

**Hands on Exercise for the Remote Sensing Introduction Using a Browser and Landsat based on Esri ArcWeb Server Applications**

**This exercise with PPT can be given in one lecture (55 minutes) and one lab (3 hours) without the need to download software or data. It is based on materials created by the Integrated Geospatial Education and Technology Training: Remote Sensing (iGETT) and the National Geospatial Technology Center of Excellence (GeoTech Center) National Science Foundation Grants.**

**Resources Available to Carry Out Exercise from iGETT website http://igettremotesensing.org :**

1. PowerPoint on ***Remote Sensing Introduction***
2. PDF of ***Viewing New Mexico from Space*** Poster
3. Poster in **Publisher** with “blank” lines or spaces to use to create your Poster

Additional resources needed:

1. Snipping Tool (or other software to do screen captures)
2. Internet Access and Web Browser to access the two browser-based applications: (1) Unlocking Earth’s Secrets, and (2) Landsat Explorer at http://www.esriurl.com/LandsatOnAWS

**Learning Objectives – individuals completing exercise will be able to:**

1. Describe basic science concepts important for use of remote sensing imagery.
2. Access different locations and dates using Landsat imagery
3. Carry out basic image interpretation including recognizing patterns and spatial relationships for different types of land use.
4. Use band combinations to create composite imagery
5. Access Spectral Signature graphics to help identify different types of land use or land cover.
6. Create a Poster for an area of interest focused on remote sensing and Landsat imagery.

**Exercise Instruction:**

This exercise is divided into three parts: The first part, Part A, will investigate the Tools in Unlocking Earth’s Secrets based on imagery from Landsat Missions. Part B will use Landsat Explorer and additional tools that use imagery from many of Landsat’s Missions. Tools will allow you to composite imagery using the bands you choose, bring in imagery from two dates and use a Swipe Tool to visually investigate differences in the imagery from the two dates or use the Change Detection tool to see where change has occurred. Part C will have you make use of what you learned to create a Poster for an area that interests you based on a template Poster and images “captured” from the two online applications.

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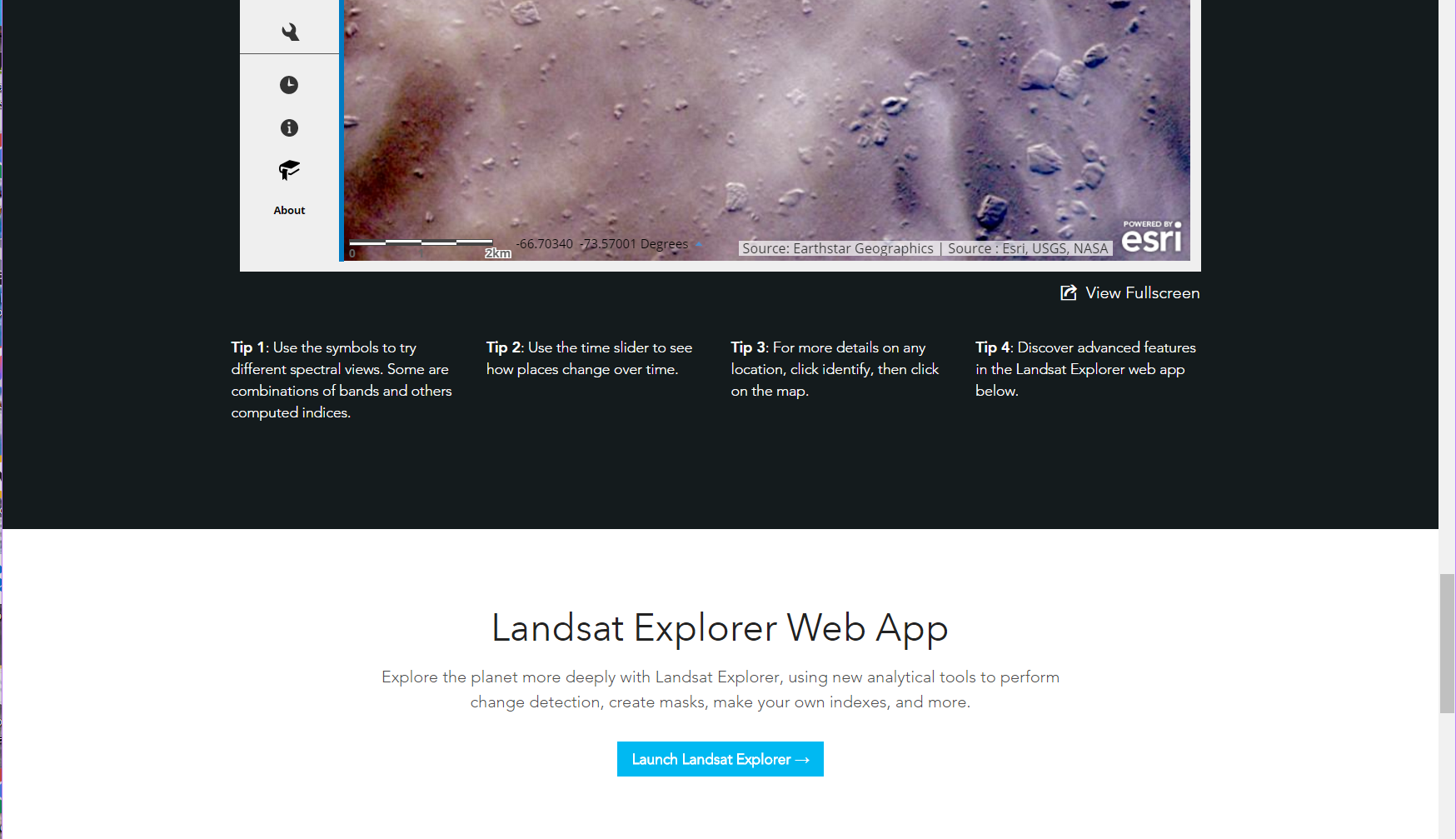
Based upon work supported by the National Science Foundation under Grant DUE ATE 1304591 and 170496 for the National Geospatial Center of Excellence and Grant DUE ATE 0703185 and 1205069 for the Grants DUE 0703185 and 1205069 for Integrated Geospatial Technology Training (iGETT). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

