Tuesday, December 13

10:00 – 11:30 ***Images of a Changing Planet: Using Remote Sensing Data and Images to Investigate Land Surface Changes*** – Dr. John Bailey (Google Geo Education), Dr. Ed Robeck (American Geosciences Institute, Center for Geoscience and Society), Peder Nelson (Oregon State University), Aida Awad (Einstein Distinguished Educator Fellow, Department of Energy), and Dr. Susan Sullivan (University of Colorado).

Team Bios for Images of a Changing Planet:
Using Remote Sensing Data and Images to Investigate Land Surface Changes

Aida Awad is an Einstein Distinguished Educator Fellow at the U.S. Department of Energy (DOE) Office of Science. She is certified to teach Geology, Earth Science, Chemistry, Physics, Political Science, Social Science, and World History. Aida was the Science Department Chair at Maine East High School in IL for thirteen years, after teaching Earth Science, Geology, Chemistry and Physics at Maine West High School for nine years. Aida served as an adjunct instructor at Oakton Community College, teaching dual credit Physical Geology courses, and as an adjunct instructor at Aurora University, teaching courses in educational technology integration. She is the Secretary/Treasurer of the National Association of Geoscience Teachers (NAGT), as well as a Past President of the organization. She was a co-convener of the Summit on the Implementation of the Next Generation Science Standards (NGSS) in the Earth and Space Sciences. Aida received her Bachelor of Science degree in Geological Science from the University of Illinois Chicago, and her Master's degree in Earth and Environmental Sciences from the University of Illinois Chicago. She is a Google for Education Certified Trainer and a Hapara Certified Educator. Aida was r ecently named as a Fellow of the Geological Society of America.

Dr. John Bailey is a former volcanologist turned Googler. He holds a MPhys in Physics from the University of Kent at Canterbury, along with a MS and PhD in Volcanology & Remote Sensing, from the University of Hawaii. After working a postdoc at the Alaska Volcano Observatory, he then became faculty at the University of Alaska Fairbanks. Finally, after almost two decades in academia, John decided he needed a new challenge and accepted an offer to join the Google Earth Outreach team as Program Manager for Geo Education. John has a passion for travel and exploring new places and landscapes for himself. To date he has visited over fifty countries and every continent. He aims to teach knowledge, understanding, and stewardship of the planet we live on through the use of Google's Geo tools and other innovative technologies.

Peder Nelson is an Instructor in the Geography Program at Oregon State University teaching cartography, geographic information systems, and remote sensing. He uses these tools to research and teach dynamic landscape processes. As a Senior Faculty Research Assistant at Oregon State University, Peder contributes to land cover and land use change research using remote sensing. He has developed an automated visualization and analysis tool for mapping changes in glacier extent using annual 1984 to 2014 satellite imagery. He also contributed significantly to research projects that mapped and analyzed forest and land cover changes using Landsat satellite imagery across the United States, eastern Europe, Russia, Mongoliia, and Kazakhstan. He holds a Master of Science degree in Biology-Environmental Education from Southern Oregon University.

Dr. Ed Robeck is Director of Education and Outreach at the American Geosciences Institute (AGI), supporting geoscience education throughout the U.S. and internationally. Ed has worked professionally as an educator at several levels, including as a middle school science teacher and an online teacher professional development facilitator. He has also worked in commercial publishing as a writer, designer, editor, and software developer. He holds a PhD from the University of British Columbia where he studied the socio-cultural context of science education and contributed to the Trends in Mathematics and Science Study (TIMSS). In 2008 Ed became a Fulbright scholar, working with teachers in Malaysia to implement technology- based instructional practices. Prior to joining AGI in 2014, Ed was a science teacher educator at Salisbury University in Maryland for 14 years.

Dr. Susan Sullivan is Director of the Education and Outreach Group at the Cooperative Institute for Research in Environmental Sciences (CIRES), a NOAA joint institute at the University of Colorado Boulder. At CIRES, Susan has focused on climate and environmental science education and professional development for teachers for more than twenty years. She is a past president of the National Association of Geoscience Teachers (NAGT) and a co-convener of the Summit on the Implementation of the Next Generation Science Standards (NGSS) in the Earth and Space Sciences. In order to support NGSS implementation, Susan coordinates a webinar series for support of NGSS Earth and Space Science as part of her activities with the NGSS-ESS Working Group, and is currently working with the Denver Public Schools to implement NGSS climate science units in the context of resiliency planning. She holds a PhD in atmospheric chemistry from the University of Colorado, Boulder.

Images of a Changing Planet: Using Remote Sensing Data and Images to Investigate Land Surface Changes

Aida Awad, John Bailey, Peder Nelson, Ed Robeck, Susan Sullivan

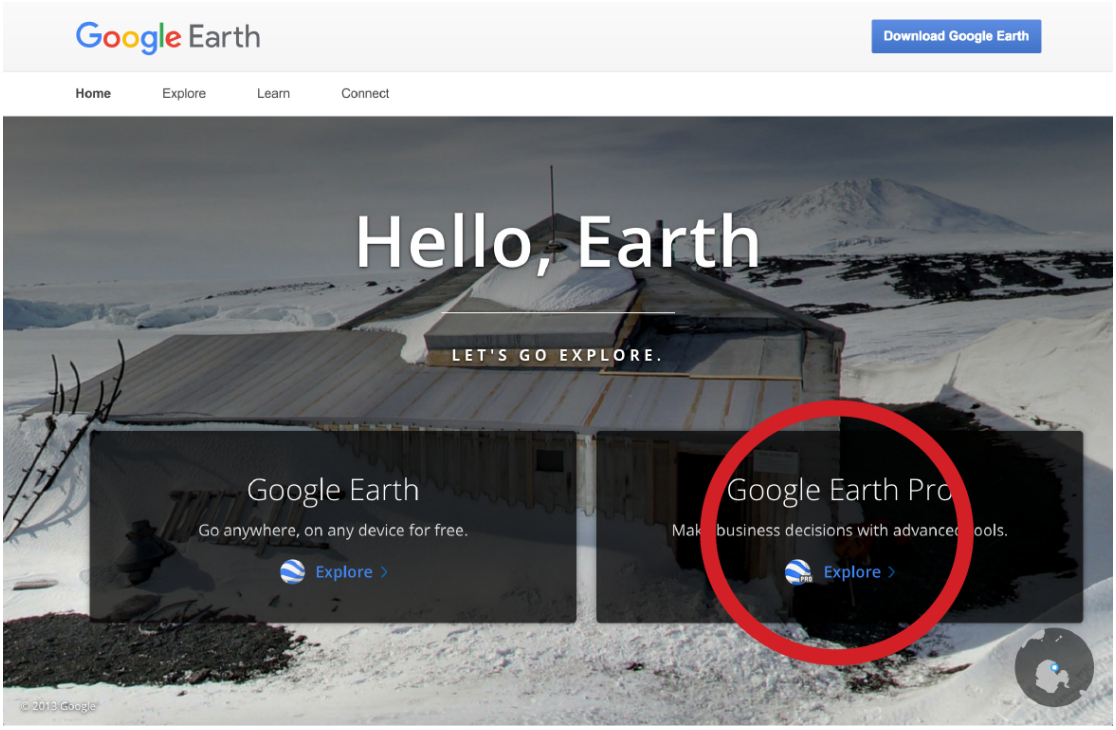
Participants in this session will need both a **laptop** and **mobile** device in order to fully partake in all activities offered. It is requested that participants download and install the following applications prior to attending the workshop.

LAPTOP

Google Earth Pro

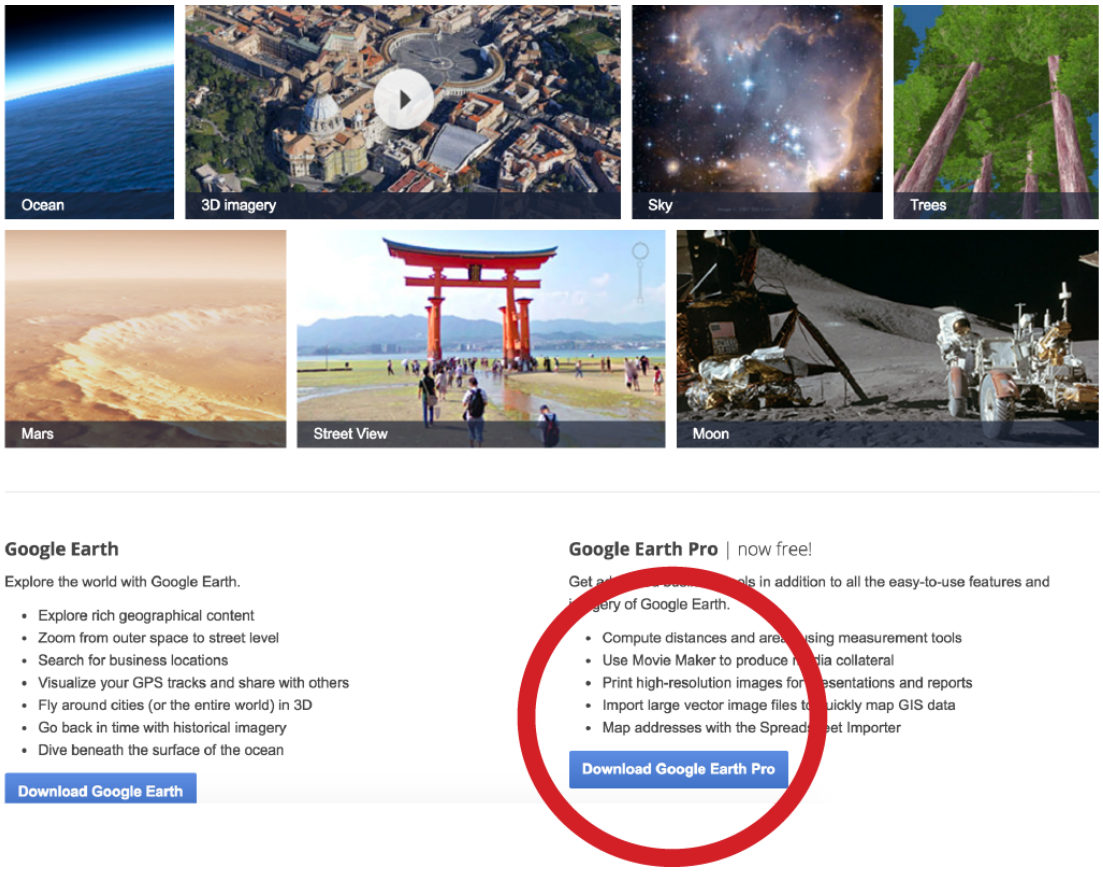
Please note that there are several versions of Google Earth. For this GIFT workshop we will be using Google Earth Pro. To install the correct version follow the instructions below.

(1) Go to earth.google.com
(2) At the landing page, click on “Explore” within the Google Earth Pro box (see red circle).



Google Earth Landing Page. Note: Background image changes with each visit

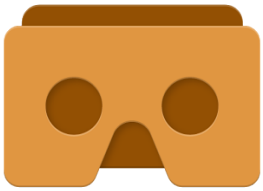
(3) Click on *"Download Google Earth Pro"* (see red circle). You may need to scroll down to see the blue download button.



(4) You will be prompted to agree to the terms and conditions, and allow the program to make changes to your computer. If a license key is requested use any email address and "GEPfree" as the password.

MOBILE

Google Cardboard



Search for "Google Cardboard" in the App Store (iPhone) or Google Play (Android). The app will be identified by the icon like the image on the left.

Google Street View

Search for “Google Street View” in the App Store (iPhone) or Google Play (Android). The app will be identified by the icon shown on the left.

