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Teaching and Learning with the Esri Living Atlas of the World

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Workshop Goal

The goal of this workshop is to provide educators at multiple levels (primary, secondary, community and technical college, university, and lifelong learning settings (museums, libraries, field camps) and multiple disciplines (geography, GIS, environmental studies, earth and biological sciences, sociology, and business) the confidence and skills necessary to make rigorous use of the Living Atlas of the World. As “Living” implies, the Atlas is continually updated with new content and many of its services encompass real time or near-real-time data. The Atlas contains authoritative content from the local to the global scale and across multiple themes such as natural hazards, health, population, and imagery, about the atmosphere, hydrosphere, lithosphere, biosphere, and anthrosphere. This content is available throughout the platform—web, desktop, and mobile, though this workshop will focus on the web (ArcGIS Online maps and apps).

- I. Data is the fuel for GIS. Without deep and rich data sets, GIS would remain a theoretical construct only, and would not be able to be applied to real world problems. GIS has always been focused on data, yet obtaining meaningful and easy-to-use data through a reliable and metadata-rich portal has always been a serious challenge to the GIS user. The Living Atlas of the World provides the GIS user with data at their fingertips, in multiple formats, so that Earth’s problems can be studied and addressed.
- II. Our dynamic Earth is a complex place operating across themes and scales, and through space and time. Because all of these themes and changes occur at specific locations and often exhibit geographic patterns, relationships, and trends, GIS is an incredibly useful and relevant tool in which to analyze the Earth. Teaching about the Earth through GIS and the Living Atlas of the World can foster skills in critical thinking, spatial thinking, working with data, and communication. It can enable students in understanding the major systems and components of Planet Earth, why change occurs in the Earth systems, and how students might be able to get involved in being a “change agent” to help their community and world change for the better—building a healthier, happier, more sustainable planet.

Workshop Outline

The Living Atlas can be accessed and used in many ways. This workshop will focus on the following 4 set of tasks, with the belief that if you work through the examples within those tasks, you will be able to examine hundreds of other themes and scales using the Living Atlas.

1. Exploring the Living Atlas via the Living Atlas website.
2. Using Living Atlas apps.
3. Using Living Atlas content in ArcGIS Online.
4. Linking your content to the Living Atlas for additional capabilities.

1. Exploring the Living Atlas via the Living Atlas website.

Begin with these 4 ways to quickly get familiar with the Living Atlas:

- (1) Living Atlas Products page: <https://www.esri.com/en-us/arcgis/products/living-atlas>. Includes news, content, lessons, and more.
- (2) Data and Location Services at Esri: A “one level up” from the Living Atlas, provides context for where and how data are served through Esri portals and tools: <https://www.esri.com/en-us/arcgis/products/data-location-services/overview>
- (3) Environmental Live Data Feeds: <https://www.esri.com/en-us/arcgis/products/data-location-services/data/environmental-data-live-feeds>
- (4) Climate models in the Living Atlas: <https://livingatlas.arcgis.com/en/browse/#d=2&q=climate%20models>.

The Living Atlas of the World is a subset of the vast content in ArcGIS Online. You can connect to Living Atlas content from many ArcGIS apps, such as the Living Atlas website, via apps, via ArcGIS Pro, and ArcGIS Online. With the Living Atlas, you can also create a campus base map with its Community Maps editor, and you can create your own customized base maps with the Vector Tile Style Editor.



Living Atlas content is ready for you and your students to use any time. You may already have used Living Atlas content without realizing it, because the World Topographic Map and other basemaps are part of the Living Atlas. The Living Atlas is well connected to the Internet of Things (IoT), offering live feeds and real-time and near-real time data on content ranging from wildfire perimeters to weather to traffic.

Subscriber and premium content. The Living Atlas contains free and subscription offerings. An individual's ability to access and use Living Atlas content depends on whether an item is classified as free, subscriber, or premium, among other factors.

Living Atlas

Free content can be used for free by anyone, including anonymous visitors to ArcGIS Online, or by people signed in with a public or developer account.

Subscriber

Subscriber content is provided as part of an organizational subscription and *does not* consume any credits. In other words, to use subscriber content, you and your students must sign in to your ArcGIS Online organization. Examples of subscriber content include certain imagery layers from Esri, landscape layers, and historical maps.

