Weather in the Elementary Classroom: spark interest in math and literacy connections

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Learn how to incorporate the NASA sponsored Global Learning and Observations to Benefit the Environment (GLOBE) Program into your elementary curriculum.

This session will help connect teachers to interact with the broader scientific community by introducing them to the NASA sponsored Global Learning and Observations to Benefit the Environment (GLOBE) Program. Teachers will go through hands-on science activities that demonstrate real-world science. Many of the activities presented encourage outdoor learning, such as collecting weather data similar to the data an atmospheric scientist would collect. Discussion of the GLOBE Data Entry tool will provide opportunities for data collected by students to be used by NASA scientists. The activities included in this presentation will not only support and encourage students in developing science and engineering practices such as asking questions, collecting and interpreting data, but they also incorporate a number of interdisciplinary core ideas within the science lesson. In addition to the science activities and data collection, a number of literacy

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What and Why STEM

Indiana STEM Belief Statement:

To achieve the intended outcomes in this plan, all stakeholders must work from the same definition of STEM. The state of Indiana believes STEM is defined as the following:

STEM education is the integration of the science, technology, engineering and math disciplines with the goal of deploying problem-based and inquiry-based approaches to teaching and learning in the classroom, while developing critical thinking skills and creating pathways to postsecondary readiness and career opportunities.

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What and Why STEM

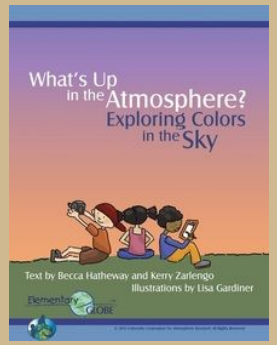
In the U.S., median earnings for STEM jobs are nearly $40 per hour compared with just over $19 per hour for all other jobs (“Education Commission of the States”).

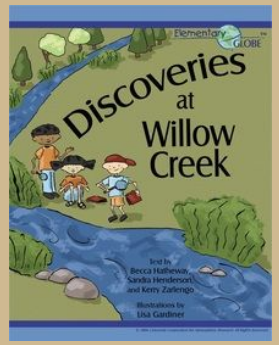
STEM education… “starts as early as preschool, is culturally responsive, employs problem/project/inquiry-based approaches, and engages students in hands-on activities that offer opportunities to interact with STEM professionals” (U.S. Department of Education, 2016).

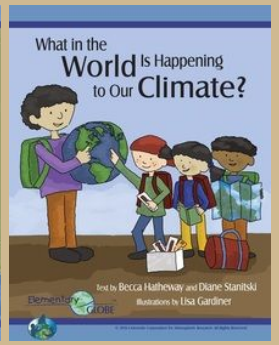
How does STEM fit in the elementary classroom?

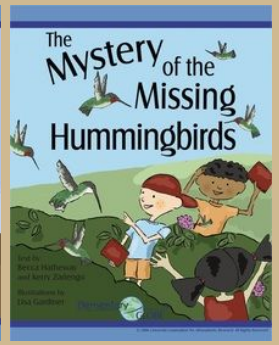
Start with literacy which leads to Science which needs Math, both of which requires Technology. Knowing the STM, we can apply it to Engineering.

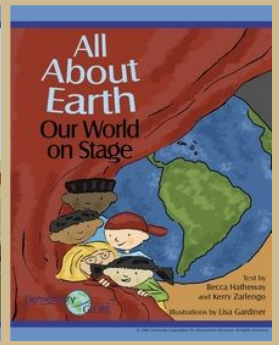
Elementary GLOBE is designed to introduce students in grades K-4 to the study of Earth system science.

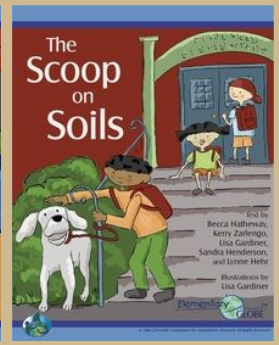


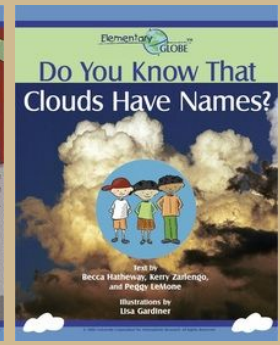












The Teacher Implementation Guide provides an overview of Elementary GLOBE, the connections that the curriculum makes to literacy, the use of science journals, elementary science inquiry, standards alignment, and connections to other parts of elementary curriculum.

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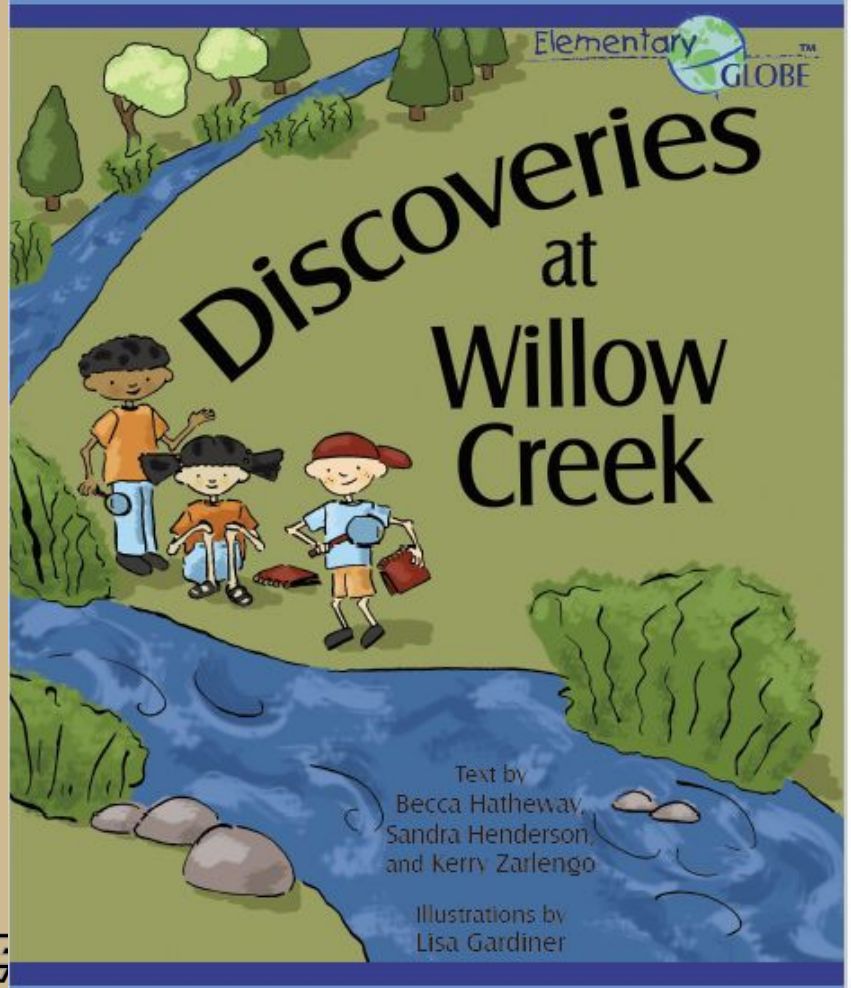
Elementary GLOBE™
Discoveries at Willow Creek
Text by
Becca Hatheway,
Sandra Henderson,
and Kerry Zarlengo
Illustrations by
Lisa Gardiner
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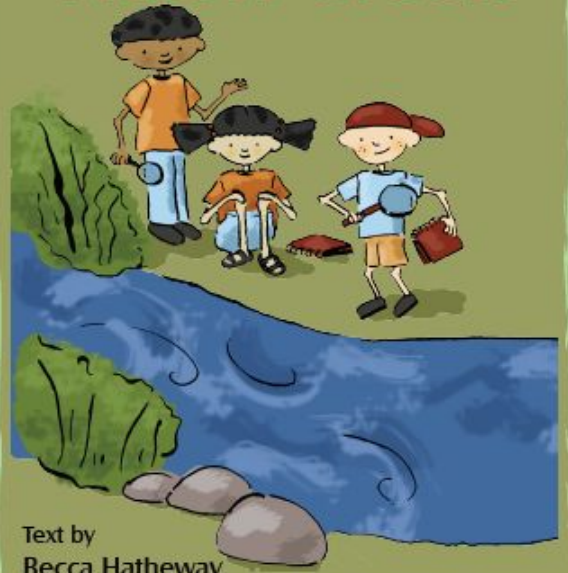
Discoveries at Willow Creek



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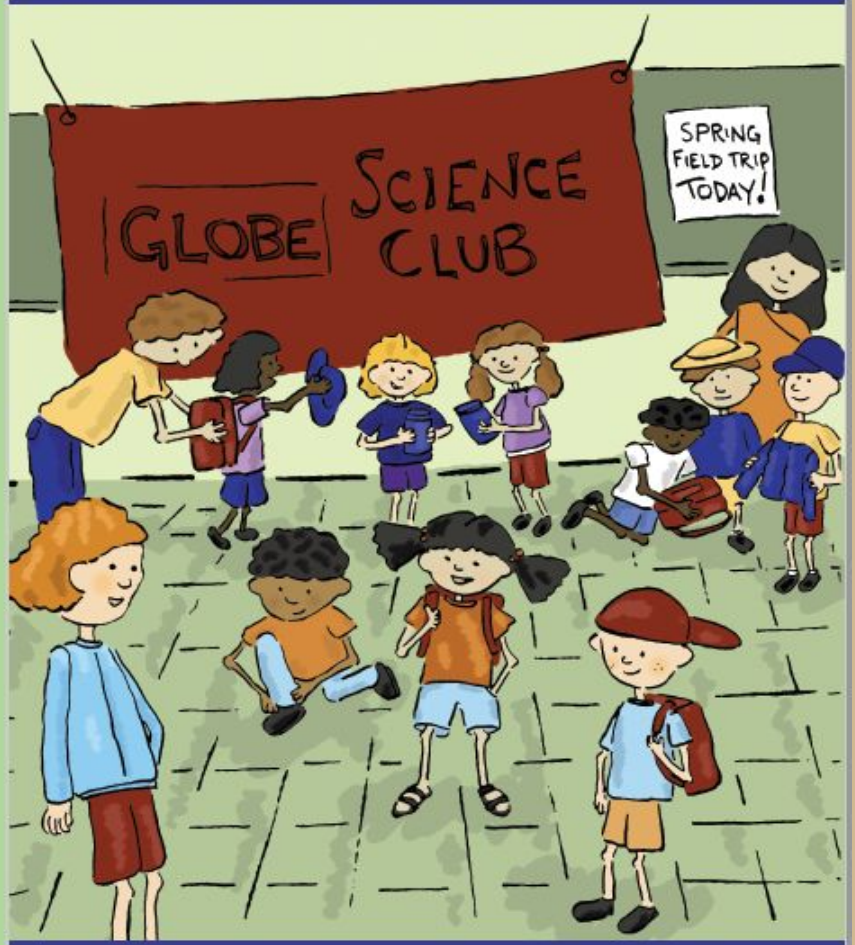
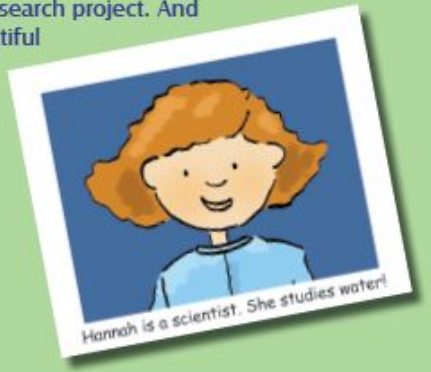


