

Picturing Earth From the Space Station

Do you have a camera or smartphone full of photos of cool places you have visited? Imagine the collection you would have if you could see our entire planet every day.

For 60 years, humans have been looking at Earth from space. When astronauts moved into the International Space Station (ISS) in 2000, they started looking at Earth daily. All along, they have been taking photographs – 4 million so far.

Their photos show how connected our world is. They show how people have built cities, destroyed and protected habitats, caused pollution and cleaned it up. They sometimes show many different landscapes and **climate zones** all in one photo.

Astronaut photos provide a long record of what our planet looks like and how nature and humans have changed it. They also remind us of the beauty and wonder of Earth.



Several climate zones meet
around the Andes Mountains.

Vocabulary

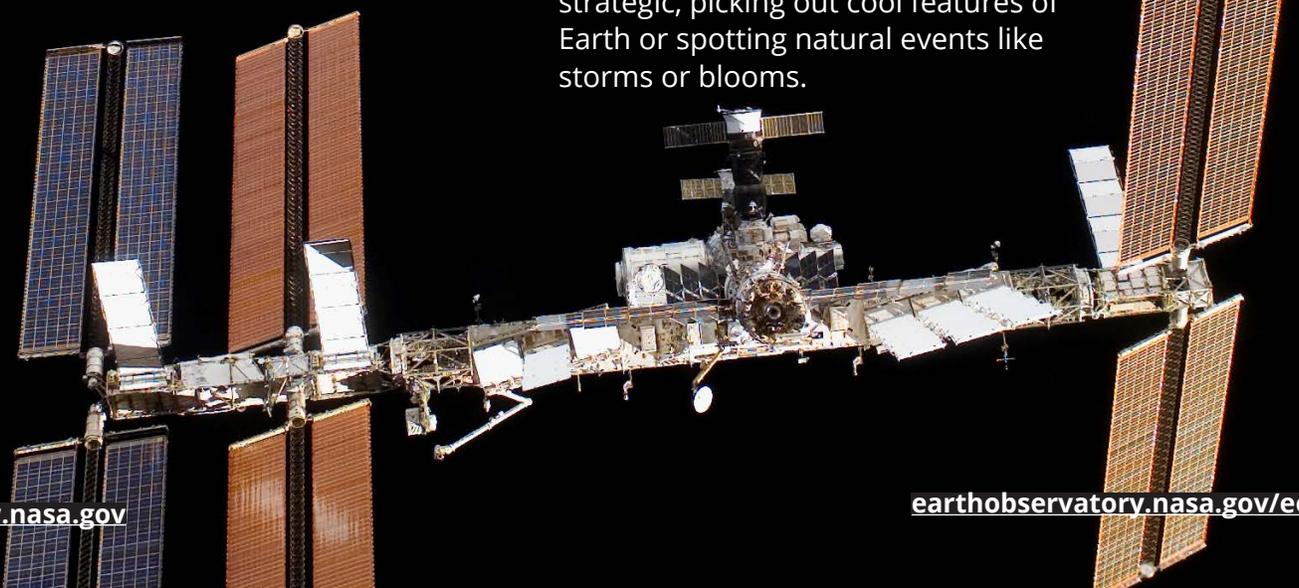


climate zone — a region with a distinct, dominant weather pattern. Zones include tropical, dry/desert, temperate, polar, and continental.

resolution — the amount of detail in an image, often measured in pixels or megapixels per inch. The more pixels, the clearer the photo.

Seeing Things Differently

Most satellites view the world at the same time and same **resolution** with each orbit around Earth. But each space station orbit allows astronauts to see the planet at different times of day with different angles, different clouds, and different lighting. And unlike a robotic satellite, an astronaut can be strategic, picking out cool features of Earth or spotting natural events like storms or blooms.



Astronaut School of Art and Science

Before launching into space, astronauts take a lot of classes, including photography and Earth science.