Light Meter Apps

You will also find a **light meter app** useful to have on a smartphone, tablet, or iPad. There are several free apps that will work in the App Store (iOS) or Google Play (Android). You only need a numerical light reading, no other features will be used. Two that we recommend are:

Lux Camera (iPhone or iPad)

Lux Meter (Android)

Images of a Changing Planet: Using Remote Sensing Data and Images to Investigate Land Surface Changes

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John Bailey, Program Manager - Google Geo Education
Peder Nelson, Oregon State University
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Susan Sullivan, Coop. Inst. for Research in Enviro. Sciences, NAGT Past President

Center for Geoscience & Society
american geosciences institute

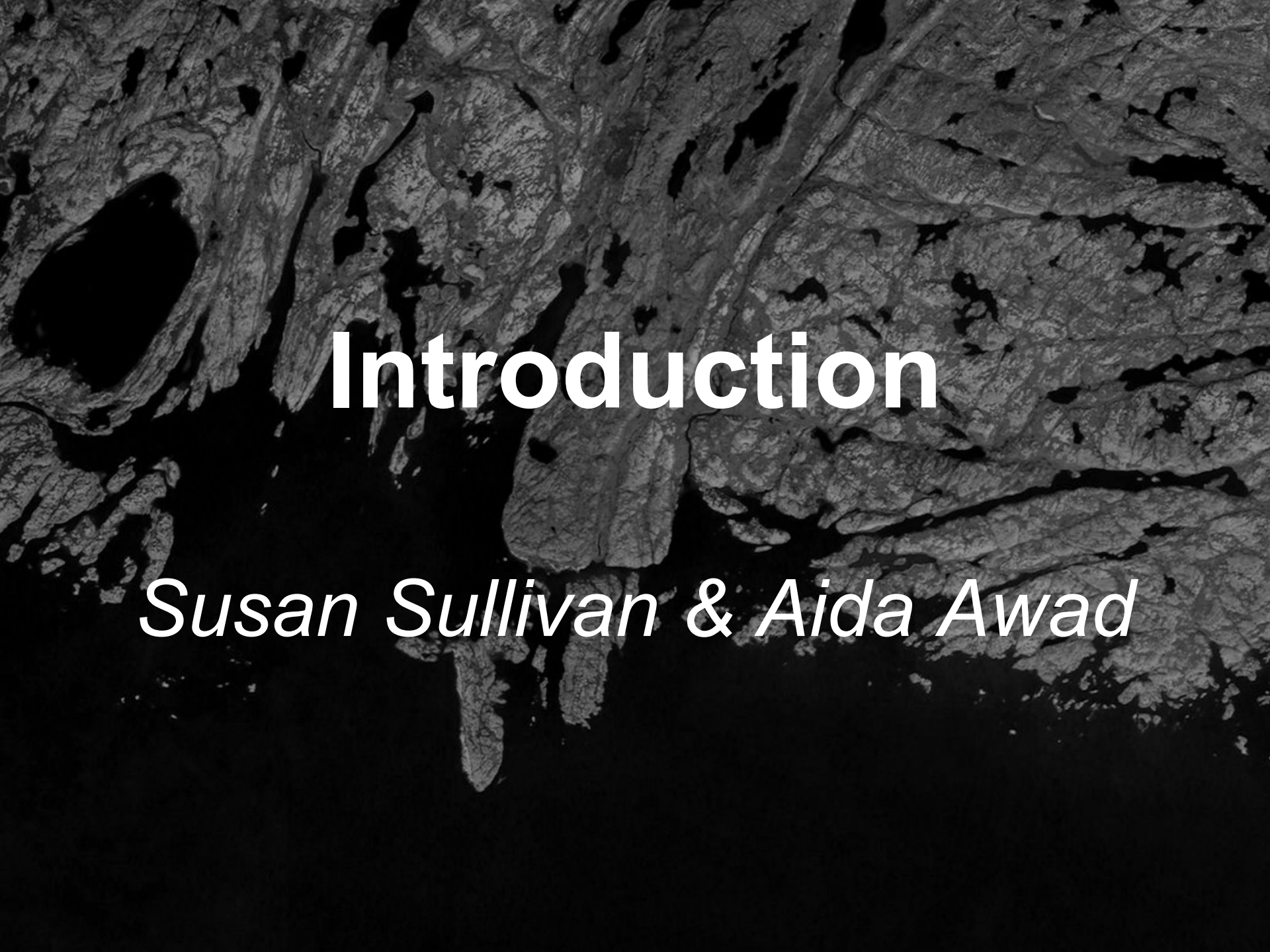
Oregon State University OSU

CIRES

NAGT

Google

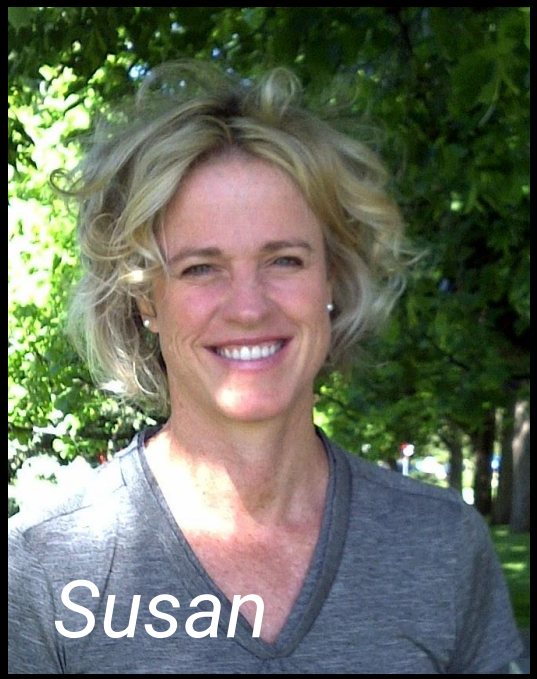
USGS
science for a changing world



Introduction

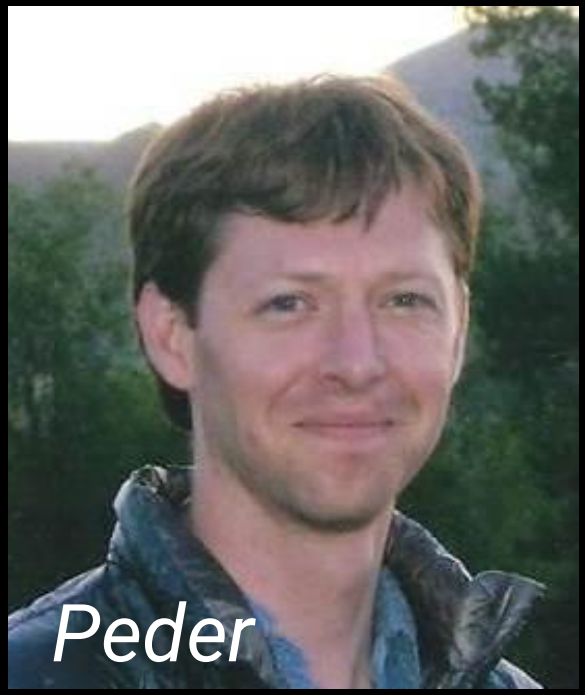
Susan Sullivan & Aida Awad


Ed


Susan


Google
John


Aida


Peder

Using storylines to bundle PEs, CCCs, & practices

- Remote sensing data provide opportunities to explore land cover and land use changes. Tools like **Google Earth, Street View and Expeditions** are tools we can use to explore the Earth, make measurements, and predictions based on observations.

- Using the tools and approaches teachers can design learning opportunities for their students that help them focus on the following **NGSS big storylines, science and engineering practices**, and crosscutting concepts.

- Qualitative and quantitative data may be collected and analyzed leading to the **development of models explaining how processes change Earth's surface over time** and spatial scales, and create feedbacks that impact other systems.