**Part A – Unlocking Earth’s Secrets**

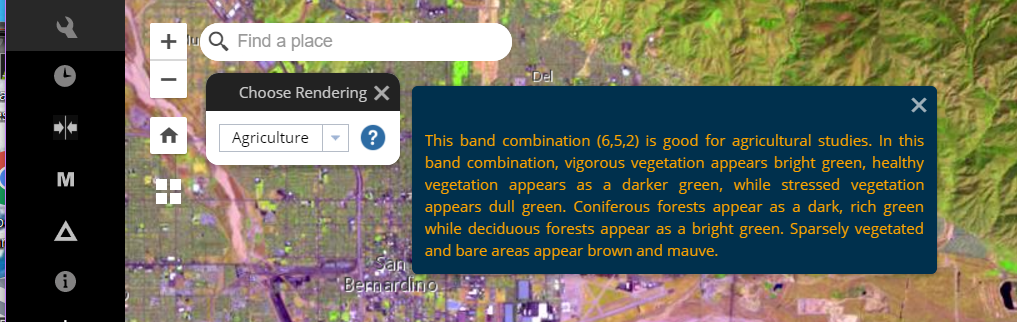
1. Open a browser (Chrome, Firefox) and go to [www.esriurl.com/LandsatOnAWS](http://www.esriurl.com/LandsatOnAWS). When it Opens, click on “Try It Live”. It opens to a default view for Mid Latitudes of Redlands, California, visualized using the Agriculture symbol .
2. Click on **each** of the **symbols** on the left for  Natural color to  Moisture index and see how the image changes.
   1. What band combination helps you most to identify different types of features?
      1. Roads \_\_\_\_\_\_\_\_\_\_\_
      2. Buildings \_\_\_\_\_\_\_\_\_\_
      3. Vegetation \_\_\_\_\_\_\_\_\_
      4. Forest \_\_\_\_\_\_\_\_\_\_\_
      5. Rock/soil \_\_\_\_\_\_\_\_\_\_\_\_
      6. Airport \_\_\_\_\_\_\_\_\_\_\_\_\_
3. Click on the About symbol  and read what bands and combinations are used for the different symbols.
4. Compare the visualization for Agriculture  using bands 6, 5, 2 and the Vegetation Index (NDVI)  band algebra (Band5-Band4)/(Band5+Band4). Which would be better for determining vegetation greenness? \_\_\_\_\_\_\_\_\_\_\_\_\_
5. Use the Time Line symbol  and change the time to mid-August 2016 and click on the Moisture symbol. What changed? Why do you think it changed? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Look at Vegetation Index for the same date of mid-August 2016 and then change date to May 2017. What changed? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. If you want to determine what Mission (current scene ID), date, and other information about an image, click on the i for identify  In the Identify information window the bottom line says, “Pick Point on the map for a spectral profile.” Click a point on the map and get a spectral profile for that point. Click points on several other features and view their spectral signature and what feature type it indicates. Change to another type of band combination and click on similar features.
7. Click on the symbol for Bookmarks. View 4 different locations. Can you identify features on the images? Note that “straight lines and features” are generally man made. Find an airport, find a solar array, find a large city, find a road network, find a geology feature. Could you do that by looking at the different locations? Did you need to change the type of composite image to make it easier?
8. Click on the Artic tab. Zoom In and out. Note that there is now a snowflake symbol. Click on the symbol. Click on other band combination symbols. Use the time slider to change dates. Click on Antarctic. Zoom out and then zoom in to an interesting area and change band combinations. Change dates to its winter and compare with its summer.