At NASA's Johnson Space Center, professional photographers and videographers give the astronauts lessons with digital cameras and video equipment like we use on Earth. They teach how to adjust to different lighting and angles and how to zoom and focus when things are moving.

Houston, Texas



Space can be disorienting. Studies have shown that it is good for an astronaut's mental health to look at their earthly home regularly.



The ocean reflects sunlight after sunrise near Sulawesi, Indonesia.



NASA scientists train astronauts how to observe our planet. They give lessons in weather and climate; rock formations, forest types, and ocean color; and how to spot certain cities and natural landmarks. The goal is to help astronauts know what they are looking at and how to recognize when something looks different or unusual.



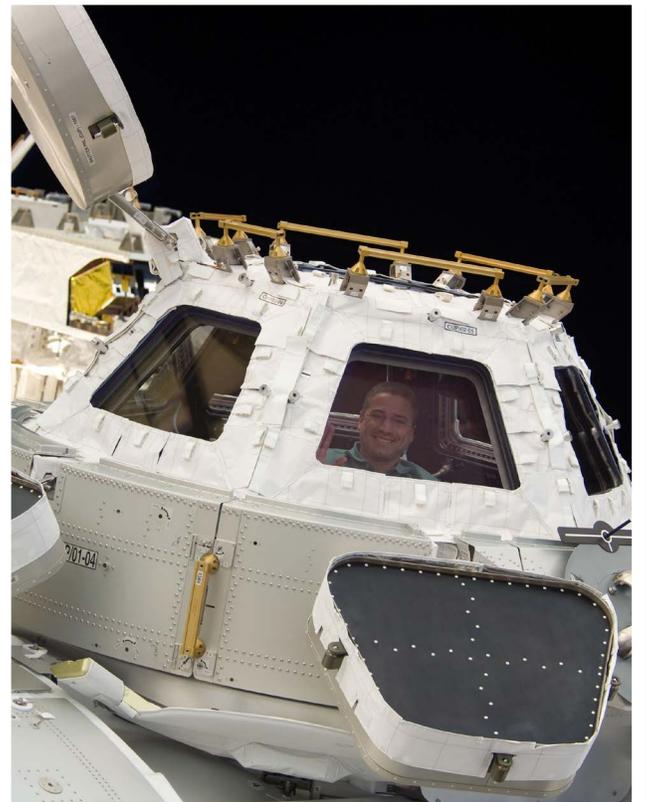
Your class can help choose photos that are taken from the space station. Visit www.earthkam.org

Geographers, engineers, Earth scientists, and even students submit requests for photos. Scientists at NASA review those requests and map what landscapes, seas, and cities the space station will fly over each day. They try to figure out when it will be daytime or nighttime, cloudy or clear. Then they decide which places to photograph and provide astronauts with clues on how to spot their targets.

Window on the World

All of the training in the world still cannot fully prepare you for life as a space photographer.

It is a challenge to take consistently good pictures on Earth. Try doing it while floating in micro-gravity, looking through thick windows, and flying through space. The space station is orbiting Earth at 17,000 miles an hour and the Earth is turning at 1,000 miles per hour. Landmarks move from near to far in seconds. There is a sunrise and sunset every 90 minutes. Since bodies and cameras float weightlessly, astronauts learn to use their arms, legs, and feet to steady themselves while looking out the windows.



Astronauts call the cupola the "window on the world." Jeff Williams says: "It is everybody's favorite window. It's the only place on the space station where you can see the entire globe."



Astronauts keep cameras and lenses near the different windows to be ready whenever they pass over something interesting. "If you are targeting a specific location on Earth, you have to be ready when it passes underneath," says astronaut Jeff Williams. "It's not going to wait for you."

So Much to See and Learn

Astronaut photos have been used to study everything from cities and energy use to unusual electricity in the atmosphere. They have been used to observe fishing boats, coral reefs, and icebergs. Sometimes they capture unexpected events like volcanic eruptions. Other hazardous events – like typhoons or floods – are shot by request from government agencies.