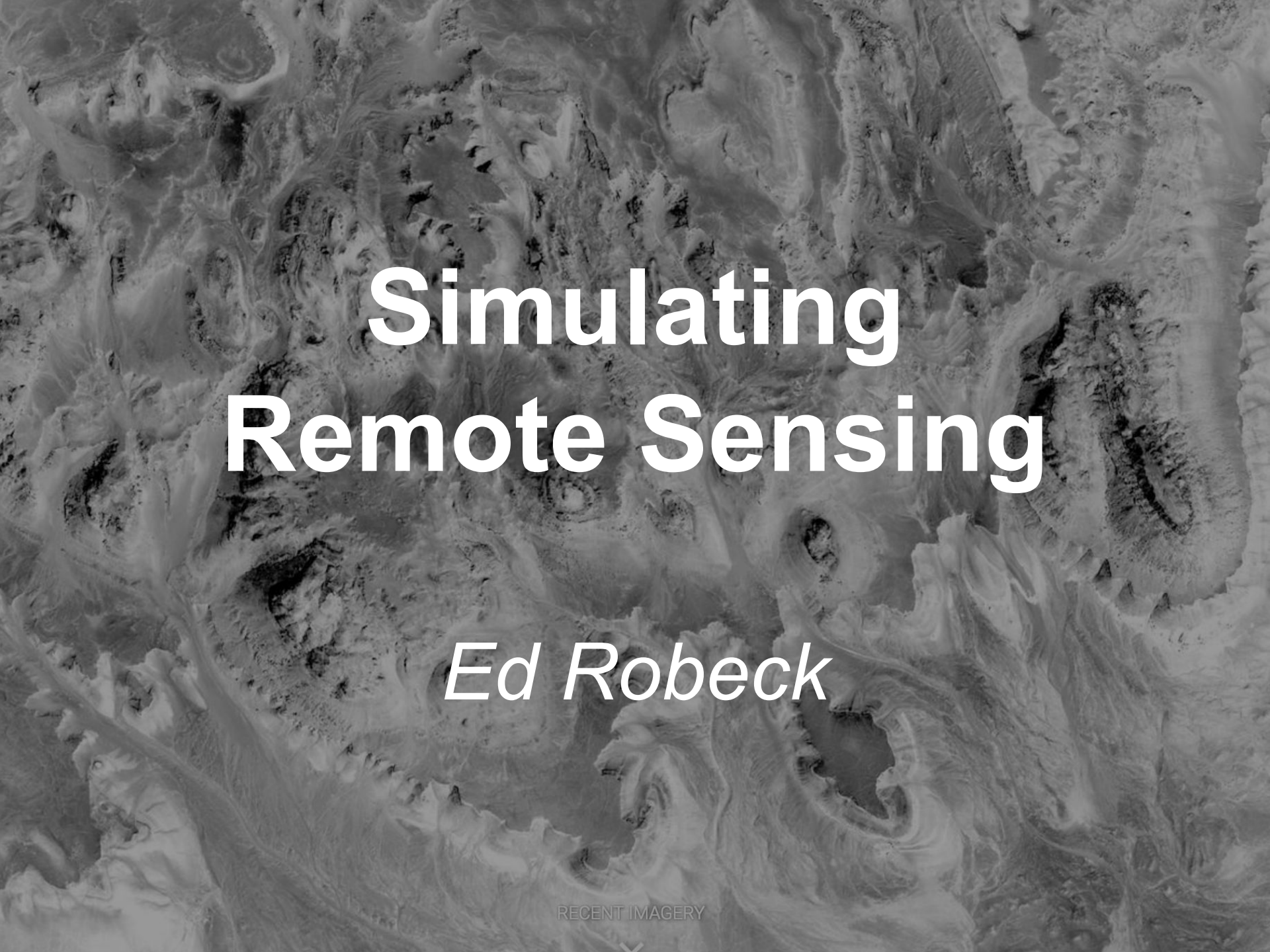
NGSS: DCIs, CCCs & Practices

- Metacognition encouraged!
- Using the matrix to document your thinking

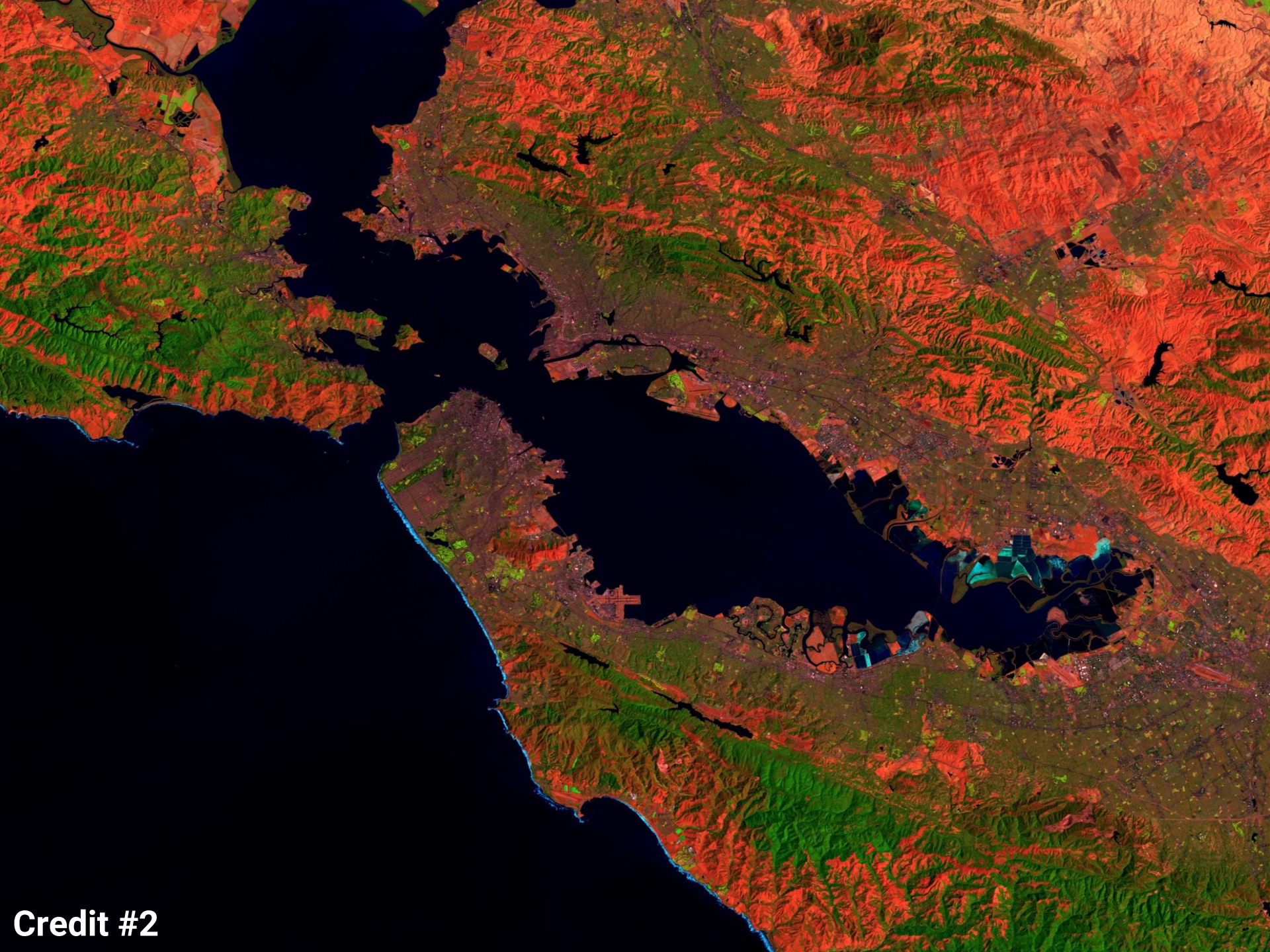
Crosscutting Concepts	Science & Engineering Practices	Disciplinary Core Ideas
Patterns	**Asking questions**	**ESS2: Earth's Systems**
Cause and effect	**Developing/using models**	**Change over time**
Scale, proportion, and quantity	**Planning/carrying out investigations**	**Earth materials & systems** **Roles of water in surface processes** **Weather and climate**
Systems and system models	**Analyzing/interpreting data**	**ESS3: Earth and human activity**
Energy and matter	**Using math and computational thinking**	**Human interactions with Earth Human impacts on Earth systems**
Structure and function	**Constructing explanations**	**Climate change**
Stability and change	**Engaging in argument from evidence**	**Natural hazards**
	Obtaining, evaluating, communicating information	

Workshop Agenda

- Introductions to us & workshop
- Simulating satellite-based remote sensing using smart devices
- Investigating land surface cover through satellite imagery
- Enhancing investigations with Google Street View and Expeditions
- Wrap-up


Simulating
Remote Sensing
Ed Robeck
RECENT IMAGERY


Credit #1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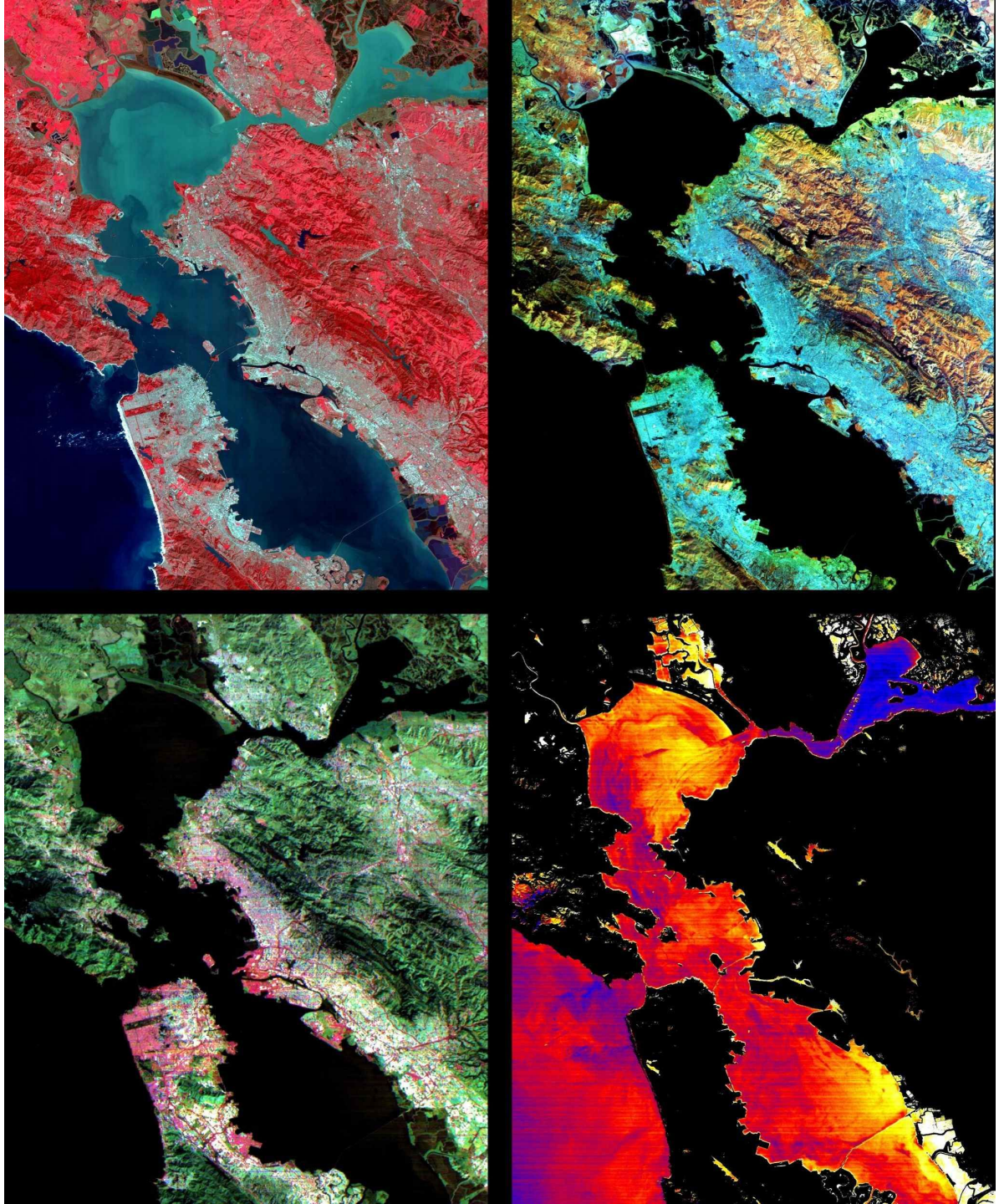