Premium

Premium content is a type of subscriber content that *does* consume credits. Premium content includes certain layers from Esri such as demographic and lifestyle maps, as well as tools such as geocoding, geoenrichment, and spatial analysis. Privileges to use premium content are managed by an ArcGIS Online organization administrator.

In this workshop, you will browse and access Living Atlas content via 3 methods via a web browser: (1) The ArcGIS Living Atlas of the World website, (2) Selected apps, and (3) Your ArcGIS Online organization.

The table describes each method and some suggested uses.

Method	Description	Suggested use
Living Atlas website	<ul style="list-style-type: none"> • Central location for Living Atlas information • Browse Living Atlas content using categories, filters, and search terms • View Living Atlas content. 	<ul style="list-style-type: none"> • Get information about new Living Atlas, tips, blog posts. • General browsing, mark favorite content for later evaluation or use. • Quickly open a free map during a lecture or discussion. • Have students access a free Living Atlas map without signing in.
Living Atlas apps	<ul style="list-style-type: none"> • Specific tools, and scales in which to examine specific topics. 	<ul style="list-style-type: none"> • Examine historical imagery and topographic maps, ecoregions, marine units, the world's water balance, and more.
ArcGIS Online organization	<ul style="list-style-type: none"> • Built-in tools to browse and access Living Atlas content • View Living Atlas content. 	<ul style="list-style-type: none"> • Browse the Living Atlas tab within the content area. • Add Living Atlas layers to maps. • Seamlessly view and use subscriber content. • Have students find, view, and analyze free and subscriber content using their ArcGIS Online Organizational account.

Sometimes you might be curious as to what resources the Living Atlas contains. What content is present about a subject of interest? What maps or layers do you find most engaging or informative? What content might help your students learn? To do this, you need an ArcGIS Online organizational account, with user role or equivalent. Let's start with a "people" theme. Open a new web browser window, and go to the Living Atlas website: <https://livingatlas.arcgis.com/en/>

Go to the Browse tool in the upper right. The top of the page has a search box, and a series of content categories and filter options. Beneath the filters, there are buttons for three views: Grid, Card, and List. If necessary, click the Grid button . Pause your mouse over the People

button , and read the tip. Click People; note # of search results. Add filters to reduce the number. Click the down-arrow to the right of the People category. Check the boxes next to: Population, Health, and Education. Scroll down and scan the results. The results include maps representing the whole world, as well as individual countries, such as the Netherlands and China. Scroll to the top of the page. Search on “world population.” The number of results is reduced to less than 100. The list is currently sorted by relevance, but at this point, most of the results could be relevant. You would like to know which items most people use. On the right side, sort the results by Popularity. What contributors are represented? Are all of the items free to use? When you are finished, scroll up to the top of the page.

Next, search the Living Atlas for a specific resource. Imagine that you would like to find an up-to-date, general-purpose political map of the world. You want to use the map during class lectures and in assignments to grow student awareness of countries and places. Because you are unsure what category would include a world political map > search all categories . Sort the results by relevance. Next to Filters, click All Content types > choose Maps. Scan the results. A world political map might not appear in the top results. You will narrow the search. If necessary, scroll up to the top of the page. To the right of Filters, check the box next to Esri-only Content. In the Search box, change the search to world political. The results are reduced to a small number. Click the Card button  which gives a brief description of the item.

Next, you will preview the Charted Territory **Map** to evaluate whether it will meet the needs of your students. In the Charted Territory map’s card, click the More Options button , and choose Map Viewer. The Charted Territory map opens in a new browser tab. The web address (URL) points to the ArcGIS Online Map Viewer app. The Living Atlas website remains available in the first browser tab. Zoom and pan the map to see how the countries, cities, and hillshade appear at different scales. Above legend, click the Show Contents of Map button . In this map, is Charted Territory a basemap or a map layer? The Charted Territory map will serve your instructional purposes. Mark as a favorite so that you can quickly find it in the future.

Return to the Living Atlas of the World tab in your web browser. In the Charted Territory card, click the Favorite button . To mark the map as your favorite, the Living Atlas website needs to know who you are > sign in with your ArcGIS Online Organization username and password. Your username is displayed in the upper right corner when you are signed in to the Living Atlas website. Below your name, open My Favorites tab to verify that the Charted Territory web map is listed.