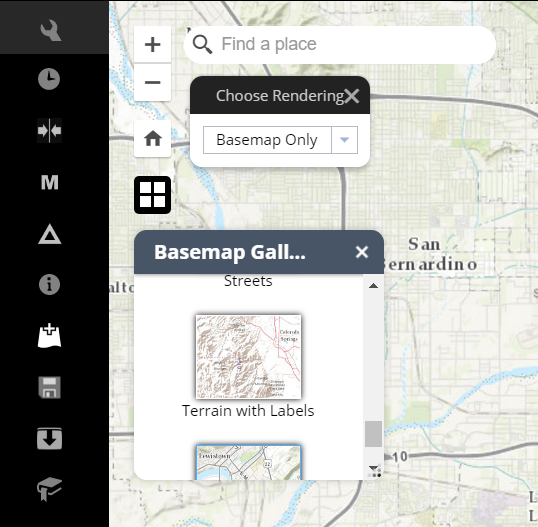
Part B – Landsat Explorer and more advanced techniques

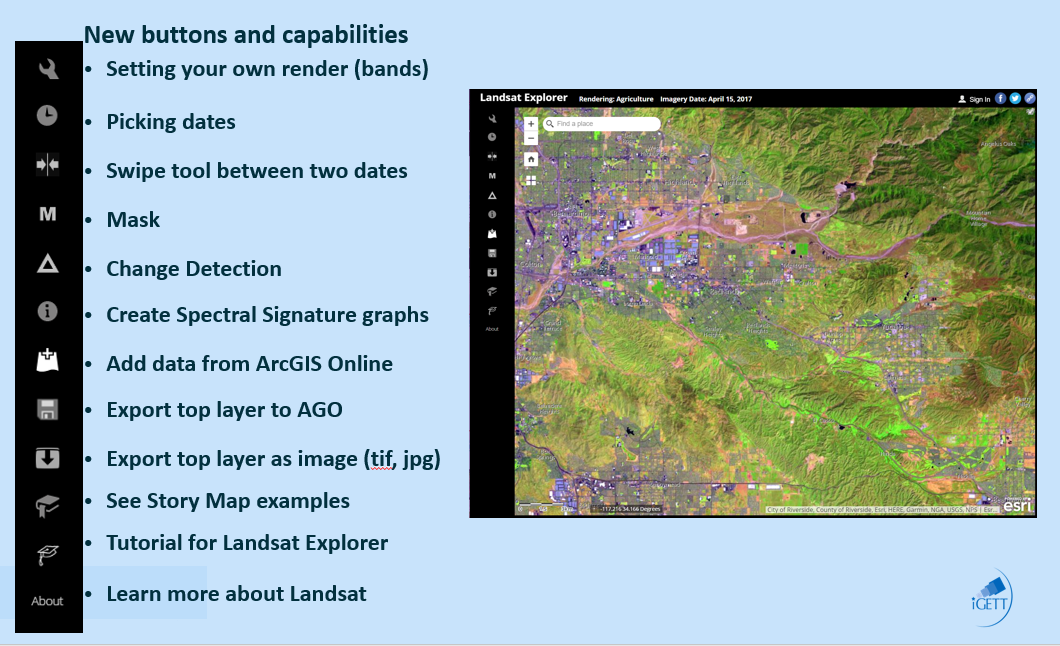
1. Use the window scroll bar and scroll off of the Unlocking Earths Secrets application until you see the Landsat Explorer Web App and the blue button – Launch Landsat Explorer. Click on the blue button.



