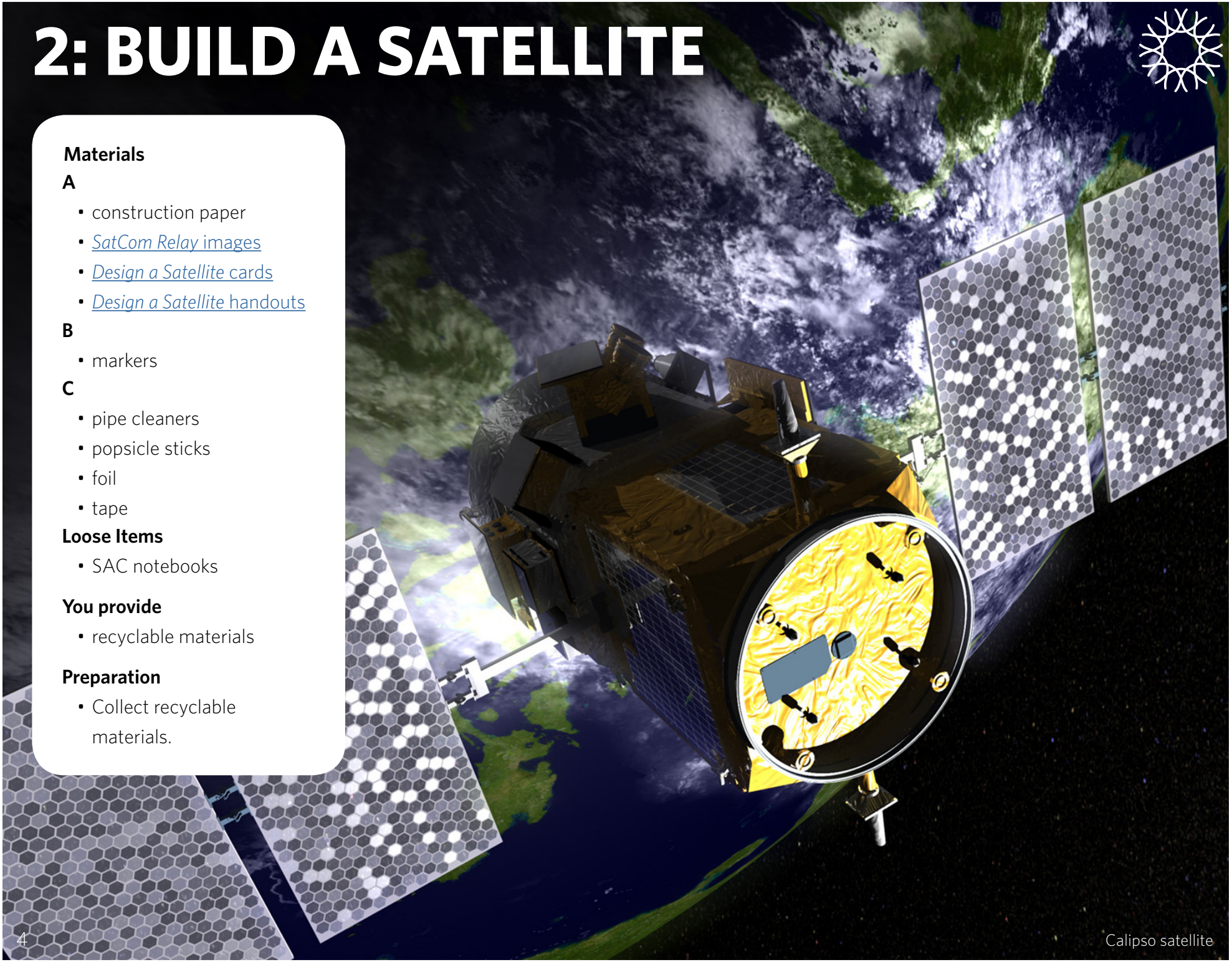
- SAC notebooks

**You provide**

- recyclable materials

**Preparation**

- Collect recyclable materials.



Calipso satellite

## *Your mission today is to design and build a model satellite.*

### Satellite Communication (SatCom) Relay

25 min. | inside or outside

What do you think of when you hear the word satellite? What do satellites do? Share some ideas with a friend.

A **satellite** is anything that orbits another object (for example, the Moon is a satellite of Earth). People build satellites to observe Earth and send signals. You most likely use satellites in some way every day, perhaps through television or a map app on your phone.

When a satellite collects data, like photos of objects from space, that information gets translated several times on its way back to Earth—from a photo to computer code to radio signal, and then the same in reverse.

This game simulates that experience, as teams compete to relay information correctly from a satellite's camera to a computer on Earth. This is not a race. The goal is for the final image to match the original *SatCom Relay* photo most closely. The team with the most accurate image at the end wins.

To begin, create five stations at least 20 steps apart from each other. Then, place the four *SatCom Relay* images face down in Station 1 and place markers and paper in Stations 2, 4, and 5. Only players—not materials—can move between stations.

**Set up summary:**

Station 1: Four *SatCom Relay* images, face down.

Station 2: Paper and markers (one set per team).

Station 3: No materials, but station must be out of earshot.

Station 4: Paper and markers (one set per team).

Station 5: Paper and markers (one set per team).

1. Form teams of four players and assign each player a number (1-4).
2. In Station 1—the satellite's camera—Player 1 must look at the *SatCom Relay* image, memorize it, and travel to Station 2 to write a description of it. Make sure no other players see the original image.
3. In Station 2—the satellite's computer encoder—Player 2 must memorize the written description, travel to Station 3, and repeat the desctiption to Player 3. Make sure only Player 3 hears the description.
4. In Station 3—the radio transponder—Player 3 will listen to the description and travel to Station 4 to record it in writing.
5. In Station 4—the radio receiver—Player 4 will read the written description and travel to Station 5 to draw the final image.
6. Station 5 is the computer on Earth. Compare the final image to the original *SatCom Relay* image.

### Design a Satellite

25 min. | inside

The goal of this activity is to build a model satellite out of a limited set of supplies.

1. Form five or fewer groups and distribute the *Design a Satellite* cards. These are five satellites that collect data

about Earth's atmosphere, land, ocean, and energy: Terra, Aqua, Suomi NPP, Calipso, and CloudSat.

2. Look at the cards and talk with your group: What parts do satellites need in order to be able to stay in space for long periods of time? To gather information? To send that information back to Earth?
3. Pass out the *Design a Satellite* handouts, pipe cleaners, popsicle sticks, foil, and recycled materials. Your challenge is to design and build a model satellite that includes the components listed on the handout and at least one moving part.

10 min. | inside

**Label and Share Your Satellites**

1. Put a piece of paper under your satellite. Draw arrows to label the different components on your satellites and describe what they do.
   - What is each component? Why have you decided to place it where it is? How does it move?
   - How will the satellite's camera and communication device stay pointed toward the Earth as it orbits?
2. Share your satellites with the rest of the club.

**Explore more:** Watch Wanna Launch a Satellite? You Can! (3 min.) to learn how to launch your own satellite into space!

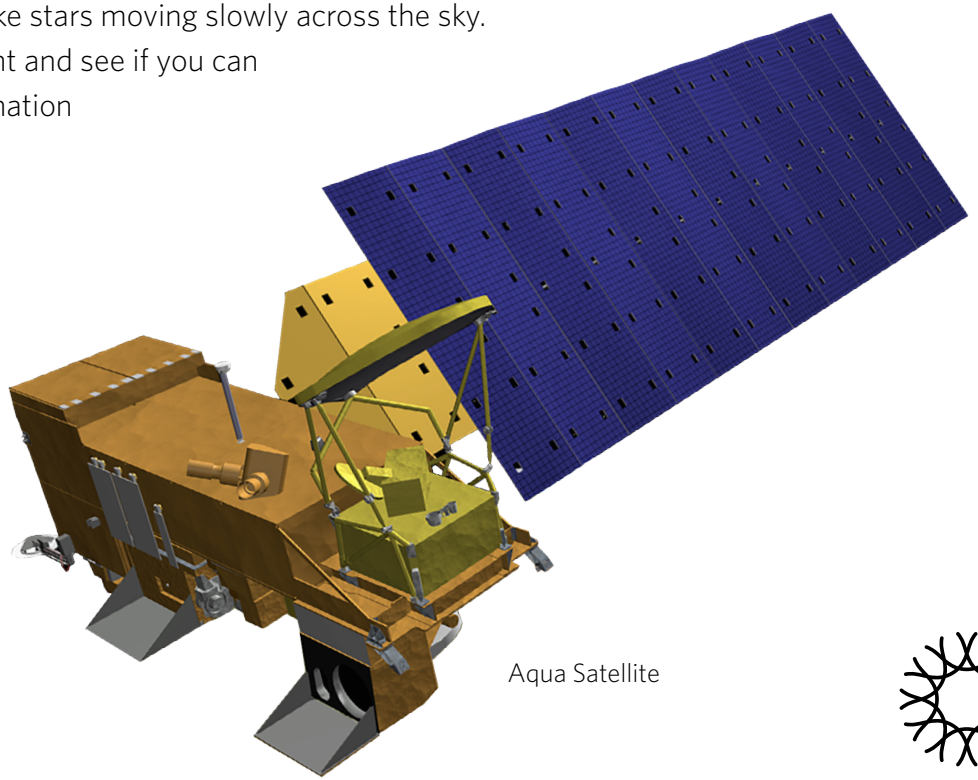
Explore more: Wanna Launch a Satellite? You Can!

**Call to action:** Human-made satellites can look like stars moving slowly across the sky. With your friends and family, head outside at night and see if you can spot a satellite orbiting overhead. For more information check out How to Observe Satellites (5 min.).