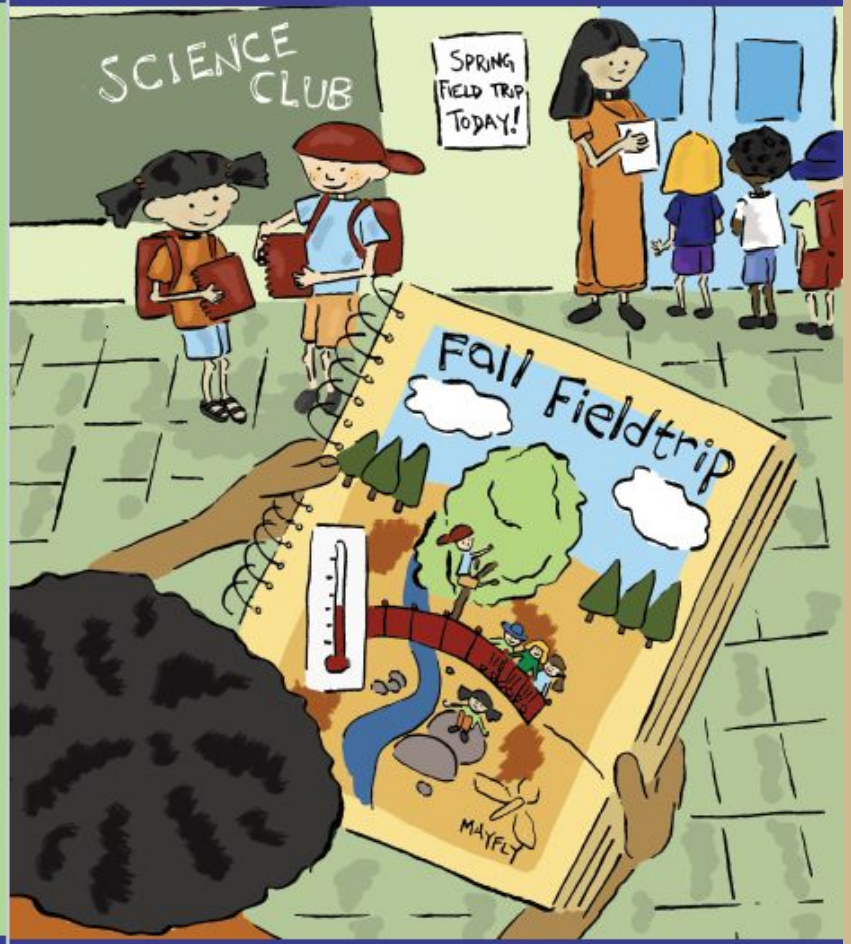
On a spring day, the GLOBE Club gathered for their meeting after school. The students were excited because Hannah, a local scientist, had joined them for the meeting so she could take them on a field trip.

"Wow! It is perfect weather today for a field trip to the Willow Creek Nature Preserve!" exclaimed Simon.

"Hannah, thanks for offering to take us there," said Anita. "We learned so much on our class trip there in the fall. It will be fun to go back."

"Well, you kids have certainly earned this trip. You deserve a reward for the good work you have done with your GLOBE student research project. And Willow Creek is a beautiful spot for a reward," Hannah said.





"Is that the place where we saw all those big rounded stones on the stream bank?" asked Dennis.

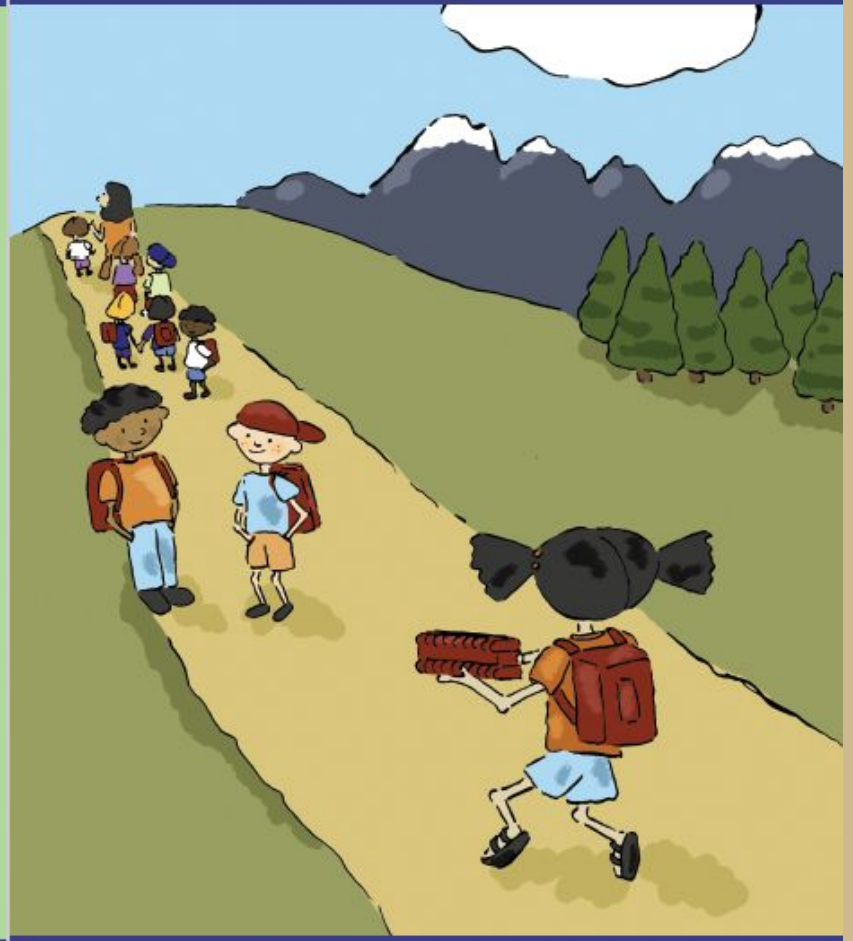
"Yes, that's the place!" Anita said. "We used our science journals there. Let's look at them to see what we recorded in the fall."

They pulled out their basket of journals from the classroom storage closet. When they looked far back in the journals to the beginning of the school year, they saw their entries from their first visit to Willow Creek.

Simon pointed to a drawing in his journal and said, "Look, I drew those big stones that were by the creek! I also wrote about the blue spruce tree and the willows on the stream bank."

"I remember that the water was warm. I even wrote down the temperature in my journal," said Dennis.

Anita added, "I wrote about the water speed in my journal. I also sketched a mayfly that we found in a pool of water on the side of the stream."



"I'm very impressed that all of you recorded your observations and measurements in your journals last fall," said Hannah.

Anita added, "We should bring our journals along this afternoon so we can make more entries."

Simon and Dennis thought about Anita's idea. Simon replied, "I think that's a waste of time because it will be the same."

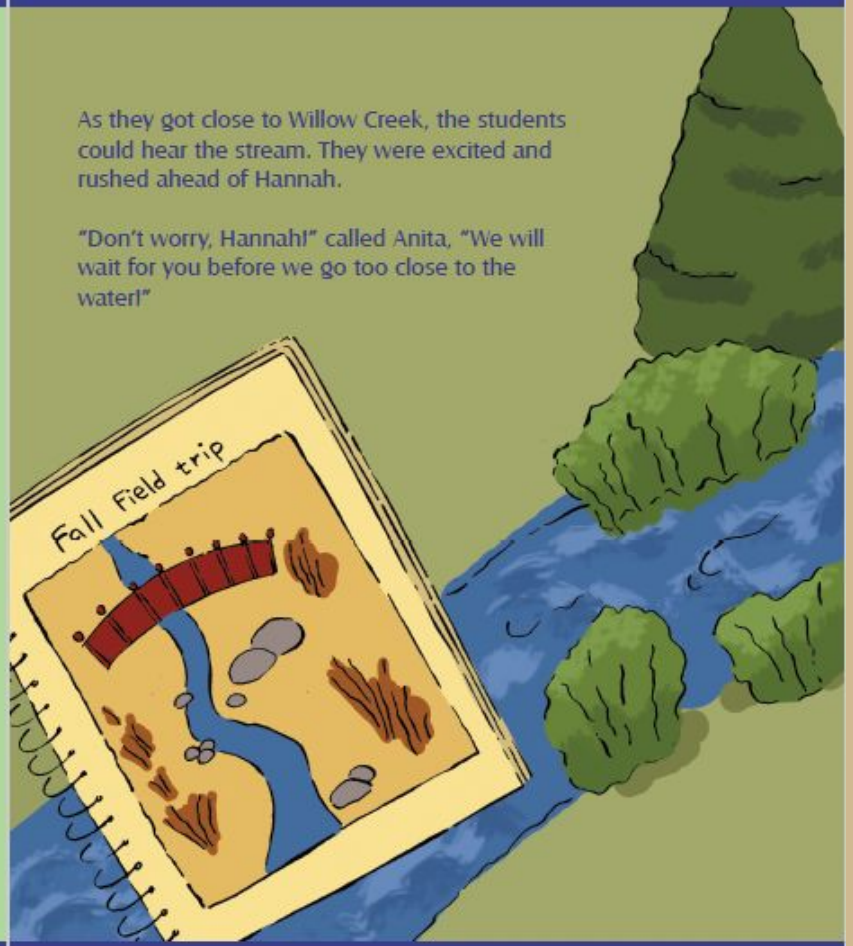
Anita replied, "Remember, Hannah told us that scientists always take their journals in the field. I think it would help if we bring our journals!"

"Okay, maybe you're right. I'll put them in my backpack," Dennis said as they packed the rest of their supplies for the field trip.

Hannah and the GLOBE club walked from their school to the nature preserve.

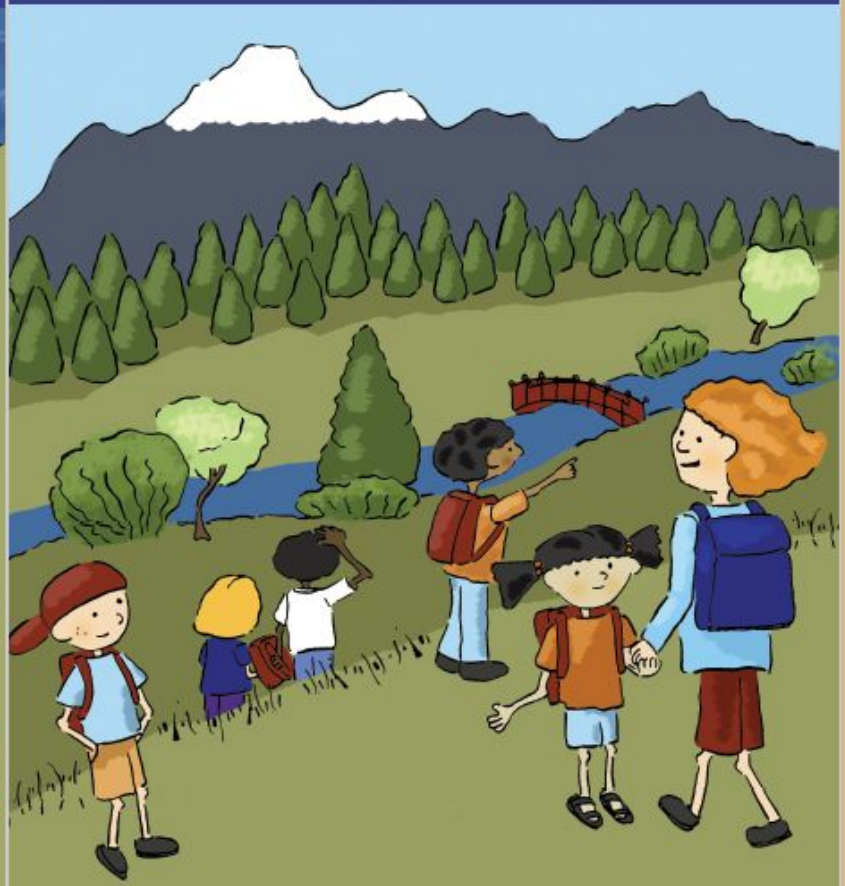
As they got close to Willow Creek, the students could hear the stream. They were excited and rushed ahead of Hannah.