Next, you will briefly experience browsing the Living Atlas when you are signed in to ArcGIS Online organization.

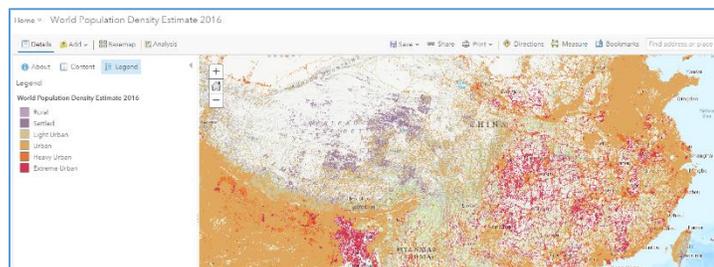
In your web browser, go to the ArcGIS > Charted Territory tab, if it is still available. Otherwise, open a new browser tab and go to ArcGIS Online: <http://www.arcgis.com>  Earlier, you signed in to the Living Atlas website using your ArcGIS Online organizational credentials so that you could complete certain tasks. Now, you will sign in directly to your ArcGIS Online organization. Click Sign In, and sign in with your ArcGIS Online organizational credentials. Search for Charted Territory Map again if necessary. Go to the upper right tool > My Favorites. The Charted

Territory web map appears in the list, confirming the association between the Living Atlas website and your ArcGIS Online account.

To further explore the connection between the Living Atlas and your ArcGIS Online account, sign in to your ArcGIS Online account. Then, go to > Content. Click on > Living Atlas tab on the blue bar. Note how you can search content and filter here as well, just as you could in the Living Atlas website. Search for: Live Stream Gauges (Flooding) > Choose the map image layer by Esri > Open in Map Viewer. What is the areal extent of this layer? What is flooding right now? Note that this layer is listed as “subscriber content”.

Go back to your tab showing your ArcGIS Online content and the blue bar that includes the Living Atlas. Search for and examine the following imagery layer’s content and metadata:

World Population Density Estimate 2016:



<https://www.arcgis.com/home/item.html?id=0f83177f15d640ed911bdcf6614810a5>

Note how the cell value populations were computed.

Lastly, search for the World Ecophysiographic Land Units 2015:

<https://www.arcgis.com/home/item.html?id=140af3e5389a4afcb421ee4633d18d3a>

Note what comprises the World Ecophysiographic Land Units and who determined them. Metadata matters!

When using content for your projects, including Living Atlas content, evaluating an item’s usefulness is important. Some considerations include: Does the map represent the features or phenomena that you want? Does the map cover the needed geographic region? Is the currentness of the data appropriate for your intended use and/or represent the needed historical time period? Is your intended use of the map or attribute data allowed? Can you change the style, open the table, or use the layer for analysis?

2. Studying selected content using Living Atlas apps.

Living Atlas apps (<https://livingatlas.arcgis.com/en/apps/>) are powerful, are often connected to real-time data feeds, and offer rich content that can be used across multiple disciplines. Let's study three of these apps here. Open a new browser tab.

- (1) Analyze change over time with the Wayback imagery, 5 years of historical high-resolution imagery for the planet:

<https://livingatlas.arcgis.com/wayback/>

- (2) Study the world's water balance, including soil moisture, precipitation, snowpack, and more:

<https://livingatlas.arcgis.com/waterbalance/>

- (3) Analyze the Ecological Land Units (ELUs) of the world:

<https://livingatlas.arcgis.com/ecoexplorer/maps.html>



3. Using Living Atlas content in ArcGIS Online.

Adding Living Atlas content to an ArcGIS Online map is another powerful way to interact with Living Atlas data, because in so doing, you have all of the tools in ArcGIS Online at your fingertips. If you add the Living Atlas data to an ArcGIS Pro session, you will similarly have access to even more analytical tools in Pro.

Start an ArcGIS Online session and sign in to your organizational account. Use Add Data > Search the Living Atlas for "historical topographic" > and select USA historical topographic maps, as shown. Add to Map Viewer. Search and find Plano, TX and click on the resulting map. Note the > arrow in the top bar of the popup. Scrolling to the right using the > arrow shows all of the dates of the USGS historical topographic maps in this area at different scales. Use the toggle visibility or transparency tools to compare the current street pattern in Plano vs that of 1960.