Call to action: How to Observe Satellites

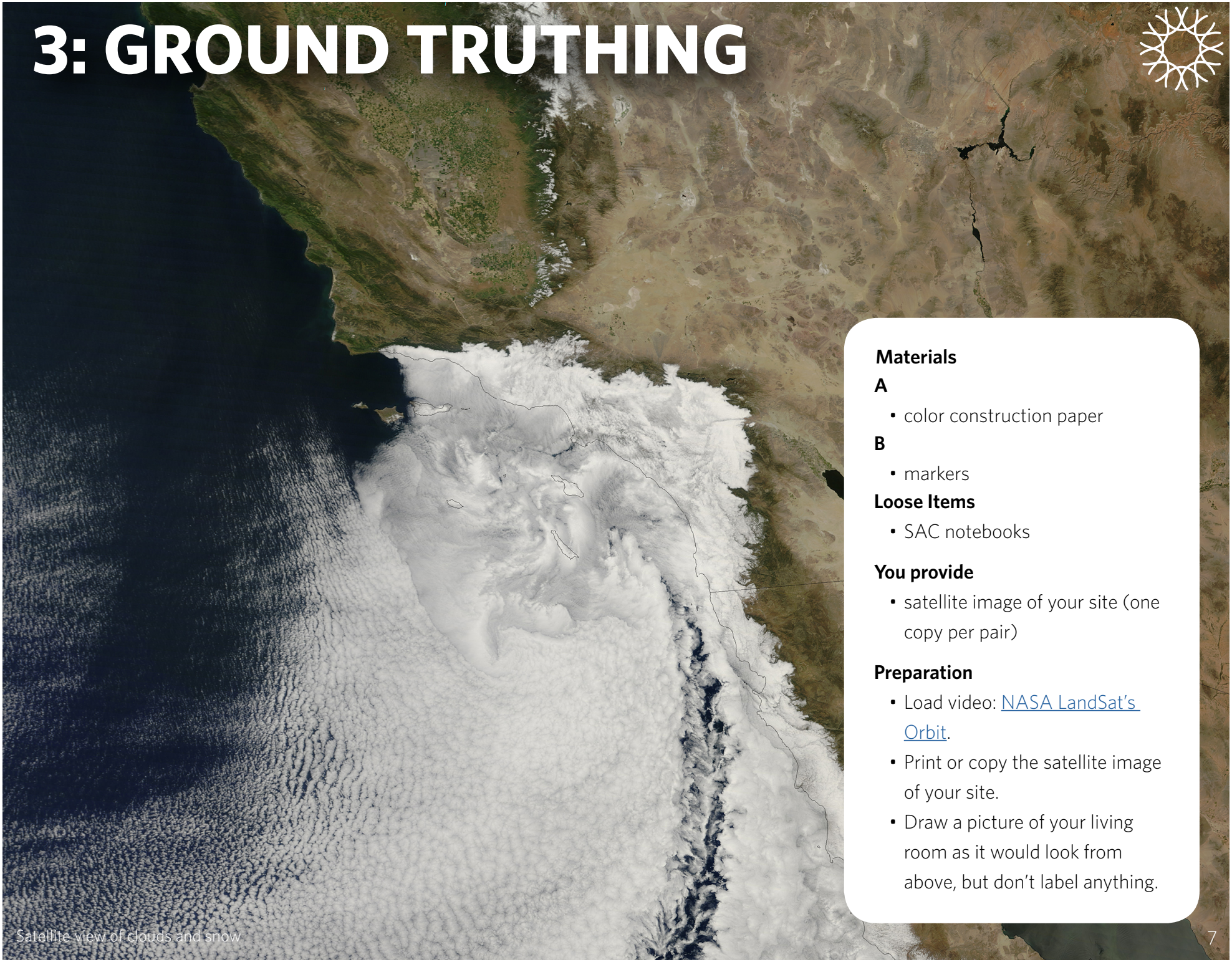
**Attendance & feedback:** How many youth attended? How did it go? Record notes here, then click or scan the link to let us know.

How did it go? Let us know!



Aqua Satellite

# 3: GROUND TRUTHING



**Materials**

**A**

- color construction paper

**B**

- markers

**Loose Items**

- SAC notebooks

**You provide**

- satellite image of your site (one copy per pair)

**Preparation**

- Load video: NASA LandSat's Orbit.
- Print or copy the satellite image of your site.
- Draw a picture of your living room as it would look from above, but don't label anything.

Satellite view of clouds and snow

***Your mission today is to ground truth your surroundings.***

25 min. | inside

**Room from Above**

Imagine a satellite's point-of-view by creating a map of a room in your home or school as it would look from above.

1. Look at the example drawing of a living room from the view of a satellite floating on the ceiling. Point out two or three items in the drawing (sofa, chair, tv, etc.).
2. Use construction paper and markers to draw a picture of your own living room from above.
   - What shape is your room? Where are doors and windows?
   - What would the furniture look like from above (for example, a lamp might just look like a circle)?
3. When you are finished, swap your picture with a partner and try to guess what each item is on their map.
   - Was it easy to recognize what everything was? What would help you?
   - Would it be useful to have people on the ground telling you what they saw? Why or why not?


35 min. | outside

**Ground Truthing**

**Ground truthing** is when data is collected at ground level to check measurements made by scientific instruments such as planes and satellites. At times, this data can be collected by hand.

LandSat's Orbit

Watch LandSat's Orbit (1 min.) to see how satellites collect data in strips around Earth.

In SAC, you are part of a team that takes ground truth measurements to check the NASA CERES satellites. Ground truthing is important because people on the ground can see differences the satellite might miss, like distinguishing between snow, smoke, and clouds. Ground truthing is done by scientists in remote locations, by the National Weather Service over long periods of time, and by citizen scientists.

Share out: Why do you think ground truthing is important?

Your challenge today is to find as many differences as you can between a satellite image and your own observations

on the ground.

Analyze the satellite view:

1. Divide into pairs and give each pair a satellite view image of your site.
   - Do you recognize any buildings or areas?
   - Is there anything you don't recognize?
   - Can you see where SAC meets?
2. When satellites collect data, sensors "decide" what the image is of (for example, ocean vs. land). Label what you recognize on your site map. This may include buildings, roads, trees, parking lots, sports fields, cars, etc.

Check from the ground:

1. Grab a pencil or marker and go outside to the location shown in your site's satellite image.
2. Explore the area and mark any differences between the satellite image and reality on your site map.
3. Decide if differences are errors by the satellite (object should have been visible from above) or were caused by the satellite's limitations (object was underneath something so the view was obstructed). Also consider when the satellite image was taken.

Share out: What sort of things did the satellite see best? Which things were hardest to record?

**Explore more:** Watch the Best of "Earth as Art" video (4 min.) to see more satellite images taken from space.

**Call to action:** Practice your ground truthing skills by examining maps of your favorite places. Enter any location into Google Maps and switch to Earth or Satellite view using the left panel. Compare the satellite images you see to your own experience on the ground. If you find any errors, you can send Google your feedback.

**Attendance & feedback:** How many youth attended? How did it go? Record notes here, then click or scan the link to let us know.

**Explore more:**
Best of "Earth as Art"

**Call to action:**
Google Maps

**How did it go?**
Let us know!

# 4: A CLOSER LOOK AT THE SKY

**Materials**

**A**

- *Altitude Axis*
- *Cloud Identification* cards
- *Sky Survey* charts
- *Cloud Cover Categories* cards
- *Cloud Cover* photos
- *Cloud Cover* grids
- *Sky Color* strips

**C**

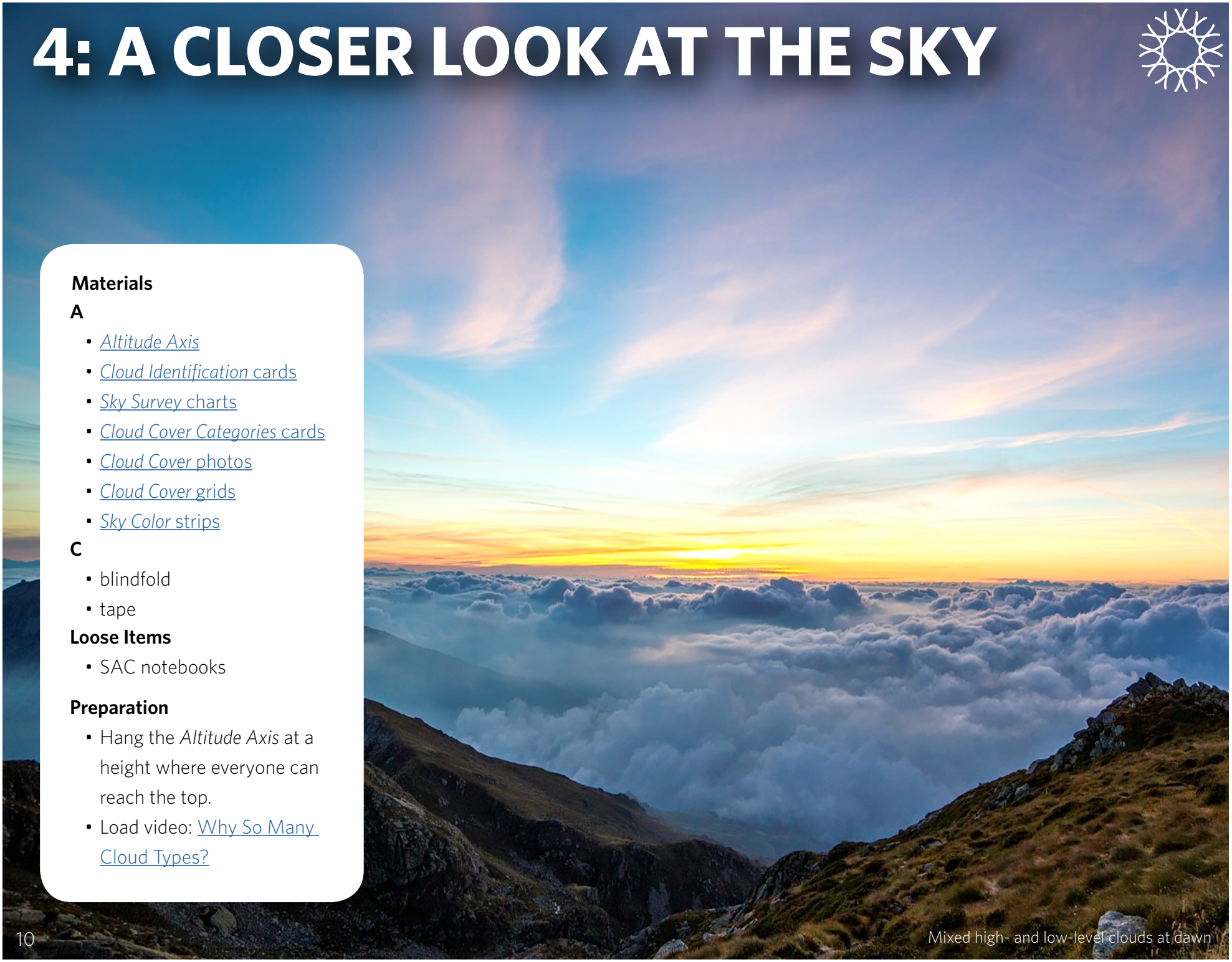
- blindfold
- tape

**Loose Items**

- SAC notebooks

**Preparation**

- Hang the *Altitude Axis* at a height where everyone can reach the top.
- Load video: Why So Many Cloud Types?