"Don't worry, Hannah!" called Anita, "We will wait for you before we go too close to the water!"



When they arrived at the hill above the creek, Simon exclaimed, "Wow! I don't recognize this place at all! It doesn't look like what we described in our journals."

"I know what you mean. It looks similar but this isn't how I remember it either," Dennis added.



At this point, Hannah caught up to the group.

"Hannah, it doesn't look the same as we remember from the fall," said Anita. "This is going to be a real discovery!"

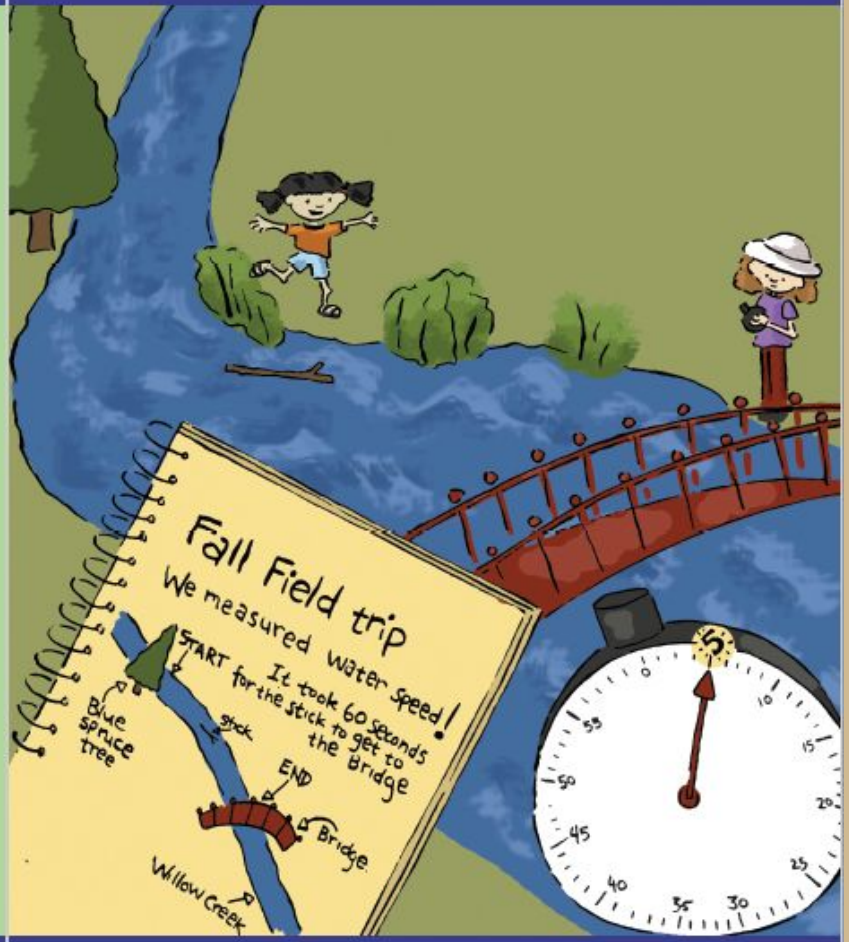
Hannah replied, "I know, it's hard to believe this is the same place. Willow Creek has definitely changed since you were here in the fall. Studying changes like the ones you see is actually part of the work I do as a scientist. Observing and measuring changes in the environment helps us understand how the Earth works."

"Let's go down to the bridge to get a better view of the creek," said Dennis. "Maybe we will be able to see something new down there!"

Standing on the bridge, Simon commented, "I can see that the creek is much wider than it was in the fall. It looks like it has more water now and it is much noisier."

"You're right," said Hannah. "But the amount of water isn't the only thing that has changed at this site. The increased amount of water has caused other changes, too. Before our picnic, try to find some things that are different from what you saw the last time you were here."

The students were up for the challenge! They decided to break into groups and list the changes they found. Then they compared what they saw with their journal entries from last fall. Hannah pulled out some supplies for them to use to collect data about the creek.



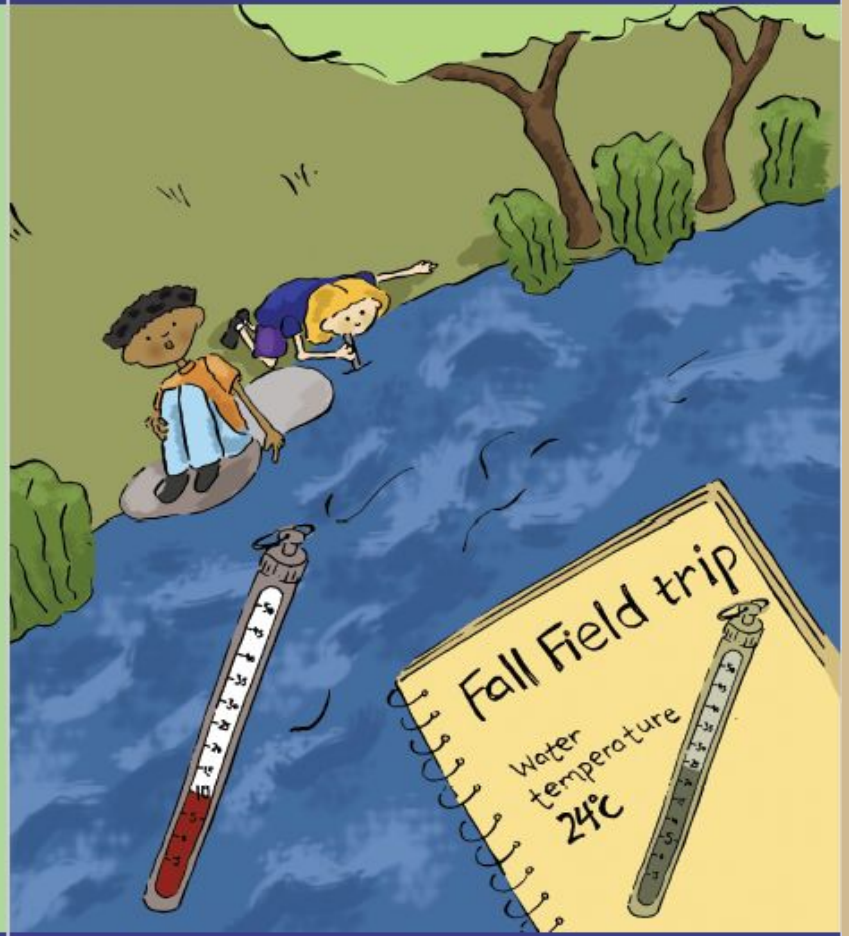
Anita and her group tried to find the area where their class tested the water speed in the fall. The water seemed to be moving so much more quickly this time, so it was hard to figure out where they needed to go.

"Look at this drawing in my journal," said Anita. "I wrote that there were a lot of pools of water along the edge of the creek, and we needed to find moving water to test its speed. It looks like we measured the water's speed starting at that big blue spruce tree. We need to head down there!"

Once they got to the tree, they put a stick in the water and used a stopwatch to time how long it took for the stick to float from the tree to the bridge.

"Ok, this time it took **five seconds** for the stick to go that far. And my notes say that it took **60 seconds** for the stick to float the same distance last fall!" Anita exclaimed. "I think we can conclude that the water is moving more quickly now."

60 seconds in fall
– 5 seconds in spring
A 55-second difference!



How does STEM fit in the elementary classroom?

Start with literacy which leads to Science which needs Math, both of which requires Technology. Knowing the STM, we can apply it to Engineering.

What science can we study from the book *Discoveries at Willow Creek*?

Temperature

Insects

Water flow rate

Seasons

Trees (plants)

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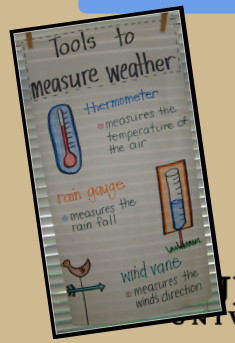
What math will we need to know to be able to study the science?



Measurement

Graphing

Counting

Distance

Time

Temperature

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What are some ways you have used graphs in your classroom?

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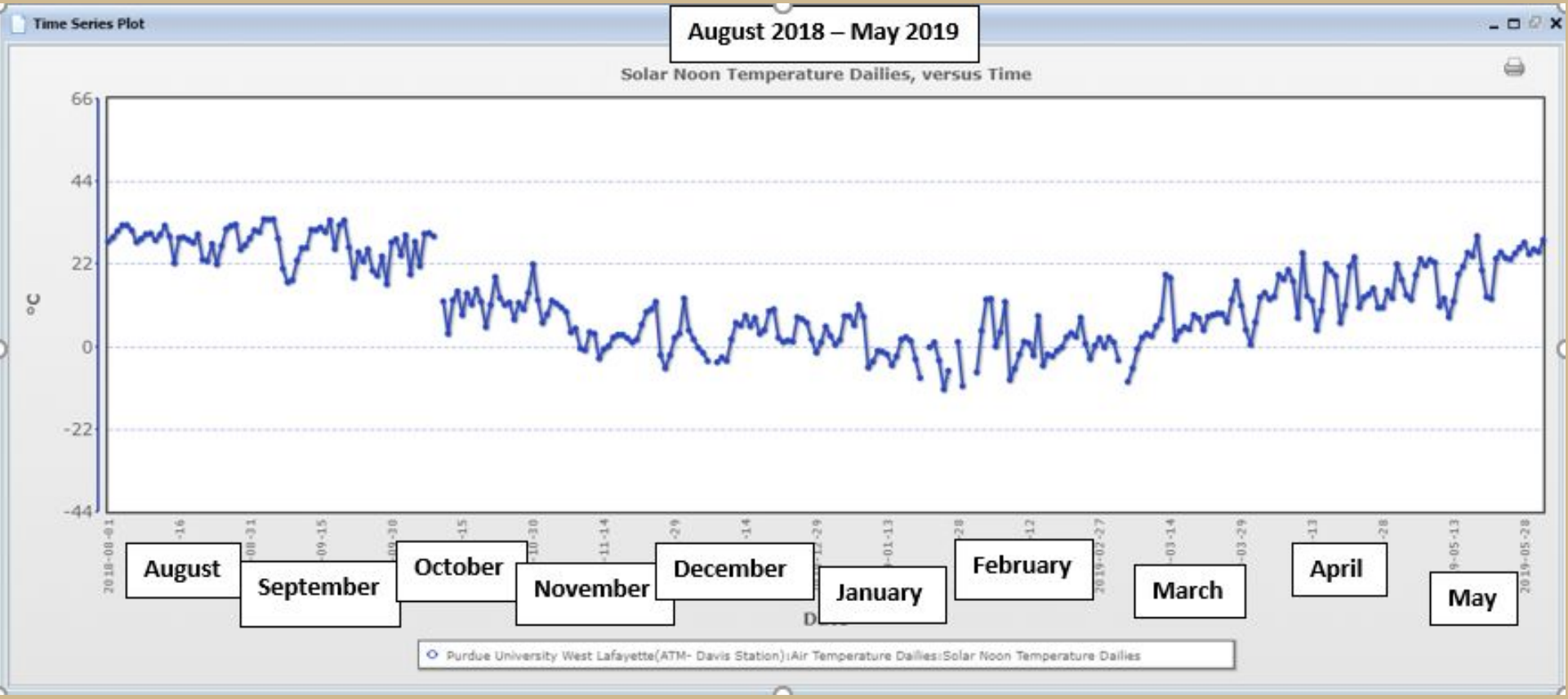
Chef - helps with lunch count and snack time
Zookeeper - feeds the fish and worms
Gardener - waters the plants
Safety Officer - the end of the line (they have to make sure the rest of the kids are "safe" and don't get lost on the way to special and lunch)
Engineer - line leader
Banker - passes out our classroom bucks and helps remove bucks from our pockets after we have banked them each day
Mail Carrier - delivers things and people to the office and nurse
Trash collector - passes out a trash buckets and empties them after projects
Librarian - helps straighten the class library and helps during library time
Office Manager - is the teacher helper, passes out papers, etc.
Safety Officer - holds the door open for us on the way to recess
Electrician - turns the lights on and off
Meteorologist - Records daily temperature