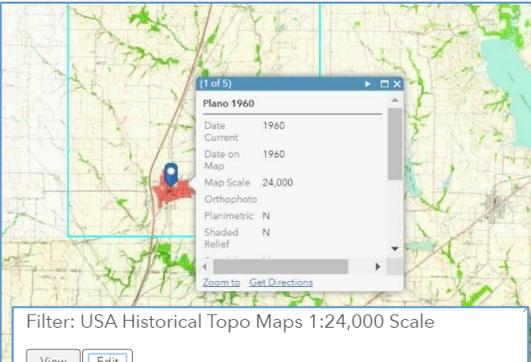


USA Historical Topo Maps 1:24,000 Scale

Imagery Layer By: [esri](#)

Displays 1:24,000 scale historical U.S. Geological Survey (USGS) topographic maps. Historical maps are visible at 1:144,448. ArcGIS Online subscription required.

Subscriber Authoritative



Plano 1960

Date: Current 1960

Date on: 1960

Map Scale: 24,000

Orthophoto

Planimetric: N

Shaded: N

Relief

Filter: USA Historical Topo Maps 1:24,000 Scale

View **Edit**

+ Add another expression Add a set

Display features in the layer that match the following expression

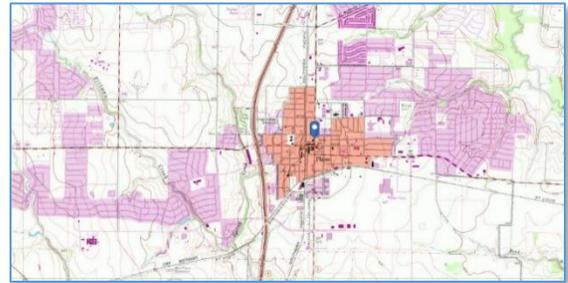
Date Current is 1973

Ask for values

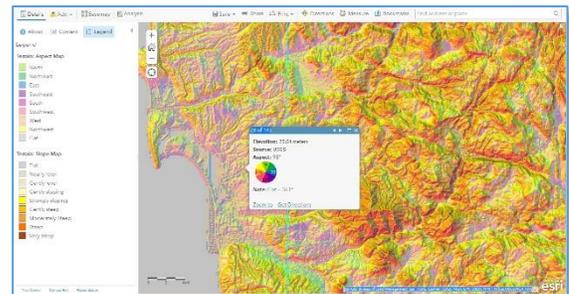
APPLY FILTER CLOSE

Recalling the date information in the popup, use > Filter on the layer to filter the Date Current to 1973, as shown.

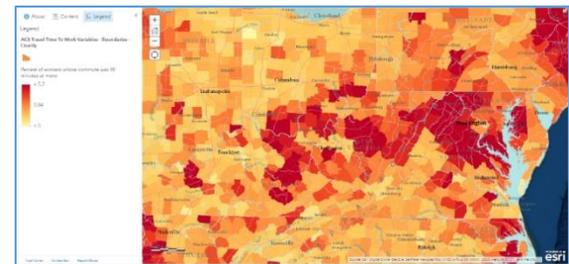
Note the beginnings of suburbanization that had occurred by 1973 by the purple revisions (as shown). Compare to the current urban area extent by examining the current open street map or streets base map.



Remove or make invisible the historical topographic map layer. Add Data > Living Atlas > Slope. Do the same for Aspect. Zoom to San Diego or another area of interest and click on points to obtain the values for slope and aspect (as shown).



Go to Washington DC and surrounding area and add US Census American Community Survey data: Add Data > Living Atlas > "current year ACS". Add Median Age Variables Boundaries. Add Travel Time to Work. Examine the patterns (see graphic).



For more information on how to add Census data from the Living Atlas, see:

<https://www.esri.com/arcgis-blog/products/arcgis-living-atlas/mapping/add-census-data-to-any-map-with-the-living-atlas/>.