1. The **Landsat Explorer** also opens on a view of Redlands California using the Bands for Agriculture that have been set using the “render” symbol tool . Click on the Render tool and then the **?** mark in the Choose Rendering box to see more about the bands.



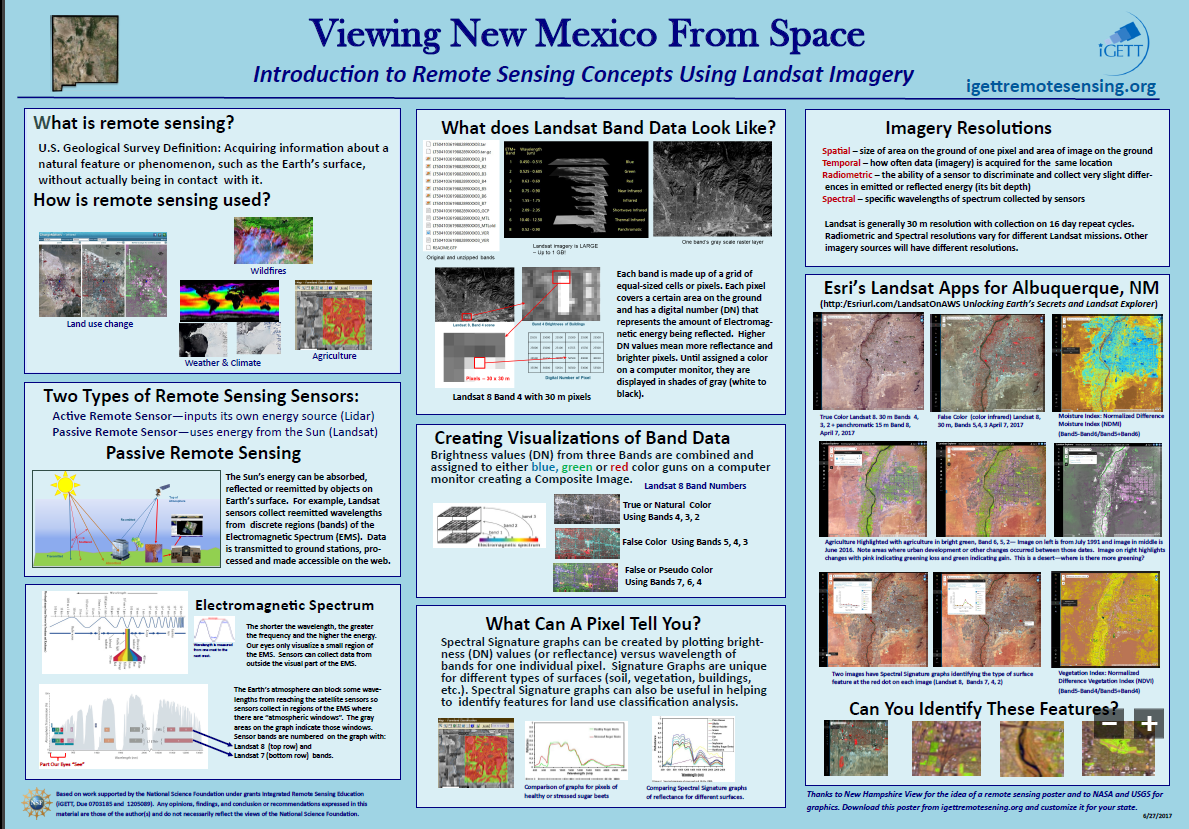
1. Click on the little down arrow and see what band options are available to you. Pick another band combination and see what the visualization is.
2. You can change the basemap from the simple light gray one with only major features and labels. You could pick any Basemap, but try Terrain with Labels and for Rendering choose Basemap Only. Then choose another rendering band combination such as Vegetation index. The additional Basemap choices can help orient you if you are uncertain of your location. 
3. There are many new buttons. Hover over each button and see its description.