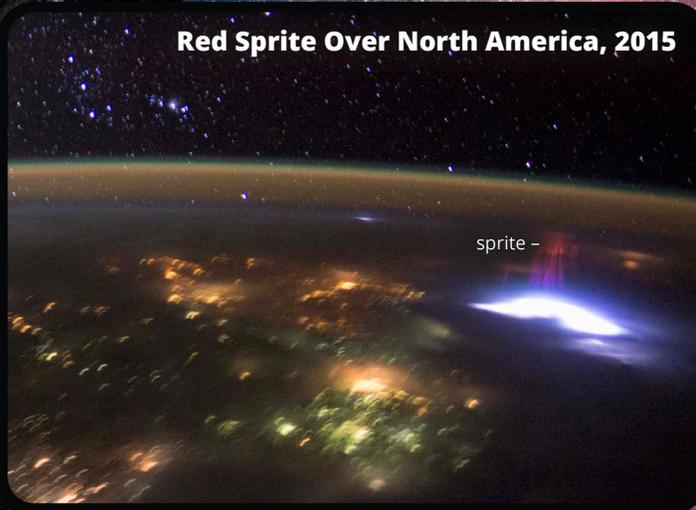
Sarychev Volcano, 2009



Hurricane Dorian, 2019



Red Sprite Over North America, 2015



Aurora Australis, 2011



Mesospheric Clouds, 2007



Astronauts have provided rare views of polar mesospheric or "night-shining" clouds. They form very high in the atmosphere near the poles.

Okavango Delta, 2011



Scientists used photos from the ISS to discover megafans, large fan-shaped deposits. They are built by many stream flows branching from a single source.

Notes From the Field

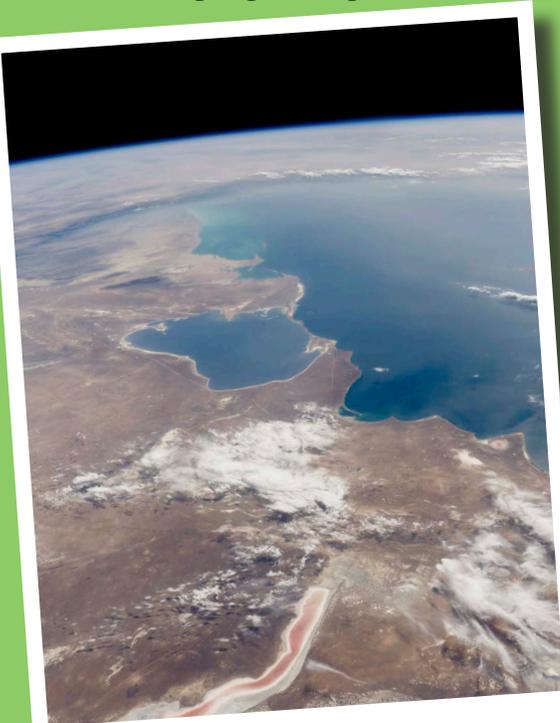
Q&A with Earth Scientist Andrea Wenzel



Andrea Wenzel works at NASA Johnson Space Center in Houston, Texas. She grew up in Texas and studied geology in college and graduate school. Now she helps train the astronauts in Earth science and the geology of the Moon and Mars. She also organizes the photography tasks for the astronauts and their support team on the ground. We asked her a few questions about her job.

EO Kids: Have you ever been scrolling through photos from the space station and thought: "Wow! I've never seen anything like that before!"

Andrea: I was scrolling through photos and I saw all these bright green lights. I thought, "Is that a lens artifact? Is that a reflection of the camera?" But then I realized: "No, there's too many lights and they're too scattered." So I looked it up: they were fishing boats with bright green lights.



Caspian Sea



image credit: Six Senses Yao Noi



Fishing boats (green lights) float near Thailand.

EO Kids: How has your work with astronaut photography changed you?

