GIS became available to everyone with the introduction of mapping applications like Google Earth, MapQuest, and many other apps that anyone could access on their desktop and mobile device. Now, whether you’re a beginner or a professional, you can access, analyze, and share data and maps within your organization and beyond.

The activities, videos, and lessons in this chapter lead to the discovery of the uniqueness of GIS on both the web and the desktop. The five lessons in chapter 1 offer instruction in the use of three visual/analytical tools and include a scenario-based lesson on the United States population change and a how-to for adding live-feed data. This chapter ends with questions that support reading comprehension, reflection, and discussion of the narratives in the corresponding chapter 1 of *The ArcGIS Book*. 
Introductory activities

Video
Videos elevate motivation and enthusiasm as well as enhance discussion. The two map videos (numbers 1 and 2) are short but compelling and could be set to loop in the background of any instructional area. Teachers run them in the background as students arrive to generate interest. Interaction with the maps results in a better understanding of the scope of work done with GIS.

To access the following videos go to video.esri.com. Search for each video by the title.

Map lovers, feast your eyes on this! 30 Years of Maps (2014).

Activity
Explore Esri Map Books, published since 1984:

www.esri.com/mapmuseum

GIS users around the world map mineral resources, ecosystems, hurricane surge, waterfowl migration, earthquake disasters, and wildfires, just to mention a few things. Published annually since 1984, the Esri Map Book acknowledges the important and innovative accomplishments of such users. Leafing through, you’ll be amazed at the great variety of maps. As you look at the maps in the map books, select three maps and for each map record the following:

- Organization that produced the map
- Reason or problem for the map
- Layers included in the map
Lessons: Account not required

Remember, you can access online all you need for the lessons in this guide, either with no sign in to an ArcGIS Online organization account required (the first set of lessons in each chapter) or by signing in with an organizational account (for the last set of lessons in each chapter).

*The ArcGIS Book* interactive version (www.TheArcGISBook.com) starts you off by exploring many of the unique analytical maps and scenes accessible online, such as Highway Access in Europe and U.S. Populations. From the GIS map or scene interface, users take up visual and analytical tools that investigate anything from election results in 3D to the terrain of the Swiss Alps. Tools like that solve problems; they help you find answers to questions along the way; and they’re available online. The following section explores three of these tools: visual recognition of spatial distribution, the analytical concepts of symbolizing/classification, and querying/filtering. Investigate each of the maps to understand the analytical value of each tool.
Scenarios of spatial distribution

Spatial distribution is such a formal term for a skill that starts early and is basic. If you show a class of third graders the US States and Cities map, they will say things like

“There are a whole bunch of dots on the right.”
“There are groups of dots here.” Or,
“There aren’t many here,” as they point with their fingers.

All these are simple observations, easy to make, but isn’t that the point? Information made visible registers instantly, especially when associated with place, which is what mapping software does. Your observations don’t need to be sophisticated or use geographic terms in order to describe spatial distribution. As you advance in your ability to use such terms, however, your spatial descriptions will become more helpful to you in your collaboration and communication with other GIS users.

Looking at spatial distribution, you begin to understand why the spatial component of GIS sets it apart from other software. GIS has the element of where. Data can be displayed using many different tools, but data that has a spatial component can be displayed in maps. One of the most compelling reasons to use a GIS is that it gives the user the ability to recognize patterns from mapping. In the following exercises, lessons that employ tools within your reach, you will use maps that show patterns of spatial distribution.

Maps show the spatial distribution of phenomena and how it is arranged across the surface of the earth. The phenomena can be Earth’s physical landscape, demographic patterns, economic patterns, and any other pattern with a spatial component that connects it to the earth. Spatial distribution, along with spatial analytics, is the heartbeat of any GIS system.

The maps that follow illustrate the spatial distribution of two types of demographic data and of one terrain model. Terrain models allow users to better visualize landscape. The study of population growth and trends over such landscapes allows government agencies to make better predictions as to where resources should be made available. Questions are included to help guide you in understanding spatial distribution.