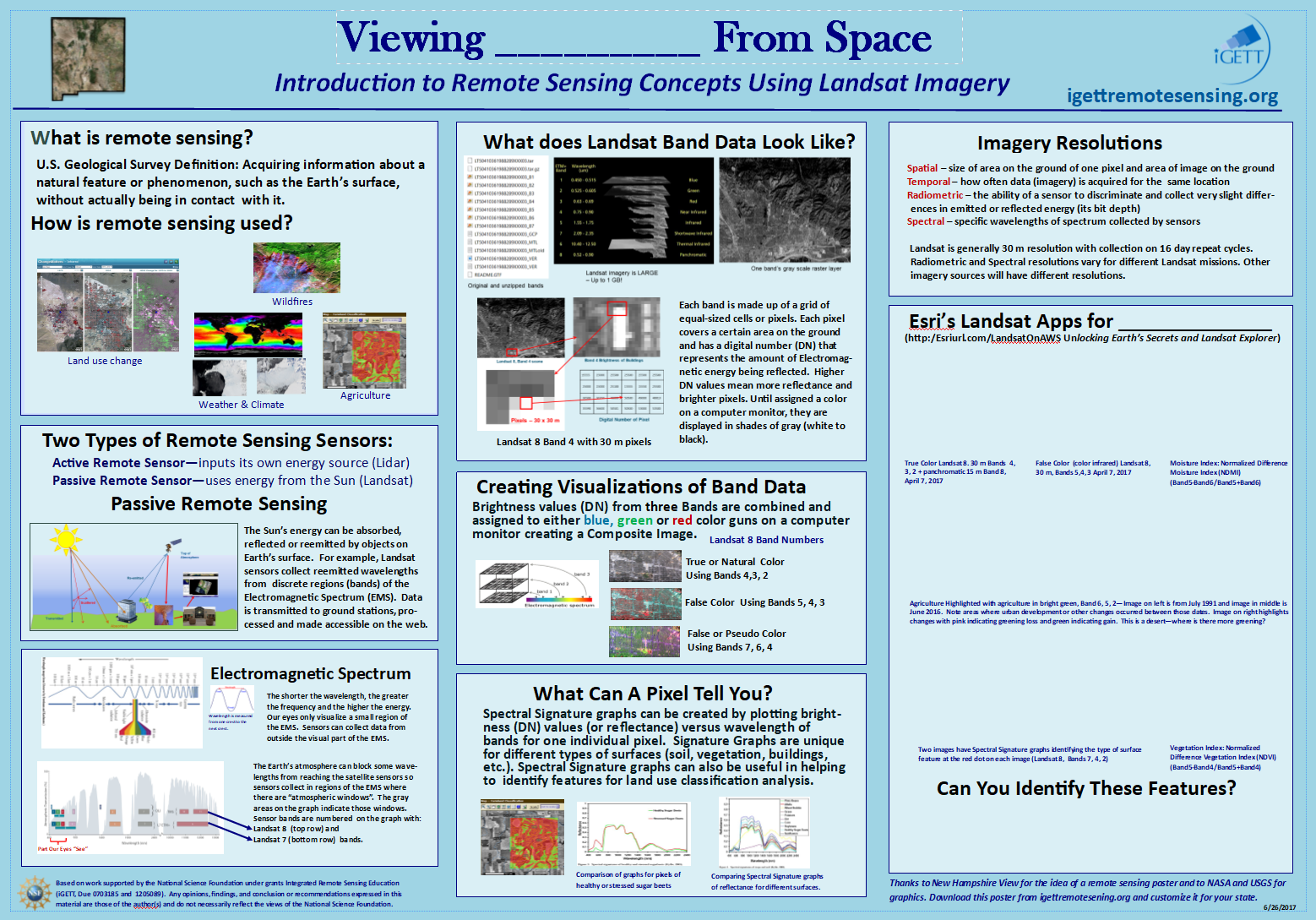


1. Change Rendering Tool to a Color Infrared composite. This composite shows green vegetation as various shades of red. Buildings and roads are blue green. Can you recognize the airport? Water bodies appear black. Can you see several water bodies or small lakes or reservoirs? Click on the identify tool to create spectral signature graphs by clicking a point on the map and see if you are correct. Do that for the airport, water bodies, roads and building. Click a point on a red area to see its spectral signature graph.
2. Click on the Tutorial symbol and complete the tutorial using “Select a tool to start:” with Render and then the down arrow to pick the other tools and learn how to use them.
3. Use “Find a place” and go to a city, a recreational areas (Yellowstone) or a shoreline. Use different renders and create an “earlier” image and then a recent image and use the slider tool and the Change detection tool. Note steps: Use time slider to pick earlier date as a “secondary Layer.” Click on time slider and go to recent date, then use Swipe tool and/or Change Detection.

**Part C – Create a Poster for Your State or Region**

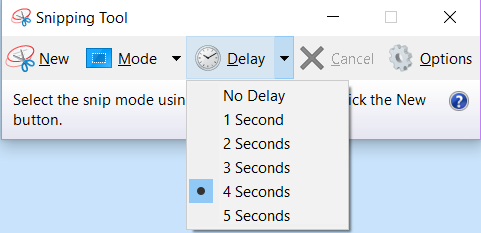
1. You will now use your skills and the two Applications (Unlocking Earths Secrets and Landsat Explorer) to create a Poster for a state or region of your choice based on the PDF of the Poster



and the Poster template for Viewing Kentucky From Space. The Poster Template is a Publisher Document with blank spaces you can customize.

1. Open the Poster Template in Publisher and use Save As with your last name and your state or region name. Be sure and Save your Poster often as you work.
2. You will be using the Snipping Tool that is part of Microsoft applications to capture images for use in your poster. To use the Snipping Tool:

* Click on the Snipping Tool Icon  and Open the tool. Change **Mode** to Rectangle and set a time Delay (this allows you to have dropdowns if you want them).



* Organize your computer monitor for what you want to capture from one of the two Applications.
* Open Snipping Tools and click on New 
* When it is “ready” (looks transparent) click/drag a rectangle around what you want to capture.