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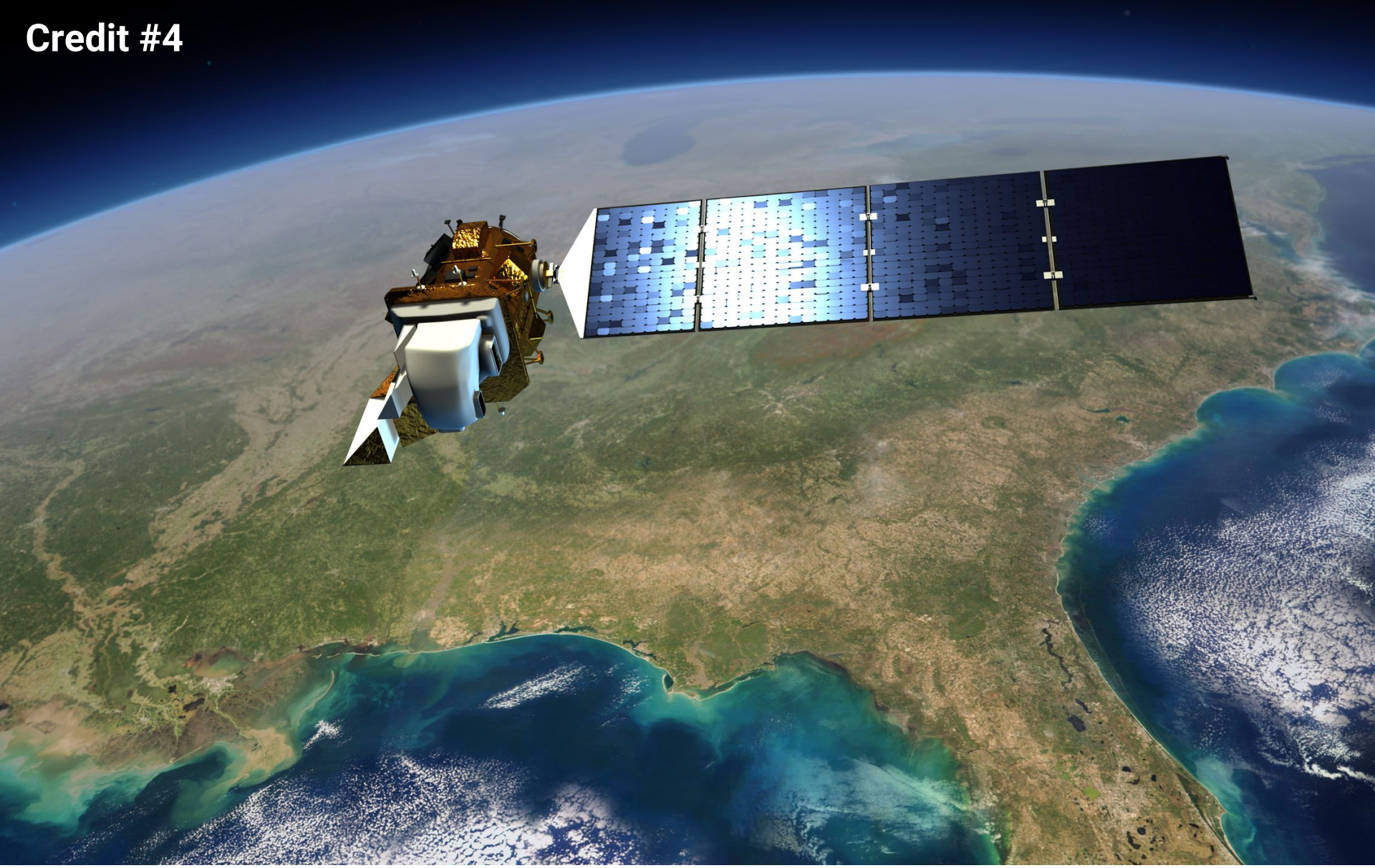
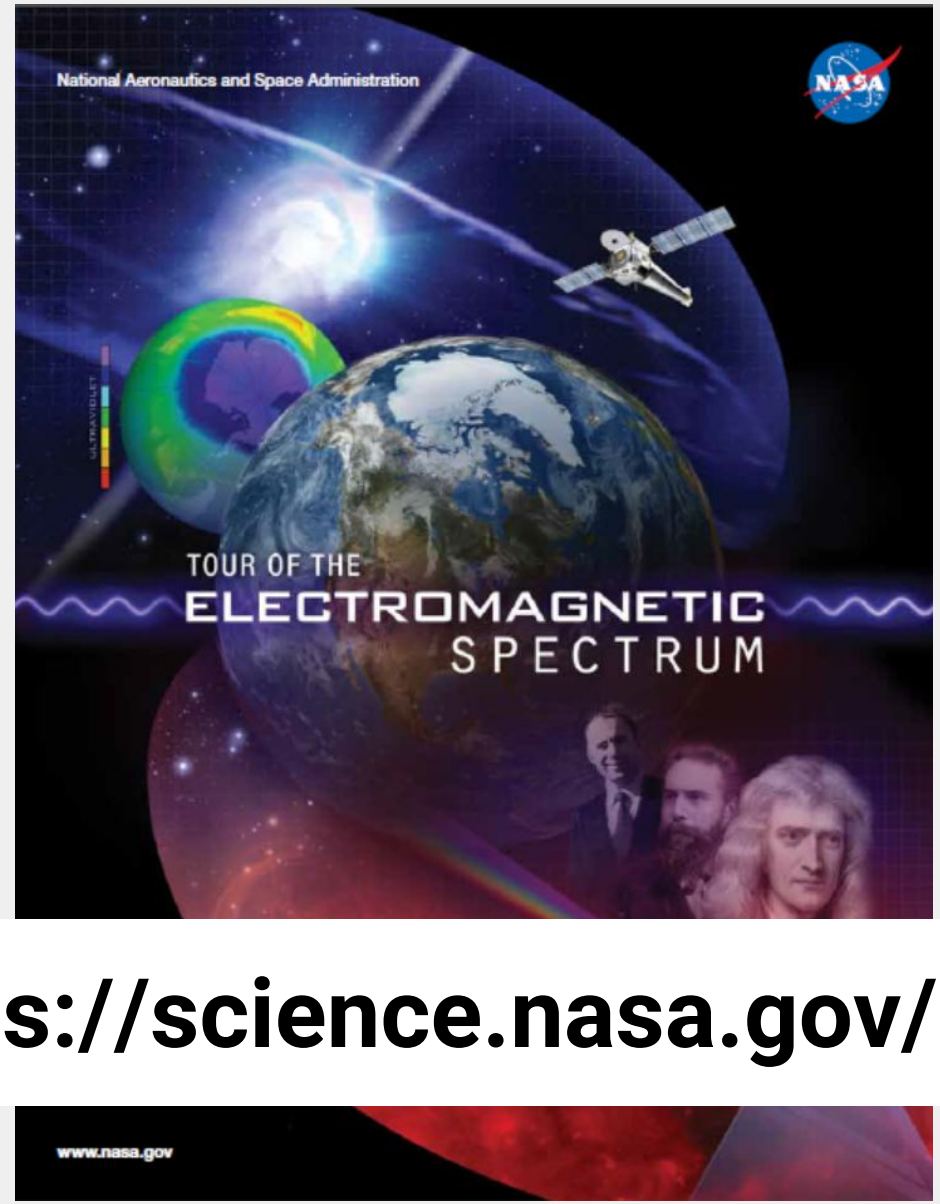


Satellite-based Remote Sensing

Simulating Satellite-based Remote Sensing



https://science.nasa.gov/ems

Activity: Exploring Remote Sensing

ACTIVITY

EXPLORING REMOTE SENSING

This lesson simulates the process of remote sensing using surface materials of different colors to represent different ground coverings on Earth. Light meters are used as an analog for satellite instruments to record data from surfaces representing the different ground coverings. The lesson will help students understand the role of satellites in remote sensing. Instructors can introduce the concept of albedo, which is the percentage of the Sun's radiation that reflects from different surfaces on Earth. Albedo is an important component of Earth's radiation budget (see pp. 26–27).

LEVEL: Grades 5–9

This is a Landsat 8 image of a portion of the Southern Ocean and the northern Antarctic Peninsula. The dark open ocean (left) and exposed rock absorb a high percentage of the Sun's energy and have a low albedo. The flowing glaciers and other ice cover (bright and smooth areas) have high albedos, and the Larson B embayment (right) is covered with sea ice (mottled dull gray tone/texture), which has a slightly lower albedo than the adjacent ice shelf.

CONNECTIONS TO THE NEXT GENERATION SCIENCE STANDARDS

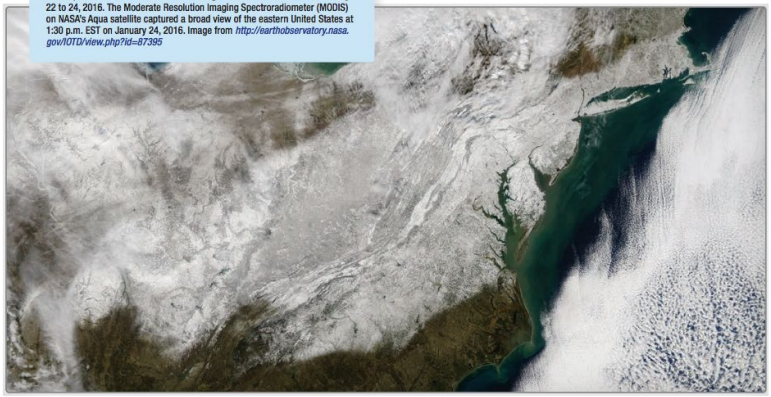
Disciplinary Core Idea PS4.B: Electromagnetic Radiation. When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.

MATERIALS

- **Paper or fabric** of different colors (about 6–10) to simulate ground coverings on Earth, including at least one each of a light-tone/white surface, a dark-tone/black surface, and a medium-tone/gray surface. Any patterns should be small and even across the surface, such as a calico print with small flowers.
- **Light meters** (or an iOS/Android device with a lux meter app).
- **Meter sticks**.
- **Copies of this booklet** printed for students, loaded onto a mobile device, or projected in the classroom. A PDF is available at *http://science.nasa.gov/ems*.
- **Access to an outdoor area** with several types of ground cover (e.g., asphalt, grass, bare dirt) (optional).

SET UP

- Place the surface materials in locations around the room. (If outdoors, identify a space that has several types of ground cover.)
- Divide the students into groups and provide each group with a light meter and a meter stick.



A MASSIVE WINTER STORM SYSTEM dropped 20 to 30 inches (50 to 70 centimeters) of snow from Tennessee and Georgia to Massachusetts from January 22 to 24, 2016. The Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite captured a broad view of the eastern United States at 1:30 p.m. EST on January 24, 2016. Image from *http://earthobservatory.nasa.gov/IOTD/view.php?id=87395*

ENGAGE

Show students the satellite image of the eastern United States after a snowstorm. Ask them what they observe on the image (e.g., cloud cover, coastlines) and record their answers. Ask what can be inferred (e.g., lack of clouds over an area suggests a sunny sky there) or what they aren't sure of regarding what the image shows (e.g., whether white-colored areas are clouds or snow). Have students record their answers. Invite students to select one or two satellite images from this booklet and ask the same questions. Ask students to share their answers and discuss what kinds of information we get from these remotely sensed images.

EXPLORE

Demonstrate to students how to use the light meter with the meter stick as a guide for height. Have students design a method for collecting, analyzing, and communicating their data. Have them determine the parameters to include in their science journal entries (e.g., headings, data, methods, predictions, conclusions). They can include predictions on the reflectance of various materials and compare those to measurements.

EXPLAIN

Ask students to communicate group results. Did they notice any patterns? How did the values differ between surfaces? What happened to the light as it interacted with different surfaces? Can they explain any differences in the light measurements? How did they decide on the height at which they held the light meter to make measurements? This process will help make student thinking discernible so both they and the teacher can assess understanding.

Discuss how these measurements are like those of passive remote sensing instruments on satellites (e.g., the light meter collects light that reflects off the surface while some light is absorbed—see pp. 12–13). Discuss how light meters are unlike satellite instruments. For example, light meters used in this activity measure light in the entire visible range of the electromagnetic spectrum (see pp. 2–3), while most satellites collect data at specific regions—sometimes called bands—of the visible spectrum as well as parts of the spectrum beyond visible light (see the back cover).

EVALUATE

A simple rubric could be created from the steps above. Did students collect and record all the parameters that would influence their data (e.g., light source, height of measurement)? Did they recognize patterns? Did they collect enough data?

Gaining insight into students' thinking is a good way to scaffold student learning and monitor their progress. Have each student draw and label a diagram (visual model) of how satellites and/or the light meters detect electromagnetic energy. Encourage students to include on their diagrams features such as the radiation source, the interaction between the radiation and the surface (i.e., whether the radiation is reflected, absorbed, or scattered), and the detector (e.g., the light meter or a satellite instrument). Have students share their diagrams with others in order to refine their thinking.

EXTEND

The measurements in this activity correspond to the amount of visible light being reflected from the surface and detected by the meter. The percentage of how much of the Sun's radiation (light) that hits a surface is reflected without being absorbed is called albedo. Albedo is an important component of Earth's radiation budget (see pp. 26–27). Snow, for example, has a high albedo, meaning that it reflects a lot of the radiation that strikes it.

Observe the sea ice image on the top of page 13. In their science journals, ask students which has a higher albedo: ice or open ocean? (Ice.) As sea ice melts, what happens to the albedo of the Arctic? Will it increase or decrease? (Decrease.) What happens when the Sun's energy is absorbed by a surface? (It heats up.) What happens as sea ice melts? (The newly exposed water reflects less and absorbs more of the Sun's energy. This causes the water to warm and melt more ice.) This phenomenon is called the ice-albedo feedback effect. As the surface ice and the sea ice melt, the overall surface albedo lowers, causing more energy to be absorbed and continuing in a cycle, thus creating a positive feedback loop.

ADDITIONAL RESOURCES

"Ice Albedo: Bright White Reflects Light" is a short animation (~30 seconds) that illustrates the albedo concept: *http://go.usa.gov/cShKA*

"Daisy World" is a short video (~4 minutes) that demonstrates the albedo feedback loop using black and white daisies: *http://go.usa.gov/cShKm*

Sequence these images by predicted reading (1=low, 6=high)

Glacier
Yellowstone Photo Collection

Volcanic Landscape
NASA Earth Observatory

Mangrove Forest
SOFIA

Open Ocean
Northeast Fisheries Science Center

Desert Rivers
Earth Science World Image Bank
(image h4vfel: (c) Bruce Molnia)

Trees and Eroded Soil
Land Cover Assessment

Credit #5

Visualizing Remote Sensing Imagery Using Google Earth

Peder Nelson

Motivations

- What is the need for Earth observing satellites?
- What do they show us?
- What could your classroom contribute to the science of long term ecological monitoring?
- How can you use technology to teach NGSS using remote sensing and virtual reality?