Andrea: Before I started, I was not used to looking at the world from above. I know my geography a lot better now. It's kind of fun to find a photo without knowing the location reference. If I have enough clues, I can figure it out. "Oh yeah, I'm looking at the Caspian Sea." Astronaut photos have really helped me learn Earth's surface.

EO Kids: What is the scientific value of astronaut photography?

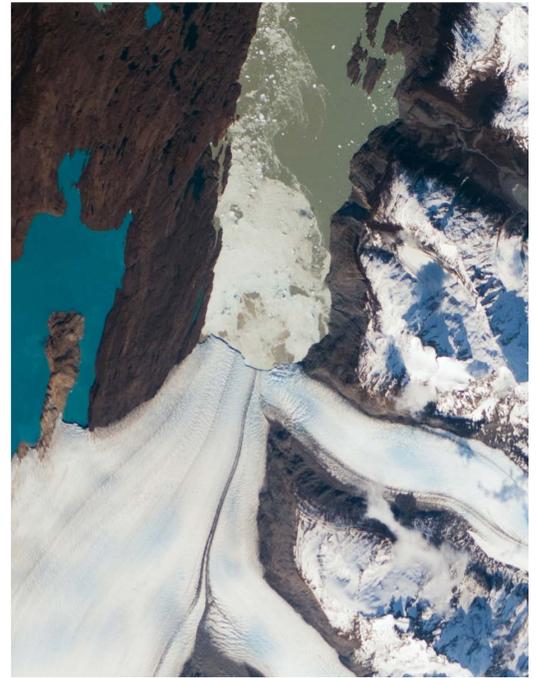
Andrea: Since we have more than 50 years of photography of Earth from space, we can look at certain areas and get a sense of what has changed over time. We can see glaciers receding or growing, or look at a volcano before and after it erupts.

EO Kids: What is the artistic value of this archive?

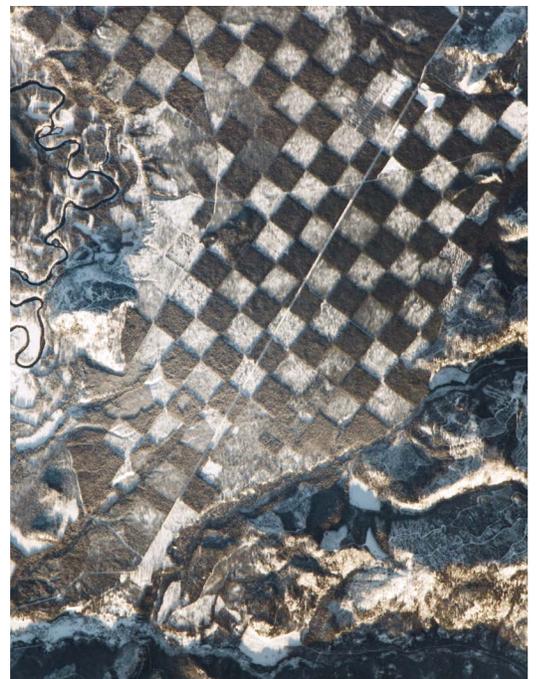
Andrea: When a photo has the perspective of looking at Earth's horizon and seeing these really wide landscapes, I think that puts into perspective just how connected our world is. It's one big, connected system, even if humans make boundaries.

EO Kids: What is your favorite part of your job?

Andrea: I like when I get to talk with the space station crew. We do all this prep for mission operations, and then when we actually have face-to-face time with an astronaut, it is really rewarding. We learn from astronauts through their spaceflight experiences and we teach them about Earth science and photography. It puts all of our work into perspective.



Astronaut photos reveal how much glaciers like the Upsala Glacier in Argentina are receding.



Humans have cut and managed forests in Idaho in a pattern that looks like a checkerboard.

Data Detective

What on Earth is That?

Even if an astronaut is not an Earth scientist, they need to learn how to spot different features and landmarks on Earth. Do you have what it takes to identify different landforms? Start training like an astronaut by playing this matching game.