* When it is captured and displayed, right click and copy it.
* Go to where you want to place it in the Poster template in Publisher, right click and Paste.

1. Open Unlocking Earths Secrets and investigate imagery by using Find a Place location. You can use the topics that are in the template on the box on the right or create new topics for imagery of your choice for your Poster. Be sure and change the Version number and date on the lower, right hand corner to V1 and today’s date. If you create new versions, you should update this information. Decide what topic you want to have an image of and use the snipping tool to capture and copy/paste into your poster. These are the topics in the template and the bands used.

* True Color Landsat 8. 30 m Bands 4, 3, 2 + panchromatic 15 m Band 8, March 2017
* False Color (color infrared) Landsat 8, 30 m, Bands 5,4, 3 March 2017
* Moisture Index: Normalized Difference Moisture Index (NDMI) March 2017

(Band5-Band6/Band5+Band6)

* Agriculture Highlighted with agriculture in bright green, Band 6, 5, 2— Image on left is from September 2000 and image in middle is September 2016. Note areas where there is urban development or other changes between those dates. Image on right highlight changes with pink indicating greening loss and green indicating gain.
* Two images have Spectral Signature graphs identifying the type of surface feature at the red dot on each image (Landsat 8, Bands 7,6,4 Short Wave Infrared)
* Vegetation Index: Normalized Difference Vegetation Index (NDVI)

(Band5-Band4/Band5+Band4)

1. Repeat the above step until you have filled in the required number of images.
2. For the “Can You Identify These Features? Section of the poster, select 5 to 7 images of features that are interesting in your state for viewers of your Poster to try and identify. This should be captured, copied and pasted to the bottom of the right part of you Poster.
3. Be sure and fill in the state name and other information on your Poster titles and save.
4. When you are finished, and satisfied with your new Poster, Save it.
5. Do a “Save As” or “Export” and create a PDF of your poster.
6. You can print your Poster or use in in PowerPoints or documents.