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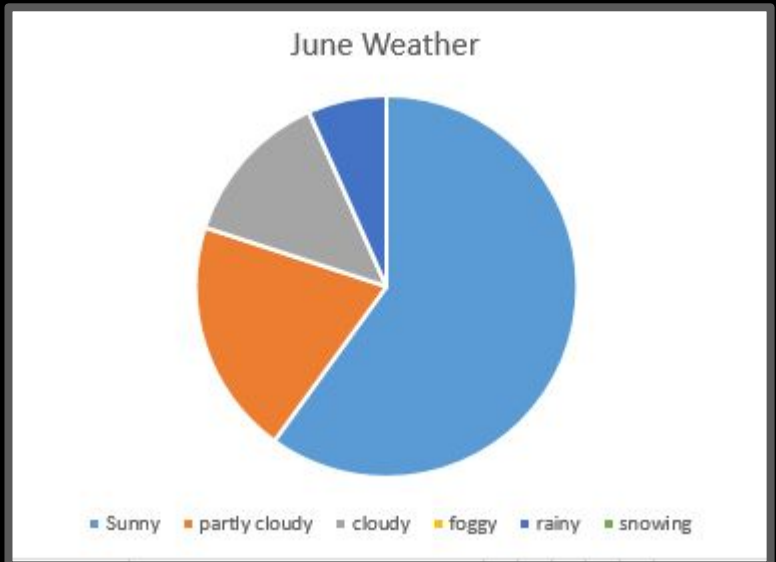
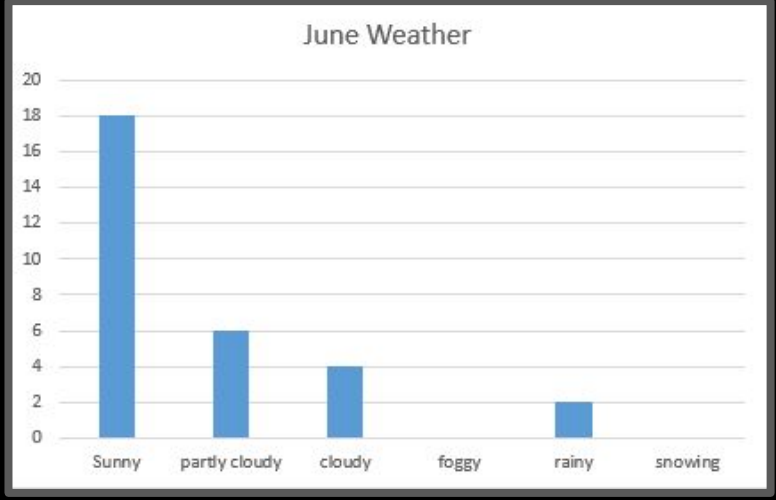
Which of the graphs represent the June weather data from the table below?

Weather	Number of days in June
Sunny	18
Partly cloudy	6
Cloudy	4
Foggy	0
Rainy	2
Snowing	0





Elementary GLOBE — Discoveries at Willow Creek

Measure Up Student Activity Sheet 1

Name _____

The object I will measure is _____.

Here's a drawing of what I measured. →

I am using _____ to measure the length of my object. This is my measurement unit.

Here's a drawing of my measurement unit. →

Estimate

I estimate (guess) that what I am going to measure is _____ units long.

Actual

My object is _____units long.

Complete the math statement below to explain the difference between the estimated and actual length of what you measured.

My estimate was... ☐ more than ☐ less than ☐ the same as ...the actual amount I measured.

Elementary GLOBE — Discoveries at Willow Creek

Measure Up Student Activity Sheet 2

Name _____

Practice measuring with a ruler

The object I will measure is a _____.

It was this long: _____

How tall is that plant?

Estimate

I estimate (guess) that the plant is _____ tall.

Actual

I measured and found that it is actually _____ tall.

In the space below, write a math statement that explains the difference between your estimate and the actual height.

My estimate was... ☐ more than ☐ less than ☐ the same as ...the actual height I measured.

How does STEM fit in the elementary classroom?

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Estimation activity: Estimating Cloud Cover

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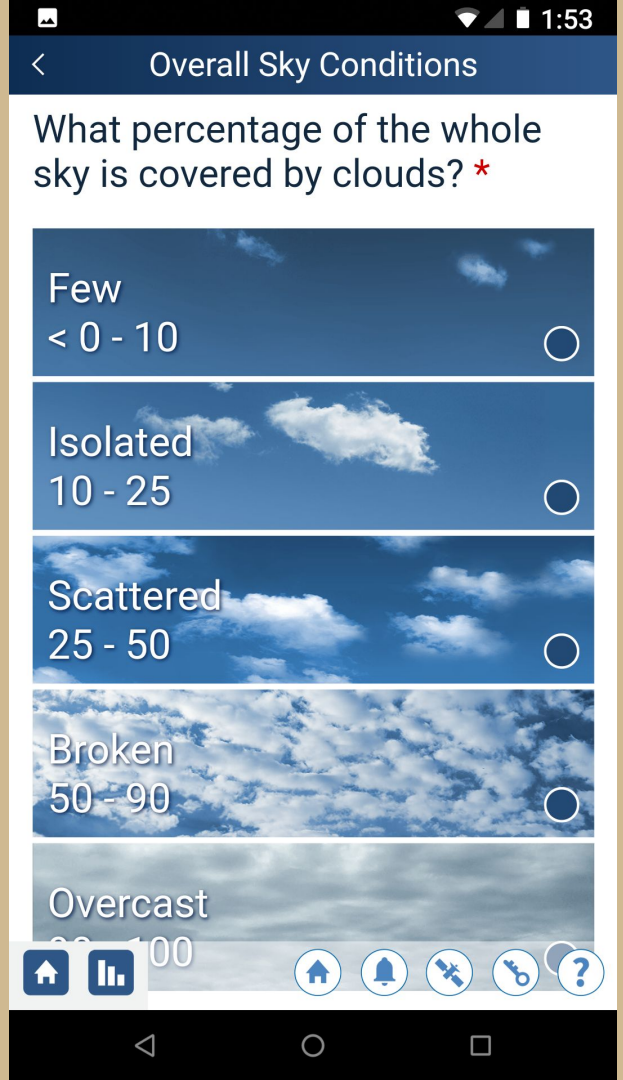

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THE GLOBE PROGRAM
GLOBE
Observer


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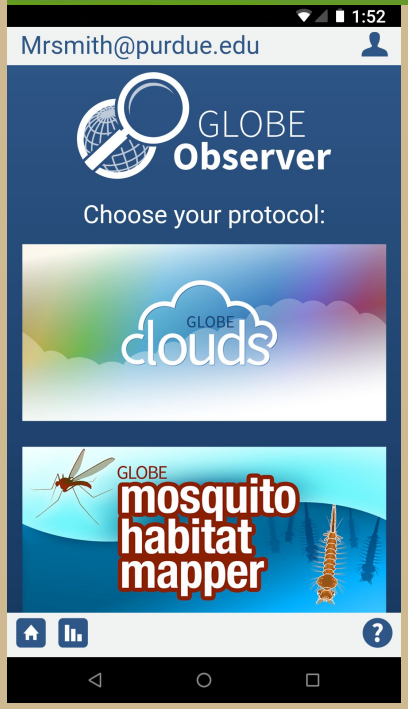
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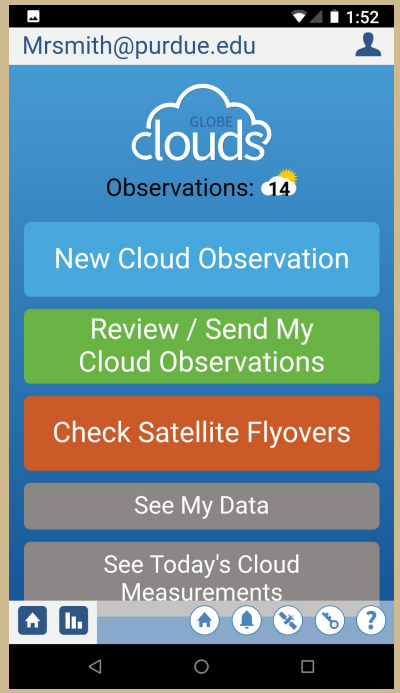
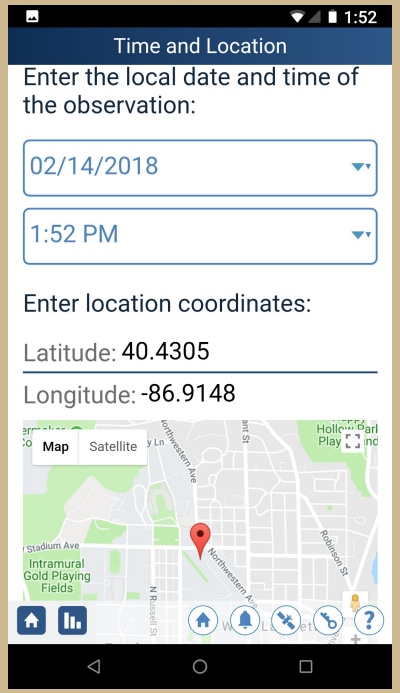
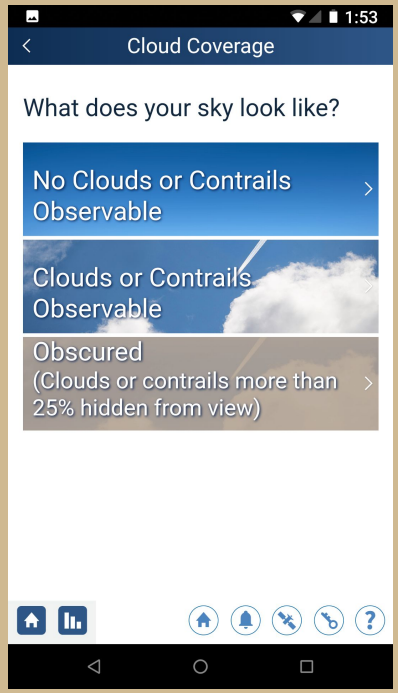
Mrsmith@purdue.edu
GLOBE
Observer
Choose your protocol:
GLOBE
clouds
GLOBE
mosquito
habitat
mapper