Mixed high- and low-level clouds at dawn

## *Your mission today is to hone your cloud observation skills.*

**Cloud Investigation** 5 min. | inside

In order to report your observations to NASA, you'll become an expert on different types of clouds and the altitudes where they are found.

Why So Many Cloud Types?

With a partner, take turns describing clouds you have seen recently. What shapes or texture did you notice? Did they seem low or high?

Watch the Why So Many Cloud Types? video (4 min.) to learn more about the many types of clouds that form in the sky.

**Pin the Cloud on the Sky** 20 min. | inside

1. Pass out one *Cloud Identification* card to each person.
2. Study your card and then tell the person next to you about your cloud using your own words.
3. Distribute *Sky Survey* charts (one per pair) and find your type of cloud on the chart.

Set up the *Altitude Axis* on a wall or board. Your challenge is to place each cloud in its correct spot on the *Altitude Axis*, but you will do it blindfolded!

1. Choose one person to be the first guesser.
2. Stand at the *Altitude Axis* and tell everyone about your cloud.
3. Stick a piece of tape to the back of your card.
4. Tie the blindfold on yourself and have the spinner gently spin you around a few times. Try to stick your cloud at the correct altitude.

**More youth can get involved by taking turns being the spinner.**

The rest of the club can shout out helping hints to make sure that the cloud ends up in the right spot. Take turns until everyone has a cloud on the board.

Share out: Why are clouds found at different altitudes?

**Cloud Cover** 25 min. | inside

Knowing how much of the sky is covered by clouds is as important to ground truthing and climate study as what kinds of clouds are visible. In this game, you will estimate what percentage of the sky is covered by clouds using a transparent grid.

1. Divide into four groups. Give each group a set of *Cloud Cover Categories* cards, *Cloud Cover* photos, and two *Cloud*

*Cover* grids.

2. Hold a grid over a photo and count how many boxes are full of clouds. If a box is partially full, estimate to the nearest percent. Thin clouds do count, but blue sky in between does not.
3. Each box is 5% of the photo. Calculate cloud cover by multiplying the number of boxes you counted by five.
4. Spread out the *Cloud Cover Categories* cards (Clear, Isolated, Scattered, etc.) and sort all of the photos into the correct categories. When you think you are done, step back and shout, "Done!"
5. If you misidentified cards, rearrange them and explain your thinking to your teammates. If you got all of your images right, compare estimates with another group.

- **Percentage can also be estimated by dividing the number of boxes counted by the total number of boxes.**
- **When a group shouts, "Done!", check their answers using the diagram on the next page. If they have images in the wrong categories, tell them how many they need to change, but not which ones they need to change.**

Share out: What made it easier or more challenging to determine the cloud coverage? Were some types of clouds easier to categorize than others? If so, why?

10 min. | outside

**Sky Color**

In addition to making observations about clouds, it's also important to look at what is behind them. We can learn more about the condition of our sky by determining its color. For example, a pale blue or milky sky tends to have a large number of particles in it.

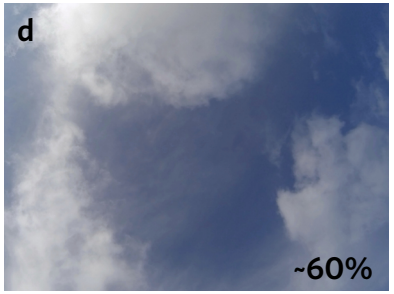
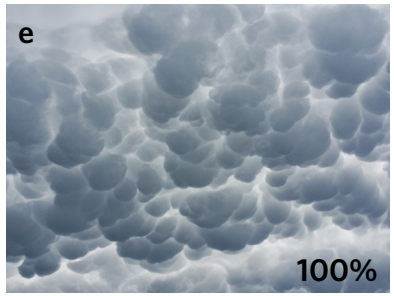
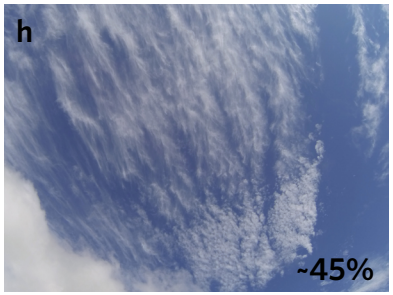
1. Estimate what the sky color is by using the *Sky Color* strips (one per pair). Hold the strips up next to the sky, looking up at a 45° angle, and try to decide which color matches best. Hint: squinting can make it easier.
2. Collect the *Sky Color* strips for use again later. You can record today's observations in your notebooks.

**Explore more:** Why Do Clouds Stay Up?

**Explore more:** Watch Why Do Clouds Stay Up? (6 min.) to learn more about how clouds float above Earth's surface.

**Call to action:** Challenge your friends and family to figure out cloud coverage and altitude. Notice if the clouds look the same or different at home. Remember to add these notes to your cloud journal.

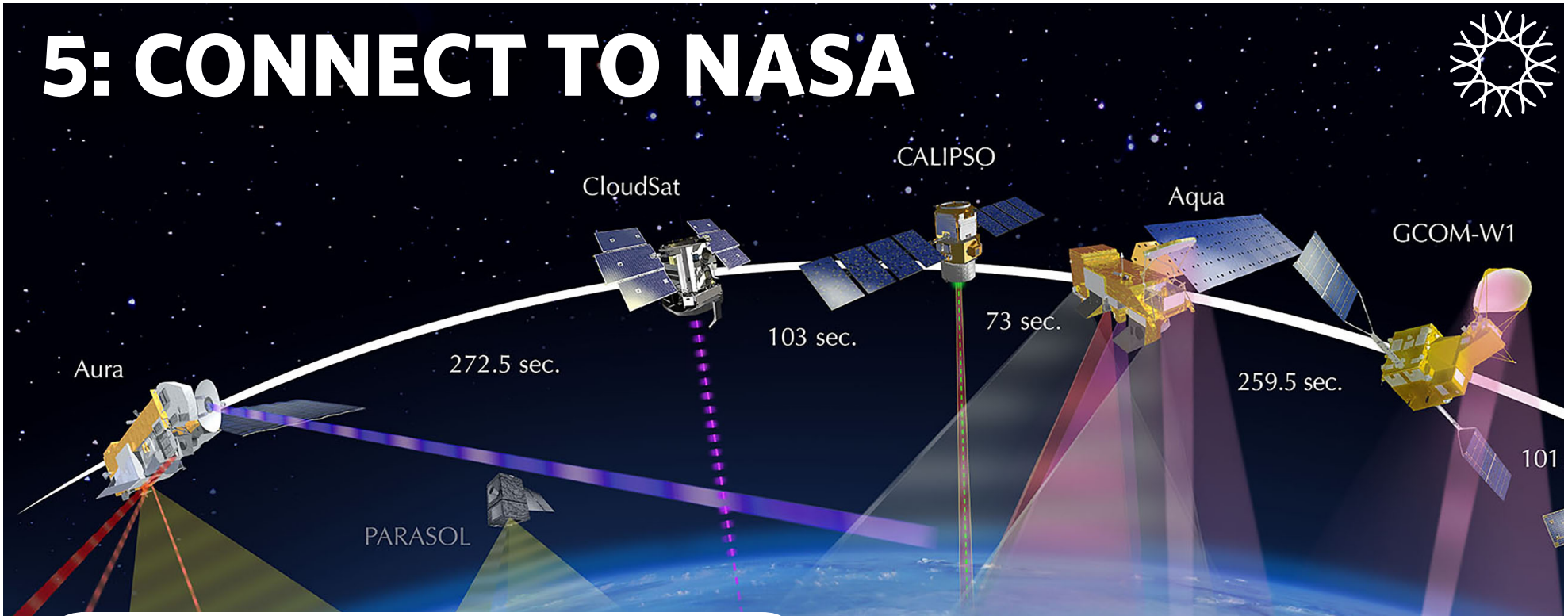
## **Cloud Cover** answer key

| Clear <10% | Isolated 10-25% | Scattered 25-50% | Broken 50-90% | Overcast >90% |
|---|---|---|---|---|
|  |  |  |  |  |
| a 0% | b ~12% | c ~30% | d ~60% | e 100% |
|  |  |  |  |  |
| f ~5% | g ~20% | h ~45% | i ~85% | j 100% |

**Attendance & feedback:** How many youth attended? How did it go? Record notes here, then click or scan the link to let us know.

How did it go?
Let us know!

# 5: CONNECT TO NASA




**Materials**

**A**

- *Cloud Quiz Show* scorecard
- *Cloud Identification* cards
- *Which Cloud Am I?* grids
- *Sky Survey* charts
- *Sky Survey* stickers
- *Sky Color* strips
- *Cloud Cover* grids

**Loose Items**

- SAC notebooks

**Preparation**

- Load videos: Cloud Names and How to Do a *Sky Survey*.
- Download the GLOBE Observer app on your digital device and sign into your club's account.