We will highlight how to use satellite imagery and virtual reality field trips in support of NGSS

HS-PS4-3 Waves and their Applications in Technologies for Information Transfer

Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

MS-ESS3-3 Earth and Human Activity

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

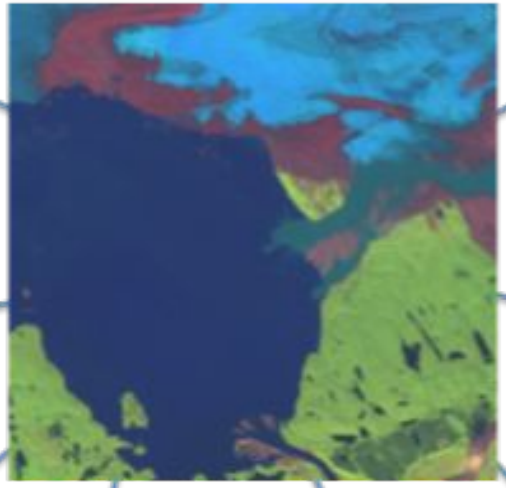
HS-ESS3-6 Earth and Human Activity

Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

MS-ESS3-5 Earth and Human Activity

Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Students can learn many subjects from this data



Engineering
- Urbanization
- Building satellites
- Computer systems

Chemistry
- Water cycle
- Carbon cycle
- Water turbidity
- Photosynthesis

Ecology
- System thinking
- Land cover
- Earth systems
- wildlife

Math
- regression
- graphing
- computation

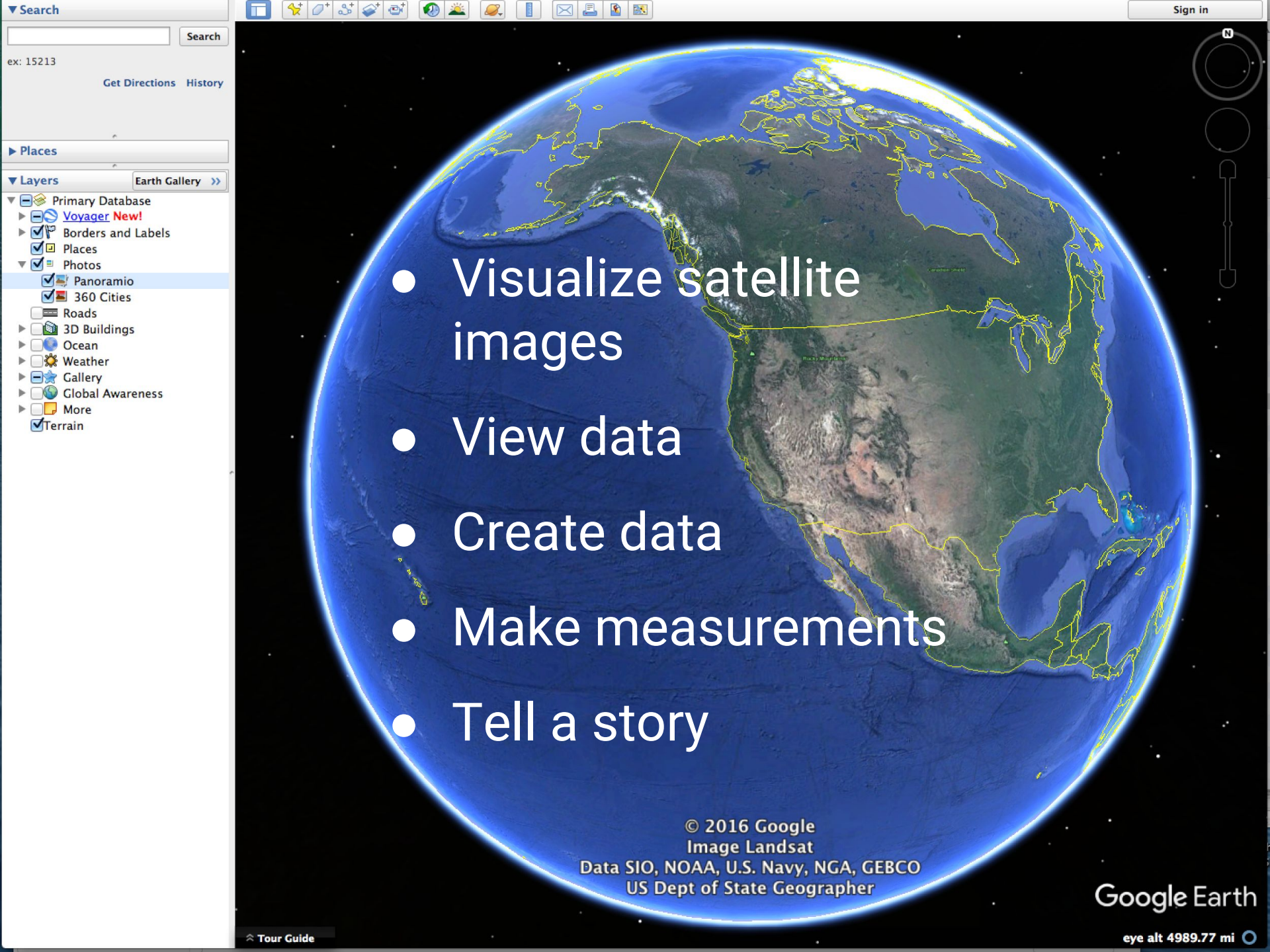
Computer skills
- Image processing
- Digital Ethics
- Data gathering

Sociology
- Land Use
- History

Physics
- measurements
- Light

Language Arts
- Summarizing
- Publishing analysis


Washington
Oregon


Search
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ex: 15213
Get Directions
History
Places
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Earth Gallery
Primary Database
Voyager New!
Borders and Labels
Places
Photos
Panoramio
360 Cities
Roads
3D Buildings
Ocean
Weather
Gallery
Global Awareness
More
Terrain
Sign in
Visualize satellite images
View data
Create data
Make measurements
Tell a story
© 2016 Google
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
US Dept of State Geographer
Google Earth
Tour Guide
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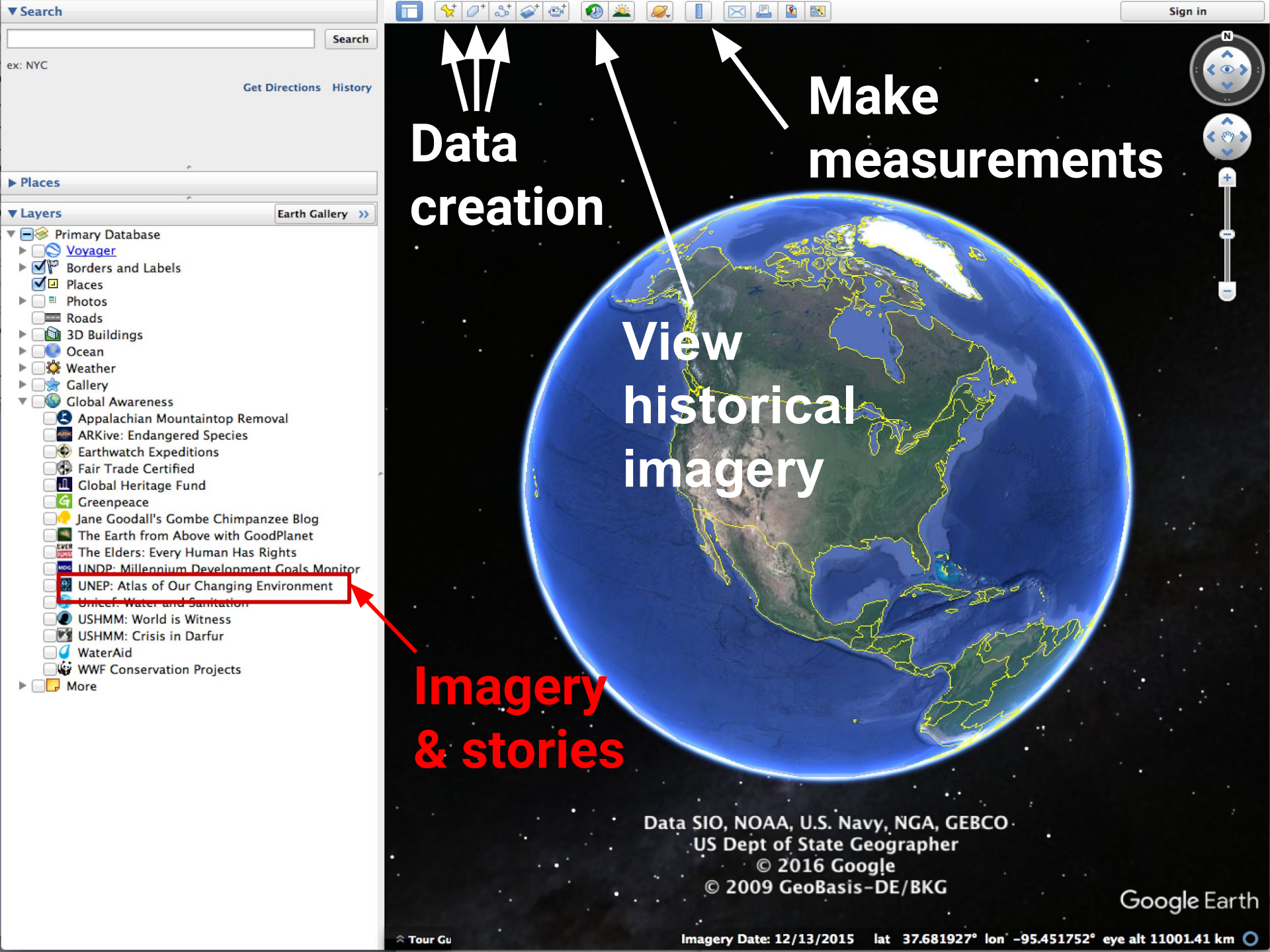
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ex: NYC
Get Directions
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Earth Gallery
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Places
Photos
Roads
3D Buildings
Ocean
Weather
Gallery
Global Awareness
Appalachian Mountaintop Removal
ARKive: Endangered Species
Earthwatch Expeditions
Fair Trade Certified
Global Heritage Fund
Greenpeace
Jane Goodall's Gombe Chimpanzee Blog
The Earth from Above with GoodPlanet
The Elders: Every Human Has Rights
UNDP: Millennium Development Goals Monitor
UNEP: Atlas of Our Changing Environment
Unicef: Water and Sanitation
USHMM: World is Witness
USHMM: Crisis in Darfur
WaterAid
WWF Conservation Projects
More
Sign in
Data creation
Make measurements
View historical imagery
Imagery & stories
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
US Dept of State Geographer
© 2016 Google
© 2009 GeoBasis-DE/BKG
Google Earth
Tour Gu
Imagery Date: 12/13/2015 lat 37.681927° lon -95.451752° eye alt 11001.41 km

Use Google Earth to study and document land cover and land use changes

Credit #6

USGS
science for a changing world

NLCD **National Land Cover Dataset**

- 11 Open Water
- 12 Perennial Ice/ Snow
- 21 Developed, Open Space
- 22 Developed, Low Intensity
- 23 Developed, Medium Intensity
- 24 Developed, High Intensity
- 31 Barren Land (Rock/Sand/Clay)
- 41 Deciduous Forest
- 42 Evergreen Forest
- 43 Mixed Forest
- 51 Dwarf Scrub*
- 52 Shrub/Scrub
- 71 Grassland/Herbaceous
- 72 Sedge/Herbaceous*
- 73 Lichens*
- 74 Moss*
- 81 Pasture/Hay
- 82 Cultivated Crops
- 90 Woody Wetlands
- 95 Emergent Herbaceous Wetlands