1:52
Mrsmith@purdue.edu
GLOBE
clouds
Observations: 14
New Cloud Observation
Review / Send My
Cloud Observations
Check Satellite Flyovers
See My Data
See Today's Cloud
Measurements


1:52
Time and Location
Enter the local date and time of
the observation:
02/14/2018
1:52 PM
Enter location coordinates:
Latitude: 40.4305
Longitude: -86.9148
Map
Satellite
Intramural
Gold Playing
Fields


1:53
Cloud Coverage
What does your sky look like?
No Clouds or Contrails
Observable
Clouds or Contrails
Observable
Obscured
(Clouds or contrails more than
25% hidden from view)

Cloud Observation

NASA Cloud Observation and Satellite Match

Satellite		GEO	Your Observation
Universal Date/Time 2019-03-15		18:33	18:43
Latitude Range Longitude Range		40.11 to 40.75 -87.24 to -86.6	Latitude 40.43 Longitude -86.91
Total Cloud Cover		Isolated 17.74%	Few (<10%)
High	Cloud Cover Cloud Altitude Cloud Phase Cloud Opacity	No Clouds	
Mid	Cloud Cover Cloud Altitude Cloud Phase Cloud Opacity	Few (6.45%) 2.5 (km) Mixed 268.26 (K) Transparent	Altocumulus Altostratus Few (<10%) Transparent
Low	Cloud Cover Cloud Altitude Cloud Phase Cloud Opacity	Isolated 11.29% 1.12 (km) Mixed 275.74 (K) Transparent	
Corresponding NASA Satellite Images Click to view image --->		GOES-16 Visible Infrared GEO Tutorial	Sky Visibility : Clear Sky Color : Blue North East South West Up Down

Are there any comments you would like to add? Be sure to add the name of the satellite for our record.

Surface Conditions	
Snow/Ice	No
Standing Water	No
Muddy	No
Dry Ground	Yes

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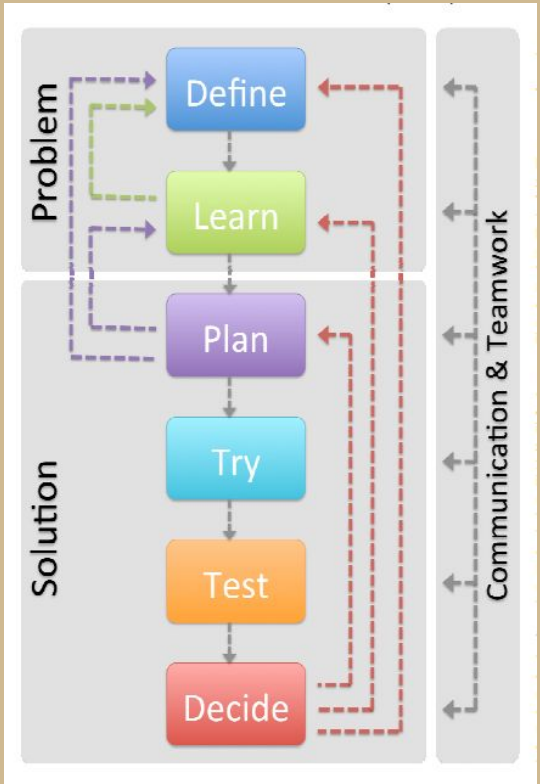

DEFINE: What is the problem? What are the criteria? Who is the client ? Who is the end user ?

LEARN: Learn about the science and mathematics skills, knowledge and tools that will help you solve the problem.

PLAN: Brainstorm many ideas before deciding which one to try. Make sure your design plan:

1) clearly communicates your idea
(2) includes some of the following information : measurements, materials, colors, how things fit together, and the order in which things should be done.
3) meets the criteria and constraints as best as possible. It is okay to go back and learn something new before finishing a plan..

TRY: Use your plan to create a prototype or a process.

TEST: Conduct fair tests to see if your plan is a good solution for the problem. Use mathematics to make sense of the data you collect.

DECIDE: Use the test results to make decisions about the solution.

COMMUNICATION/TEAMWORK: Clearly communicate your solution to the client.

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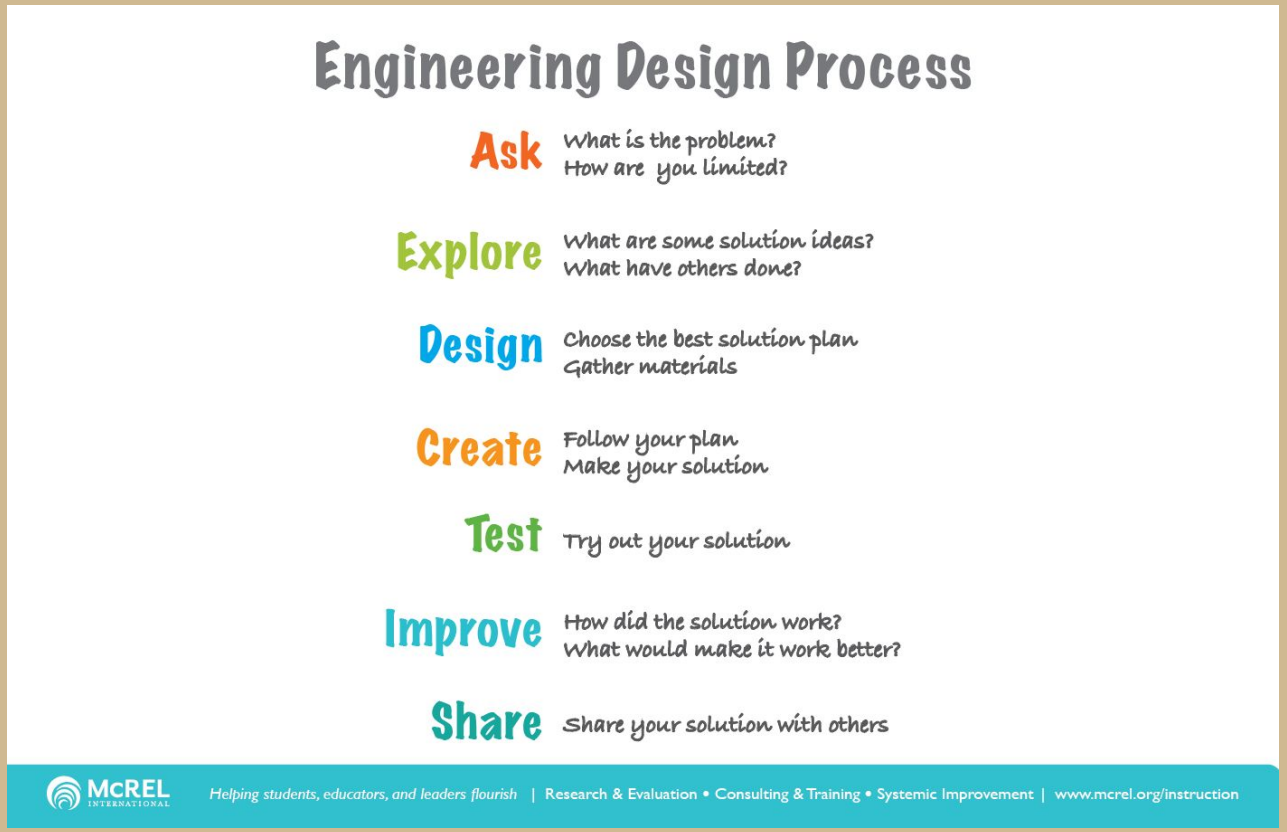

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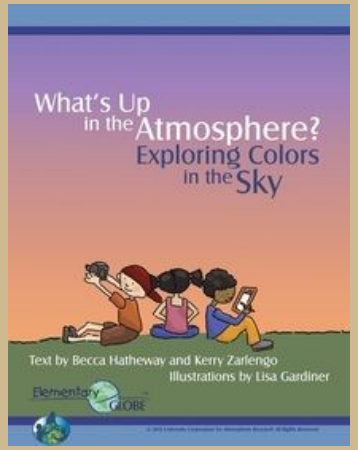
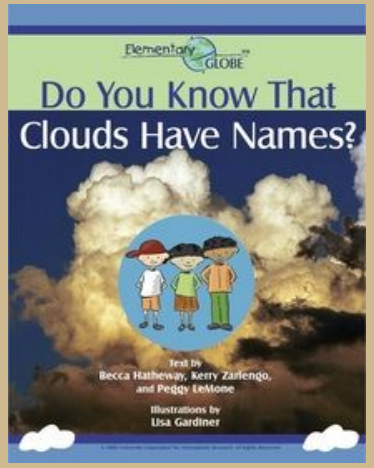
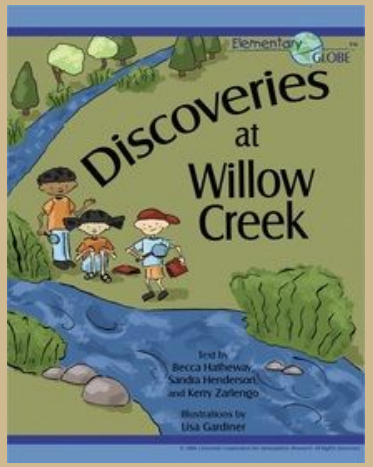
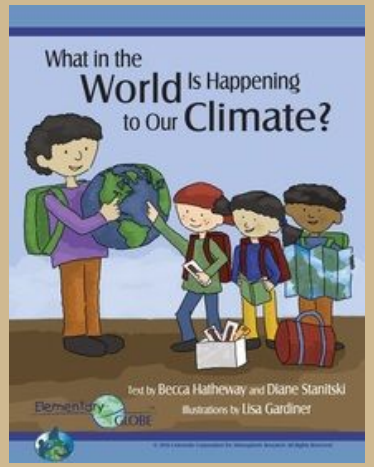
The Read Aloud

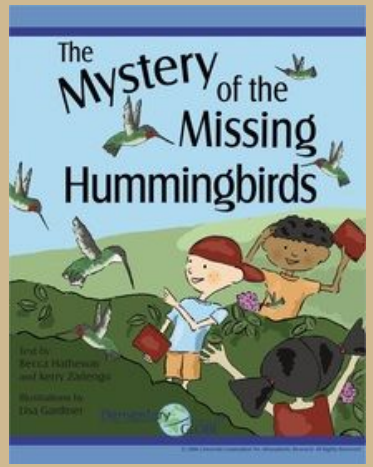


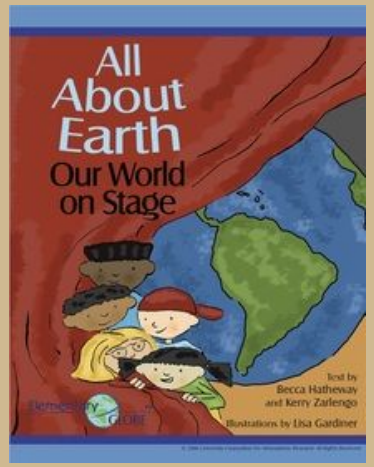
https://www.globe.gov/web/elementary-globe

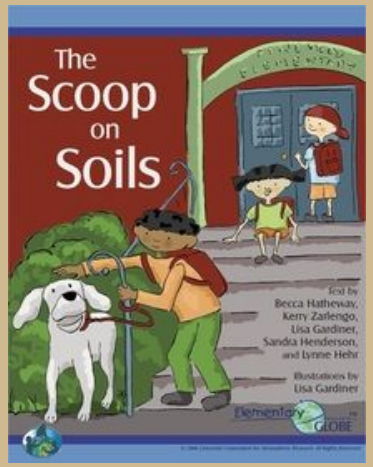








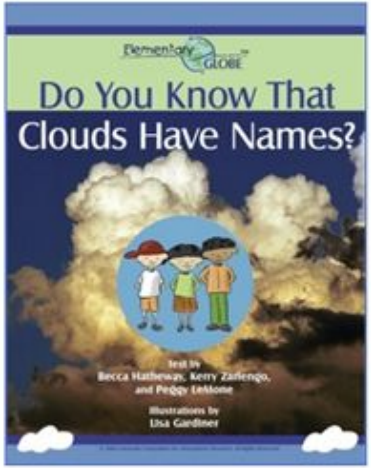




https://www.globe.gov/web/elementary-globe

Clouds Module

In this book, descriptions of cloud types are combined with analogies related to cloud shapes and are acted out by the GLOBE Kids. Activities give students the opportunity to describe the shape and appearance of cumulus clouds and learn the types of weather that are associated with cumulus clouds. They identify cloud types using cloud classification names and explore the three types of contrails.