Materials:

- color printer
- paper or cardstock
- scissors
- 2 - 4 players

Instructions:

1. Print pages 8 – 10.
2. Cut along the dotted lines to create three sets of cards.
3. Turn all the cards from pages 8 and 9 face down in front of you and the other players.
4. On your turn, flip over two cards. If the pair is a match keep them. If the pair is not a match, flip them back over and the next player takes a turn. A match is the name of the feature and the matching picture of the feature.
5. When all cards have been matched, the winner is the player with the most pairs.

Answers are on page 6.

Where on Earth?

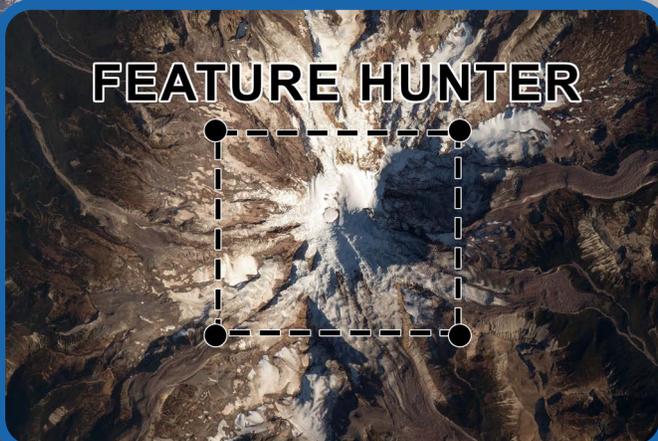
After playing the matching game, see if you can match the pictures to the clues on page 10.

Example Match

Glacier



FEATURE HUNTER



Citizen Science

Join citizen scientists in sorting and organizing photos. Feature Hunter is a fun way to test your skills while helping to teach computers – through machine learning – how to recognize features on Earth's landscape. <https://eol.jsc.nasa.gov/BeyondThePhotography/FeatureHunter/>

Islands

Glacier

Volcano

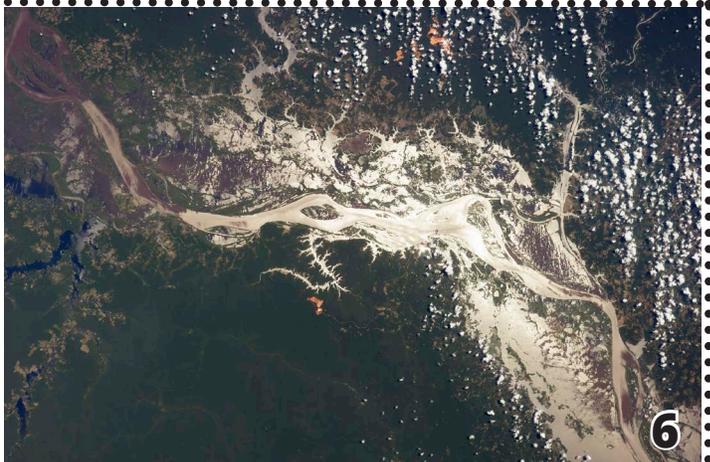
**Smoke
Plumes**

Lake

Farm

River

City



The desert darkness contrasts starkly with the brightly lit street grid of Las Vegas in this photo from the International Space Station.

A

The deepest lake in the United States is a haven for fishermen.

B

Astronauts use the Sun's reflection point to reveal features that are otherwise difficult or impossible to see on the Amazon River.

C

Surrounded by water, islands can also be cities. This island city is known for its canals.

D

Greenery sprouts from the Sahara Desert in Egypt thanks to the Nubian Sandstone Aquifer System.

E

An unexpected series of blasts from a remote volcano in the Kuril Islands sent ash and volcanic gases streaming high over the North Pacific Ocean.

F

The looping medial moraines on Tajikistan's Bivachny glacier offer a clue of periods when it surged rapidly forward.

G

Fires burned so fiercely that they lofted smoke to unusual heights. on January 4, 2020, in Australia.

H