NASA's A-train satellite formation

***Your mission is to collect data about clouds to help NASA conduct Earth science research.***

**Cloud Quiz Show**

15 min. | inside

Learning cloud names takes practice. Knowing the meaning of those names can offer clues about how clouds look. For example, **cirrus** clouds are wispy and **stratus** clouds form in layers, so when you hear the name **cirrostratus**, you can expect to see a wispy layer of clouds. In this game show, teams will compete to identify cloud names.

Cloud Names

Start by watching the Cloud Names video. As you watch, practice saying the name of each cloud out loud. See the sidebar for a full list of names. Now you're ready to play.

1. Choose one player to be the scorekeeper. Give her or him the *Cloud Quiz Show* scorecard.
2. Divide into teams of four to five players.
3. To begin, say, "Name a cloud that begins with... " and insert one of the starting sounds. See sidebar for the list of five starting sounds.
4. Team members must huddle to choose a cloud name that begins with that sound. The first team to raise their hands and make a buzzer sound gets a chance to respond.
5. Identify that team and say, "And the cloud is...."
6. The team then calls out the name in unison.
7. The scorekeeper checks if the name is correct and keeps score.

Award two points for the first correct answer. If the first answer is incorrect, or if there are additional correct cloud names, the team to the left gets a turn to respond. Each additional correct answer is worth one point.

Teams take turns responding until all valid clouds are named. Repeat steps 3-7 for each of the five starting sounds.

Play for six minutes or complete all five rounds.

- Names of Clouds
  - Cirrus
  - Cirrostratus
  - Cirrocumulus
  - Cumulus
  - Cumulonimbus
  - Stratus
  - Stratocumulus
  - Altostratus
  - Altocumulus
  - Nimbostratus
- Starting sounds:
  - Alto-
  - Cirr-
  - Cumul-
  - Nimbo-
  - Strat-

**Bonus round:** Each team has 30 seconds to write down as many cloud names as possible. The team with the most correct cloud names gets five bonus points. Spelling is not important.

Share out: Why do you think scientists have multiple names for clouds? What strategies did you use to help you remember clouds names?

20 min. | inside

**Which Cloud Am I?**

In this game, one person will use clues to figure out which *Cloud Identification* card their partner is holding.

1. Create teams of two. Determine who will guess and who will respond first. The Guesser needs a *Which Cloud am I?* grid and the Responder needs one *Cloud Identification* card.
2. Responders use a book or folder to hide the *Cloud Identification* card from the Guesser.
3. All of the clouds are on the grid, so Guessers ask yes or no questions to determine which one their partner has. Focus on characteristics of the cloud itself rather than other parts of the picture.
4. Once a card is guessed, switch roles and pick a new *Cloud Identification* card. Use details when describing color, shape, texture, or position in the sky.

Share out: Which clouds look the most similar to you? How can you tell them apart?

25 min. | outside

**Sky Survey**

How to Do a *Sky Survey*

Through GLOBE Observer, citizen scientists like you help NASA understand how clouds affect weather and climate. By observing the sky and reporting what you see, you can help confirm or clarify valuable data from NASA satellite photos. Watch the How to Do a *Sky Survey* video to learn how it works.

1. Form teams of four. Each team needs the following *Sky Survey* tools:
   - *Sky Survey* sticker (this goes in the recorder's notebook)
   - *Sky Survey* chart
   - *Sky Color* strip
   - *Cloud Cover* grid
2. Record the location, time, and date on the *Sky Survey* sticker. Then, head outside to observe the sky.
3. Review the *Sky Survey* sticker together as a club. There are three basic sky conditions:
   - No Clouds: The sky is completely clear.
   - Some Clouds: Clouds are visible.
   - Obscured: Clouds can't be seen in more than one-quarter of the sky because of heavy rain, snow, or fog.
4. You will use the *Cloud Cover* grid to estimate cloud cover (few, isolated, scattered, broken, or overcast) for the entire sky.

GLOBE Observer

5. Observing cloud cover at different altitudes takes practice. While clouds might all seem to be the same distance away, some are closer to Earth's surface and others are high in the sky. The closer ones might block our view of higher ones. Only on a relatively clear day can we estimate cloud cover for low, middle, and high altitudes all at once.
6. To estimate cloud cover, first, identify clouds at each level of the sky. Then, use the *Cloud Cover* grid to estimate how much of the sky at each level is full of clouds. Each team will be responsible for a different direction—north, south, east, and west—so we can collect more accurate observations of the entire sky.
7. Now you are ready to do your first *Sky Survey*. You have 10 minutes to observe the sky and record observations in the *Sky Survey* sticker.
8. Discuss your observations as a club. You will submit only one report for the entire club each time we meet. Ask a youth to hold the mobile device and walk everyone through the GLOBE Observer data entry process.

Congratulations! You've completed your first *Sky Survey* as a NASA citizen scientist.

Share out: What did you find challenging about observing the sky? What strategies would you recommend for next time?

**Explore more:** How do clouds affect climate? Watch Cloudy Forecast (1 min.) to learn how NASA is studying clouds and Earth's climate.

**Call to action:** Teach your friends the names of different clouds and help them identify clouds in your neighborhood.

**Explore more:** Cloudy Forecast

**Attendance & feedback:** How many youth attended? How did it go? Record notes here, then click or scan the link to let us know.

How did it go? Let us know!

# 6: ROCKET SCIENCE

NASA's space shuttle *Atlantis* launch

**Materials**

**A**

- color construction paper
- *Sky Survey* charts
- *Sky Survey* stickers
- *Sky Color* strips
- *Cloud Cover* grids

**B**

- markers

**C**

- effervescent tablets
- plastic vials
- tape

**Loose Items**

- SAC notebooks

**You provide**

- large bottle of tap water

**Preparation**

- Load video: On a Rocket Launch to Space.
- Find a flat open space to launch the rockets.
- Make a model rocket and practice launching it.

## *Your mission today is to build and launch a model rocket.*

### Sky Survey

20 min. | outside

During today's *Sky Survey*, pay special attention to **contrails**, which are trails of water vapor and smoke left behind by planes or rockets. Form teams and gather your *Sky Survey* tools to begin.

1. Observe the sky and record your cloud observations in your notebook.
2. Discuss your observations and decide as a club what to report to NASA.
3. Submit your club's report using the GLOBE Observer app.

Share out: Why do you think contrails are straight and long? How do you think contrails are created? What else would you like to know about these unique clouds?

### Build a Rocket

25 min. | inside

What do you picture when you hear the word *rocket*? For example, how is it shaped? Where is it? What is it doing?

Watch On a Rocket Launch to Space (4 min.) to ride along as a rocket reaches an altitude of nearly 400,000 feet and returns to Earth.

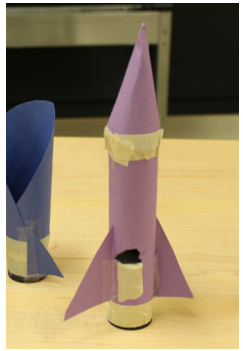
On a Rocket Launch to Space

Share out: What parts of the rocket did you notice?

NASA's rockets are launched by setting off engines that powerfully push air straight down toward the ground. This pushes the rocket up, shooting it into the sky. Working in pairs, you will design and build a rocket to launch in an outdoor area.

1. The body will be made of a rolled up piece of construction paper. In groups of two or three, decorate the visible part of the body before taping it into a tube.
2. Use tape to securely attach the rocket body to the plastic vial. The open end of the plastic vial should face down.
3. Attach any fins or other additions that you design to help your rocket fly.
4. Practice closing the vial quickly and placing it firmly on the ground. This can be tricky, so practice several times.

**You can poke a hole in the body so one finger can hold the back of the plastic vial while putting the cap on.**



15 min. | outside

## Launch Your Rockets

1. Head outside to your chosen rocket launch spot.
2. Hold the rocket upside down and fill the plastic vial about halfway with water.
3. These next steps need to be done quickly, since the reaction will start right away. Place one fuel tablet into the vial and quickly place the lid on securely. Place the rocket on a level surface with the lid touching the ground. Step at least five feet away from the rockets—they may not fly straight up!

Pause to modify your rockets: What did you notice about how your rocket flies? What do you want to try to change?

1. Experiment with your rocket to see if you can change how it flies. Think about using more or less water, making the rocket lighter, adjusting the fins or shape of the cone, etc.
2. Use two or three more fuel tablets to test your ideas.

Share out: What worked well? What can you conclude about how these rockets fly?

Explore more: How Do We Launch Satellites Into Space?

**Explore more:** Watch How Do We Launch Satellites Into Space? (2 min.) to learn more about how satellites are launched.

Call to action: SpaceX

**Call to action:** Can we reuse rockets? In April 2016, SpaceX successfully landed the first reusable rocket back on Earth. How else can we make space exploration more sustainable?

How did it go? Let us know!

**Attendance & feedback:** How many youth attended? How did it go? Record notes here, then click or scan the link to let us know.

# 7: DRAIN TO RAIN

**Materials**

**A**

- *Drain to Rain* stations
- *Drain to Rain* signs
- *Drain to Rain* maps
- *Sky Survey* charts
- *Sky Survey* stickers
- *Sky Color* strips
- *Cloud Cover* grids

**B**

- graduated cylinders

**Loose Items**

- SAC notebooks

**You provide**

- 10 ice cubes
- 5 bowls

**Preparation**

- Load video: The Water Cycle.
- Fold the *Drain to Rain* signs.

## *Your mission today is to trace a drop of water through the water cycle.*

20 min. | outside

**Sky Survey**

During today's *Sky Survey*, notice if the air around you feels dry or wet and look for cloud types that could signal rain. Form teams and gather your *Sky Survey* tools to begin.

1. Observe the sky and record your cloud observations in your notebook.
2. Discuss your observations and decide as a club what to report to NASA.
3. Submit your club's report using the GLOBE Observer app.

Share out: How do you think clouds and weather are related? Which clouds are you likely to see on warm, humid days? What about cold, dry days?

10 min. | inside or outside

**Ice Cube Challenge**

The Earth is a closed system. This means that all of the water on Earth stays on Earth. The water does not go off into space. Instead, it moves around from place to place, changing from liquid to gas or ice and back to liquid again.

Your goal is to convert as much ice into water as you can before time runs out.