* Alaska only

Landcover questions

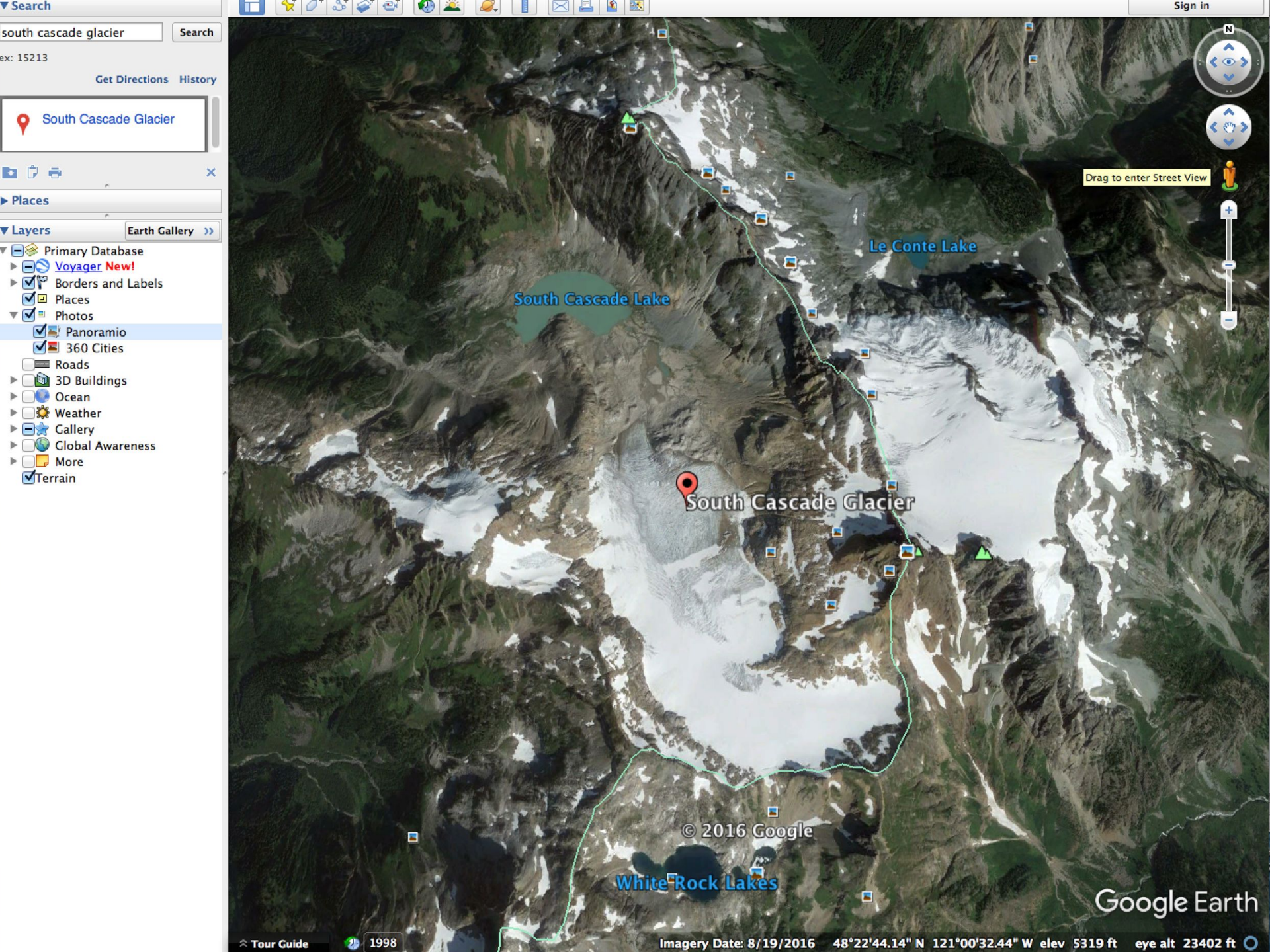
We will use this form to help us identify and keep track of the labels for these plot points.

Complete label classification definitions can be found at the following website - http://www.mrlc.gov/nlcd11_leg.php

What is the label for 45.00565, -92.8564

- Developed - area with a mixture of constructed materials and vegetation.
- Forest - area dominated by trees
- Grass - generally greater than 80% of total vegetation
- Open Water - areas of open water, generally with less than 25% cover of vegetation or soil

bit.ly/landcoverqus


Search
south cascade glacier
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ex: 15213
Get Directions
History
South Cascade Glacier
Places
Layers
Earth Gallery
Primary Database
Voyager New!
Borders and Labels
Places
Photos
Panoramio
360 Cities
Roads
3D Buildings
Ocean
Weather
Gallery
Global Awareness
More
Terrain
Sign in
Drag to enter Street View
Le Conte Lake
South Cascade Lake
South Cascade Glacier
© 2016 Google
White Rock Lakes
Google Earth
Tour Guide
1998
Imagery Date: 8/19/2016 48°22'44.14" N 121°00'32.44" W elev 5319 ft eye alt 23402 ft

Create points, lines, polygons to track changes

Credit #7

Use tools to measure length, area

predict, measure, summarize

Examples of adding more context to the satellite images

Performance Task:

Graph SWE using SNOTEL sites

SWEet! Oregon's Snowpack and Water Supply

Where do YOU get your water? What are the characteristics of Oregon's snowpack and how have they changed over time? In this activity we will be looking at current and past snow data and the affects it can have on our local economy.

SNOTEL-
The Natural Resources Conservation Service (NRCS) operates and maintains *an automated system (SNOwpack TELemetry or **SNOTEL**) designed to collect snowpack and related climatic data* in the Western United States and Alaska and to develop accurate and reliable water supply forecasts. For over 30 years **SNOTEL** sites in Oregon and the west have collected data on snow depth and **SWE** (*snow water equivalent*). We will use yearly SWE data to look for changes and to relate our snowpack to Oregon's Economy.

A. Using the data in the table, graph the SWE for your site over time (1980-2012).

B. Analyze your results:
1-What trend do you see on the graph?

2-Compare your graph with another group and discuss your observations.

3-After your discussions what do you think the possible effects will be of less snow in Oregon? Who/What could be effected? How might they be effected?

4-What questions do you still have? List 1+.

Maximum Yearly SWE (measured in inches)

Water Year	Summit Lake 5610 ft.	Hogg Pass 4790 ft.	Santiam Jct. 3740 ft.
1980		30.1	10.1
1981		17.8	4.3
1982	56.3	61.8	37.1
1983	50.5	31.3	17.8
1984	63.5	46.6	18.3
1985	48.1	48.8	32.7
1986	42.8	39.4	18.5
1987	37.8	38.8	18.5
1988	33.9	37.4	15
1989	58	56	29.6
1990	30.1	31.5	18.7
1991	35	31.5	10.4
1992	26	19.8	4.7
1993	59.8	48.1	25.3
1994	25.1	29.2	12.8
1995	44.8	42.6	18.8
1996	39.4	48.8	14.1
1997	49.8	52.1	21.7
1998	39.4	37.2	13.2
1999	69.7	68.5	37.2
2000	40.7	45.5	20.7
2001	27.1	24	8.5
2002	48.6	54	26.2
2003	35.4	27	7.2
2004	49.6	32.5	17.8
2005	29.5	10.6	4.1
2006	53.1	40.2	19.7
2007	42	22.4	12.7
2008	55.3	50.3	38.4
2009	43.9	29.9	21.1
2010	42.1	25	5.4
2011	54.5	31	24.7
2012	43	33.2	20.1

Credit #8, #9

Performance Task:

Glacier mass balance graphing

The Big Melt? Glaciers and Mass Balance

Are glaciers really melting? As our climate changes there appear to be changes to the glaciers around the world. In this activity we will be looking at past and current glacial data from North America and discussing the possible implications for the future.

Glacial Mass Balance

For over 50 years scientists from around the world have studied changes in glaciers. This long period of observation and data provide us with the opportunity to look at glaciers more closely. A ***glacier*** is a large, slow moving body of ice that over the years has accumulated ice from snowfall. On glaciers around the world the amount of snow and ice that is added to a glacier, snow and ice ***inputs***, and the amount of snow and ice that melts and runs off as water, the ***outputs,*** are measured. Using this data we can determine the yearly **net *mass balance***, or the net increase or decrease, of the glacier. This can tell us whether the glacier is shrinking or growing year by year.

A. Using the data to the right, calculate the **net mass balance** of the glacier for each year by ADDING the Summer water outputs to the Winter snow inputs (1980-2011).

B. Graphing: Create a line graph of the mass balance for your glacier over time.

C. Analyze your results:
1-Look at your graph. Explain what the data says is happening to this glacier over time. What evidence do you have to support this answer?

2-Create a figure map showing the location of the glacier. On this map, use points, lines, or polygons to show this change over time.

South Cascade Glacier, Washington
(measurements are in meters water equivalent)

Balance Year	Winter Snow Inputs	Summer Water Outputs	Net Mass Balance (+/-)
1980	1.83	-2.85	
1981	2.28	-3.12	
1982	3.11	-3.03	
1983	1.91	-2.68	
1984	2.38	-2.26	
1985	2.18	-3.38	
1986	2.45	-3.06	
1987	2.04	-4.10	
1988	2.44	-3.78	
1989	2.43	-3.34	
1990	2.60	-2.71	
1991	3.54	-3.47	
1992	1.91	-3.92	
1993	1.98	-3.21	
1994	2.39	-3.99	
1995	2.86	-3.55	
1996	2.94	-2.84	
1997	3.71	-3.08	
1998	2.76	-4.62	
1999	3.59	-2.57	
2000	3.32	-2.94	
2001	1.90	-3.47	
2002	4.02	-3.47	
2003	2.66	-4.76	
2004	2.08	-3.73	
2005	1.97	-4.42	
2006	2.61	-4.19	
2007	3.41	-3.61	
2008	*3.22*	*-3.51*	
2009	*3.12*	*-4.98*	
2010	*2.54*	*-3.35*	
2011	*3.81*	*-2.60*	

Credit #10

Contribute ground observations for long term ecological research

Enhancing Investigations with Google Street View & Expeditions

John Bailey

Street View

- Launched in 75+ countries
- Driven over 7 million miles
- 1000s of Special Collects


Google


Tengboche Monastery
See inside - Feb 2013
boche Monastery
त्याङबोछे गुम्बा
Google


ELEVATORS
Google
Street View Trolley
When a group of art-loving Googlers wanted to take Street View technology to museums around the world, we needed to develop a system that could easily fit through museum doorways and navigate around sculptures. We worked to fit all of the equipment on an even smaller frame: a push-cart lovingly dubbed the Trolley. The Trolley has captured hundreds of complex interior locations all over the world, including over 40,000+ pieces of art in 200 museums across 40 countries as part of the Google Art Project.