Build skills in these areas

- Opening and modifying an existing online map
- Interpreting legends
- Determining formulas used to calculate change
- Writing spatial descriptions of various geographic areas. A spatial description refers to the pattern of data arranged according to its physical position or relationships

What you need

- Account not required
- Estimated time: 30 minutes for U.S. Population Change 2000 to 2010
- Estimated time: 15 minutes for Terrain of Swiss Alps
Lesson 1-1: Spatial distribution
U.S. Population Change 2000 to 2010

Find the USA Population change map for this lesson in the first chapter of the thearcgisbook.com. Under the ArcGIS information items heading, locate it beneath the subhead WEB MAPS and SCENES.

The “About” section of the map explains that the U.S. Population Change 2000 to 2010 map indicates the annual rate of total population change in the United States from 2000 to 2010. The map shows two spatial components: counties and census tracts. The census tracts are not revealed until the user is zoomed in at a scale of 750 kilometers to 100 kilometers. Counties are typical political divisions. A census tract is a man-made division as well.
Scenario
The new startup company Build for Us has had so much success that they are looking to expand. The company knows that any geographic location that is increasing in population requires more housing and would need to buy more material from Build for Us. They have asked for an analysis of counties and even sections of counties that would be a good place to locate new Build for Us facilities. They are looking for both general areas in the United States and specific areas in certain counties.

1. Click the USA Population Change Map and zoom out to see contiguous USA. This multiscale map allows you to view geographic data across a range of scales.
   a. What is the first spatial component that is seen?
   b. What is the second spatial component that is seen as you zoom in?
   c. What does a census tract represent?
   d. Examine the legend and write a description of the legend in your own words.
   e. What formula was used to calculate the percent change in population from 2000 to 2010?

Build For Us has asked for written spatial descriptions of the United States, individual states, and specific counties. They will use these descriptions along with the map to decide where to locate new Build For Us stores.

2. Using the scalability of the map, write spatial distribution descriptions for the following areas.
   a. Write a description of the spatial distribution of the United States by county by population change from 2000 to 2010.
   b. Zoom in to your state and write a description of the spatial distribution of your state by population change from 2000 to 2010.
   c. Zoom in to your county and write a description of the spatial distribution of the census tracts by population change in your county.
   d. How could other state and county agencies use this information?
Lesson 1-2: Spatial distribution
Terrain of Swiss Alps

Find the *Terrain of Swiss Alps* map for this lesson in the first chapter of the *thearcgisbook.com*. Under the ArcGIS information items heading, locate it beneath the subhead Layers.

**Scenario**
As a new professor of geography you are looking for ways to incorporate new technologies into your classroom while still teaching core content. You have chosen to use interactive GIS software to demonstrate both physical and political boundaries. You want your students to identify the countries that are home to the Alps by looking at the spatial distribution of the terrain.

1. Click the Terrain of Swiss Alps map. It opens as a Demo Terrain map.
   a. What does a terrain map show?
2. On the top of the page, click Basemap and investigate the area using various basemap image layers.
   a. Using these basemaps, write a paragraph about the spatial distribution of the Alps.
   b. To whom would this map be interesting?
Symbolization and classification
Before explaining symbolization and classification in classical GIS terms, let’s take a look at the essence of these processes.

You’re familiar with using a symbol to represent something else: A heart represents love; a fist signifies anger; balloons stand for celebration; and don’t forget that entire language of symbols on your phone, those expressive Emojis. Esri mapping products provide a plethora of symbols to use professionally on your maps.

Classification is another thing you’re accustomed to. When you group things that are in some way the same, you are classifying them. “All the girls, stand together.” “Anyone that rides Bus 3, gather over here.” Classifying becomes easy in a GIS because of the inherent features of a GIS system.