1. Form teams of three or four. Give each team a bowl and two ice cubes.
2. Ice cannot be put into mouths. Otherwise, you can use any methods that you can think of to melt the ice into water.
3. You will have four minutes to fill up your container with as much water as possible. Remove any remaining ice from the container once time is called.
4. Measure how much water each team finished with in the graduated cylinders.

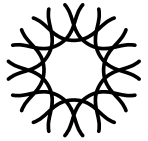
Share out: What tactics did you try? What helped your ice to change to liquid water most quickly? Were you able to see evidence of water in all three forms: solid, liquid, and gas?

25 min. | inside or outside

**Drain to Rain**

Water is everywhere! In fact, Earth could be mapped in sections called **watersheds**, or an area of land where all water flows to the same place. We can easily see water in rivers or snow, but it is also stored in the ground, frozen as ice, and even in the air we breathe. Remember, water and ice molecules in the air collect around dust particles to form clouds.

With a partner, spend one minute making a list of as many places as you can think of where water can be found. Can



you come up with a place that nobody else can think of?

The Water Cycle

Watch The Water Cycle video (6 min.) to see how water flows on, in, and above the Earth.

Imagine you are a water molecule. Your mission is to make your way through every water location in the system, mapping your journey as you go. Set up nine stations with the matching *Drain to Rain* signs and *Drain to Rain* station at each.

1. Each player gets a *Drain to Rain* map.
2. You can start at any water location you want. Not all stations are connected, so refer to the card at each station to choose where to go next.
3. As you move from one station to the next, draw and number a line on your map showing your path.
4. Strategize to get to all of the stations.

Share out: Which places did you end up going the most? How many lines did you draw? What was surprising about where the water went?

**Let's Make a Toast**

5 min. | inside

Give everyone a small cup of water (or pretend!). Our bodies are about 60% water. Talk about how far the water we drink has traveled and the experiences it may have had along the way. Volunteers can make a toast to water. Drink up!

**Explore more:** Check out how satellites help us save water by watching Recharging Aquifers (3 min.).

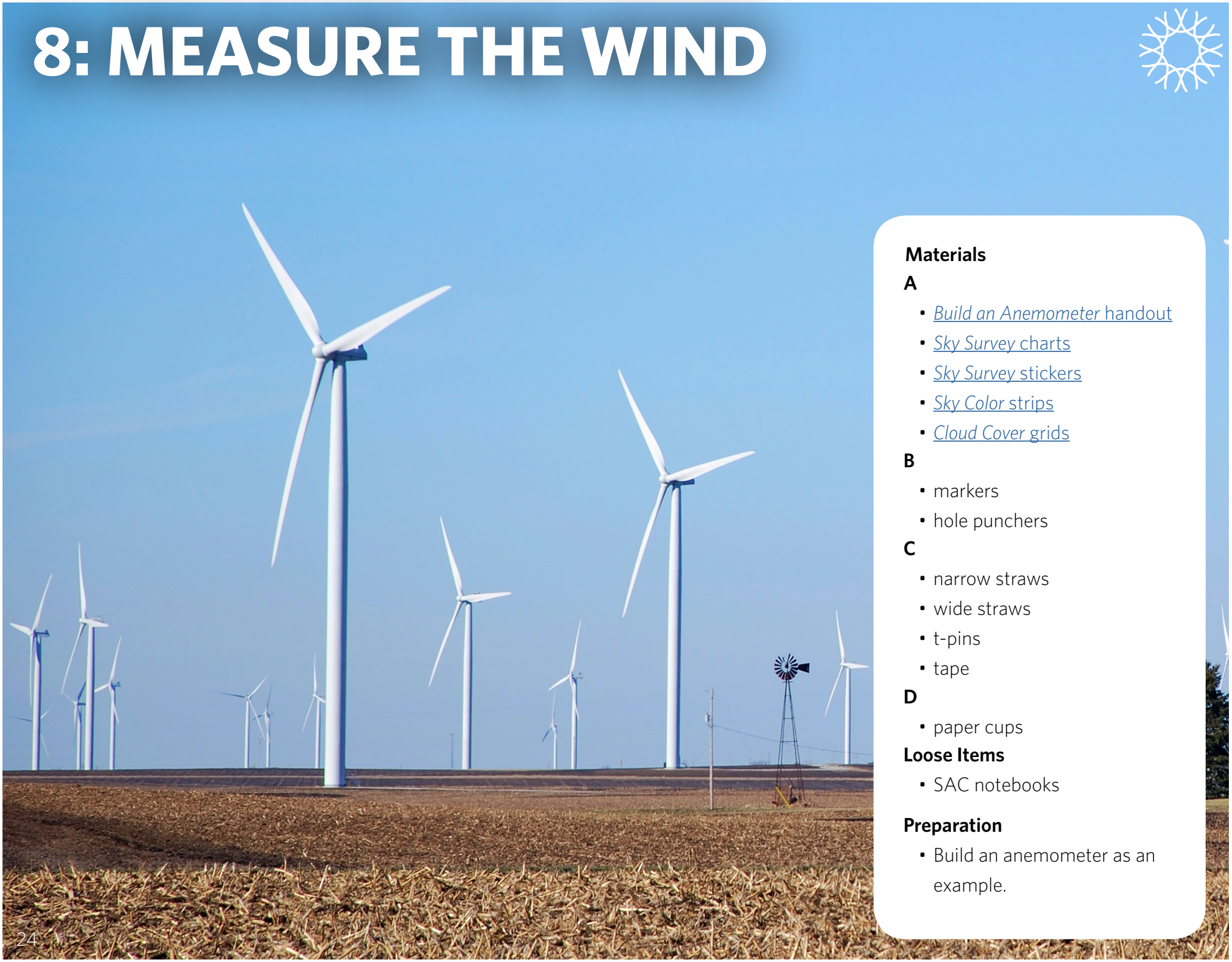
Explore more: Recharging Aquifers

**Call to action:** Find out where your city's water comes from and where it goes. Check your city's public utilities website.

**Attendance & feedback:** How many youth attended? How did it go? Record notes here, then click or scan the link to let us know.

How did it go? Let us know!

# 8: MEASURE THE WIND



**Materials**

**A**

- *Build an Anemometer* handout
- *Sky Survey* charts
- *Sky Survey* stickers
- *Sky Color* strips
- *Cloud Cover* grids

**B**

- markers
- hole punchers

**C**

- narrow straws
- wide straws
- t-pins
- tape

**D**

- paper cups

**Loose Items**

- SAC notebooks

**Preparation**

- Build an anemometer as an example.

## *Your mission today is to test the wind speed.*

**Sky Survey** 20 min. | outside

During today's *Sky Survey*, pay special attention to wind conditions and how clouds move. Form teams and gather your *Sky Survey* tools to begin.

1. Observe the sky and record your cloud observations in your notebook.
2. Discuss your observations and decide as a club what to report to NASA.
3. Submit your club's report using the GLOBE Observer app.

Share out: How do you think wind affects clouds? How might the wind affect other weather conditions?

**Wind Power** 15 min. | inside or outside

Wind is one of the most powerful forces on Earth. It moves clouds, creates waves, and shapes mountains. We can't see wind, but we can see and feel its effects. Changes in wind speed and direction can have different effects on the environment. For example, short, strong gusts move objects differently than sustained, gentle breezes.

In this game, your goal is to work with your team to keep a piece of tissue afloat for as long as possible using only your breath.

1. Form teams of four to six. Each team starts with two narrow straws, two wide straws and a piece of tissue paper. It's ok if some players don't have straws, they can blow on the tissue directly.
2. When you hear the signal to start, drop the tissue paper from above and try to keep it afloat for as long as possible. Keep trying for 30 seconds.
3. Gather with your team. You will have one minute to come up with a different strategy to try. You can change the combination of straws or get rid of them altogether. You can also change the tissue in any way you want, change the arrangement of people, or the way that you blow on the tissue, or try any other ideas you have. Try again for 30 seconds.
4. Gather your team and discuss what you've discovered so far. You will have one minute to develop a new strategy based on your findings and test it out. Continue this process for up to five minutes.

Share out: What strategy worked best? How did you know which parts of your strategy worked? What would you try next time if you could do this again?

25 min. | inside or outside

## Build an Anemometer

Scientists use many instruments to measure the weather: thermometers to measure temperature, barometers to measure atmospheric pressure, and rain gauges to measure rainfall, to name a few. An **anemometer** (an-eh-mom-eh-ter) is a device that measures wind speed by spinning at different rates when there is more or less wind.

Build an anemometer to test the wind speed around you.

**Be sure to align the holes in your cups so your anemometer can spin freely.**

1. Form pairs. Each pair needs a *Build an Anemometer* handout.
2. Work through the steps on the instructions side of the handout to build your anemometer.
3. Go outside to test the anemometers. You will use the table on the back of the *Build an Anemometer* handout to determine the wind speed based on how quickly the anemometer spins.
   - If there isn't any wind, that is still a result. Then, you can also measure the speed of your breath or a fan.

Share out: When or why would it be useful to know the wind speed? Tell a partner, or record a list of ideas in your notebook. (List could include weather forecasting, sailing, flying, construction, plant growth, etc.)

Explore more: Wind Power

**Explore more:** Watch Wind Power (3 min.) to learn how we can harness wind power.

**Call to action:** Take your anemometer home to show your friends or family how it works. Try attaching it to a spot where it could measure the wind, like outside a window or on your roof.

How did it go? Let us know!

**Attendance & feedback:** How many youth attended? How did it go? Record notes here, then click or scan the link to let us know.

# 9: ERUPT A VOLCANO

*Steam plume from Mount Gharat on Gaua Island in the South Pacific.*

**Materials**

**A**

- color construction paper
- *Sky Survey* charts
- *Sky Survey* stickers
- *Sky Color* strips
- *Cloud Cover* grids

**B**

- scissors

**C**

- tape

**D**

- baking soda
- food coloring

**Loose Items**

- SAC notebooks
- vinegar
- dish soap

**You provide**

- small plastic bottles
- gallon of water

**Preparation**

- Load video: Volcanoes 101.
- Collect small plastic bottles from your site or home recycling.