CATLIN


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Lodge
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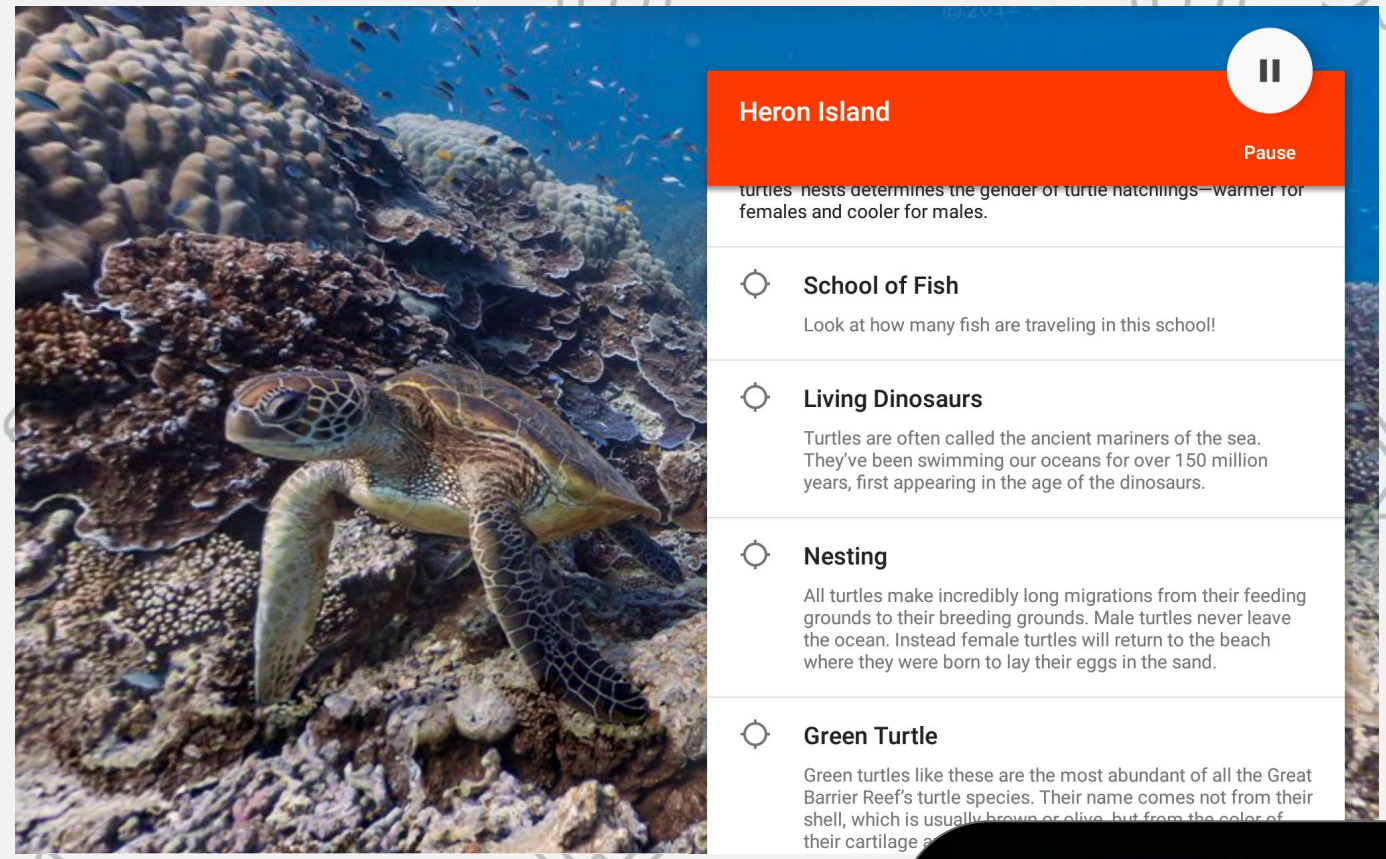
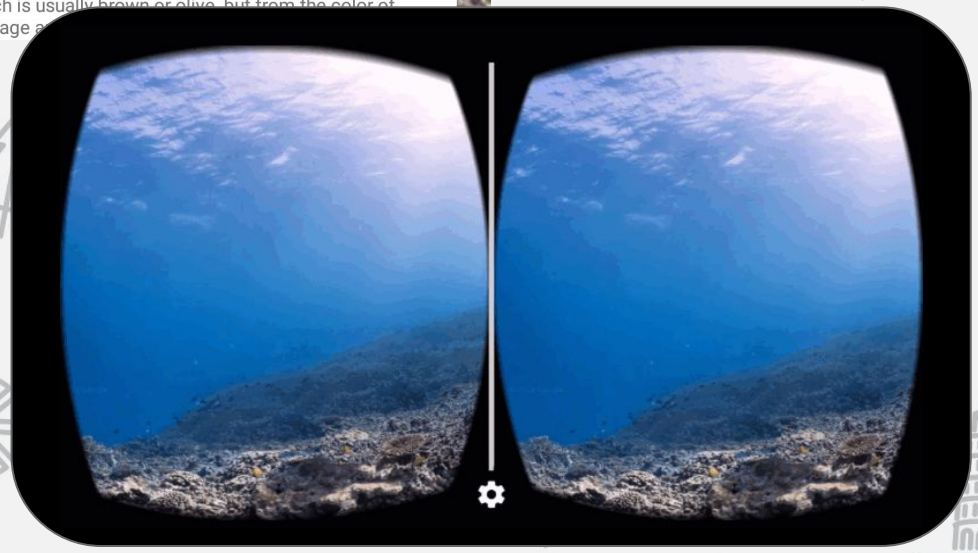


Guide
(Teacher View)

Explorer
(Student View)