Zoom to Toronto, Canada. Add from the Living Atlas, "1818 Phillpotts Plan of York" in metropolitan Toronto, Canada. Zoom to the extent of the map and note the origins of York and the changes since 1818. Next, add 2019 Canada median age, and 2019 median household income, in York. Note patterns across space and relationship between median age and household income.

4. Linking your content to the Living Atlas for additional capabilities.

As I wrote in the guidelines and essay, [More Power for Your GIS Analysis through Joining Features to ArcGIS](#), the paradigm that GIS users have been operating under for decades is being challenged in new exciting ways. Instead of the standard workflow of "downloading data > joining the attribute tables of two data layers > performing analysis", you can join your data to layers in the Living Atlas of the World directly, without downloading. Another related workflow in the new paradigm is with spatial joins. A spatial join affixes data from one feature layer's attribute table to another according to its location. Spatial joins begin by selecting a target feature and comparing

it spatially to other feature layers, to determine how many water wells are in a drainage basin, businesses in a census tract, or the number of earthquakes that fall within specific countries.

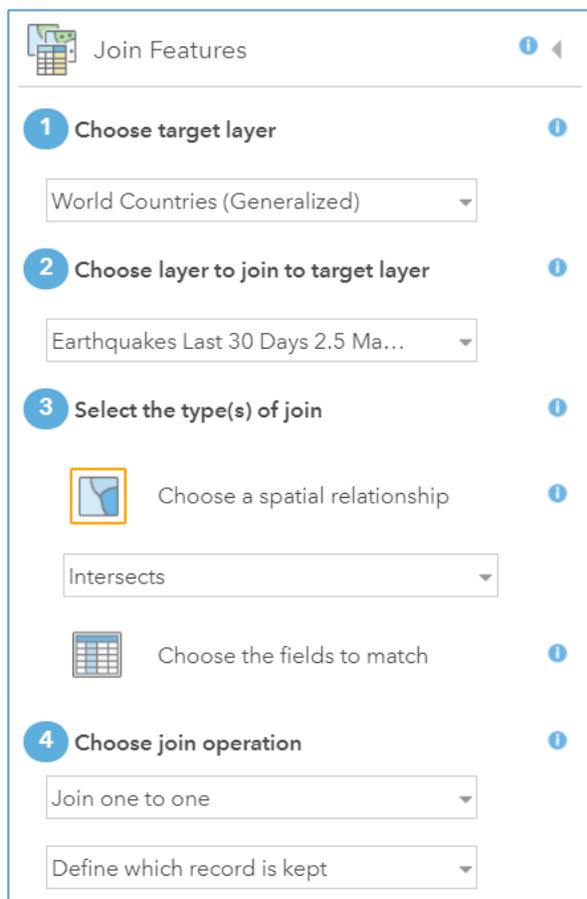
Let's take this last example and use the Living Atlas to accomplish it. Let us say that you want to determine how many earthquakes occurred in the past 30 days according to the USGS. In ArcGIS Desktop, you would need to download two data layers – (1) a point layer for earthquakes, (2) a polygon layer for world countries, and then perform a spatial join. Nothing is wrong with that method, and works well in ArcGIS Pro. But let's say you want to do that in ArcGIS Online, you don't want to download anything, but want to use the cloud-based method with the Living Atlas. The analysis tool in ArcGIS -- Join Features, will enable you to do so. To use the analysis tools, you need to be signed in to ArcGIS and have a publisher role.

To begin, start with this web map:

<https://www.arcgis.com/home/webmap/viewer.html?webmap=b9a8028b9627441daab9b85a2056499d> – showing USGS earthquake data for the last 30 days. Then: Analysis > Join Features:

> Choose target layer > search for World Countries (generalized) in the Living Atlas of the World. This is your target layer, so named because my goal or "target" is to create a choropleth map by country polygons. The layer to join **to** these polygons is the last 30 days of earthquakes > Choose "intersect" - - if an earthquake is inside or "intersects" the country polygon, you want it to be considered > One to one > Name your resulting layer "join earthquakes to countries (your initials) > Uncheck "use current map extent" just in case your current extent cuts off any outlying islands in the South Pacific, for example. Then > Run Analysis.

Your results should look similar to this example, with all countries defaulting to single symbol.