Storybook: *Do You Know That Clouds Have Names?*

- Book PDF (printer friendly)
- eBook (for computers and tablets)

Activities:

- Cloud Fun
- Cloudscape
- To Spread or Not To Spread

Help

- Printing Tips
- eBook Instructions

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Elementary GLOBE™

Do You Know That Clouds Have Names?

Text by
Becca Hatheway, Kerry Zarlengo, and Peggy LeMone

Illustrations by
Lisa Gardiner

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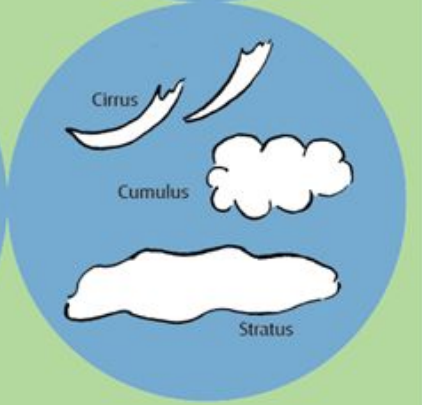


Do you know that kids have names like Simon, Anita, or Dennis?

Do you know that dogs have names like Mila, Murphy, or Tank?

Do you know that flowers have names like marigold, daisy, or tulip?

Well, clouds have names, too! Some cloud names are cirrus, cumulus, and stratus.

Teachers: Explain to your students the use of the words "names" and "groups" here. "Names" can be for individual things or for groups of things (e.g., a cirrus cloud may be one individual cloud or it may refer to that group of cloud types. And when something is in a group, you can also use the word "category."

When reading this page to your class, you can replace the names listed above with names of students in your class, their pets' names, and plants you have in or near your classroom!

Do you know that clouds get their names from their shape, how high they are in the sky, and if they produce **precipitation**?

On different days and in different places, when you look up in the sky, you might see different types of clouds.

Let's get started and learn the names of the different types of clouds you might see the next time you go outside. In this book, we will use some words we already know to help us learn the names and types of clouds.

Teachers:

The chart below shows the cloud types that are described in this book and whether they are found at low, middle, or high levels in the atmosphere. Use this as a reference and organizer as you introduce students to the various types of clouds.

Altitude					RAINMAKERS CLOUDS	
HIGH	Cirrostratus Clouds (pages 17-18)	Cirrus Clouds (pages 15-16)	Contrails (pages 21-22)	Cirrocumulus Clouds (pages 19-20)		
MIDDLE	Altostratus Clouds (pages 11-12)			Altocumulus Clouds (pages 13-14)	Cumulonimbus Clouds (pages 25-26)	Nimbostratus Clouds (pages 23-24)
LOW	Stratus Clouds (pages 7-8)	Stratocumulus Clouds (pages 9-10)		Cumulus Clouds (pages 5-6)		

Remember that there is a range within each cloud type and that the clouds you see in the sky may not look exactly like the photographs in this book. Additionally, talk to your students about size and scale, and about how the clouds they see in the sky and in photographs have a scale relative to each other. See the *Teacher's Notes* at the end of this book (pages 29-30) for more information on scale and relative size. Also, remember that there can be more than one kind of cloud in the sky at a given time! **Precipitation** is water in solid or liquid form that falls to Earth's surface from the atmosphere (rain, sleet, hail, snow, etc.).

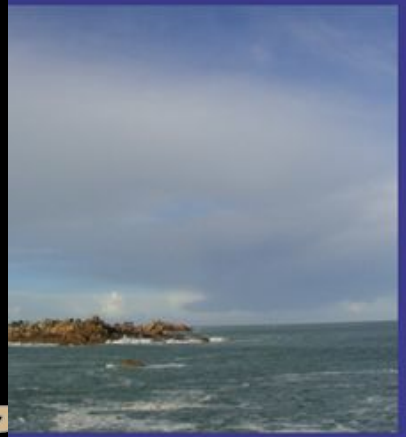
Low Level Cloud

Do you know that some clouds are low in the sky? They are found where blimps, helicopters, and small planes fly. Other clouds are high in the sky, as high as jet planes fly!

One type of low cloud looks like big puffy cotton balls or cauliflower. This is a **cumulus** cloud.

It's fun to lie on the ground and look up at **cumulus** clouds to see what shapes you can find in them. You should try it!

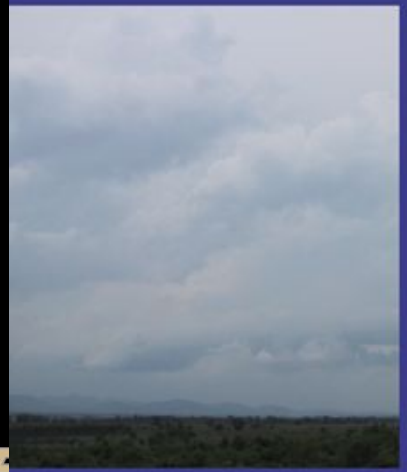
Teachers: **Cumulus clouds** are puffy and sometimes look like pieces of floating cotton. Cumulus clouds are made of water, have sharp outlines, and the base of each cloud is often flat. The top of the cloud has rounded towers. Cumulus clouds can be associated with good or bad weather. Some show up on warm summer days and are associated with fair weather. These clouds are below 2,000 m high. They are usually not very tall and they are separated from each other with lots of blue sky in between.



Do you know what kind of cloud looks like a gray blanket covering the sky? These are **stratus** clouds and they are found low in the sky. Sometimes you can almost see the Sun shining through **stratus** clouds.

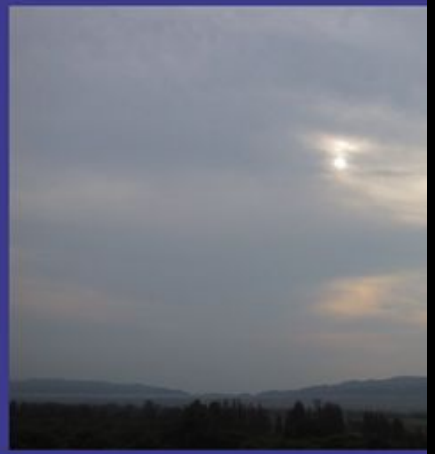
Teachers:

Stratus clouds are uniform clouds that often cover the entire sky. They resemble fog that does not reach the ground. Usually precipitation doesn't fall from stratus clouds, but sometimes they may produce drizzle. Stratus clouds can be found from Earth's surface up to 2,000 m high. Stratus clouds are made of water, not ice, so when you see the Sun's disk through them the edges look sharp.



Do you know what kind of cloud looks soft like cotton candy or pillow stuffing? It is a **stratocumulus** cloud. These are low, gray, puffy clouds that can cover lots of the sky.

Teachers: **Stratocumulus** clouds consist of water droplets and belong to the low cloud (surface to 2,000 m) group. These clouds are low, lumpy, and gray. Some form in rows with blue sky visible in between. Precipitation rarely occurs with stratocumulus clouds. To distinguish between a stratocumulus and an altocumulus cloud, point your hand at arm's length toward the cloud. If the cloud is about the size of your fist or larger, then it is stratocumulus.

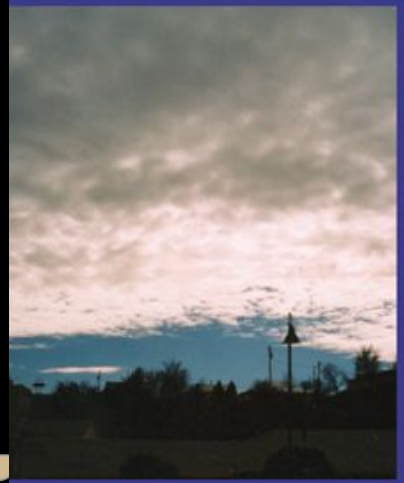


Middle Level Cloud

Do you know that some clouds are higher in the sky? One of the types of clouds you can see at middle altitudes are **altostratus** clouds. These clouds look smooth and uniform, like a blank wall or the frosting on a cake.

Teachers: **Altostratus** clouds are gray or blue-gray middle level clouds (2,000-7,000 m up*) composed of ice crystals or water droplets. These clouds usually cover the entire sky. In the thinner areas of the cloud, the Sun may appear to be behind heavily frosted glass or dimly visible as a fuzzy round disk. Altostratus clouds often form ahead of storms that may produce continuous precipitation.

(* The altitude of middle and high clouds varies depending on latitude. Please see the *Teacher's Notes* on pages 29-30 for more information about the altitude of clouds at your latitude.)



Middle Level Cloud

Do you know which clouds look like fish scales or a flock of sheep? These are **altocumulus** clouds and they are puffy and patchy. They are the other type of middle level cloud and they might trick you because they look similar to cumulus clouds. But they are farther away so they look smaller!

Teachers: **Altocumulus** clouds are middle level clouds (2,000-7,000 m up) made of water droplets or ice crystals and appear as white to gray, puffy masses, sometimes in parallel waves or bands. They usually occur in groups. The appearance of these clouds on a warm, humid summer morning often means thunderstorms may occur by late afternoon. You can distinguish an altocumulus cloud from a stratocumulus cloud by pointing your hand at arm's length toward the cloud. If the cloud is about the size of your thumb, then it is altocumulus.

High Level Cloud

Do you know what kind of clouds are higher than any other type? **Cirrus** clouds are way up high. They are feathery, like the soft downy feathers baby chicks have, or like horse tails floating in the sky.

Teachers: **Cirrus** clouds are thin, wispy clouds spread horizontally into long, thin streamers. They are made of ice crystals and are considered "high clouds," forming above 5,000 m. They generally indicate fair to pleasant weather.

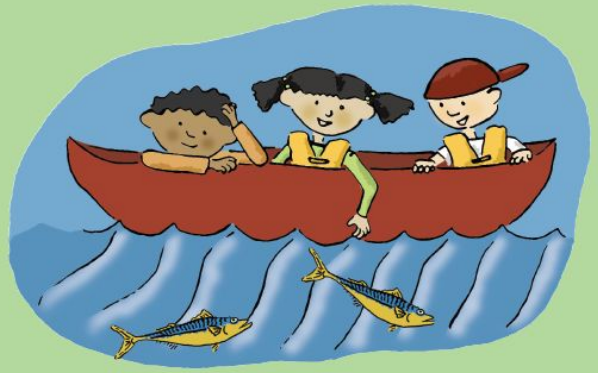
Cirrus clouds are commonly known as "mares' tails" because of their appearance. The reason for the long tail is primarily due to the wind. In the upper troposphere, the winds travel at very high speeds, carrying the cirrus clouds with them.