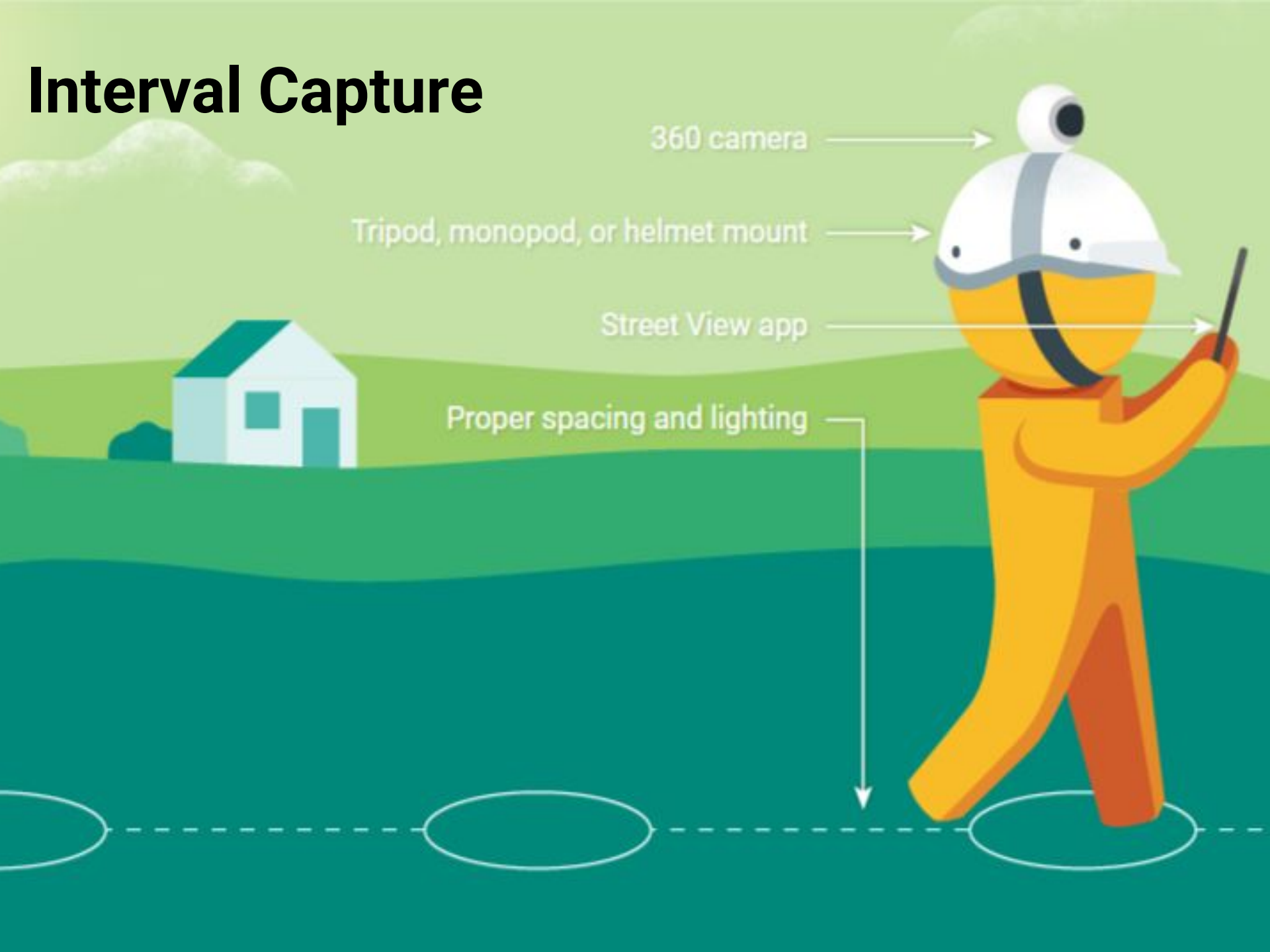
www.moonshotincubator.com/expeditions


~~Street~~ View
Sheep

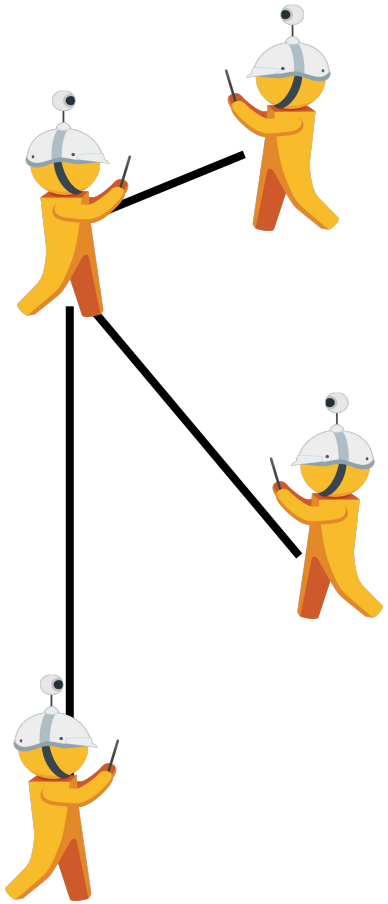
Ricoh Theta-S

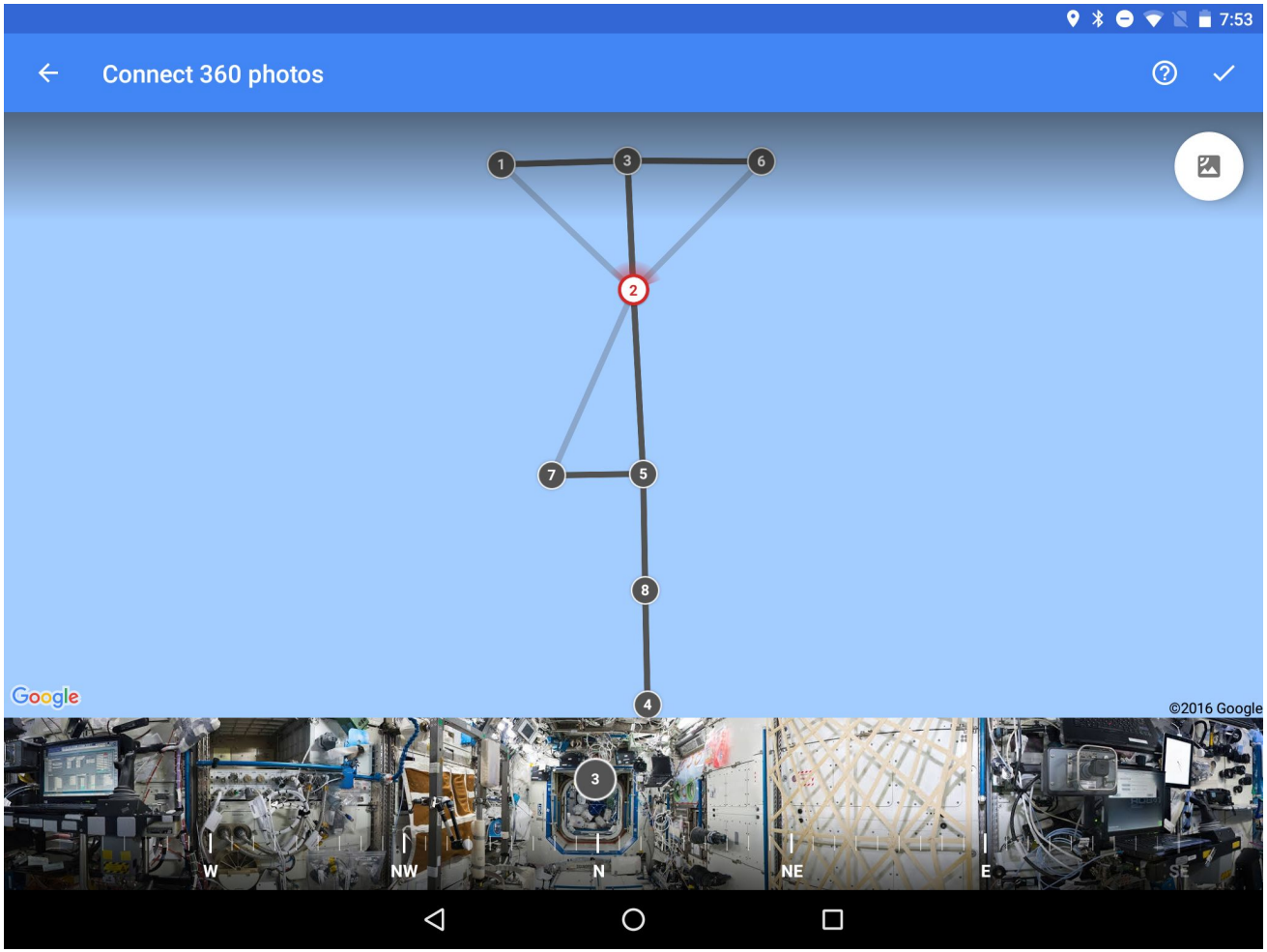
Samsung Gear 360

Interval Capture



Inter-connecting





Blurring

TOOLS OF THE TRADE

Choose the camera and accessories that best suit your needs — or apply to borrow a Street View camera.

RICOH THETA S

- Exceptional quality
- A new 360 photo every 8 seconds
- 1.25 hours of continuous use
- $350

See example image
Learn more and order

SAMSUNG GEAR 360

- Swappable batteries and memory
- A new 360 photo every 8 seconds
- 2 hours of use per battery
- $350

See example image
Learn more

GOOGLE TREKKER

- The same camera Google uses
- Captures constantly
- Lasts all day
- Available for loan

See example image
Borrow a Trekker

google.com/streetview/publish

Wrap Up

Aida Awad & Susan Sullivan

Small group processing:

- Which CCCs, practices, DCIs did we address throughout the course of the activities?

- At your table, how did your perceptions of what we addressed differ?

Final thoughts:

- Planning for activities in your classroom

- Metacognition!

Downloads

Download the Lux Apps

Available on the App Store

iOS - Lux Camera

By Tu Anh Do

GET IT ON Google Play

Android - Lux Meter

By KHTSXR

Download the Street View App

GET IT ON Google Play

Available on the App Store


Resources

Image & Data Credits

#1 https://commons.wikimedia.org/wiki/File:SF_Bay_area_USGS.jpg

#2 https://svs.gsfc.nasa.gov/vis/a000000/a000800/a000876/index.html

#3 http://www.jpl.nasa.gov/spaceimages/details.php?id=PIA02605

#4 https://www.nasa.gov/sites/default/files/578319main_20110809-ldcm-lrg.jpeg

#5

(a) https://www.nps.gov/features/yell/slidefile/geology/glacial/Outside%20Yellowstone%20Park/Page.htm
(b) http://earthobservatory.nasa.gov/IOTD/view.php?id=43859&eocn=image&eoci=moreiotd
(c) http://sofia.usgs.gov/projects/gcc_impacts/photogallery.html
(d) http://nefsc.noaa.gov/rcb/photogallery/pelagic.html
(e) http://www.earthscienceworld.org/images/search/results.html?Category=$Category&Continent=$Continent&ImageID=h4vfel
(f) http://lca.usgs.gov/lca/theme5task7/results.php

#6 http://www.mrlc.gov/nlcd11_leg.php

#7 http://onrep.forestry.oregonstate.edu/authentic-science-activities

#8 http://www.wcc.nrcs.usda.gov/snotel/earth/

#9 http://www.nohrsc.noaa.gov/earth/

#10 http://onrep.forestry.oregonstate.edu/authentic-science-activities

Resources: Google Earth Education

Google Expeditions

Homepage: https://www.google.com/expeditions/
Google Help Pages: https://support.google.com/edu/expeditions
How to create a kit *and* run Expeditions tours

Google Street View

Street View Galleries: https://www.google.com/streetview/
Learn about Street View: https://www.google.com/streetview/publish/

Other Presentation Links:

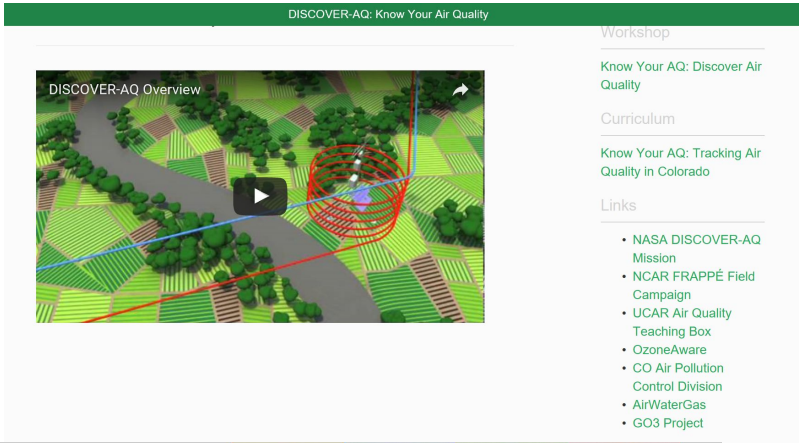
Sheep View: http://visitfaroeislands.com/sheepview360/
Expeditions in Hawaii: http://www.moonshotincubator.com/expeditions/

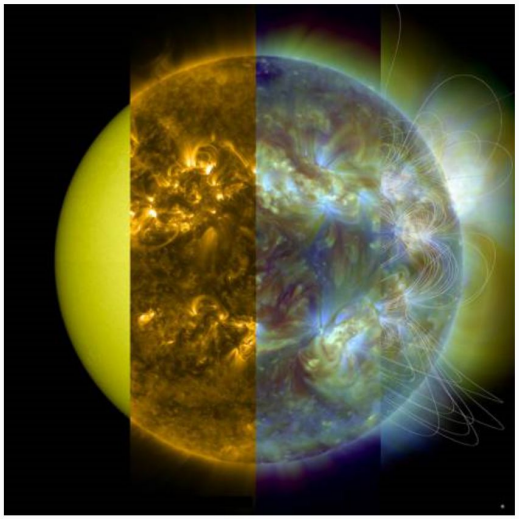
Resources: AGI Education

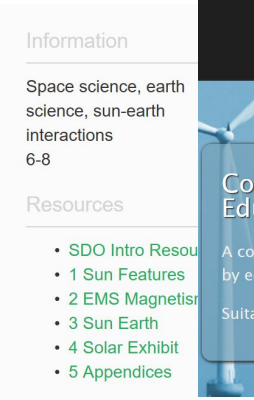
	Earth Science Week Discover the resources offered through this international event, organized by AGI each October to promote better understanding and appreciation of Earth science and encourage stewardship of the planet. http://www.earthsciweek.org/classroom-activities
	**Big Ideas in Earth Science** Big Ideas videos bring to life the "big ideas" of Earth science—the nine core concepts that everyone should know. Teachers can use the videos in many ways. http://www.earthsciweek.org/big-ideas
	AGI's **Center for Geoscience and Society** Education Resource Network – The geoscience education resources on this site come from a variety of providers. The site provides visitors with the widest possible collection of curricula, classroom activities, teacher professional development opportunities, science education standards, virtual field trips, teaching ancillaries, and much more. http://www.americangeosciences.org/center-for-geo/ern Critical Issues Program The Critical Issues Program provides a portal to decision-relevant, impartial, expert information from across the geosciences. http://www.americangeosciences.org/critical-issues/
Image Bank	**Earth Science World Image Bank** The Image Bank now has over 6,000 images available to search, making it one of the largest sources of Earth Science imagery available on the web. http://www.earthscienceworld.org/images/index.html

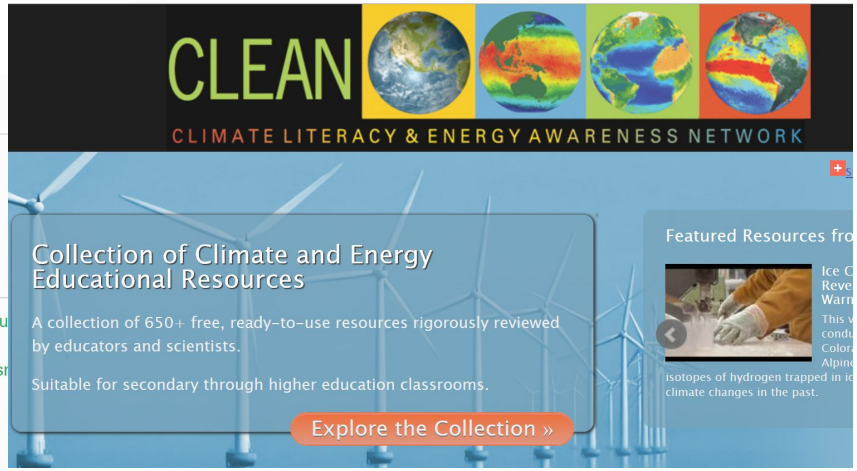
Resources: CIRES

- Climate Literacy and Energy Awareness Network
- Solar Dynamics Observatory Module
- Discover Air Quality Module
- Arctic Climate Connections









Resources: Oregon State University

Land cover change & science:
http://Geotrendr.oregonstate.edu
http://ltweb.ceoas.oregonstate.edu/mapping/

GLOBE Observer: http://observer.globe.gov
http://www.globe.gov/web/peder.nelson

SnoTel data: http://www.wcc.nrcs.usda.gov/snotel/earth/

National Snow and Ice Data Center:
https://nsidc.org/data/google_earth/

Earthquake hazards:
http://earthquake.usgs.gov/learn/kml.php

USGS Stream Flow (viewing in Google Earth):
http://waterwatch.usgs.gov/?m=real&r=us&w=real%2Ckml

Explore Mt St Helens:
http://volcano.oregonstate.edu/volcanoes-lesson-5.

Source of NASA produced data for viewing in Google Earth (land cover, biomass, etc)
http://webmap.ornl.gov/wcsdown/

Resources: NAGT

NGSS webinar series:

- January 12, 2017 - 4 p.m. ET / 1 p.m. PT
  - **Teaching for Sustainability with NGSS**

- Archived videos/slides of previous webinars:
  - **http://nagt.org/nagt/profdev/workshops/ngss_summit/index.html**