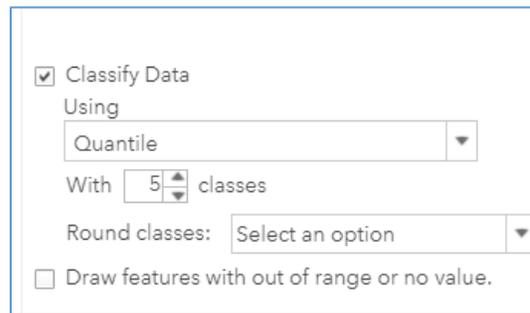


You will change the style shortly, but before you do, examine the new table of data. The "join count" field contains the number of earthquakes by country:

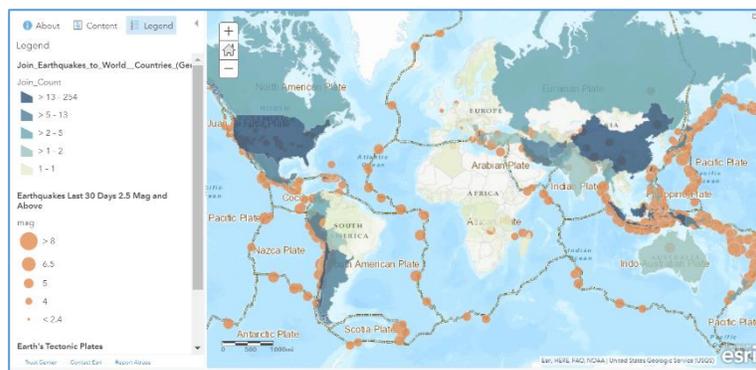
Join Earthquakes to World Countries (Generalized) (Features: 41, Selected: 0)					
Join_Count	FIPS_CNTRY	ISO_2DIGIT	ISO_3DIGIT	NAME	COUNTRYAFF
254	US	US	USA	United States	United States
33	CI	CL	CHL	Chile	Chile
20	ID	ID	IDN	Indonesia	Indonesia
15	CH	CN	CHN	China	China
13	AR	AR	ARG	Argentina	Argentina

Next > Change Style to symbolize the countries on Join_Count, and make a color coded (choropleth) map by the number of earthquakes that occurred in each country.

Because the USA contains so many earthquakes, the default Counts and Amounts symbology lumps most countries into one category. The reason why is in part because the USGS earthquake center is in the USA, in Golden Colorado. The earthquake center receives transmitted signals of information from the global seismic network, but also senses ground motion from nearby earthquakes in the western USA. As it senses more small earthquakes in the USA than it does for other countries, the results are a higher number for the USA. Thus, under Options, change the classification to Quantile with 5 classes, as shown. This is all a critical part of knowing your data (See the Spatial Reserves data blog <https://spatialreserves.wordpress.com> for more).



Through the results (shown here) you have a better sense of the frequency of earthquake by country. Given an ocean polygon layer, you could also map oceans by earthquake frequency.



Next, make a few final adjustments. Because over the last 30 days, according to the USGS, earthquakes had occurred in only 41 countries, and 254 polygons exist in the generalized world countries data set, countries with no earthquakes have no symbol or color. This looks a bit odd. Thus, show countries with no earthquakes over the past 30 days with a pale yellow color, as follows: > Add Data button > Browse Living Atlas > add world countries (generalized) > change style to pale yellow with a yellow outline. Once done > move position to underneath the joined earthquakes layer. Move earthquakes to top of the contents so that map users can more clearly see them. > **Label** the countries with the number of earthquakes that occurred within each one.

To view an example map that used the above workflow, see:



<https://www.arcgis.com/home/webmap/viewer.html?webmap=283cd96790834a13a55767ba283e4b80>.

Think of Living Atlas as a vast storehouse of data that you can join your own data to for rich analysis.

Congratulations! You have used the Living Atlas of the World in meaningful ways, and gained skills and content knowledge along the way!

Tool	URL
Living Atlas of the World	https://livingatlas.arcgis.com
ArcGIS Online	https://www.arcgis.com
Teaching with the Living Atlas	https://www.esri.com/training/catalog/5dc1b74ce4212b48e187e837/teaching-with-arcgis-living-atlas-of-the-world/
Data Book and Blog	https://spatialreserves.wordpress.com

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