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 recently named as a Fellow of the Geological Society of America.

**Dr. John Bailey** is a former volcanologist turned Googler. He holds an 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, Mongolia, 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](http://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

Aida Awad, Einstein Distinguished Educator Fellow, NAGT Past President
John Bailey, Program Manager - Google Geo Education
Peder Nelson, Oregon State University
Ed Robeck, American Geosciences Inst., Director Center for Geoscience & Society
Susan Sullivan, Coop. Inst. for Research in Enviro. Sciences, NAGT Past President
Introduction

Susan Sullivan & Aida Awad
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

<table>
<thead>
<tr>
<th>Crosscutting Concepts</th>
<th>Science &amp; Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patterns</td>
<td>Asking questions</td>
<td>ESS2: Earth’s Systems</td>
</tr>
<tr>
<td>Cause and effect</td>
<td>Developing/using models</td>
<td>Change over time</td>
</tr>
</tbody>
</table>
| 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
Satellite-based Remote Sensing
Simulating Satellite-based Remote Sensing

https://science.nasa.gov/ems
Activity: Exploring Remote Sensing

Exploring Remote Sensing

This lesson simulates the process of remote sensing using surface materials of different colors to represent different ground coverages on Earth. Light meters are used as an analog for satellite instruments to record data from surfaces representing the different ground coverages. 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 Earth's radiation that reflects from different surfaces on Earth. Albedo is an important component of Earth's radiation budget (see pp. 26–27).

**Materials**
- Paper or fabric of different colors (about 8–10) to simulate ground coverings on Earth, including at least one each of a light-tone/white surface, a dark-tone/black surface, a medium-tone/grey surface. Any patterns should be small and even across the surface, such as a cardiac print with small flowers.

**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.

**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 visible as both they and the teacher can assess understanding.

- Discuss how these measurements are like those of passive remote sensing instruments or 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**
- 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 road patterns). Ask what can be inferred (e.g., lack of clouds over an area suggests a sunny day). Ask them to compare what they observe on the satellite image with what they predicted in their lab notebooks. Ask students to summarize the differences and discuss what kinds of information we get from these remotely sensed images.

**Extend**
- 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 visible as both they and the teacher can assess understanding.

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**Additional Resources**
- Ice Albedo: Bright White Reflects Light: a short animation (~30 seconds) that demonstrates the albedo concept: [http://gpl.nasa.gov/ICAB](http://gpl.nasa.gov/ICAB)
- Daily Water: a short video (~6 minutes) that demonstrates the albedo feedback loop using black and white dailies: [http://gpl.nasa.gov/DSW](http://gpl.nasa.gov/DSW)
Sequence these images by predicted reading (1=low, 6=high)
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**
  - Building satellites
  - Computer systems

- **Ecology**
  - System thinking
  - Land cover
  - Earth systems
  - Wildlife

- **Computer skills**
  - Image processing
  - Digital Ethics
  - Data gathering

- **Physics**
  - Measurements
  - Light

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

- **Math**
  - Regression
  - Graphing
  - Computation

- **Sociology**
  - Land Use
  - History

- **Language Arts**
  - Summarizing
  - Publishing analysis
3-minute video describing how satellite images are used. Brief overview of landscape changes recorded by Landsat satellites.
- Visualize satellite images
- View data
- Create data
- Make measurements
- Tell a story
Data creation

View historical imagery

Make measurements

Imagery & stories
Use Google Earth to study and document land cover and land use changes.
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

Notice the time slider bar

bit.ly/landcoverqus
Create points, lines, polygons to track changes

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 effects 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 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? Why/What could be effected? How might they be effected?
4. What questions do you still have? List 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 glacier 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.