## *Your mission today is to build and erupt a volcano.*

20 min. | outside

**Sky Survey**

During today's *Sky Survey*, pay special attention to the surrounding natural environment. Form teams and gather your *Sky Survey* tools to begin.

1. Observe the sky and record your cloud observations in your notebook.
2. Discuss your observations and decide as a club what to report to NASA.
3. Submit your club's report using the GLOBE Observer app.

Share out: What nature did you observe? How do you think clouds affect your natural environment?

15 min. | outside

**Lava Flow**

The goal of this game is to avoid being swallowed by lava (similar to Sharks and Minnows).

1. Define the boundaries of the Lava Field and line up along one edge.
2. Choose two people to be the Lava. They will begin in the center of the field and try to tag the others.
3. When the Lava call out "Eruption!" the others run to the opposite side of the field and try to avoid being tagged. Anyone caught by the Lava becomes a Lava Tube and freezes in place. Lava Tubes cannot move, but can reach out and tag from where they stand.
4. Play another round. This time, look out for both Lava and Lava Tubes.
5. Play several rounds until only two people remain untagged. They win!

25 min. | inside or outside

**Erupt a Volcano**

**Share the photo on the previous page of a steam plume from Mount Gharat.**

What comes to mind when you think of volcanoes? Inside Earth are layers of solid and melted rock. Volcanoes erupt when enough pressure builds to push gases or some of the melted rock, called **magma**, through the Earth's surface. Some volcanoes release long steam plumes that can be seen from space.

Volcanoes 101

Watch Volcanoes 101 (3 min.) to learn what causes volcanoes to form and erupt before you build your own.

1. Divide into teams of three or four. Each group will need a bottle, two sheets of paper, tape, markers, and scissors.

2. Fold the sheets of paper into cones around the bottle and cut the corners off. The point of the cone should fit tightly around the opening of the bottle.
3. Measure out a small amount of water and twice as much vinegar in the plastic bottle. Add three to five drops of food dye and one small squeeze of dish soap. Swirl everything together gently.
4. When everyone is ready, set the first volcano on the ground near a drain or on a large tray.
5. To erupt a volcano, add baking soda to the bottle. Set it down quickly and stand back.
6. The next team can choose to add the same amount of baking soda, more baking soda, or less baking soda to change the rate of eruption.

Share out: If you were to erupt volcanoes again, what would you do differently? How do you think a volcano could influence the weather?

Tips for erupting volcanoes:

- Avoid spills by carrying a large container of water out with you, or teams may fill their bottles individually before going outside.
- Make a funnel out of paper to pour the baking soda into the bottle more easily.
- Ask youth to help you carry the materials outside. Youth helping out will develop a stronger sense of connection to the club.

Explore more: How do Volcanoes Change Clouds?

**Explore more:** Watch How Do Volcanoes Change Clouds? (2 min.) to learn about the connections between active volcanoes and clouds.

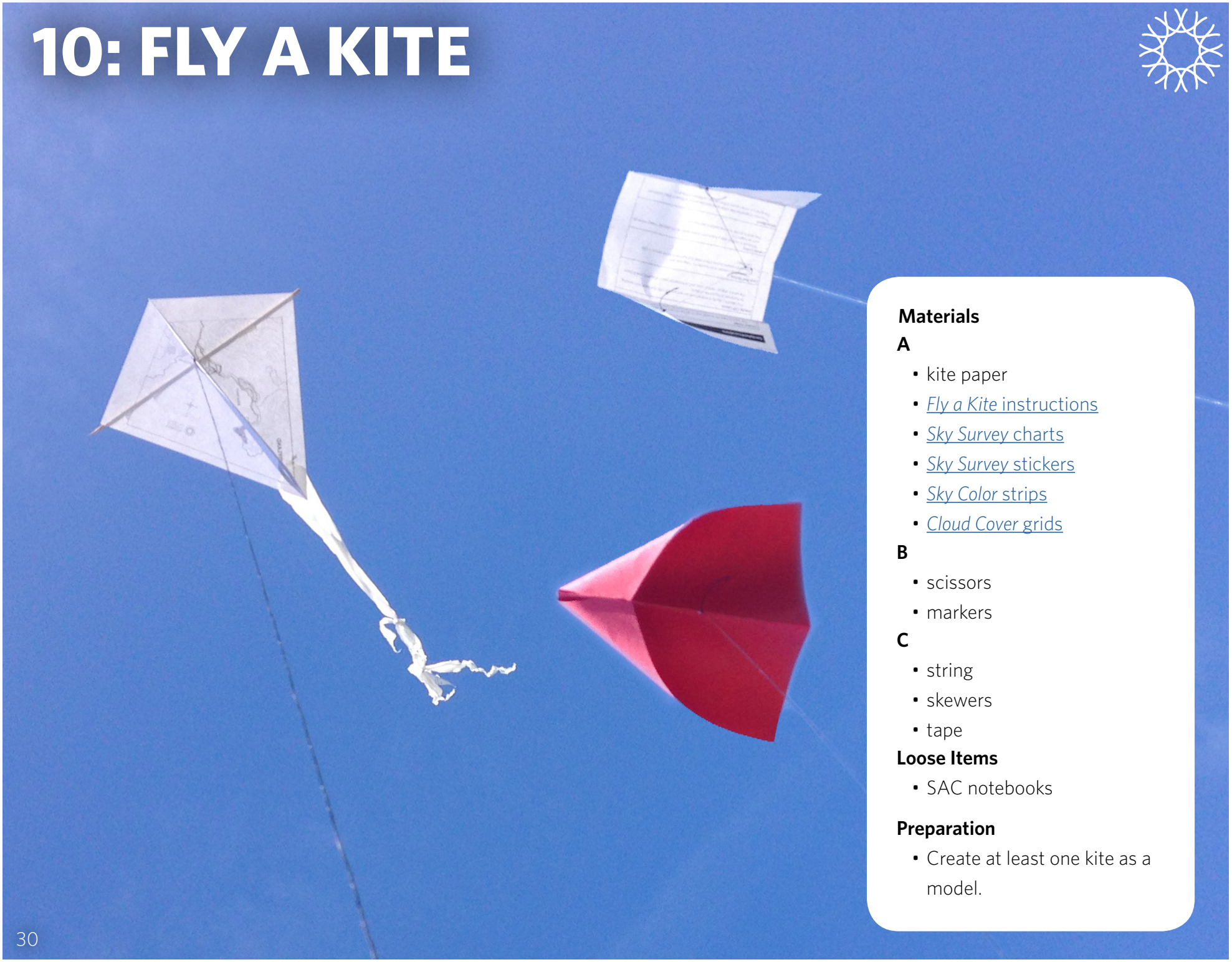
Call to action: Footprint Calculator

**Call to action:** When volcanoes erupt, they release large amounts of carbon dioxide into the atmosphere. Carbon dioxide is one of the leading greenhouse gases responsible for global warming. Unfortunately, human activities release a lot more carbon dioxide than volcanoes. Use the Carbon Footprint Calculator to figure out how much carbon dioxide your household releases every year. Can you think about ways in which you might reduce the amount of carbon dioxide you release?

How did it go? Let us know!

**Attendance & feedback:** How many youth attended? How did it go? Record notes here, then click or scan the link to let us know.

# 10: FLY A KITE



**Materials**

**A**

- kite paper
- *Fly a Kite* instructions
- *Sky Survey* charts
- *Sky Survey* stickers
- *Sky Color* strips
- *Cloud Cover* grids

**B**

- scissors
- markers

**C**

- string
- skewers
- tape

**Loose Items**

- SAC notebooks

**Preparation**

- Create at least one kite as a model.

## *Your mission today is to design and build a kite that can fly.*

**Sky Survey** 20 min. | outside

During today's *Sky Survey*, keep an eye out for birds, airplanes, or other flying objects. Form teams and gather your *Sky Survey* tools to begin.

1. Observe the sky and record your cloud observations in your notebook.
2. Discuss your observations and decide as a club what to report to NASA.
3. Submit your club's report using the GLOBE Observer app.

Share out: What objects or animals did you spot flying through clouds? What do you think it feels like to be inside a cloud?

**Wind, Kite, Flight** 10 min. | outside

A kite flies by balancing lift from the wind (pushing the kite up) and the tension from the string (pulling the kite down). Whenever these two forces are in balance, the kite flies.

In this game, one person will shout one of three commands for the rest of the group to act out:

1. Wind: everyone walks around as if blown by the wind. (individual activity)
2. Kite: find a partner and form a diamond-shaped kite with your arms. (groups of two)
3. Flight: find two other players; two will form a diamond-shaped kite and the third player will act as wind under the kite. (groups of three)

Anyone who can't form the shape of the command is out. The last three players to form the Flight shape win!

**Fly a Kite** 30 min. | inside or outside

Kites can be designed in many shapes and sizes, depending on their use: for entertainment, carrying messages, measuring distances, investigating weather, observing the sky, transporting objects—and people!—or carrying out scientific experiments.

Your goal is to design and build a kite with the potential to fly. Most kites will not fly on the first try so you will need to test, revise, and try again.

1. With a partner, explore and examine the three different kite designs. Choose one kite design or create your own. Think about what features you want your kite to have.

Explore more: Super Pressure Balloon

2. Use the kite paper to create a **prototype**, or model to test, and try to fly it.
3. Consider how you can improve how you launch or how you fly your kite. Make small changes and try again.

Share out: What changes helped? Did you see any modifications on other kites that could help yours?

