Exercise 1: Analyzing Demographics

Instructions
Use this guide and ArcGIS Online to analyze data and maps showing world demographics.

Note: ArcGIS Online is a dynamic mapping solution. The screenshot graphics that you see in course materials may differ slightly from the version of ArcGIS Online that you will use.

Introduction

In this exercise, you will use ArcGIS Online to analyze data and maps that show world demographics. Each step covers a key component or feature of the platform. Feel free to experiment and try things out. Exercises later in this course will present more chances to apply what you learn.

There are questions throughout this exercise. These questions are intended to encourage you to think critically–and spatially.

What you will learn
As a result of this activity, you will accomplish the following tasks:

- Gain the perspective necessary for spatial analysis work in this course and beyond.
- Acquire skills for using ArcGIS Online, the solution used throughout this course.
- Reflect on your learning through self-assessment quiz questions.

Technical notes

1. You will make full use of web mapping services throughout this course. You will need a robust web connection to complete this exercise and the exercises that follow.
2. Use the latest version of Google Chrome or Microsoft Edge. Other web browsers may not display your maps and apps correctly.

   Note: For information on supported browsers, see ArcGIS Online Help: Supported browsers (https://esriurl.com/browsers).

Estimated completion time: Approximately 30-45 minutes

- Step 1: Sign in to an ArcGIS Online organization

This course uses ArcGIS Online, a web-based GIS. Every registered student receives a username and password to access ArcGIS Online during the course. Collectively, your username and password are known as your course ArcGIS credentials. This step explains where to find your course ArcGIS credentials and how to sign in for the first time.

You may already have an ArcGIS Online organizational account of your own. For this course, we strongly advise you to use the provided student account. Using this account will ensure that you have the privileges and access needed to complete the exercises. Using your own account also limits our ability to offer support if you encounter technical issues.

ArcGIS Online offers two map viewers for viewing, using, and creating maps. In this course, you will use Map Viewer Classic for the exercises because it offers full support for analysis capabilities. Map Viewer Classic has been configured as the primary map viewer for your course ArcGIS credentials organization. To learn more about the functionality of the map viewers, see ArcGIS Online Help: Map Viewer web map compatibility (https://esriurl.com/mv).

a On the black navigation bar in the MOOC platform, click the Lessons tab to locate your credentials.

If you registered within the past few hours, your credentials may not be ready. If this is the case, you will see a message asking you to check back later.

Note: When you return to check whether your credentials are available, you will need to refresh the web page. We will do our best to provide your credentials within one business day after you register.

After you locate your ArcGIS credentials on the Lessons tab, you may sign in to ArcGIS Online for the first time.

b Open a new private or incognito web browser tab or window.

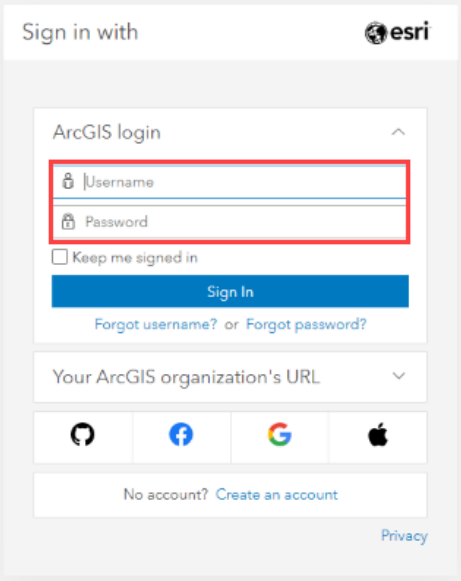
- Hint

  To learn how to enable private browsing, go to **https://esriurl.com/private**.

c In the address bar, type **www.arcgis.com** and press Enter.

d Click Sign In.

e Under ArcGIS Login, copy and paste or type your course ArcGIS username and password.



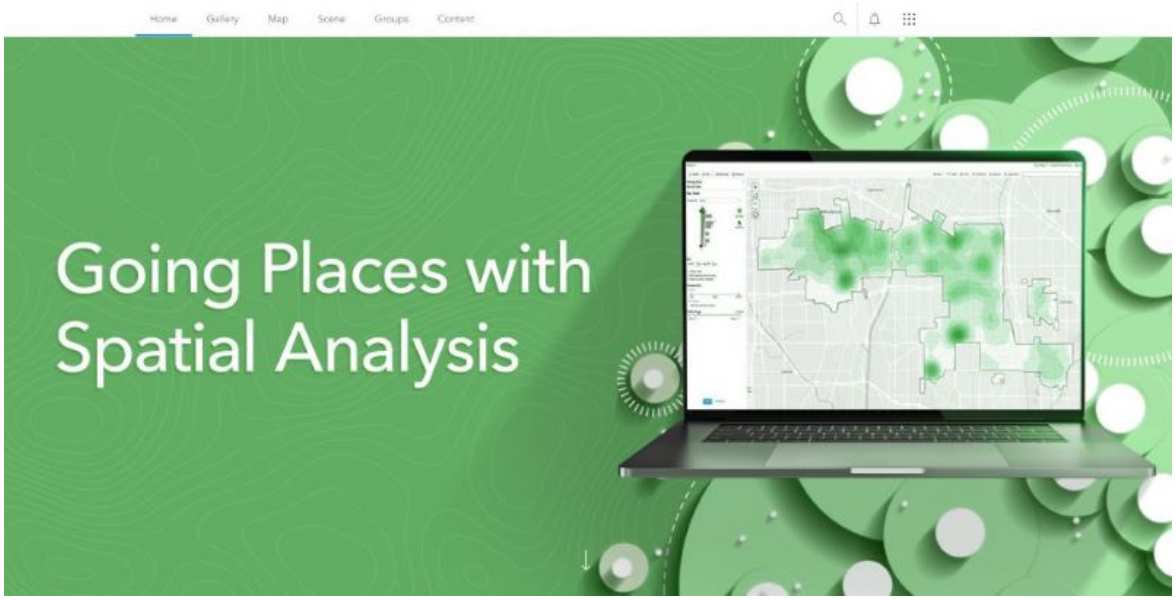
f Click Sign In.

The first time that you sign in, you will be asked to set a security question.

g Follow the on-screen instructions to set your security question.

Note: An automated email will be sent to the email address associated with the account. This email will state that your account was recently modified. No action is required.

After you set your security question, you will see the Home page for the MOOC organization.



Note: ArcGIS Online is a dynamic mapping platform, so the organization's Home page may look slightly different than this graphic.

Use a private or incognito web browser window.

Each exercise will instruct you to open a new private or incognito web browser window and sign in to ArcGIS Online (or another website) with your course ArcGIS credentials. Using an incognito web browser window ensures that you access ArcGIS Online with the correct account.

Note: If you have trouble signing in or have questions about an exercise, try these steps:

1. Check the Common Questions on the Help tab.
2. Search in the Forum for other students with the same issue.
3. Use the Have A Question form at the bottom of the Help tab.

- Step 2: Save a copy of a map

In this step, you will open an ArcGIS Online world demographics map. Then, you will save a copy to your own ArcGIS account so that you can make permanent changes to the map.

a In the upper right, click the Search button .

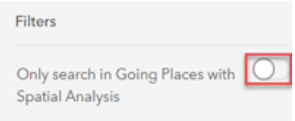
You will use keywords and an item field to find the web map. The map that you are searching for is owned by EsriTrainingSvc, so you will use the owner field to refine the search. When searching by owner in ArcGIS Online, both the owner field and the EsriTrainingSvc value are case sensitive.

b Type **geography matters owner:EsriTrainingSvc** and press Enter.

Note: As you are typing, below the search bar, you may see results for maps created by other students listed. You do not want to click any of these maps. You want to access the web map created by EsriTrainingSvc, so you need to type the full search term.

Your search does not initially return any results because the web map was created by someone who is not a member of your ArcGIS Online organization. You will turn off the option to only search within your organization.

c Under Filters, turn off the Only Search In Going Places With Spatial Analysis option.



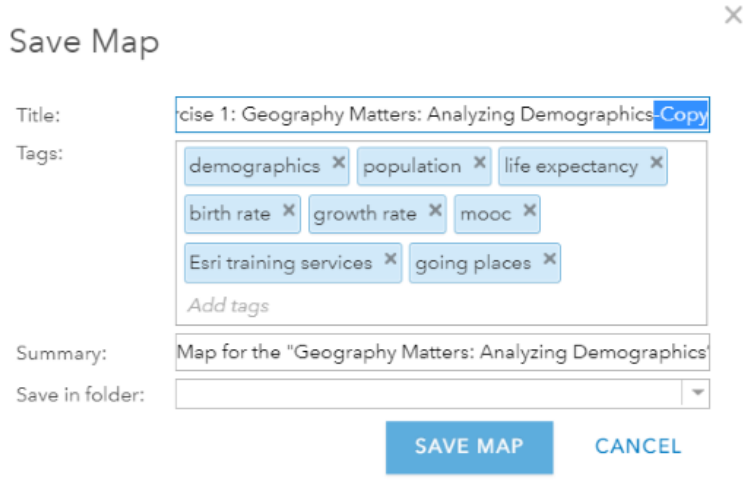
d For the Section 1, Exercise 1: Geography Matters: Analyzing Demographics web map owned by EsriTrainingSvc, click the thumbnail image to open the map.

Note: If you receive a message about the new Map Viewer, click Not Right Now to dismiss the message.

A map of the world displays, as shown in the image below. For this exercise, you will save a working copy of the map.

e On the ribbon above the map, click Save and choose Save As.

f In the Save Map dialog box, for Title, replace -Copy at the end of the name with your initials.



g Click Save Map.

A copy of the map will be saved to your My Content collection.

Note: ArcGIS Online does not automatically save maps; therefore, you should periodically save your map as you are working.

Next, you will share the map. You can share it with everyone, with specific groups of colleagues, or with no one at all.

Note: In this course, you are encouraged to share your maps with everyone. This way, all course participants—as well as any colleagues, teachers, and friends—will be able to view your map.

h On the ribbon above the map, click Share.

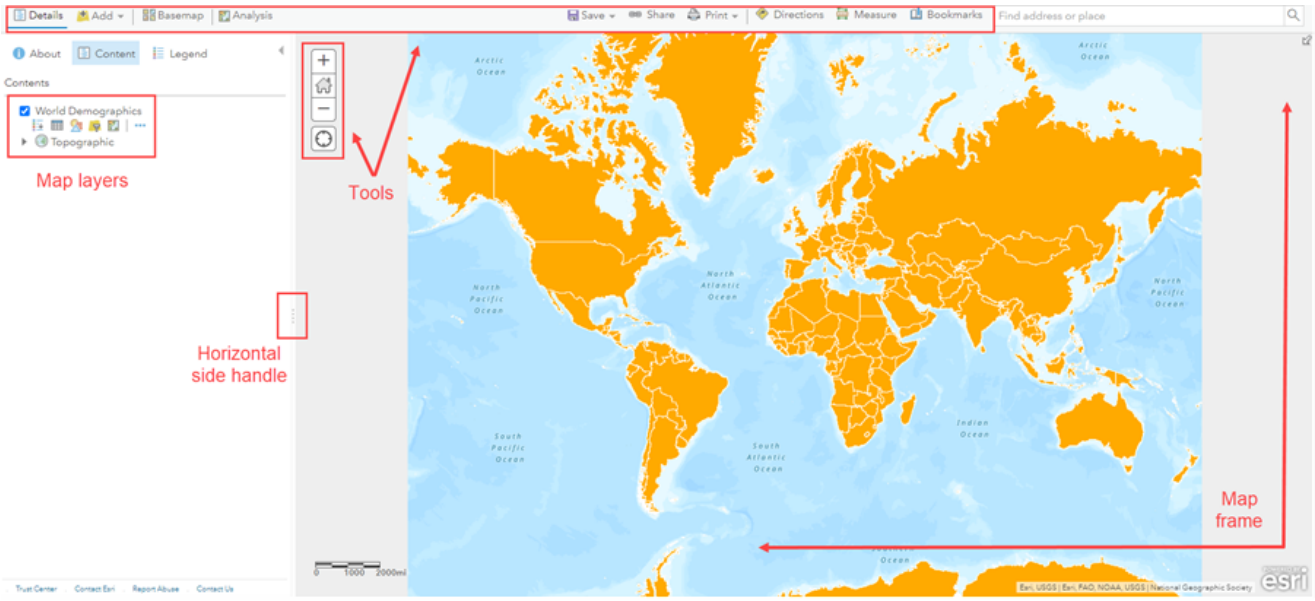
i In the Share dialog box, check the Everyone (Public) box.

j Click Done.

In this step, you saved a copy of the web map and then shared it publicly. Next, you will explore the web map.

- **Step 3: Explore the ArcGIS Online interface and map**

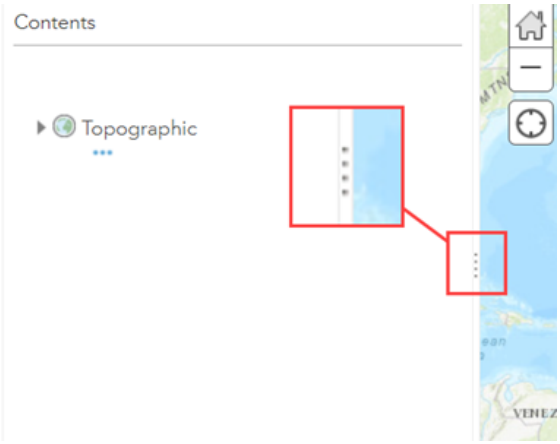
ArcGIS Online displays map layers on the left side of the map, tools above the map (with some accessible on the left), and a map frame that displays the layers (https://esriurl.com/layer).



As shown in the following image, the three buttons at the top of the Details pane provide options to see information about the map, the map contents, and a legend.

The About button displays descriptive information about the map, the Content button displays a list of the layers in the map, and the Legend button displays a legend for the layers in the map. Depending on the width of the Details pane, labels on the buttons may be visible or hidden.

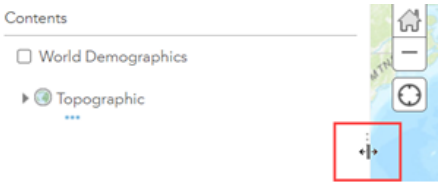
On the right edge of the Details pane, a horizontal size handle icon allows you to adjust the size of the Details pane and map frame.



You will now practice resizing the Details pane and map frame.

a On the divider between the Details pane and the map frame, point to the horizontal size handle icon.

b When your pointer becomes a double arrow, click and drag the pane horizontally to expand or reduce the size.



Note: Reducing the size of the Details pane expands the size of the map frame. Likewise, expanding the size of the Details pane reduces the size of the map frame.

Now, you will explore the contents of the ArcGIS Online map.

c At the top of the Details pane, click the Content button .

As you can see on the left side of the map, this map contains two layers: World Demographics and Topographic, which is a basemap (https://esriurl.com/ChooseBasemap) layer.

d To view the topographic basemap, uncheck the World Demographics layer.

Next, you will practice changing the basemap.

e On the ribbon above the map display, click Basemap.

f From the gallery, choose a basemap, and then experiment with several selections, such as Imagery or OpenStreetMap.

g When you are finished exploring the different basemap options, change the basemap back to Topographic.

In this step, you explored the Details pane and practiced changing the basemap. Next, you will begin working with the map data.

- Step 4: Work with spatial data

As with all of the maps that you will use in this course, the map in this exercise is not simply graphics floating around in cyberspace. Rather, the map is a representation of a geographic information system (GIS). Each point, line, polygon, and pixel on the map is attached to locational information—a latitude and longitude coordinate.

Depending on the question that you want to answer and the map that you want to produce, you will work with different aspects of GIS data. Several core skills are fundamental to analyzing data spatially. These skills include the following:

- Sorting and querying
- Filtering
- Symbolizing
- Classifying

Throughout this exercise, you will learn how to perform each of these skills using ArcGIS Online. You are likely to use these skills whenever you perform spatial analysis.

In this step, you will examine and work with the spatial data behind the map, including locational information, topological information, and attribute information. First, you will look at some locational information.

a On the ribbon above the map display, click Measure.

b In the Measure tool pop-up window, click the Location button .

c Move your pointer around the map to see how the latitude and longitude details for locations change in the Measurement Result area of the Measure tool pop-up window.

Unlike in other coordinate systems that you may be familiar with, for coordinates in the latitude-longitude system (https://esriurl.com/latlon), the y (latitude) is given first and then the x (longitude). On the globe, the x-axis is the equator, and the y-axis is the prime meridian. Negative x-values, therefore, represent locations in the western hemisphere, while negative y-values represent locations in the southern hemisphere.

Locational information does not have to be latitude and longitude. Locational information could also be street addresses or any spatial data created with geocoding (https://esriurl.com/geocoding) or by mapping a specific location.

You can also measure areas and distances with the Measure tool.

d In the Measure tool pop-up window, click the Area button .

e Click a location on the map to start drawing a polygon, click to add any additional vertices, and then double-click the last point to finish the polygon.

The Measurement Result indicates the number of square miles included in the identified area.

Note: You can change the unit of measurement by clicking the down arrow to the right of Sq Miles and choosing a different unit of measurement.

f In the Measure tool pop-up window, click the Distance button .

g Click the map to place a starting point, and then double-click to place another point and complete the line.

The Measurement Result indicates the distance between the points.

Note: You can change the unit of measurement by clicking the down arrow to the right of Miles and choosing a different unit of measurement.

h Close the Measure tool pop-up window.

In this step, you explored locational information. Remember, maps also have topological information and attribute information.

All maps in a GIS environment, including the map in this exercise, contain topological information. Thanks to topology, everything on the map understands how near or far every other thing, or feature, on the map is. You will take advantage of this topological information later in the course when you perform proximity, overlay, and other types of analysis on your data.

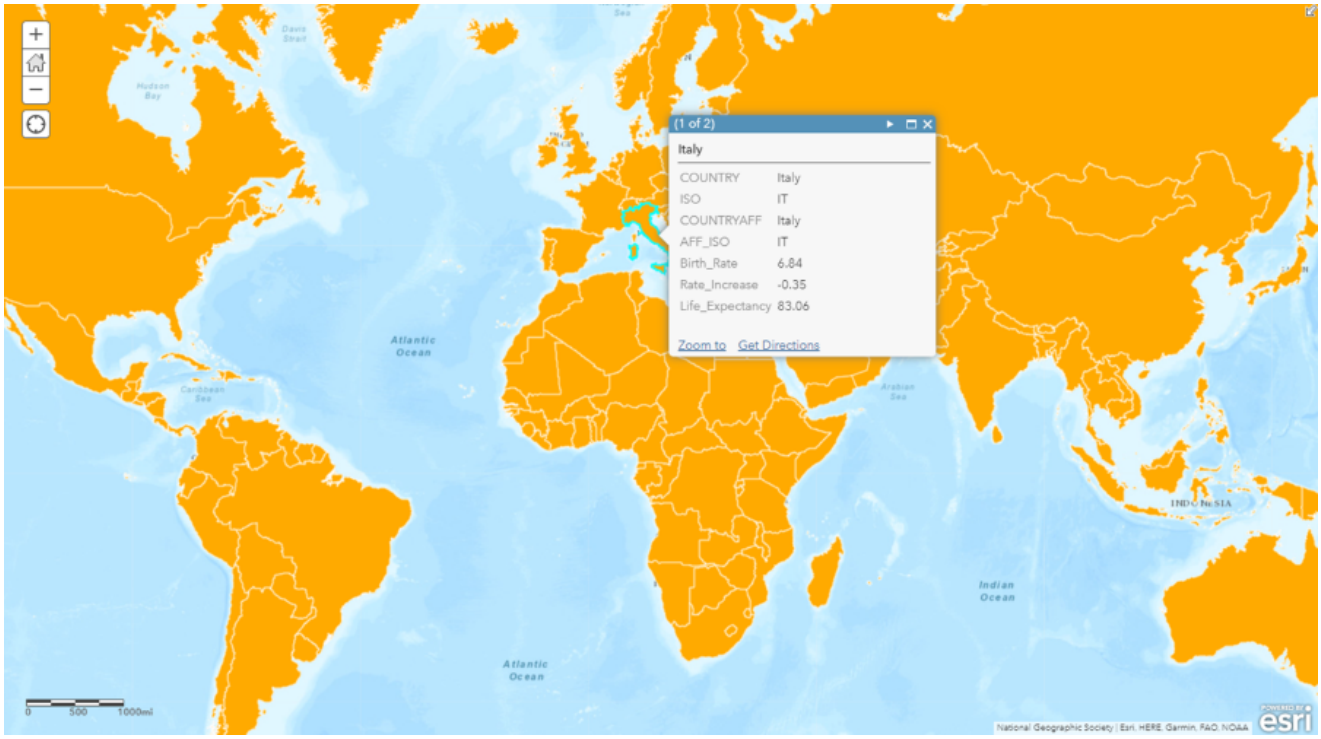
The third type of information in a GIS map is attribute information, which is stored in an attribute table. You will explore attribute information next.

- Step 5: Explore attribute information

Attributes can include how much water is flowing in a specific river segment, the median age in a neighborhood, or the depth of an earthquake. In this map, each feature, or world country, contains information about births, annual rate of population change, and life expectancy. Now, you will examine some attribute information.

a In the Contents pane, check the World Demographics box to turn the layer on.

b On the map, click a country.



Step 5b: Explore attribute information.

The information in the pop-up window is pulled from the attribute table that is associated with the location that you clicked.

You can think of the map as the G (geographic) part of GIS and the attributes as the I (information) part of GIS.

c Close the attribute pop-up window.

d In the Contents pane, point to the World Demographics layer name and click the Show Table button .

World Demographics (Features: 249, Selected: 0)

COUNTRY	ISO	COUNTRYAFF	AFF_ISO	Birth_Rate	Rate_Increase	Life_Expectancy
American Samoa	AS	United States	US	18.22	1.23	74.30
Cook Islands	CK	New Zealand	NZ	13.24	0.46	76.44
French Polynesia	PF	France	FR	14.16	0.88	77.76
Samoa	WS	Samoa	WS	19.79	1.45	74.44
Tonga	TO	Tonga	TO	21.27	1.64	76.87

Step 5d: Explore attribute information.

The attribute table appears at the bottom of the map, with each country represented by one row, or record, in the table. The variables that you have been examining appear as fields in the table.

? How many records are in this table?

- Answer
There are 249 records in this table.

e In the attribute table, click a country.

f On the map, notice how the country that you selected is highlighted.

Note: You may need to zoom or pan to see the highlighted country.

g Conversely, click a country in the map and notice how the corresponding row in the table is highlighted.

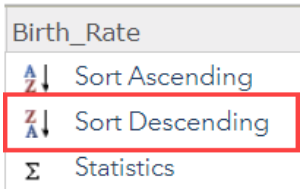
Note: You may need to scroll up or down within the table to see the highlighted row.

h Close the pop-up window.

i In the table, click the Birth_Rate column heading.

The Birth_Rate data is the birth rate, or annual number of births per 1,000 total population in each country, according to the U.S. Census Bureau International Database.

j From the drop-down list, choose Sort Descending, as indicated in the following graphic.



? According to this dataset, which country had the highest birth rate?

- Answer

Niger had the highest birth rate of any country in the dataset, at 47.76 per thousand.

k Scroll to the bottom of the table.

? Which two countries had the lowest birth rate?

- Answer

Monaco and South Korea had the lowest birth rate.

When examining spatial data, it is important to look for relationships. You will notice the relationship that seems to be evident when comparing the birth rate to the growth rate (Rate_Increase): higher birth rates correspond to higher growth rates. The relationship is not perfect because immigration, health measures, and other factors also affect a country's growth rate. Nevertheless, thinking about spatial information and relationships is a key skill that you are already fostering in these types of studies.

l In the table, click the heading of the Country column and choose Sort Ascending to reorder the list of countries in the table.

The table is now sorted alphabetically, using the same technique that you used to sort numerically.

m Using the skills that you have learned for sorting columns, sort the Life_Expectancy column so that the highest life expectancies appear first in the table.

You will notice that Monaco and Singapore have the highest life expectancies.

n In the table, click the country name of Monaco to select the row.

World Demographics (Features: 249, Selected: 1)

COUNTRY	ISO	COUNTRYAFF	AFF_ISO	Birth_Rate	Rate_Increase	Life_Expectancy
Monaco	MC	Monaco	MC	6.63	-0.33	89.32
Singapore	SG	Singapore	SG	9.37	0.56	85.77
Japan	JP	Japan	JP	7.13	-0.40	84.34
Canada	CA	Canada	CA	10.25	0.24	83.44
San Marino	SM	San Marino	SM	8.70	0.17	83.39
Spain	ES	Spain	ES	7.70	-0.12	83.21

Step 5n: Explore attribute information.

The polygon representing the country of Monaco is highlighted in bright blue.

o In the upper-right corner of the table, click the Options button ☰.

p Choose Center On Selection to zoom to Monaco.

q Turn off the World Demographics map layer to see the topographic basemap.

r Zoom out as needed to get a sense of the location of Monaco.

s Continue to explore the map and attribute data table.

As you move through the table, you will notice that some data is missing from the table, particularly for some small islands. Like other data, spatial data is imperfect; however, the data is still useful. Managing errors and imperfect data is another key skill that you will build in this course.

- Step 6: Filter layer data to limit feature display

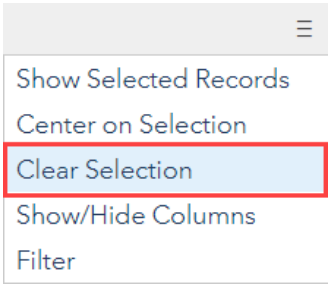
Another way to access attribute information is by filtering, or selecting, data. In this step, you will filter the table data to select certain features.

a Turn on the World Demographics map layer.

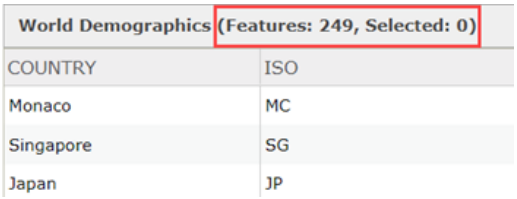
Next, you will clear the selection to deselect the row for Monaco.

b At the upper right of the table, click the Options button ☰.

c Choose Clear Selection, as indicated in the following graphic.



The table header shows 249 features, with 0 selected.



World Demographics (Features: 249, Selected: 0)	
COUNTRY	ISO
Monaco	MC
Singapore	SG
Japan	JP

Consider this example of how you might use a filter: Imagine that you manage a program at the United Nations. Your team needs to analyze societies that are experiencing rapidly decreasing populations. Using the World Demographics map and associated data, you could apply the Filter tool to select countries with population growth rates that meet your criteria.

You will now learn how to filter or select information from the table.

d In the Contents pane, point to the World Demographics layer name and click the Filter button .

- Hint

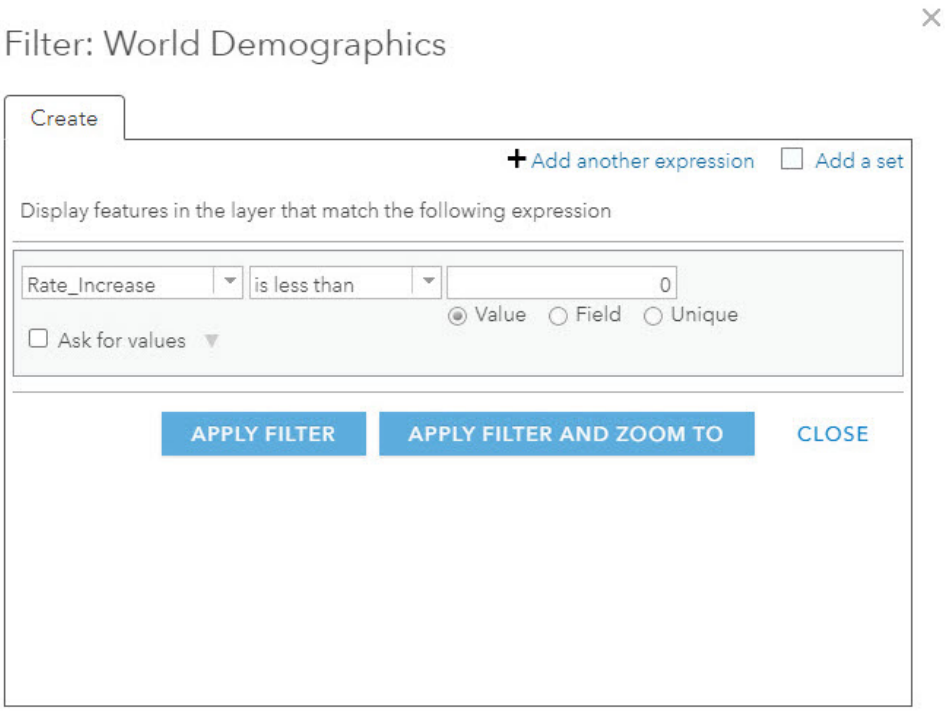
You may have to switch to the Content view.

e In the Filter dialog box, for the first field, choose Rate_Increase.

Rate_Increase is the annual growth rate of the population in each country year over year, according to the U.S. Census Bureau International Database.

f For the second field, choose Is Less Than.

g For the third field, type a value of **0**.



Step 6g: Filter layer data to limit feature display.

In plain language, the expression that you created will display features in the map layer when the value of the Rate_Increase field in the table is less than 0.

h Click Apply Filter And Zoom To.

? Where are the countries with a growth rate less than 0?

- Answer

Many of the countries are located in Eastern Europe and Northern Asia.

- Hint

You may need to zoom in or pan the map to examine the map closely.

i Examine the table and look at the data critically.

? How many countries had a growth rate less than 0?

- Answer

A total of 30 countries had a negative growth rate, or growth rate less than 0.

Although the world population is expected to grow to 9.7 billion by 2050, many countries around the world are experiencing negative growth rates. A key part of spatial analysis is to understand the variables and data that you are using.

j In the table, click the Rate_Increase column heading.

k From the drop-down list, choose Statistics to generate statistics for the selected countries.

> ? What is the minimum rate of growth for the selected countries?
>
> - Answer
> The minimum growth rate for any country in the dataset is -0.62.

l Close the Statistics pop-up window, and then sort the table by Rate_Increase to answer the following question.

> ? Which country has the lowest growth rate?
>
> - Answer
> The lowest growth rate occurred in Bulgaria.

m Close the attribute table.

As useful as scrolling through the attribute table and filtering are, the map is an even more powerful medium for spatial analysis. You will now practice two more key skills: changing the map symbology and classifying the data.

- Step 7: Change the map style

You have been working with a map layer represented as a single symbol. Every polygon (country) is represented as a single color. In this step, you will practice changing the symbol color, transparency, outline color, and outline width.

First, you will remove the filter.

a In the Contents pane, point to the World Demographics layer name and click the Filter button .

b In the Filter dialog box, click Remove Filter.

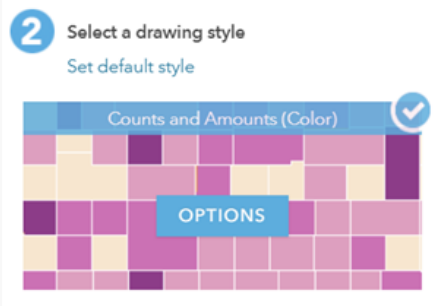
Next, you will apply changes to the map style for better visual representation of the data in the attribute table.

c Point to the World Demographics layer name and click the Change Style button .

d In the Change Style pane, from the first drop-down list, choose Life_Expectancy as indicated in the following graphic.

This attribute represents the years of life expectancy at birth in each country, according to the U.S. Census Bureau International Database.

e For the drawing style, confirm that Counts And Amounts (Color) is selected.



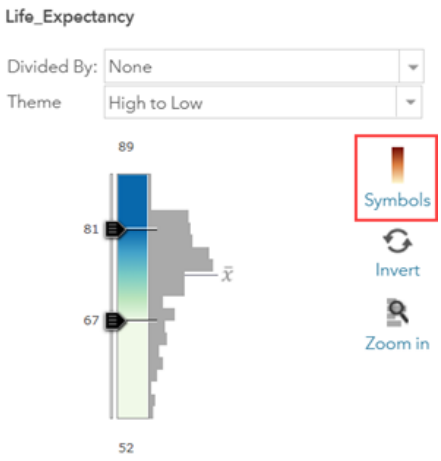
Step 7e: Change the map style.

The resulting map will distinguish features using a color gradient. A check mark in the upper right corner indicates the current styling of the layer.

f Click Options to configure the look of the layer.

The default color gradient, or color ramp, uses a range of the color teal to represent life expectancy values. You will change the color gradient.

g Click Symbols, as indicated in the following graphic.



h In the Change Symbols window, confirm that Fill is selected.

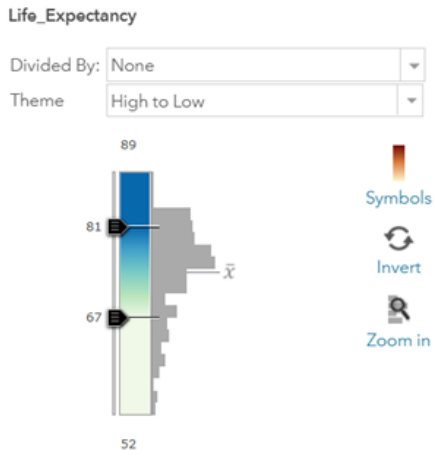
i From the palette, choose a color ramp, such as blue to white.

j At the top of the pop-up window, click Outline.

k From the palette, choose an outline color, such as black (hex color #1A1A1A).

l Click OK to close the Change Symbols window.

The map display updates, and the color values indicate life expectancy by country. To change how the data is applied to the color sequence, you can use the handles along the color ramp.



Step 7l: Change the map style.

You can adjust the display by dragging the handles or by clicking the number beside the handle and typing a precise value. Experimenting with the position of the handles allows you to fine-tune the message of the map. Using the histogram beside the color ramp allows you to see the distribution of the data.

To further generalize your map, you can classify the data.

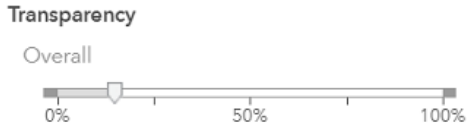
m In the Change Style pane, check the Classify Data box.

n From the drop-down menus, choose the Natural Breaks classification method with 5 classes.

Step 7n: Change the map style.

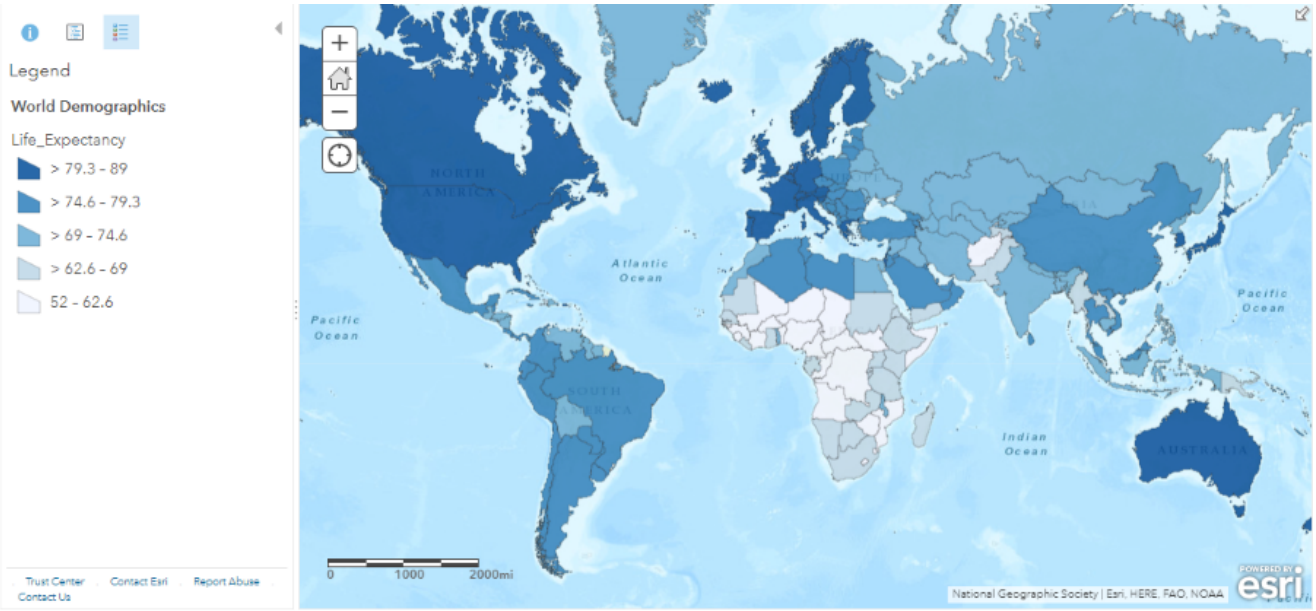
Natural breaks are automatically defined based on groupings that maximize the differences between the classes.

o To change the transparency of the layers, move the Transparency slider to the left or right.



p Click OK, and then click Done to apply your changes.

q At the top of the Details pane, click the Legend button .



The resulting world demographics map shows life expectancy in years based on the natural breaks classification method.

What are patterns that you notice on the resulting map?

- Answer

Answers may vary, but there are notable patterns of higher life expectancies and lower life expectancies across the globe.

What is the lowest life expectancy in the color ranges?

- Answer

The lowest value for life expectancy is 52.

This map shows data based on natural breaks. The natural breaks method evaluates a histogram of the data and selects naturally occurring breaks in the data to split the classes.

- Step 8: Classify the data

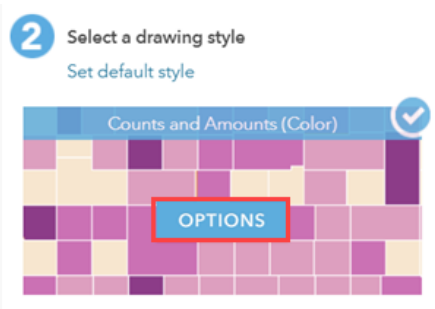
In this step, you will classify the map data using a different method.

a At the top of the Details pane, click the Content button .

b In the Contents pane, point to the World Demographics layer name and click the Change Style button .

c In the Change Style pane, under Select A Drawing Style, confirm that Counts And Amounts (Color) is selected.

d Click Options, as indicated in the following graphic.



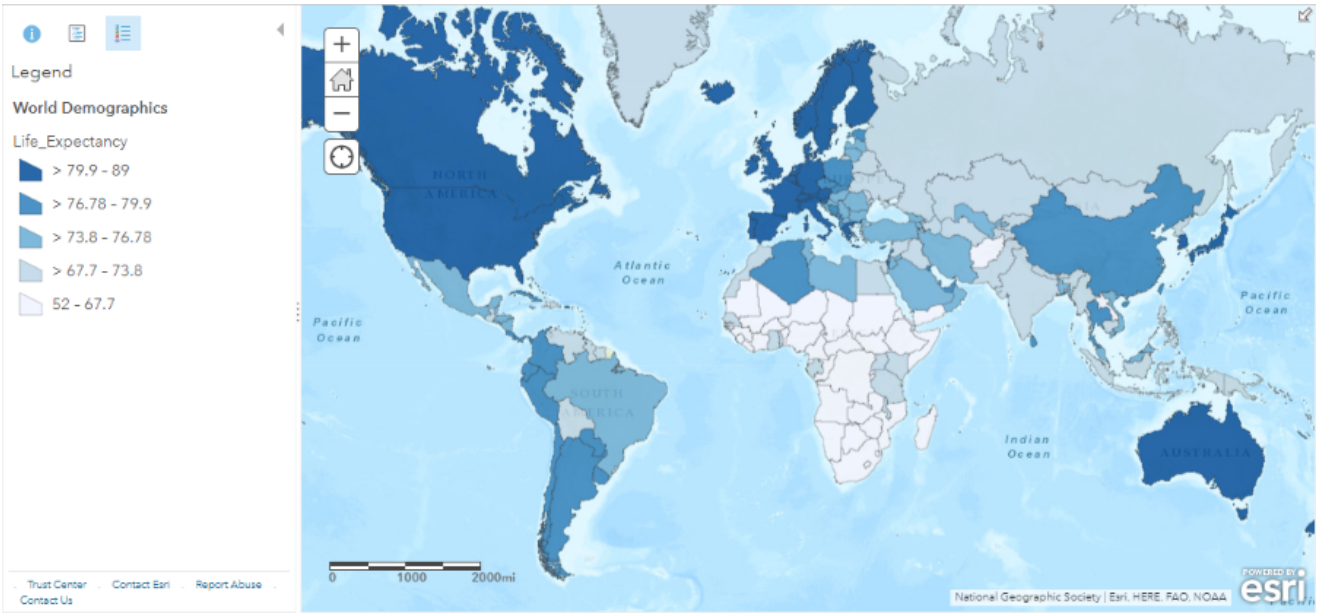
e Change the data classification method from Natural Breaks to Quantile.

f Leave the number of classes as 5.

Quantile evaluates the number of data values that you are mapping and splits the classes so that the same number of observations exists in each class. You are mapping 249 features, meaning classes of roughly 50 countries each.

g Click OK, and then click Done to apply your changes.

h At the top of the Details pane, click the Legend button .



Step 8h: Classify the data.

i Look at the values in the legend.

Although subtle, there are some changes in the legend now that each class contains the same number of features.

? What changes do you notice after classifying the data using the quantile method?

- Answer

Answers may vary, but note that the class break values and the appearance of the map have changed.

j Try the other classification methods (Equal Interval and Standard Deviation) and examine the results.

Note: For more information about changing symbols and using classification schemes, see ArcGIS Online Help: Change style (https://esriurl.com/ChangeStyle).

k On the ribbon above the map, click Save and choose Save.

Your map will be saved to your My Content collection.

You changed the classes using different classification methods. Each classification method produced a different looking map.

- Step 9: Explore the map metadata

Every web map is composed of data layers from one or more web services. Data could be served by national mapping organizations, such as the U.S. Geological Survey or the UK Ordnance Survey; from an international agency, such as the World Health Organization; or from a city government, university, or private company.

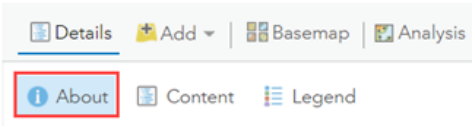
Because of the migration of GIS to the web, anyone can serve mapping data. Therefore, it is more important than ever to assess data quality. Questions that you should consider include which organization created the mapping data, why the data was created, how often the data is updated, and at which scale the data was created.

When you are better informed about the quality of the data that you are using, you can make wiser choices about whether and how to use the data.

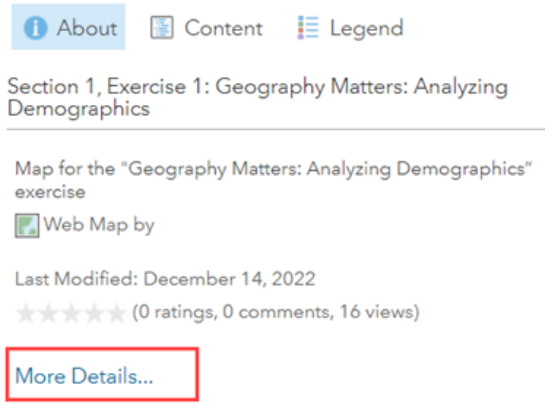
Information about the map is contained within the metadata.

In this step, you will access metadata in ArcGIS Online to find out who created the demographics data that you are using.

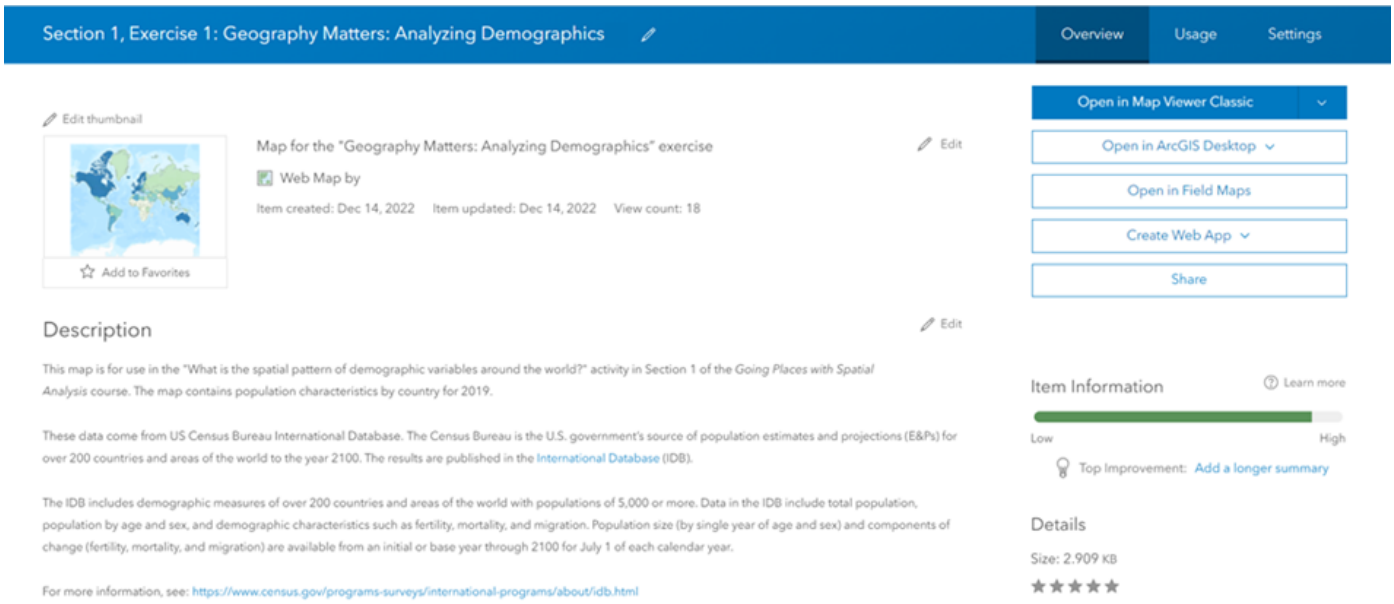
a At the top of the Details pane, click the About button , as indicated in the following graphic.



b In the About pane, click More Details, as indicated in the following graphic.



Metadata, populated by the author of the map, is displayed in a new web browser tab.



Step 9b: Explore the map metadata.

? Where does the data come from?

- Answer

The U.S. Census Bureau International Database (https://www.census.gov/programs-surveys/international-programs/about/idb.html) created the data.

c Return to the web browser tab containing the Demographics map.

d Save your map.

- Close your private or incognito web browser window.

- Step 10: Conclusion

Congratulations! You have investigated a map and its associated attribute table, thought spatially and critically about the map, asked questions about the map by reviewing the table and filtering, and symbolized and classified the data. In the upcoming exercises in this course, you will continue to apply these skills while increasing your analytical abilities.