Credit #10

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

<table>
<thead>
<tr>
<th>Balance Year</th>
<th>Winter Snow Inputs</th>
<th>Summer Water Outputs</th>
<th>Net Mass Balance (+/–)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>1.83</td>
<td>–2.85</td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td>2.28</td>
<td>–3.12</td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td>3.11</td>
<td>–3.03</td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>1.91</td>
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<td></td>
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<tr>
<td>1984</td>
<td>2.38</td>
<td>–2.26</td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>2.18</td>
<td>–3.38</td>
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</tr>
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<td>1986</td>
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<td>2010</td>
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<td></td>
</tr>
<tr>
<td>2011</td>
<td>3.81</td>
<td>–2.60</td>
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</tr>
</tbody>
</table>
Contribute ground observations for long term ecological research

NASA and GLOBE Launch New Opportunity for Citizen Scientists

Want to be a citizen Earth scientist? Join GLOBE Observer.
Enhancing Investigations with Google Street View & Expeditions

John Bailey
Street View
● Launched in 75+ countries
● Driven over 7 million miles
● 1000s of Special Collects
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, briefly dubbed the Trolley. The Trolley has captured hundreds of Google interior locations all over the world, including over 42,500+ pieces of art in 300 museums across 40 countries as part of the Google Art Project.
Heron Island

turtles' nests determines the gender of turtle hatchlings—warmer for females and cooler for males.

School of Fish
Look at how many fish are traveling in this school!

Living Dinosaurs
Turtles are often called the ancient mariners of the sea. They've been swimming our oceans for over 150 million years, first appearing in the age of the dinosaurs.

Nesting
All turtles make incredibly long migrations from their feeding grounds to their breeding grounds. Male turtles never leave the ocean. Instead female turtles will return to the beach where they were born to lay their eggs in the sand.

Green Turtle
Green turtles like these are the most abundant of all the Great Barrier Reef's turtle species. Their name comes not from their shell, which is usually brown or olive, but from the color of their cartilage and fat.
Ricoh Theta-S

Samsung Gear 360
Interval Capture

- 360 camera
- Tripod, monopod, or helmet mount
- Street View app
- Proper spacing and lighting
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](google.com/streetview/publish)
[Learn more and order](google.com/streetview/publish)

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

[See example image](google.com/streetview/publish)
[Learn more](google.com/streetview/publish)

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

[See example image](google.com/streetview/publish)
[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

iOS - Lux Camera
By Tu Anh Do

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


#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/IO/TD/view.php?id=43859&eoan=image&eoic=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

<table>
<thead>
<tr>
<th><strong>Earth Science Week</strong></th>
<th>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. <a href="http://www.earthsciweek.org/classroom-activities">http://www.earthsciweek.org/classroom-activities</a></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Big Ideas in Earth Science</strong></td>
<td><strong>Big Ideas videos</strong> bring to life the &quot;big ideas&quot; of Earth science—the nine core concepts that everyone should know. Teachers can use the videos in many ways. <a href="http://www.earthsciweek.org/big-ideas">http://www.earthsciweek.org/big-ideas</a></td>
</tr>
<tr>
<td><strong>AGI’s Center for Geoscience and Society Education Resource Network</strong></td>
<td>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. <a href="http://www.americangeosciences.org/center-for-geo/ern">http://www.americangeosciences.org/center-for-geo/ern</a></td>
</tr>
<tr>
<td><strong>Critical Issues Program</strong></td>
<td>The Critical Issues Program provides a portal to decision-relevant, impartial, expert information from across the geosciences. <a href="http://www.americangeosciences.org/critical-issues/">http://www.americangeosciences.org/critical-issues/</a></td>
</tr>
<tr>
<td><strong>Earth Science World Image Bank</strong></td>
<td>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. <a href="http://www.earthscienceworld.org/images/index.html">http://www.earthscienceworld.org/images/index.html</a></td>
</tr>
</tbody>
</table>
Resources: CIRES

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

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.
Resources: NAGT

The National Association of Geoscience Teachers (NAGT) works to foster improvement in the teaching of the Earth sciences at all levels of formal and informal instruction, to emphasize the cultural significance of the Earth sciences and to disseminate knowledge in this field to the general public.

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Community Voices: Essays
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](http://nagt.org/nagt/profdev/workshops/ngss_summit/index.html)