High Level Cloud

Do you know what type of cloud looks like a thin veil that covers most of the sky? This is a **cirrostratus** cloud and it is one of the two other types of high cirrus clouds. You usually can see the Sun or the moon through them.Sometimes there appears to be a big halo or circle around the Sun through the cirrostratus cloud.

Teachers: **Cirrostratus** clouds consist almost entirely of ice crystals and belong to the high cloud (5,000-13,000 m) group. They are thin, sheet-like clouds that usually cover the entire sky. The Sun or moon can shine through cirrostratus clouds. Sometimes a halo will appear around the Sun or moon when in the presence of cirrostratus because the cloud's ice crystals bend the light. The distance from the sun to the halo is about the width of an outstretched hand held at arm's length. Cirrostratus clouds usually come 12-24 hours before a rain or snowstorm. You can distinguish a cirrostratus from an altostratus cloud by looking for your shadow on the ground. If you can see your shadow, then the cloud is cirrostratus.

Do you know the name of high clouds that look like ripples on the water? They are **cirrocumulus** clouds. They often have a rippled pattern like a lake or bay has on a windy day, or like the pattern on these fish.



Teachers:

Cirrocumulus clouds are small, rounded puffs or long, parallel bands that are made up of ice crystals and usually appear in long rows. They are usually white. Cirrocumulus clouds are found above 5,000 m. The individual cloud elements are the size of your littlest finger or smaller. If the cirrocumulus ripples (or bands) cover most of the sky, it is called a "mackerel sky" because the sky looks like the scales of a mackerel fish. Cirrocumulus clouds are usually seen in the wintertime and indicate fair, cold weather.

A plane just flew by and made this contrail.

This contrail is a few minutes older. It is spreading out!

This contrail is the oldest of the three. It is becoming a cirrus cloud!

This is a good example of a *persistent spreading* contrail!

Contrails that stay in the sky a long time are called *persistent*.

Some contrails don't stay in the sky very long. They are called *short-lived*.

High Level Cloud

Do you know that when airplanes fly they often leave behind a trail of moisture? This is called a **contrail**. Some contrails stay in the sky for a long time after the airplane is gone. These contrails can become human-made cirrus clouds.

(Remember cirrus clouds? Here's a hint: They are high in the sky and look like wispy horse tails.)

Teachers: The word "contrail" comes from the phrase "condensation trail." **Contrails** are clouds formed when water vapor condenses and freezes around small particles (aerosols) that exist in aircraft exhaust. The water vapor comes from the air around the plane and the exhaust of the aircraft. The study of contrails addresses important scientific questions, as they are clouds whose formation is a direct result of human activities. A change in the amount of high-level cloudiness resulting from contrails may impact our climate.

Low to Middle Level Cloud

But wait a minute, we are not done yet! We have gone over the names of clouds, from low to high. What are we missing?

Here's a hint: Do you know that some clouds make different types of precipitation like rain and snow?

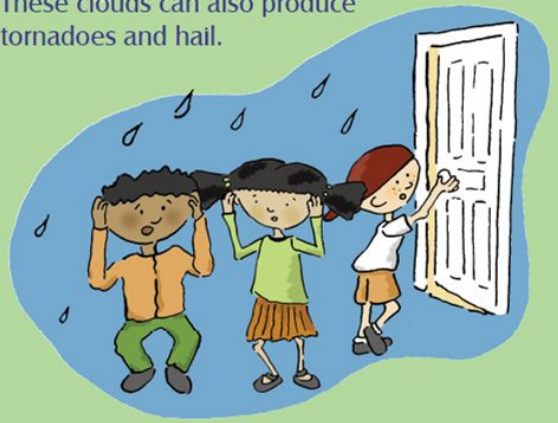
One of these types of clouds is called **nImbostratus**. This cloud is like a big blanket that covers the sky and has steady rain falling from it for a long time. When rain falls from a nimbostratus cloud, it goes on and on and you'll need your raincoat if you go outside!

Sometimes the cloud covers the whole sky, and you can't see any edges. Sometimes you can't even see the cloud because it is raining or snowing really hard.

Teachers: **Nimbostratus** clouds form a dark gray, "wet" looking cloudy layer associated with continuously falling rain or snow. They produce precipitation that is light to moderate. Nimbostratus clouds are low to middle clouds, forming below 2000 m in the sky.

Do you know that the other type of rain cloud can be very noisy?

Cumulonimbus clouds are big, billowing clouds that can be darker at the bottom and white and puffy at the top. Sometimes they produce thunder and lightning and are called thunderheads. These clouds can also produce tornadoes and hail.



Teachers: **Cumulonimbus** clouds are thunderstorm clouds that form if cumulus clouds continue to grow vertically. Their bases may be no more than 1,000 m above Earth's surface. Their tops may extend upward to over 18,000 m. At the top of cumulonimbus clouds, the cloud spreads out, forming an anvil shape. Rain, snow, hail, lightning, thunder, and even violent tornadoes are associated with cumulonimbus clouds.

The next time you go outside, take a look at the sky. Do you see clouds? What types of clouds do you see?

Now you know that those clouds have names!

Teacher's Notes

Tips for Determining Cloud Size, Height and Cloud Type
The cloud heights provided in the text and the definitions below are accurate for middle latitudes. For height ranges at other latitudes, see the diagram at the bottom of the page.

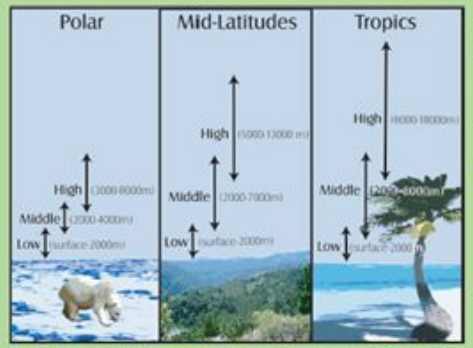
Note about safety: Remind students not to look directly at the Sun when observing clouds!

Low Clouds: These are generally clouds made of water droplets whose base is below 2,000 m altitude. Low cloud types include stratocumulus, cumulus, stratus, cumulonimbus, and nimbostratus. Fog can also be put in this class because it is a ground-level stratus cloud. The tops of cumulonimbus clouds can be high enough to form ice crystals. Note: depending on how dry the air is, the cloud base may be higher than the level listed here.

Mid-level Clouds: These are generally clouds whose base is between 2,000 and 7,000m altitude. Altostratus or altocumulus clouds are mid-level clouds. These clouds are generally made of water, depending on the atmosphere's temperature and other conditions at the cloud altitude.

High Clouds: High clouds are those whose base is 5,000m to 13,000m. This includes cirrus, cirrocumulus, and cirrostratus. These clouds can be made of either ice or water droplets, but are more often made of ice crystals. Water clouds tend to have definite edges, while ice clouds are more wispy. Persistent contrails (airplane trails of moisture that don't just disappear as the airplane passes) are high clouds as well.

Multiple Cloud Layers: Often there is more than one cloud layer present in the sky. If the lower layer is broken, then you will be able to see different clouds above it. When a solid cloud layer is present, any clouds in the layers above it will not be observable from the ground.



Cloud Height	Cloud Type
High	Cirrus Cirrostratus Cirrocumulus
Medium	Altostratus Altocumulus
Low	Cumulus Stratus Stratocumulus Cumulonimbus Nimbostratus

Note: *The International Cloud Atlas* uses the cloud heights listed above. The *GLOBE Teacher's Guide* lists slightly different heights in an effort to average out cloud heights in different latitudes.

Relative Sizes of Clouds
To give your students practice with measuring relative size of clouds, take your students outside or into a hallway and have one student stand at a certain distance away from your group (approximately 3 meters away) and another student stand at a farther distance (approximately 10 meters away). Have the rest of the group look at each student and "measure" their height with their hands/fingers. They will see that the student who is farther away "measures" smaller. This activity can also be done on a stairway or a hill. Students will use this information when determining the level of cumulus and stratus clouds (see hints below).

Unless you live next to a tall skyscraper or a mountain, or you are in an airplane, it isn't possible to figure out the height of a cloud just by looking. This is because there aren't any points of reference in the sky. That's why our determination of height relies on identifying the cloud type.

Hints about Perspective/Relative Sizes:
- It is more difficult to estimate the height of a distant tree than one you can stand by. The farther away an object is, the smaller it looks.
- When we know the actual height of something in the distance, the size it appears to be helps us to estimate how far away it is.
- Estimating both the distance and the height of an unfamiliar object is very difficult unless you can also see the height and distance of something you already know.

Hints for Cumulus-Type Clouds:
- Low cumulus cloud cells (the individual puffs of stratocumulus or cumulus clouds) are about the size of your fist or larger when you hold up your hand at arm's length.
- Mid-level cumulus cloud cells (altocumulus) are about as wide as your thumb when you hold your hand at arm's length.
- High-level cumulus cloud cells (cirrocumulus) are the same size or smaller than the width of your littlest finger when you hold your hand at arm's length.

Hints for Stratus-Type Clouds:
- Without the size clues provided by individual cumulus clouds, determining the height of stratus-type clouds can be a challenge.
- If it rained recently or the cloud layer is very thick and you can't see the Sun, it is most likely a low-level stratus cloud.
- If it's raining during your observation, it is a nimbostratus cloud (or cumulonimbus – but the difference should be obvious if there is thunder and lightning!).
- If a stratus cloud is so thick you can't tell where the Sun is, it is most likely a low-level stratus cloud.
- If you can see the Sun but it looks diffused (like looking through ground glass), it is most likely an altostratus cloud.
- If there is a halo around the Sun whose edge is the width of your hand at arm's length from the Sun itself, then it is a cirrostratus cloud.
- Cirrostratus clouds will generally be thin enough that the Sun is still quite distinct. If the cirrostratus cloud isn't located between you and the Sun, you may be able to distinguish cirrostratus clouds as being so thin that parts of the cloud appear bluish (that is, you are seeing through to blue sky).
- If the cloud does not produce a halo, it can still be a cirrostratus cloud.