**Explore more:** Watch Super-Pressure Balloon to see how NASA uses high-flying devices to study Earth.

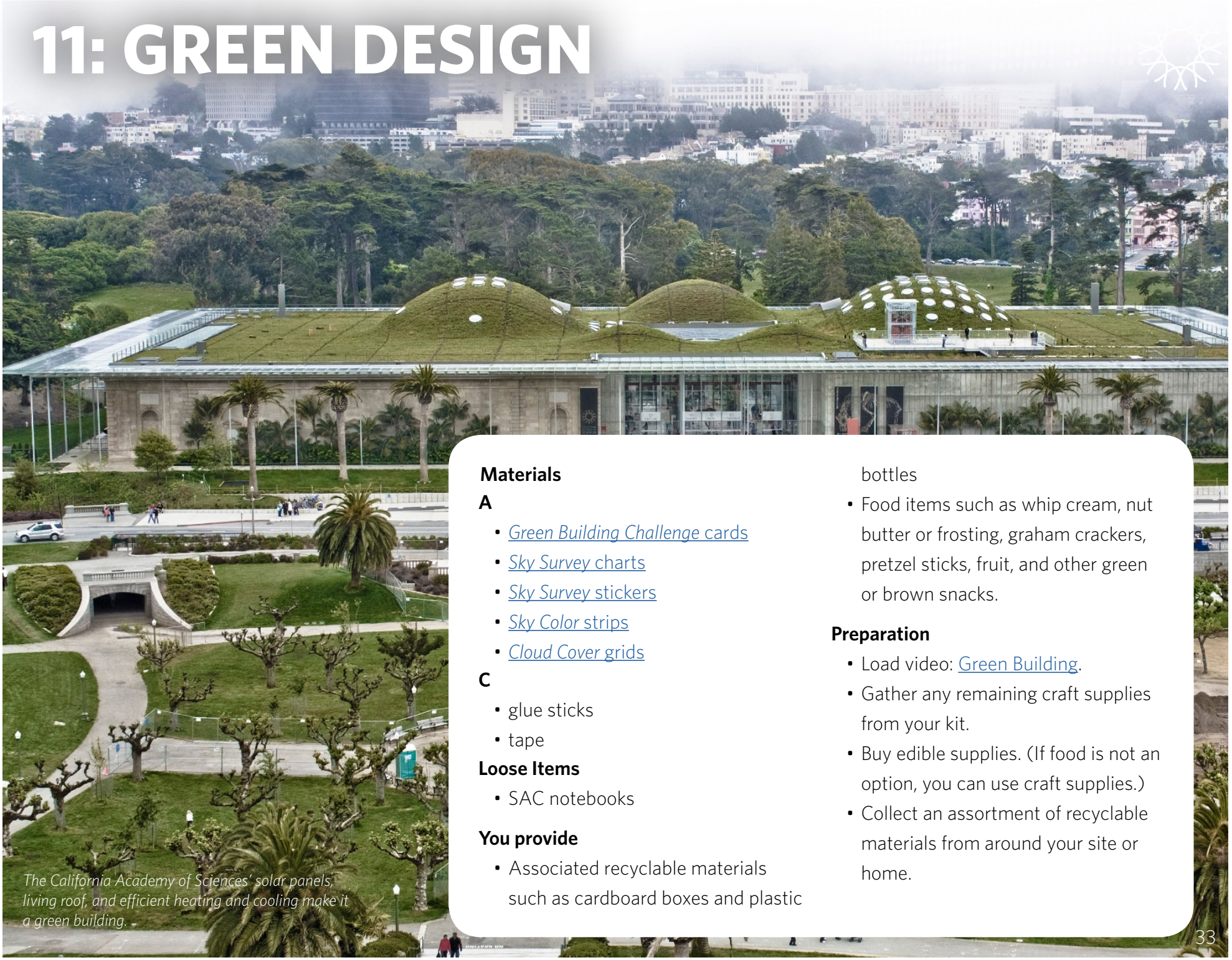
**Call to action:** Watch Float Beijing to learn more about how citizen scientists in China are using kites to measure air pollution. Can you think of other ways in which kites can be used for citizen science?

Call to action: Float Beijing

**Attendance & feedback:** How many youth attended? How did it go? Record notes here, then click or scan the link to let us know.

How did it go? Let us know!

# 11: GREEN DESIGN



*The California Academy of Sciences' solar panels, living roof, and efficient heating and cooling make it a green building.*

**Materials**

**A**

- *Green Building Challenge* cards
- *Sky Survey* charts
- *Sky Survey* stickers
- *Sky Color* strips
- *Cloud Cover* grids

**C**

- glue sticks
- tape

**Loose Items**

- SAC notebooks

**You provide**

- Associated recyclable materials such as cardboard boxes and plastic bottles
- Food items such as whip cream, nut butter or frosting, graham crackers, pretzel sticks, fruit, and other green or brown snacks.

**Preparation**

- Load video: Green Building.
- Gather any remaining craft supplies from your kit.
- Buy edible supplies. (If food is not an option, you can use craft supplies.)
- Collect an assortment of recyclable materials from around your site or home.

## *Your mission today is to design an eco-friendly building.*

20 min. | outside

**Sky Survey**

During today's *Sky Survey*, pay special attention to the surrounding buildings and other human-made parts of the environment. Form teams and gather your *Sky Survey* tools to begin.

1. Observe the sky and record your cloud observations in your notebook.
2. Discuss your observations and decide as a club what to report to NASA.
3. Submit your club's report using the GLOBE Observer app.

Share out: How might clouds affect the buildings and structures in your environment?

40 min. | inside

**Green Building Challenge**

Watch Green Building (1 min.) to learn about sustainable building design.

Green Building

Your challenge is to design an eco-friendly residential building and construct a model using edible or reusable materials.

1. Visit Green Solutions and explore the website as a club.
2. Brainstorm what it means for a building to be green or eco-friendly. Research and discuss:
   - Renewable energy technologies, such as solar panels, hydroelectricity, and wind turbines.
   - Sustainable building materials, such as bamboo and adobe.
   - Beneficial landscaping, like a living roof or vegetable garden.
   - Water conservation methods, such as harvesting rainwater or installing a graywater system.
3. Form teams of four. Each team needs one *Green Building Challenge* card.
4. Design an eco-friendly building according to your *Green Building Challenge* card. Use edible or reusable materials to construct a model of your building. Make sure to include at least one moving part. Be creative in your designs. Think about how you can turn your challenge into an advantage.

Green Solutions

- **Take time to brainstorm about green buildings. The more you discuss and explain what makes a building green, the better ideas and final products the youth will have.**
- **If a group finishes early, give them another Green Building Challenge card.**

Share out: When everyone has finished building, have an open house. Invite youth to gather around each building while the youth briefly describe their models and explain their choices.

**Explore more:** Watch how architects and engineers are building smarter in Waste Water Recycling (2 min.).

**Call to action:** Visit the World Green Building Council to learn more about green design strategies. Choose one building you are familiar with, such as your school or home, and identify what you can do to make it greener. Discuss your ideas with others who use that building, and see if you can implement any changes.

**Attendance & feedback:** How many youth attended? How did it go? Record notes here, then click or scan the link to let us know.

Explore more:
Waste Water Recycling

Call to action:
World Green Building Council

How did it go?
Let us know!

# 12: CLOUD CONCLUSIONS

**Materials**

**A**

- SAC certificates

**Loose Items**

- SAC notebooks
- *Clouds* buttons

**Preparation**

- Fill out a certificate for each youth.
- Plan a fun celebration for completing Science Action Club.

*Cirroculumus clouds*

***Your mission today is to summarize the data from your sky surveys.***

**Replay** 15 min. | outside

Vote to play your favorite clouds game: A1 - Eye of the Storm; A2 - Satellite Communication Relay; A5 - Cloud Quiz Show; A8 - Wind Power; A9 - Lava Flow; A10 - Wind, Kite, Flight.

**Cloud Conclusions** 30 min. | inside or outside

You have successfully learned how to identify clouds and record sky conditions to help NASA scientists study Earth's climate. Now you're ready to review your observations, make sense of what you found, and share your results with the local community.

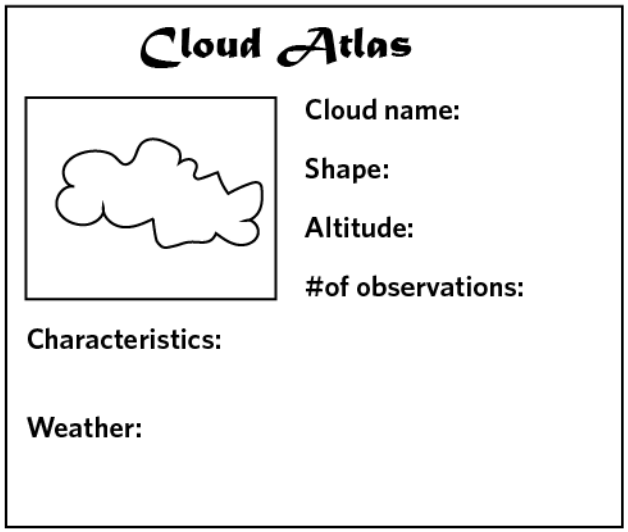
Part I. Review your records.

1. Review the sky conditions you recorded in your notebook for each *Sky Survey*.
2. Open the Globe Observer app and select **See My Data** to review your club's observations.
3. Use your findings to answer the following questions as a club:
   - How many times did you do a *Sky Survey*?
   - What types of clouds did you see?
   - How many of the days were sunny? Cloudy? Rainy or snowy?
   - Which clouds did you see on rainy or snowy days? Which clouds did you see on dry days?

Part II. Create a cloud atlas.

1. Working alone or in small groups, choose one cloud that you saw during your *Sky Surveys*.
2. Create a cloud atlas for your chosen cloud. A **cloud atlas** is a guide that includes information such as:
   - Images of the cloud.
   - Descriptions of shape, height, and characteristics.
   - Descriptions of accompanying weather, such as rain, heat, or cold.
   - How often the cloud was observed during the *Sky Surveys*.

Share out: Present your cloud atlas to the rest of the club. Which cloud did you choose and why? Talk about some of the information you included in the cloud atlas.



15 min. | inside or outside

**SAC Ceremony**

Congratulations! You have proven your skills as a NASA citizen scientist, and you have earned your certificate of success, as well as a *Clouds* button. Hold a ceremony to honor your achievements. Then, take home your notebook and use it to continue your explorations.

Explore more: Climate Kids: Eyes of Earth

**Explore more:** Continue exploring clouds and climate with NASA by visiting the Climate Kids: Eyes on Earth website.

**Call to action:** Introduce your family and friends to the GLOBE Observer project. Encourage them to download the app and start contributing to citizen science!

**Attendance & feedback:** How many youth attended? How did it go? Record notes here, then click or scan the link to let us know.

How did it go? Let us know!

# California Academy of Sciences

presents this

# Certificate of Success

to

_____

Presented on _____ , 20_____

_____

Science Action Club Leader

CALIFORNIA ACADEMY OF SCIENCES

CALIFORNIA ACADEMY OF SCIENCES

SCIENCE ACTION CLUB

# CONNECT TO THE ACADEMY

## California Academy of Sciences offers several ways to stay connected:

**Field Trips to the Academy**
The Academy is proud to offer special, discounted rates for Science Action Club youth.

**Distance Learning**
Visit the Academy virtually from anywhere in the world! Our interactive Distance Learning programs connect students and educators to Academy experts, animals, collections, and exhibits via the Internet.

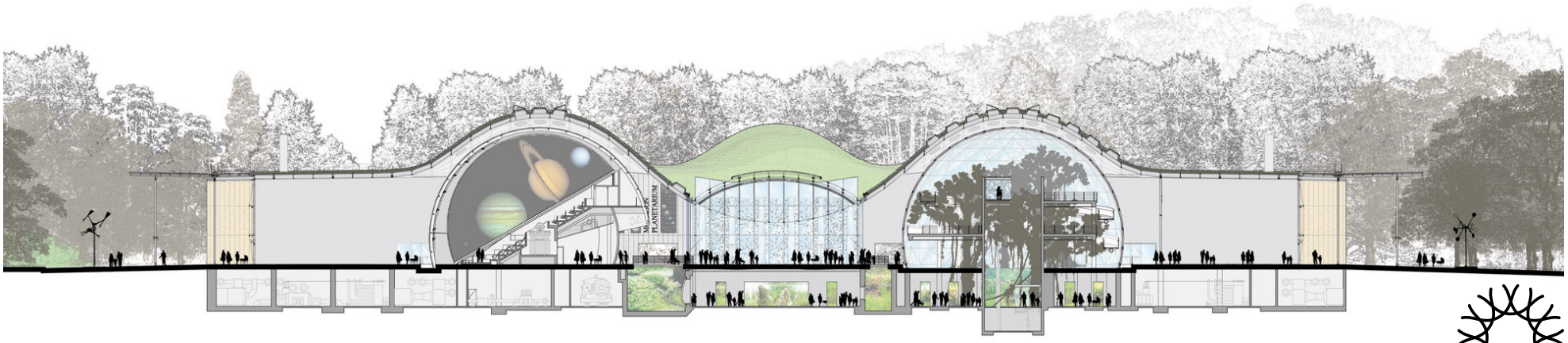
**Citizen Science Projects**
To protect biodiversity, we need to know more about it. Academy scientists travel the globe to make discoveries, but they can't be everywhere at once. We need your help!

*QUICK LINKS*

Apply for a Field Trip

Distance Learning Information

Citizen Science Projects



# NGSS CONNECTIONS

The Next Generation Science Standards (NGSS) offer a new vision for K-12 science education. Released for states' adoption in 2013, and designed with decades of research on best practices for teaching and learning science, the NGSS offer an opportunity to move science education into the 21st century.

The activities in *Cloud Quest* support youth engagement in some aspects of the three dimensions of the NGSS. Specifically the Science and Engineering Practices (SEPs) are used as strategies for making sense of content that connects to the Crosscutting Concepts (CCCs) and the Disciplinary Core Ideas (DCIs).

## Science and Engineering Practices (SEPs)

**Analyzing and Interpreting Data**
*Activities 1 - 12*
- Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
- Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.
- Analyze and interpret data to determine similarities and differences in findings.

**Developing and Using Models**
*Activities 2, 3, 6, 7, 10, 11*
- Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.

**Designing Solutions**
*Activities 2, 6, 10, 11*
- Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process, or system.

## Disciplinary Core Ideas (DCIs)

**ESS2.C: The Roles of Water in Earth's Surface Processes**
- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.

**ESS2.D: Weather and Climate**
- Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.

**ETS1.B: Developing Possible Solutions**
- A solution needs to be tested, and then modified on the basis of test results, in order to improve it.

## Crosscutting Concepts (CCCs)

**Patterns**
*Activities 4, 12*
- Macroscopic patterns are related to the nature of microscopic and atomic-level structure.
- Patterns can be used to identify cause and effect relationships.
- Graphs, charts, and images can be used to identify patterns in data.

**Structure and Function**
*Activities 2, 10, 11*
- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

Connections are from 3-5 and MS grade bands. See www.nextgenscience.org for more information.

# REFERENCES

**Photos**

All images were created by NASA, California Academy of Sciences staff members, or released to the public domain without copyright. Other satellite images were obtained from Google Earth.

# WEB LINKS

| | | |
|---|---|---|
| | Attendance and Feedback | sciclub.link/clouds-feedback |
| **1: Get to Know a Cloud** | GLOBE Observer Cloud Science | sciclub.link/globemission |
| | Why Are There Different Types Of Clouds? | sciclub.link/cloudtypes |
| | The Making of a Cloud | sciclub.link/cloudmaking |
| **2: Build a Satellite** | Want to Launch a Satellite? You can! | sciclub.link/satlaunch |
| | How to Observe Satellites | sciclub.link/a3d9 |
| **3: Ground Truthing** | Landsat's Orbit | sciclub.link/nasaSAT |
| | Best of "Earth As Art" | sciclub.link/earthart |
| | Google Maps | sciclub.link/gmaps |
| **4: A Closer Look at the Sky** | Why So Many Cloud Types? | sciclub.link/cloudtypes2 |
| | Why Do Clouds Stay Up? | sciclub.link/cloudsup |
| **5: Connect to NASA** | Cloud Names | sciclub.link/cloudnames |
| | How to Do a *Sky Survey* | sciclub.link/skysurvey |
| | GLOBE Observer | sciclub.link/globeobserver |
| | Cloudy Forecast | sciclub.link/nasacloud |
| **6: Rocket Science** | On a Rocket Launch to Space | sciclub.link/rocketlaunch |
| | How Do We Launch Satellites Into Space? | sciclub.link/satlaunch2 |
| **7: Drain to Rain** | The Water Cycle | sciclub.link/watercycle |
| | Recharging Aquifers | sciclub.link/aquifers |
| **8: Measure the Wind** | Wind Power | sciclub.link/windpower |
| **9: Erupt a Volcano** | Volcanoes 101 | sciclub.link/volcanoes101 |
| | How Do Active Volcanoes Change Clouds? | sciclub.link/volcanoecloud |
| | Carbon Footprint Calculator | sciclub.link/footprint |
| **10: Fly a Kite** | NASA Launches Super-Pressure Balloon | sciclub.link/nasaballoon |
| | Float Beijing | sciclub.link/floatbeijing |
| **11: Green Design** | Green Building | sciclub.link/greenbuild |
| | Green Solutions | sciclub.link/greensolutions |
| | Waste Water Recycling | sciclub.link/wastewater |
| | World Green Building Council | sciclub.link/greenbldg |
| **12: Cloud Conclusions** | Climate Kids: Eyes on Earth | sciclub.link/nasaclimate |

# GLOSSARY

| | |
|---|---|
| **altitude** | the height of an object or point in relation to sea level or ground level |
| **alto-** | prefix for mid-level clouds |
| **anemometers** | an instrument for measuring the speed of the wind, or of any current of gas |
| **atmosphere** | the envelope of gases surrounding the earth or another planet |
| **cirro-** | prefix for high-level clouds |
| **cirrus** | cloud forming wispy filamentous tufted streaks (“mare's tails”) at high altitude |
| **citizen science** | the collection and analysis of data relating to the natural world by members of the general public, typically as part of a collaborative project with professional scientists |
| **cloud** | a visible mass of condensed water vapor floating in the atmosphere, typically high above the ground |
| **condensation** | the conversion of a vapor or gas to a liquid |
| **contrail** | a trail of condensed water from an aircraft or rocket at high altitude, seen as a white streak against the sky |
| **cumulus** | a cloud forming rounded masses heaped on each other above a flat base at fairly low altitude |
| **evaporation** | the process of a substance in a liquid state changing to a gaseous state due to an increase in temperature and/or pressure |
| **ground truthing** | manual collection of data that enables calibration of remote-sensing data, and aids in the interpretation and analysis of what is being sensed |
| **lava** | hot molten or semifluid rock erupted from a volcano or fissure, or solid rock resulting from cooling of this |

| | |
|---|---|
| **magma** | hot fluid or semifluid material below or within the earth's crust from which lava and other igneous rock is formed by cooling |
| **meteorology** | the branch of science concerned with the processes and phenomena of the atmosphere, especially as a means of forecasting the weather |
| **nimbo-** | prefix for clouds that bring precipitation, such as rain and snow |
| **-nimbus** | postfix for clouds that bring precipitation, such as rain and snow |
| **orbit** | the curved path of a celestial object or spacecraft around a star, planet, or moon, especially a periodic elliptical revolution |
| **precipitation** | rain, snow, sleet, or hail that falls to the ground |
| **prototype** | a first, typical or preliminary model of something, especially a machine, from which other forms are developed or copied |
| **rocket** | a cylindrical projectile that can be propelled to a great height or distance by the combustion of its contents |
| **satellite** | a celestial body orbiting the earth or another planet; or an artificial body placed in orbit around the earth or moon or another planet in order to collect information or for communication |
| **solar panel** | a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating |
| **stratus** | cloud forming a continuous horizontal gray sheet, often with rain or snow |
| **sustainability** | able to be maintained at a certain rate or level |
| **volcano** | a mountain or hill, typically conical, having a crater or vent through which lava, rock fragments, hot vapor, and gas are being or have been erupted from the earth's crust |
| **watershed** | an area or ridge of land that separates waters flowing to different rivers, basins, or seas |

# NOTES


CALIFORNIA ACADEMY OF SCIENCES


ACTION CLUB

Genentech

*A Member of the Roche Group*