Symbolization in GIS is a method of assigning different sizes, colors, and shapes to features. For instance, capital cities are often represented by stars, and danger areas are usually shown in red.

Classification or styling allows GIS users to display their data by any variable that is attached to points, lines, or polygons. The variables attached are called “attributes.” The following exercise gives the learner an opportunity to explore several different types of symbolization and classification/styling.
Lesson 1-3: Symbolization and classification
Nepal Earthquake Epicenters

Find the Nepal earthquake epicenters map for this lesson in the first chapter of the thearcgisbook.com. Under the ArcGIS information items heading, locate it beneath the subhead Layers.

This is a map of epicenters of the earthquakes that occurred in and around Nepal. The year of the earthquake, its epicenter, and magnitude can be viewed by clicking the points on the map. The points are also symbolized by the magnitude of the earthquake. The district divisions can be seen on the map as outlines. Now you will see how the data can be displayed differently by changing the symbolization of the map, which will allow the viewer to visualize and observe even more information.

Build skills in these areas
- Opening and modifying an existing online map
- Changing transparency
- Changing style to unique values
- Changing style to Counts and Amounts
- Changing size and color of symbols

What you need
- Account not required
- Estimated time: 30 minutes

Nepal Earthquake Epicenters
Scenario
The United Nations Disaster Assessment and Coordination (UNDAC) team needs an emergency response system map to respond to the Nepal earthquake. They have seen the original Nepal Earthquake Epicenter Locations map and are impressed. However, for their immediate need, they have asked that the map be altered to show the following:

- The epicenters of the 2015 earthquakes must be seen at all scales.
- All of the 75 districts should be shown by population.
- All recorded earthquakes with a magnitude of 5 and above should be shown. On the Richter scale, earthquakes above 5 can be felt by everyone and can cause slight damage to all buildings.

1. Click the Nepal earthquake epicenters map.
2. In the upper right corner, click Modify Map.
3. Click Show Contents of Map under Details.

As you zoom in and out of the map you can see that the NepalEarthquake 2015 layer disappears and appears according to the scale of the map. The UNDAC wants this layer visible at all times.

4. Click the three dots at the end of the NE 0425 layer.
5. Go to Set Visibility Range.
6. Move the slider to World. This makes this layer visible at all scales.

7. Again, click Contents under Details.

8. Zoom out to see the entire country of Nepal with the outlines of districts shown. The 75 districts are shown, but only their outlines are visible. All of the values of the districts look the same, which means they are classified on the map as location and only shows you the distribution of the data.
When you classify or style data, you have many options. The Change Style menu is your gateway to changing the look of your data.

9. Click Change Style under the District layer.

10. The individual districts can be seen more distinctly if you choose DISTRICT as the attribute. A single symbol will give you a unique symbolization by the district name.

11. All of the districts are not displayed in a unique color on the map. Click Options.
   a. Use the top slider to scroll down until you see the double arrow pointing up. Click the double arrow to Move all values out.
   b. Click Ok.
   c. Click Done. All the districts are now displayed on the map and in the Contents pane as unique values. It is now much easier to see the unique district.

12. Click District and click Change Style.
   • Select POP_91.
   • Click Done.

13. Uncollapse the District layer to see the legend.

14. Write a brief explanation of how the legend helps you understand the map.
   a. What does the legend show about the population?

Your last task for the UNDAC is to show only the earthquakes with a magnitude of 5 and above. You want only the values of 5 and above to be shown on the map.

15. Click NepalEarthquake2015 and go to Change Style.

16. Click the Counts and Amounts (Size) options.
   • Scroll down and change the classes to 2.
   • Move the slider to 5.

You have displayed the districts by a unique value, NAME; however, the UNDAC wants the districts displayed by population. Seeing the districts displayed in a choropleth map by population would provide the responders with information about districts that would need the most resources during an earthquake. Numeric data can be displayed with counts and colors that display the features on the map as a color gradient.
21. Click OK.

This leaves only the earthquakes with a magnitude of above 5 shown on the map.

22. Click 5 to 7.5.

23. Click Symbol, change the size of the symbol to 30, and choose a distinct symbol.

24. Click OK.

a. Where on the map are the earthquakes with a high magnitude in relationship to a district with a high population?

b. Turn off the District layer and observe the basemap layer. What would make rescue efforts difficult in the northern districts?
Filtering and querying
Earthquakes of the World

Again, terminology can seem more threatening than it needs to be. Filtering and querying means asking a question and, at an advanced level, asking a couple of questions strung together. A simple question would be “Where can I eat lunch?” A complex question would be “Where can I eat lunch and shop for clothes?”

A GIS system allows you to do further analysis with the data after it is mapped. In this way, GIS is more than a map. The most basic analysis in a GIS allows the user to ask questions of the data. Asking questions of the data can involve asking questions using the attributes or asking questions using the location. Questions can be constructed so they return a set of spatial results that extract meaning from your data.
Lesson 1-4
Filter and query to understand earthquakes

For this lesson, find this simple live map, showing earthquakes that happened over the previous 60 days, in the first chapter of the thearcgisbook.com. Locate it under the heading “It all begins with a map.”

On the map, earthquakes over the last 60 days are symbolized by magnitude and depth. Here are some basic facts about earthquakes:
• Earthquakes between 5 and 7 are the ones that occur most frequently and cause damage.
• Earthquakes that are 7 and above are extremely damaging and much rarer.
• Earthquakes deeper than 300 kilometers are usually associated with convergent boundaries.

Build skills in these areas
› Opening and modifying an existing online map
› Changing transparency
› Changing Style to unique values
› Changing Style to Counts and Amounts
› Changing the size and color of symbols
› Filtering data by attributes

What you need
› Account not required
› Estimated time: 20 minutes

<table>
<thead>
<tr>
<th>Richter scale of earthquake magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnitude level</strong></td>
</tr>
<tr>
<td>Less than 1.0 to 2.9</td>
</tr>
<tr>
<td>3.0–3.9</td>
</tr>
<tr>
<td>4.0–4.9</td>
</tr>
<tr>
<td>5.0–5.9</td>
</tr>
<tr>
<td>5.0–6.9</td>
</tr>
<tr>
<td>7.0–7.9</td>
</tr>
<tr>
<td>8.0 and higher</td>
</tr>
</tbody>
</table>
Scenario
The United States Geological Survey (USGS) wants to use its live-feed earthquake data to promote understanding of earthquakes and their magnitude and depth. The USGS has asked you as a representative of the American Association of Geographers to write a lesson using this live-feed earthquake data, combined with the querying/filtering capabilities of the ArcGIS Online software.

Note: All answers will vary because of the last 60-day time frame of the data.

1. Click this simple live map, showing earthquakes that happened over the previous 60 days.
2. Click Show Map Contents under Details.
3. Click Earthquakes and Points to uncollapse both layers.
4. Click Filter under the Points layer.
5. Choose Magnitude field from the drop-down menu.
6. Choose greater than from the Operator menu.
7. Click Unique.
8. Choose 5 from the pull-down menu.
9. Click Apply Filter.
You now only see the spatial display of the earthquakes that meet your criteria.
10. Click Filter.
11. Click Remove Filter.
You can ask questions that have more than one criterion. For example, you could ask to see all the earthquakes that have a magnitude of greater than 5 and a depth of more than 300 kilometers. If you have more than one criterion, choose to display features in the layer that match. ALL requires that each of the criteria specified must be true.

A multiple expression filter can be created to show only earthquakes that have a magnitude of between 5 and 7. If you have more than one expression, choose to display features in the layer that match. ALL requires that each of the criteria specified must be true.
expression, choose to display features in the layer that match All or Any of your expressions. All requires the criteria you have specified must be true. Any means that only one of your expressions must be true for the features to display.

12. Click Edit.
   a. Click Magnitude is greater than 5.
   b. Add another expression.
   c. Depth (kilometers) is greater than 300.
   d. Click Value.
   e. Click All.

The map shows earthquakes that have both a magnitude greater than 5 and a depth (kilometers) greater than 300.

In the following lessons, you will enrich a layer to your map, add fields, and calculate values. You will also clarify the legend and publish the lesson as an app showing the rate of population change by region.
Lessons: Account required

Many of the lessons in this book do not require an ArcGIS Online organization account, but most do require saving. While users can save and share maps with either a free public account or with an organizational account, you will need an organizational account for quite a few of the lessons. If you do not have an organizational account, follow the instructions below to obtain one.

Connect with and deploy the ArcGIS platform
If you’re an existing user and already have an ArcGIS subscription (with Publisher privileges), you’re good to go. If you don’t have these three things, continue reading.

Get a Learn ArcGIS organization membership
Some lessons in this book are carried out on the ArcGIS platform (in the cloud), and require membership (with Publisher privileges) in an ArcGIS organization. The Learn ArcGIS organization can be accessed at http://learnegis.maps.arcgis.com/home/. It is available for students and others just getting started with ArcGIS. With your membership, you can immediately begin to use maps, explore data resources, and publish geographic information to the web. Go to the Learn ArcGIS organization and click the Sign up now link to activate a 60-day membership.

Getting a Learn account is the quickest and easiest way to experience web GIS at ArcGIS Online.

Using a public account
An alternative way for students, individuals, and educators who prefer not to start a 60-day trial subscription is to sign up for a Public Account at https://www.arcgis.com/home/createaccount.html. With this you will still be able to do the majority of the lessons in the book—all the “account not required” ones. The latter few that require you sign in to an organizational account appear last in each chapter, flagged by a purple vertical bar at the start of those sections.

ConnectED
In response to President Barack Obama’s call to help strengthen STEM education through the ConnectED Initiative, Esri President Jack Dangermond provided a grant to make the ArcGIS system available for free to the more than 100,000 elementary, middle, and high schools in the United States, including public, private, and home schools.

ConnectED is a US government education program developed to prepare K-12 students for digital learning opportunities and future employment. This education initiative sets four goals to establish digital learning in all K-12 schools in the United States during the next few years. These goals include providing high-speed connectivity to the Internet; access to affordable mobile devices to facilitate digital learning anytime, anywhere; high-quality software that provides multiple learning opportunities for students; and relevant teacher training to support this effort.

www.esri.com/ConnectED
Lesson 1-5: Build and publish a web app
US Population Change 2000 to 2010

The U.S. Census Bureau is preparing a report on changing population trends between 2000 and 2010. They have hired your Data Visualization Company to produce a map showing rate of change by state and county during this time period. Your company has chosen to use ArcGIS Online to produce the required product. The Census Bureau has given you data for the population of 2000 and 2010 for both states and counties. They have asked for a map symbolized to distinguish areas of population growth from areas of population decline. They want to be able to have a story map web app on their website that the general public can view.

Scenario
In the following lessons you will enrich a layer to your map, add fields, and calculate values. You will also clarify the legend and publish the lesson as an app showing the rate of population change by region.

Build skills in these areas
- Opening a map
- Enriching layers
- Adding a field
- Calculating values
- Symbolizing the data
- Publishing a map as a web app

What you need
- User, Publisher, or Administrator role in an ArcGIS organization
- Estimated time: 2 hours 30 minutes
Open the map
1. Sign in to your ArcGIS organizational account.
2. Search for the Population Change ArcGIS Online group.
3. Uncheck Only search in Participants and Resources (or Only search in Learn ArcGIS).
4. Click the Population Change group.
5. Click the thumbnail of the U.S. Population Change 2000 to 2010 map.
6. Click the Show Map Contents Button under Details.

The map opens showing the Topographic basemap, state, and county boundaries. States and counties are political boundaries.

Change basemap
A basemap provides a background of geographic context for your map and, in this instance, the Light Gray Canvas Map shows the population data better.

1. Click Basemap on the top menu and change the basemap to Light Gray Canvas.

Save the map
1. On the top of the page, click Save and choose Save As.
3. Type tags and a brief description of the map’s content.

Show table and examine attributes
To see information about features in a layer, you can display an interactive table at the bottom of the map.

1. Show Table for States.
2. Examine the table. Notice the table shows only basic information.

<table>
<thead>
<tr>
<th>State</th>
<th>2000 Total Population</th>
<th>2010 Total Population</th>
<th>FIPS number</th>
</tr>
</thead>
<tbody>
<tr>
<td>West</td>
<td>12</td>
<td>15</td>
<td>MT</td>
</tr>
<tr>
<td>Midwest</td>
<td>30</td>
<td>35</td>
<td>VA</td>
</tr>
<tr>
<td>South</td>
<td>20</td>
<td>25</td>
<td>SC</td>
</tr>
<tr>
<td>East</td>
<td>25</td>
<td>30</td>
<td>NY</td>
</tr>
</tbody>
</table>

3. Close the table by clicking the X in the upper right corner.

**Enrich data for states**
Data enrichment produces an enriched layer that retrieves information about the people, places, and businesses in a specific area. Detailed demographic data is returned for your chosen area. You are interested in a layer that shows the total population of 2000 and 2010.

1. Click States and Perform Analysis. The analysis icon can be activated by either clicking the analysis icon under State or by clicking Analysis in the top ribbon.
5. Click Apply.

2. Click Data Enrichment and Enrich Layer.

3. Click Enrich Layer to activate the Enrich layer pane. States is the chosen layer to enrich with new data.

4. Click Select Variable to open Data Browser and browse for variables.

a. Be sure the United States is chosen in the upper right corner.
b. Click the arrow to go to the second page.
c. Click Population.
d. Click the Arrow to go to the next page.
e. Click Population Totals.
f. Click 2000 data in 2010 Geography (U.S. Census).
g. Check 2000 Total Population (U.S. Census).
h. Click 2010 Population (U.S. Census).
i. Check 2010 total Population (U.S. Census).

6. Give Result layer a unique name.
7. Uncheck Use current map extent.
8. Click Run Analysis.

**Add field and calculate: states**
1. Click Show Table on your new layer. The interactive table appears at the bottom of your map.

Notice that the table now shows 2000 Total Population and 2010 Total Population. It also shows the FIPS number, which is the Federal Information Processing Standard number developed by the United States federal government for use in computer systems.
The information in the table that you need to calculate the annual rate of change from 2000 to 2010: is State_Abbr, the 2000 Total Population, and the 2010 Total Population.

2. Click Table Options in the upper right corner of the table and choose Show/Hide Columns.


Your next step is to add a new field to the table to store the calculation that you are going to make.

4. Click Table Option in the right corner of the table and choose Add Field.

5. Add the following parameters to the Add Field menu:
   - Name = rate_change.
   - Alias = Annual rate of change from 2000 to 2010.
   - Type = Double.
   - Click Add New Field.

You can now see the new field added to the table.

6. Click the column you have just created (Annual rate of change from 2000 to 2010) and choose Calculate. This opens the Expression Builder dialog box.

You are trying to find the average rate of change per year from 2000 to 2010. If you subtract the population of 2000 from the population of 2010 and divide by the population of 2000, you will have the rate of change for 10 years; if you divide that number by 10, you will have the annual rate of change; and if you multiply that by 100, you will have a percent. The formula is shown below.

7. Click the Annual rate of change from 2000 to 2010 field and click Calculate. Type or copy the following formula in the Expression Builder.

\[
\left( \frac{\text{TOTPOP10} - \text{TOTPOP00}}{\text{TOTPOP00}} \right) / 10 \times 100
\]
8. Click Calculate.
   When you click Calculate, it populates the rows with the annual rate of change for each state.
9. Close the table by clicking the X in the upper right corner.

Symbolize and adjust legend: states
You want to distinguish your features based on the color gradient provided by the field you just calculated. The color gradient you should choose is Counts and Amounts (Color).
1. Click Enriched States and click Change Style.
2. In the Choose an attribute to show window, choose Annual rate of change 2000 to 2010.
3. Choose Counts and Amounts (Color).
4. Click Options.
   5. Click Classify Data and choose Natural Breaks.
   6. Choose 6 classes.
   7. Click Symbols and choose Red to Green ramp.
   8. Click Legend.
   9. For Round classes choose 0.1.
10. Click Legend and type percent symbols in the legend entries. You might have to enlarge the style pane to see legend.
11. Click OK.
12. Click Done.
13. Click States and the legend will show.
   a. Write a description of the spatial distribution of the United States by state population from 2000 to 2010.

Enrich data by Counties for States
For this exercise three states have been chosen, Virginia, Nebraska, and Arizona.

Virginia

1. Click Counties and Filter.
2. For the expression, choose:
   a. STATE_NAME
   b. Is
   c. Click Unique
   d. Scroll to Virginia
3. Click Apply Filter.

Only Virginia counties are shown on the map.

5. Name the file.
6. Run Analysis.
8. Add field rate_change.
9. Use the following expression when you calculate in the Expression Builder.
   \[
   \frac{\left( TOTPOP10 - TOTPOP00 \right)}{TOTPOP00} \times 100
   \]
10. Symbolize and adjust legend.
11. Save the map to use in your web app.

**Nebraska**

12. Remove the filter for Virginia.
13. Filter for Nebraska.
14. Repeat steps 4 through 11.

**Arizona**

15. Remove the filter for Virginia.
16. Filter for Nebraska.
17. Repeat steps 4 through 11.

**Create web app**

You can create a web app from your map using a configurable app template. Your client has asked that the population rate change map you have built be displayed as a web app. Your client has asked you to use the configurable Story Map Series Web App.

1. Click Share.
2. Click Create a web app.
3. Select Build a Story Map.
4. Select Story Map Series.
5. Click Create app.
6. Specify a title, tags, and summary for the new web app.
7. Click Done.
8. Select Tabbed on the Welcome to Map Series Builder.
9. Click Start.
10. Type **Rate of Change Population 2000 to 2010** as the title for your Tabbed Map Series.

11. Click the arrow.
12. Add County Change for the Add tab.
13. Type **U.S. Population Change 2000 to 2010** for your map.
14. Check Legend.
15. Click Add.
16. Write an analysis of the map in the text box.
17. Add the map VA.
18. Add the map NE.
19. Add the map AZ.
20. Click Save.

21. Click Share on the top of the page.
   The Organization tab is highlighted.
22. Click View live.

Additional analysis
The enrichment tool gives you access to a vast amount of data. For an additional learning activity, choose a variable to study and, using the above exercise as a guide, repeat the process for the chosen variable. For example, you may be interested in calculating the change in density of the population over age 65 in the last ten years. You can do this analysis either by state or at the county level.

Steps for this exercise:
1. Enrich population over 65 in 2000.
2. Enrich population over 65 in 2010.
   \[ \frac{(\text{Density 2010} - \text{Density 2000})}{\text{Density 2000} \times 100}/10. \]
Lesson 1-6
Use live feeds to observe the earth

Your ArcGIS Online organization account allows you access to a collection of earth observation layers that describe current conditions. These live feeds include the following:

- Active Hurricanes: Describes the path and forecast path of tropical activity from the NOAA National Hurricane Center and Joint Typhoon Warning Center.
- Recent Hurricanes: Hurricane tracks and positions, providing information on recent storms.
- Current Wind and Weather Conditions: Provides hourly data, including temperature, dew point, wind speed and direction, precipitation, cloud cover and heights, visibility, and barometric pressure.
- MODIS Thermal Activity: Presents detectable thermal activity from MODIS satellites for the last 24 hours.
- USA Stream Gauges: Provides readings of stream gauges around the United States, which depict the current water level in the measured areas.
- USA Short-Term Weather Warnings: Presents continuously updated weather warnings for the United States based on data from the NOAA National Weather Service.
- USA Wildfire Activity: Presents recent wildfire activity for the United States, featuring data from USGS GeoMac.

Scenario
As a GIS user you will learn how to add live-feed data.

Build skills in these areas
- Opening a map
- Adding live-feed data
- What you need
- User, Publisher, or Administrator role in an ArcGIS organization
- Estimated time: 30 minutes

What you need
- User, Publisher, or Administrator role in an ArcGIS Organizational Account
- Estimated time: 30 minutes
Open the map
1. Sign in to your ArcGIS organizational account.
2. Click Map on the top of the page.
3. Click the Add pull-down tab and choose Search for Layers.

4. In the Search for Layers menu, use the following parameters:
   - Find: live feeds earthquakes.
   - In: ArcGIS Online.
   - Uncheck Within map area.

5. Select Earthquakes Live Feed from USGS.
6. Click Add.
7. Click Done Adding Layers.
   The map opens showing the Topographic basemap. A basemap provides a background of geographic context for your map, and in this case the Dark Gray Canvas Map shows the earthquake data.
8. Click Basemap on the top menu and change the basemap to Dark Gray Canvas.

9. Refer to the lesson Earthquakes in chapter 1 for more analysis directions for this live feed.

10. Remove the live-feeds earthquakes and add live-feeds weather.

12. Remove the live-feeds weather and add stream gauges.

More online lessons
At the end of chapter 1 in the online version of The ArcGIS Book (http://learn.arcgis.com/en/arcgis-book/chapter1/), you’ll find two Learn ArcGIS Lessons. In the first lesson you will create a map of lava flow risk and in the second lesson you will analyze emergency shelters.
The ArcGIS Book, chapter 1
Questions for reading comprehension, reflection, and discussion

Teachers can use the items in this section as an assignment, an introduction, or an assessment, tailored to the sophistication of learners. Some learners can read all the sections at one time, while others are more comfortable with small segments. The questions and tasks are designed to stimulate thought and discussion.

1. **Geography applied**

   **Thought Leader: Jack Dangermond:** Web GIS is an incredible new pattern for applying geography

   a. Write an explanation of web GIS.

2. **Web GIS is collaborative**

   All GIS data fits onto the earth’s surface:

   a. What does “Geography is the organizing key” mean?

   b. Explain what the term “georeferenced” means.

   c. This has been a fundamental concept in mapmaking for thousands of years. How has web GIS changed and expanded our use of georeferenced data?

3. **The expansive reach of web GIS**

   GIS is evolving: The new ArcGIS is a web GIS

   a. “ArcGIS has become a web GIS platform” is a phrase used in this section. Does this phrase raise any questions for you?

   b. What is a basemap?

4. **A condensed and specific chart**

   a. How is web GIS different from traditional desktop GIS? Read the material in Maps, the Web, and You and complete the following chart.

<table>
<thead>
<tr>
<th>Data storage</th>
<th>Traditional (desktop) GIS</th>
<th>Web GIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data creation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interacting with maps and data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharing and Collaboration</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. ArcGIS information items

a. What is the difference between a map and a scene?

b. Investigate the maps. Pick one map and write about the information it portrays.

c. Investigate the scenes. Pick one scene and write about the information it portrays.

d. List three different types of layers.

Additional resources

Understanding the Difference between Consumer and GIS Mapping Applications

Static Web maps vs dynamic Web GIS