For information about clouds, see the Atmosphere section of the GLOBE Teachers Guide (www.globe.gov).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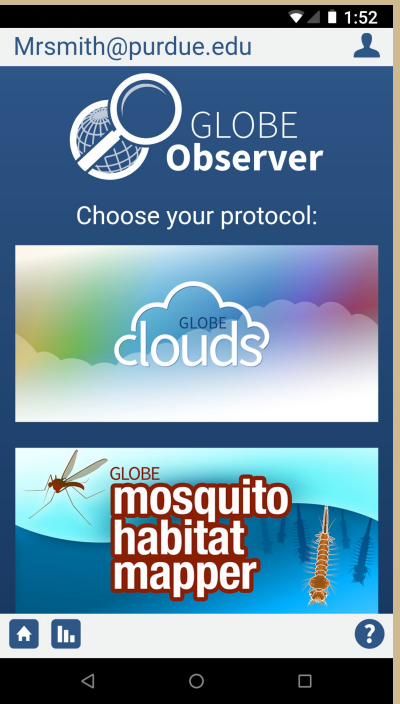
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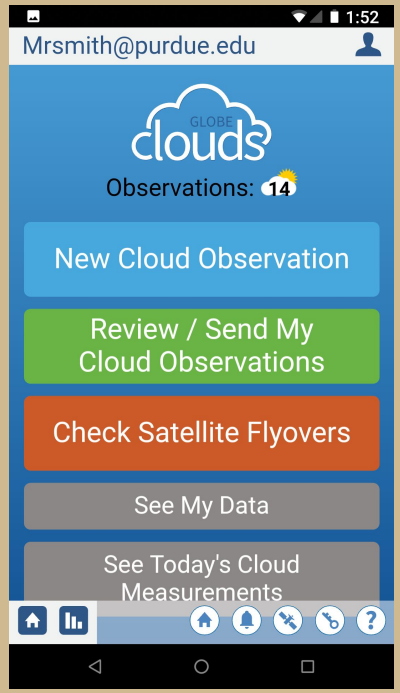
mapper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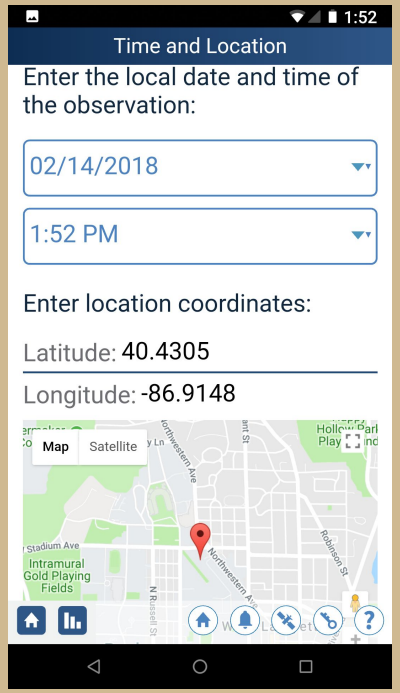
Review / Send My
Cloud Observations
Check Satellite Flyovers
See My Data
See Today's Cloud
Measurements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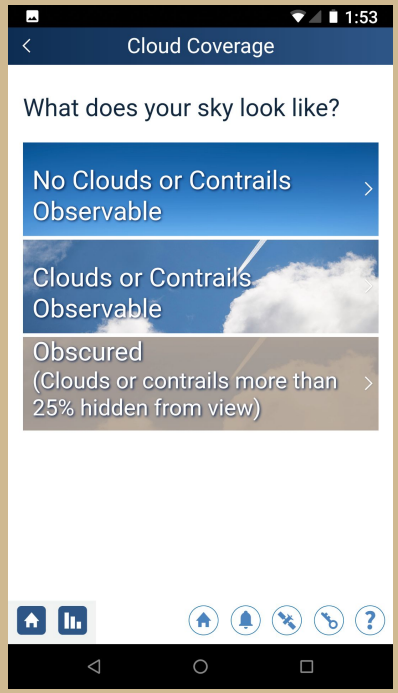
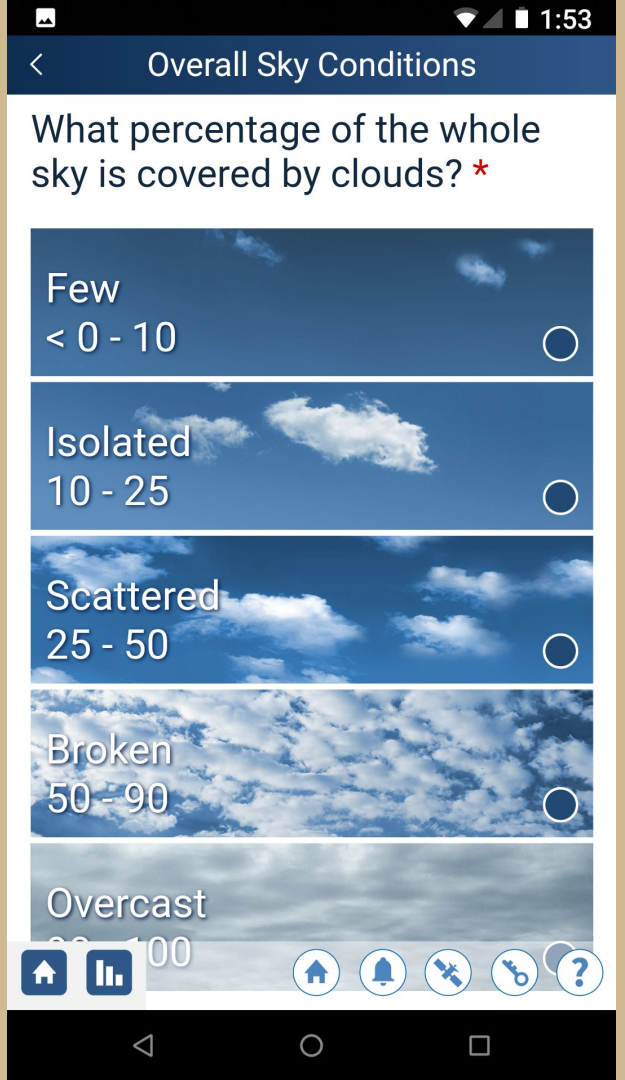

1:53
Cloud Coverage
What does your sky look like?
No Clouds or Contrails
Observable
Clouds or Contrails
Observable
Obscured
(Clouds or contrails more than
25% hidden from view)

What is a cloud?

Can you make one in a bottle?

Back to the app...

Estimating cloud cover.



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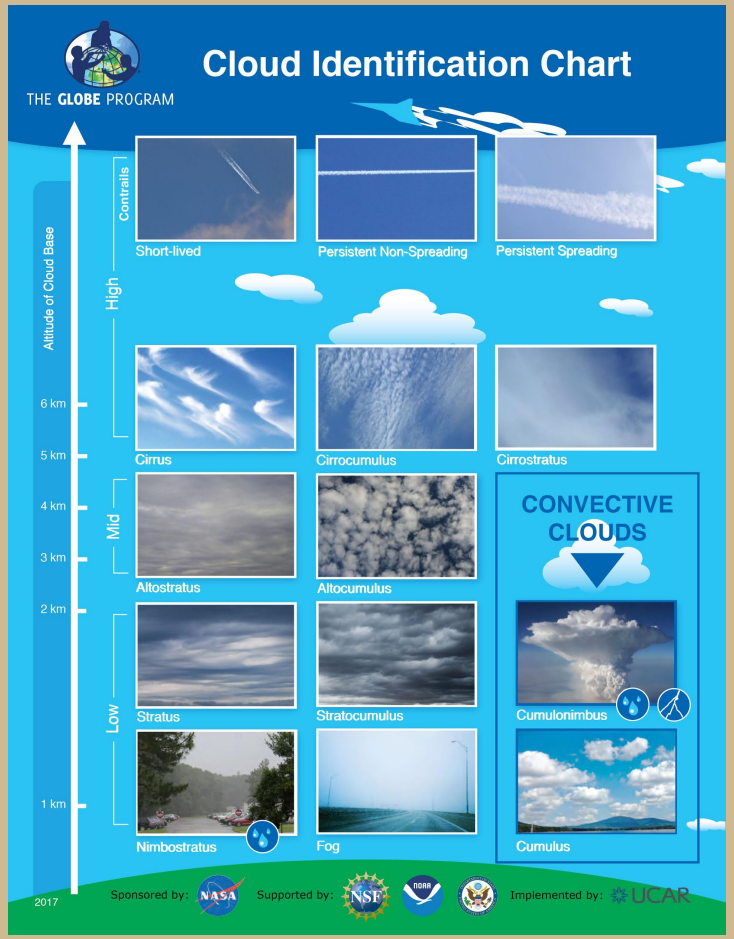
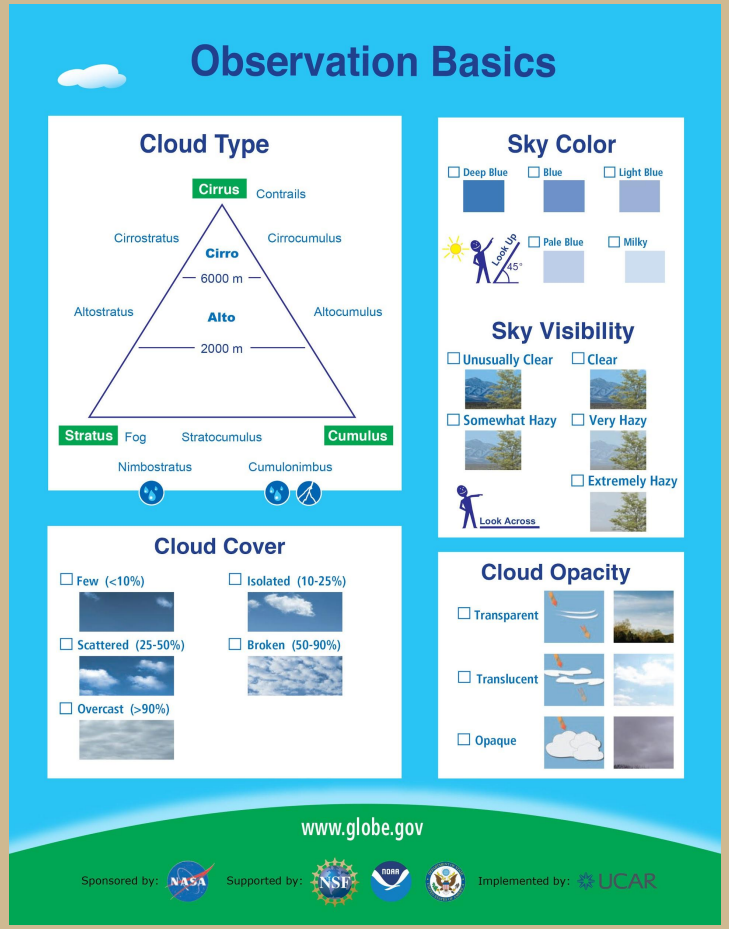
Cloud types





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Elementary GLOBE

What's Up in the Atmosphere? Exploring Colors in the Sky

Up in the Air Student Activity Sheet

Name: _____ Time: ___:___ AM or PM (circle one)

Date: _____

Are there clouds?
- ☐ no clouds
- ☐ some clouds
- ☐ lots of clouds
- ☐ fog

Is there precipitation?
- ☐ none
- ☐ rain
- ☐ sleet
- ☐ snow

Is there wind?
- ☐ gentle wind
- ☐ strong wind
- ☐ no wind

Visibility:
- ☐ very clear
- ☐ clear
- ☐ somewhat hazy
- ☐ very hazy
- ☐ extremely hazy

Temperature:
- ☐ cold
- ☐ chilly
- ☐ comfortable
- ☐ warm
- ☐ hot

Weather data was collected:
- ☐ when the sampler was put outside
- ☐ when the sampler was collected

Aerosol Sample Analysis (8-10 Random Squares):

	# Aerosols
Sample Square 1	
Sample Square 2	
Sample Square 3	
Sample Square 4	
Sample Square 5	
Sample Square 6	
Sample Square 7	
Sample Square 8	
Sample Square 9	
Sample Square 10	
Total (add Squares 1-10)	
Average (divide total by 10)	

Elementary GLOBE

What's Up in the Atmosphere? Exploring Colors in the Sky

Up in the Air Aerosol Sampler Grid

Name: _____ Time of collection: ___:___ AM or PM (circle one)

Date: _____

Aerosol Sampler Grid: