

# **SD2005 Labs**

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# Preface

This is a Quarto book. To learn more about Quarto books visit <https://quarto.org/docs/books>.

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1 + 1
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```
[1] 2
```

# Introduction

This is a book created from markdown and executable code.

See Knuth (1984) for additional discussion of literate programming.

```
1 + 1
```

```
[1] 2
```

# Summary

In summary, this book has no content whatsoever.

1 + 1

[1] 2

# **Lab No 1: Getting Started with ArcGIS Online**

This tutorial is inspired from ArcGIS Online Learning resources available at <https://learn.arcgis.com/en/projects/get-started-with-arcgis-online/>

## **Mapping Census Data for Emergency Planning**

By the end of this lab, students will be able to:

- Navigate and use the ArcGIS Online interface
- Add and configure data layers from ArcGIS Living Atlas
- Style demographic data using appropriate symbology
- Filter data to focus on specific geographic areas
- Apply visual effects to emphasize important data patterns
- Create a professional web map for emergency planning purposes

### **Background**

In this lab, you will create a web map to identify areas that may need additional evacuation assistance during emergencies. You will work with census data to identify households with limited vehicle access, which is crucial information for emergency planning and resource allocation.

**Estimated time of completion:** 45 Minutes

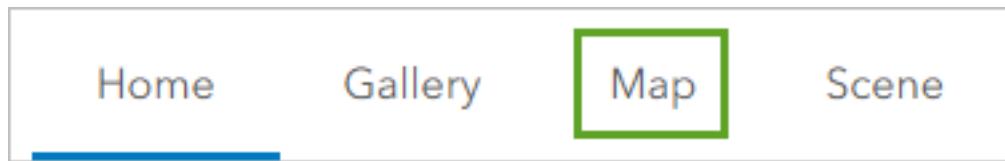
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## **Part 1: Begin a Map**

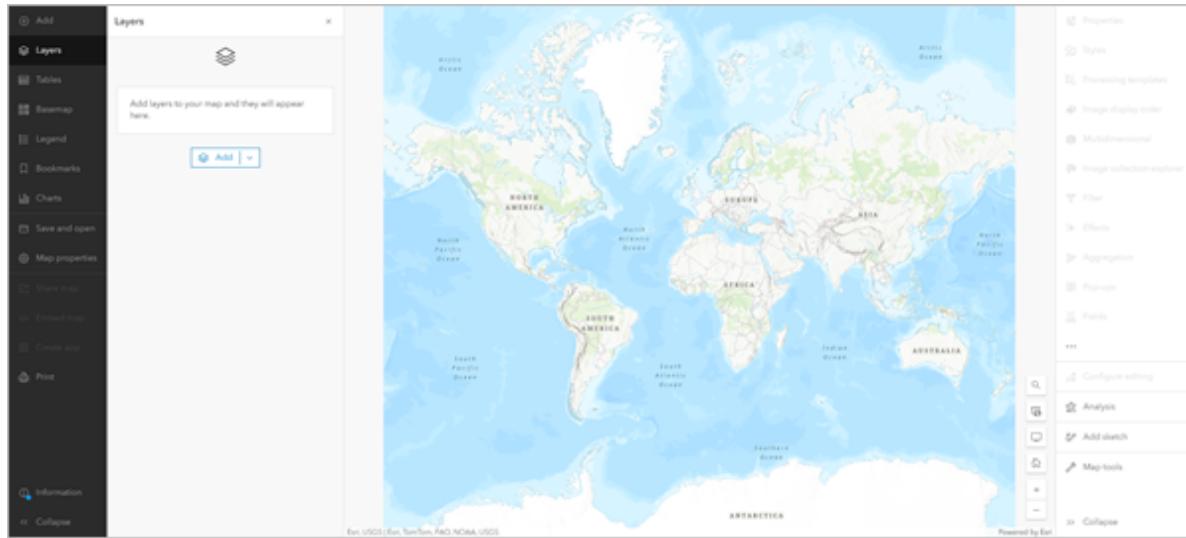
### **Step 1: Access ArcGIS Online**

1. Sign in to [ArcGISOnline](#), using your University Credentials.

2. On the ribbon, click the **Map** tab



A default web map appears. Your map's appearance varies based on your account or organizational settings and your browser window size. It may show the United States, the world, or another extent.



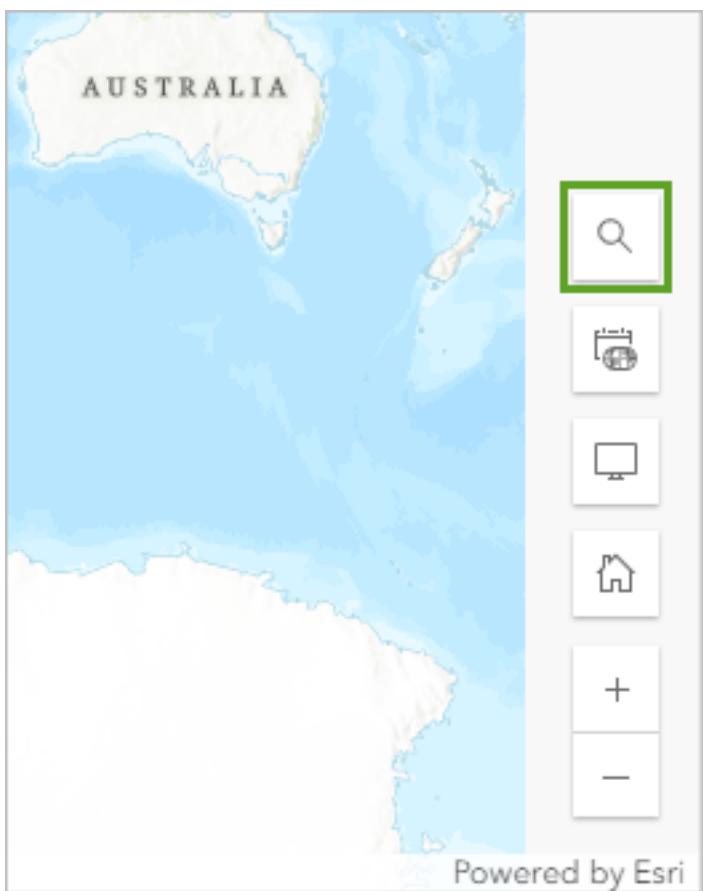
The only layer on the map is the basemap, which provides geographic context such as water bodies and political boundaries. The default basemap is **Topographic**, but your map may have a different basemap depending on your organization's settings.

On either side of the map are the toolbars:

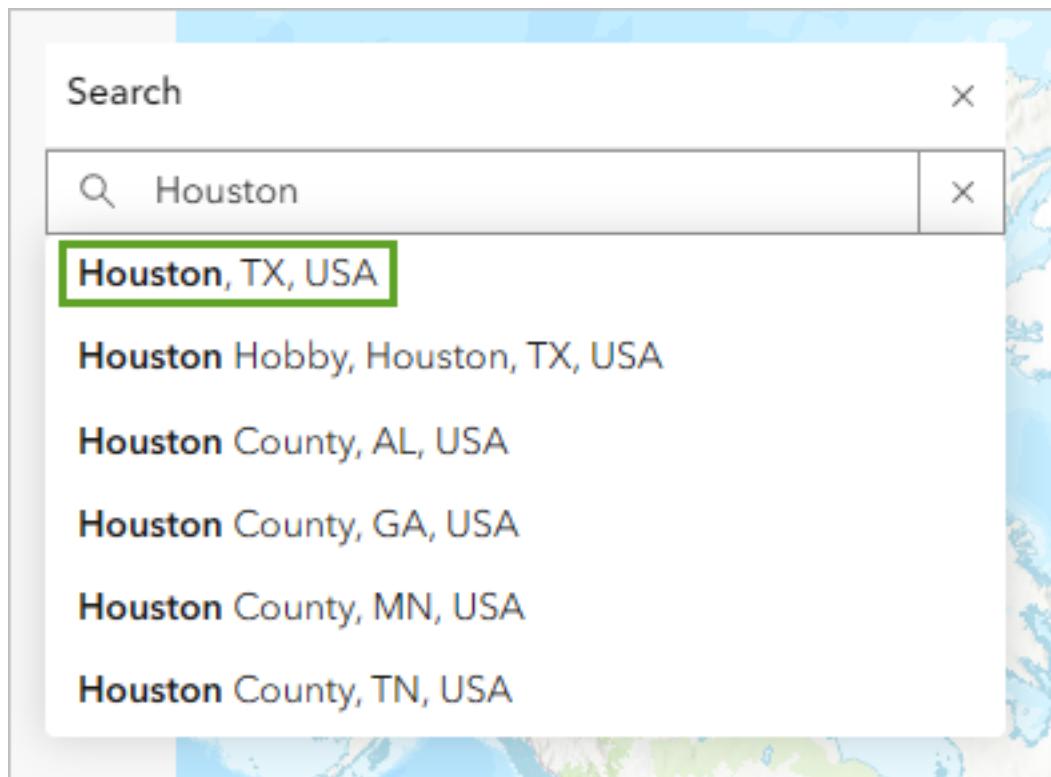
- **Contents (dark) toolbar:** Allows you to manage and view map contents
- **Settings (light) toolbar:** Provides tools and options for configuring and interacting with map layers
- **Layers pane:** Lists the data you add to the map

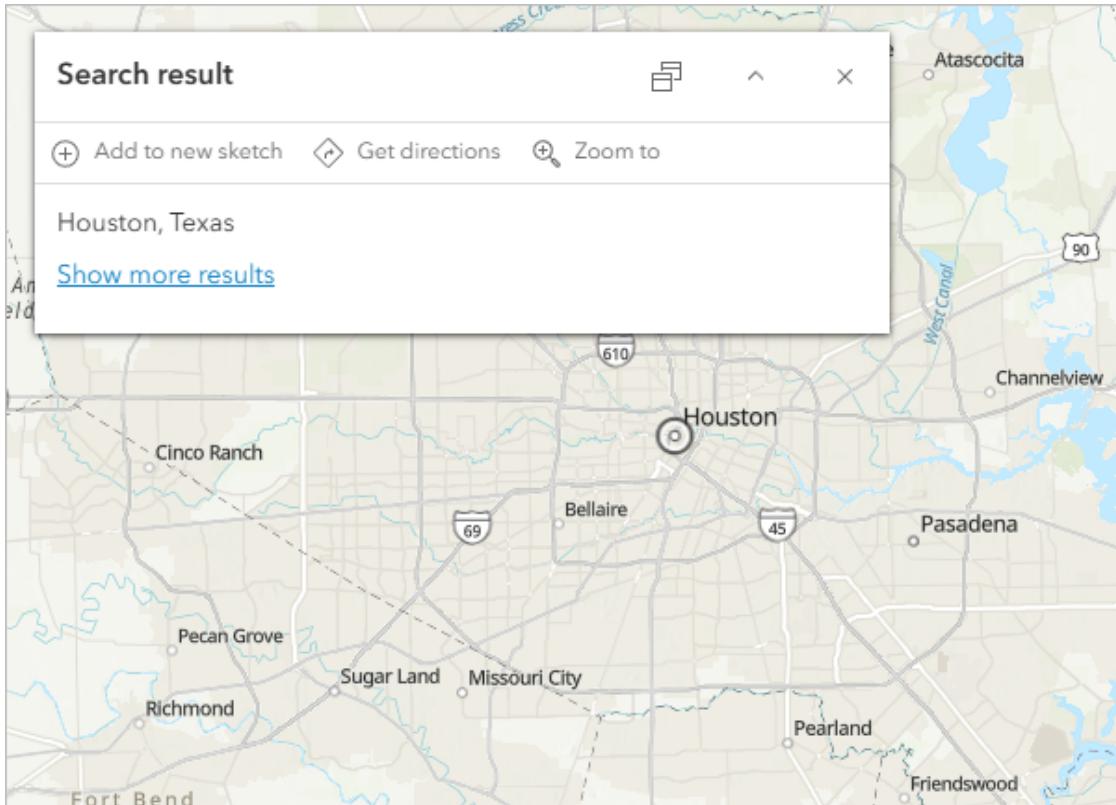
## Step 2: Navigate to Your Area of Interest

1. On the map, at the bottom corner, click the **Search** button



2. In the search box, type **Houston** and choose **Houston, TX, USA** from the list of suggested locations



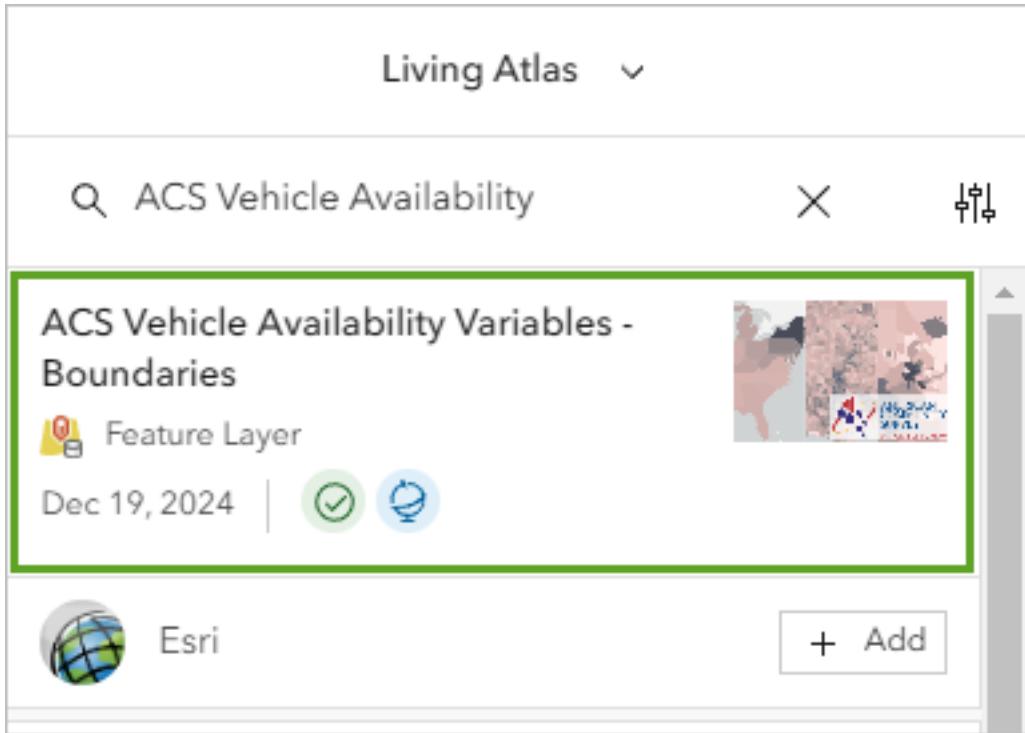


3. Close the **Search** result window when the map zooms to your location
- 

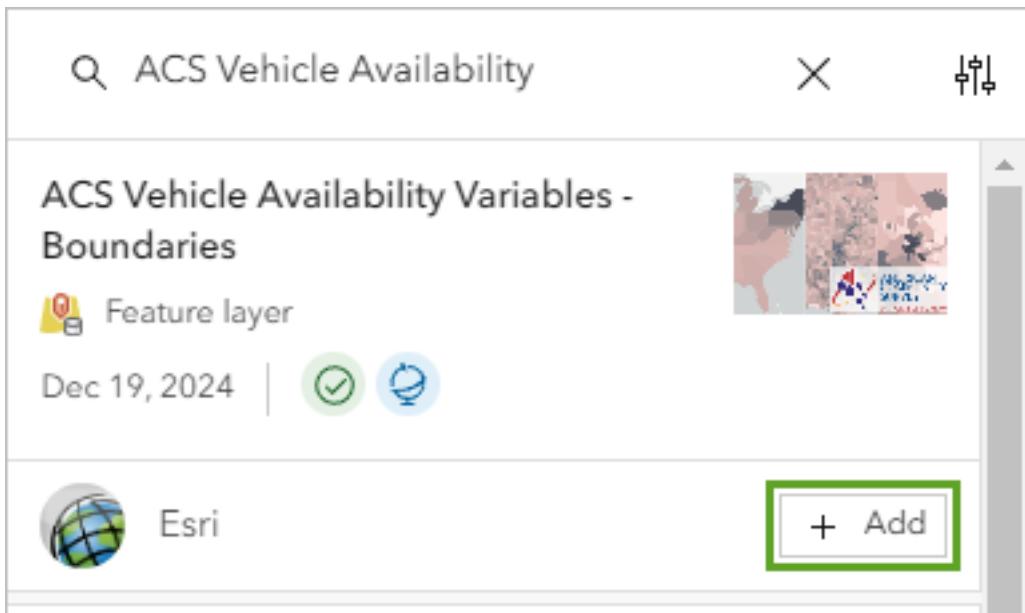
## Part 2: Add a Layer

Layers contain geographic data that can be displayed on your map. To determine areas that may need evacuation assistance, you'll add a layer containing demographic data by census tract.

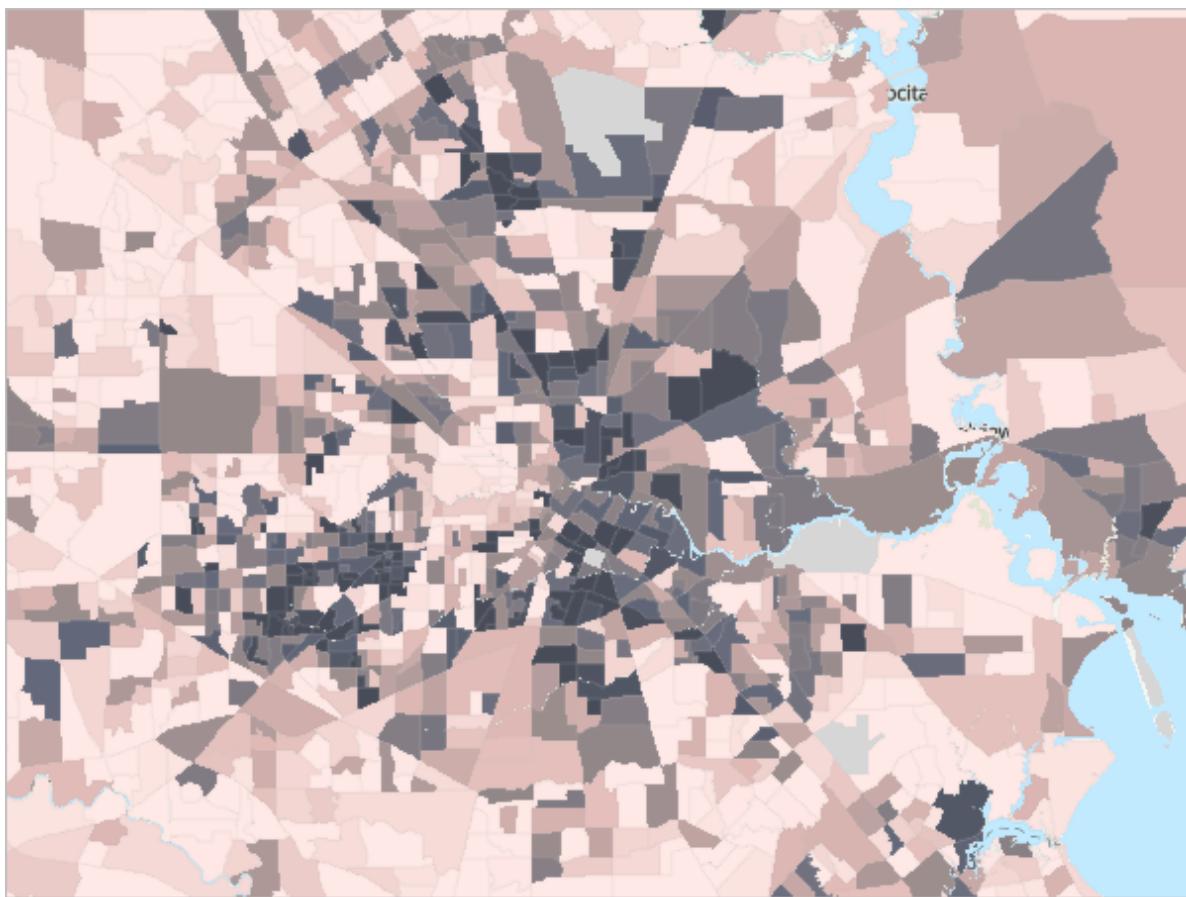
1. In the **Layers** pane, click **Add**
2. In the **Add layer** pane, click **My content** and choose **Living Atlas**
3. In the search box, type or paste **ACS Vehicle Availability**
4. Click the **ACS Vehicle Availability Variables - Boundaries** result



5. In the item pane, expand the **Description** section and read about the layer
6. Close the item pane
7. For the **ACS Vehicle Availability Variables - Boundaries** layer, click **Add**



The layer is added to the map, styled to show the percentage of households with no vehicle available in each census tract. Darker areas have higher percentages of households without vehicle access.

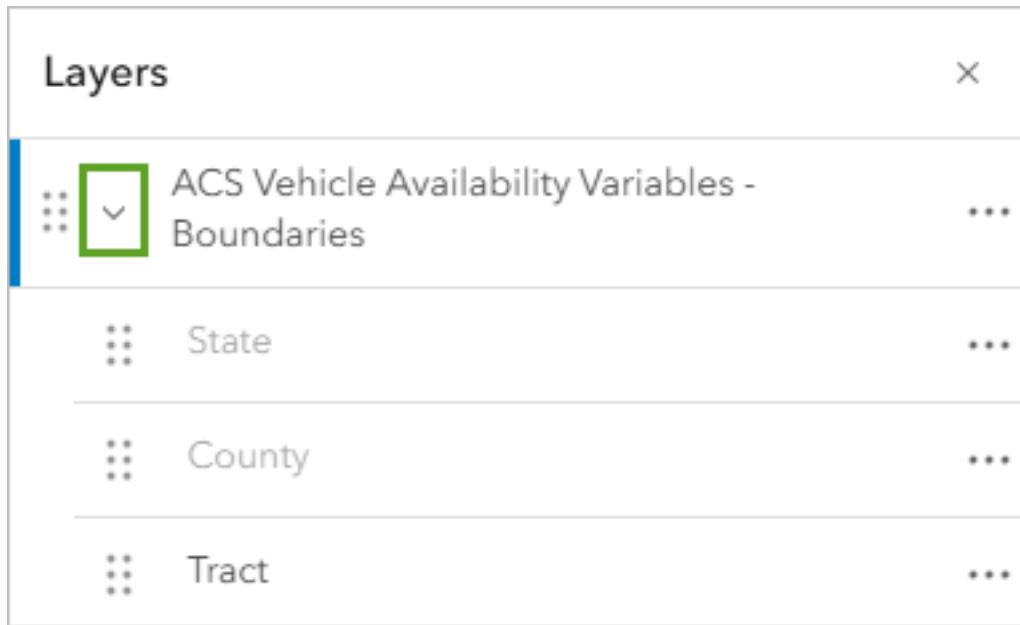


### Step 1: Manage Layer Groups

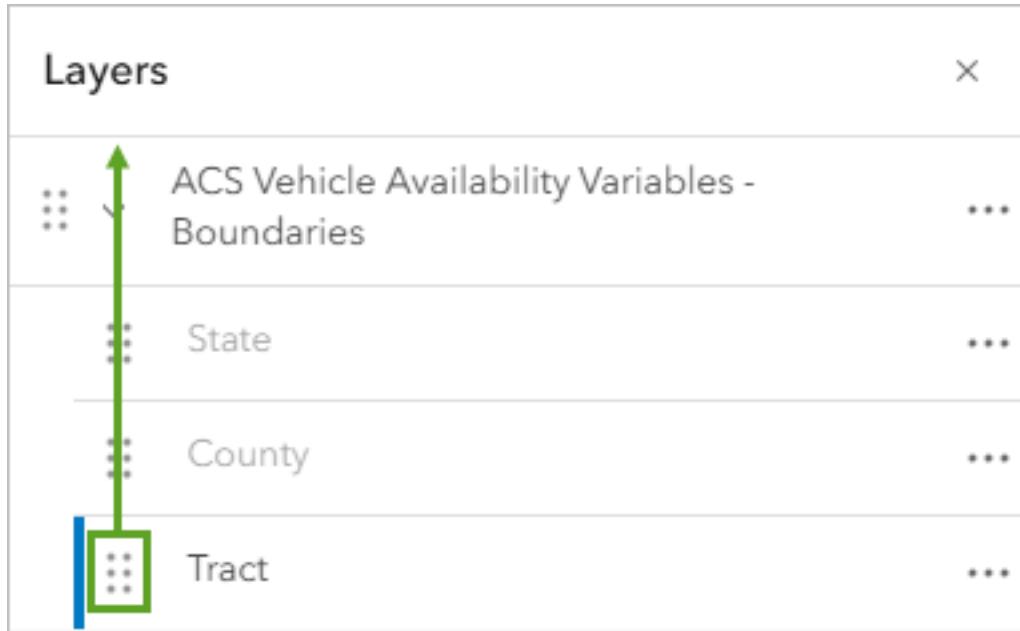
1. At the top of the Add layer pane, click the **Back** button



2. In the **Layers pane**, expand the **ACS Vehicle Availability Variables - Boundaries** group



3. Drag the ==Tract== layer above the group



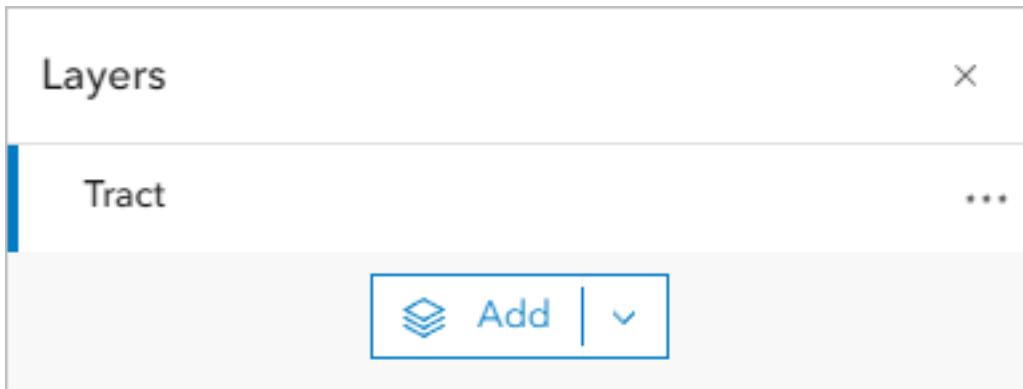
4. For the group, click the **Options** button and choose **Remove**

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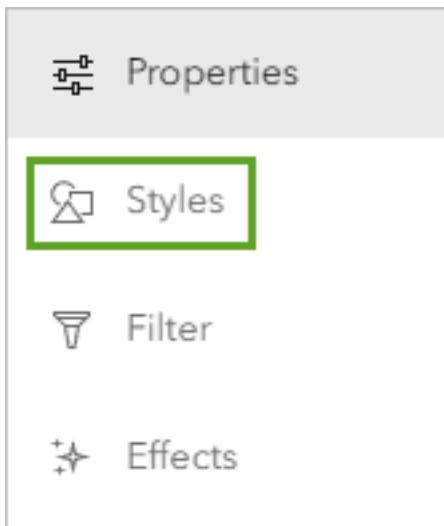
## Part 3: Style Demographic Data

### Step 1: Select Styling Options

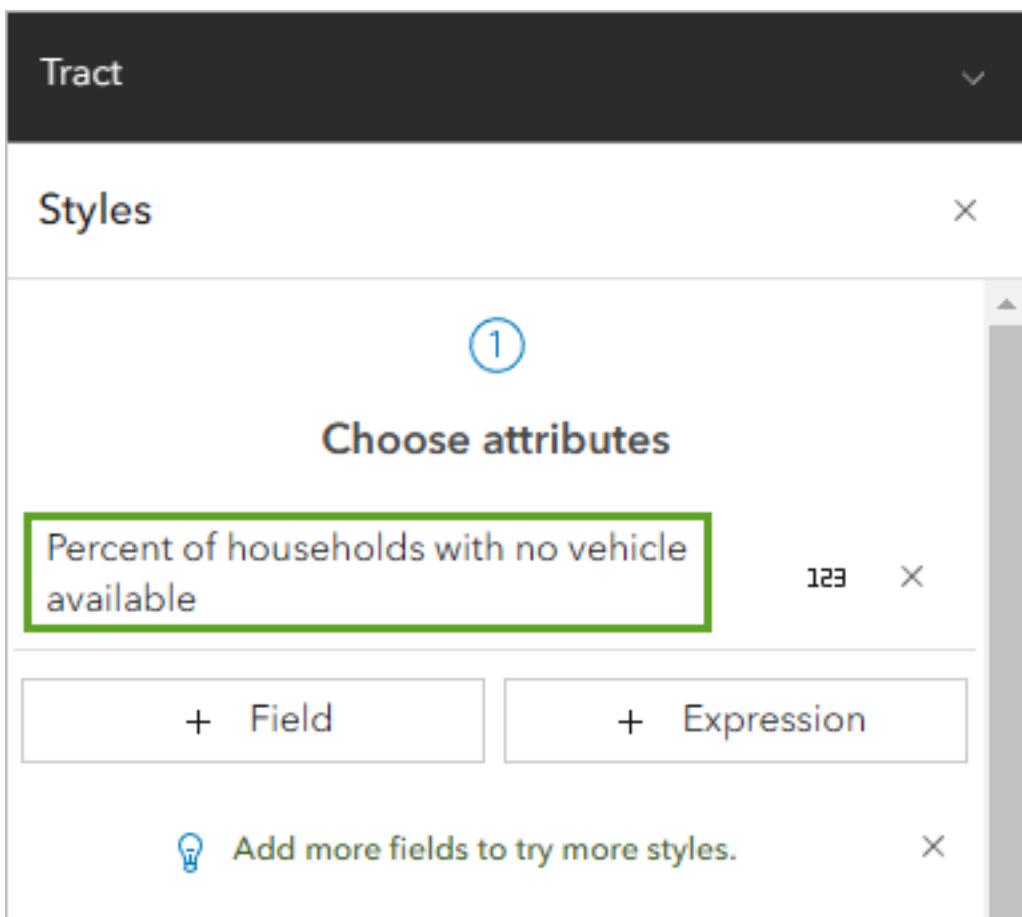
1. In the **Layers** pane, click the **Tract** layer to select it



2. On the **Settings toolbar**, click the **Styles** button



3. In the **Styles pane**, ensure ==Percent of households with no vehicle available== is selected



The list of available styles is determined by the data type. In this case, the options are for numeric data. The map shows the **Counts and Amounts (color)** style. The colors are based on the **High to low** theme. This style symbolizes each census tract with a different color based on the percentage of households without a vehicle. Census tracts with the lowest values have a light color, while those with the highest values have a dark color.

## Step 2: Customize Symbol Style

1. For **Pick a style**, on the **Counts and Amounts (color)** card, click **Style options**

## Choose attributes

Percent of households with no vehicle available 123 X

+ Field + Expression

💡 Add more fields to try more styles. X

(2)

### Pick a style

These styles are good for visualizing a single numeric field.



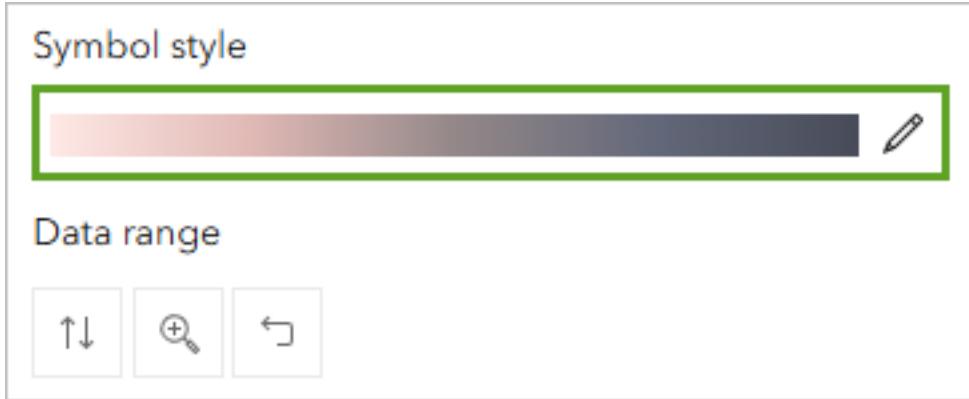
Counts and Amounts (color) ⓘ

Theme

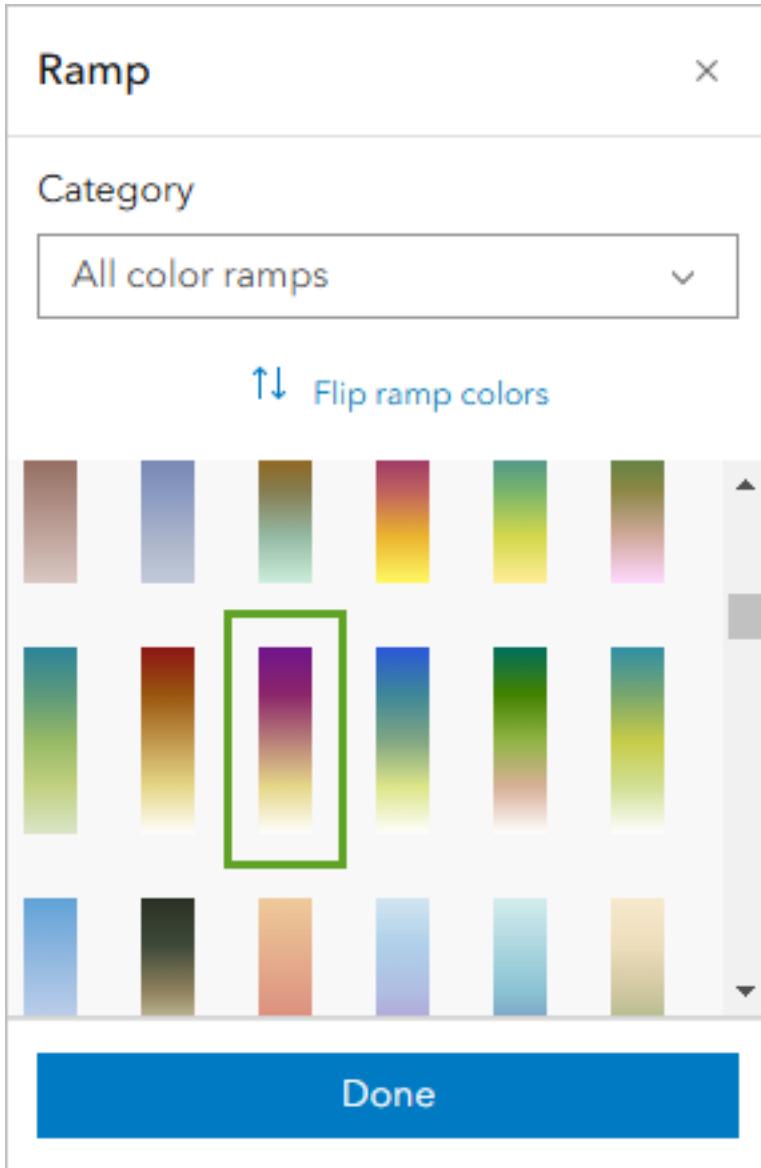
High to low

Style options

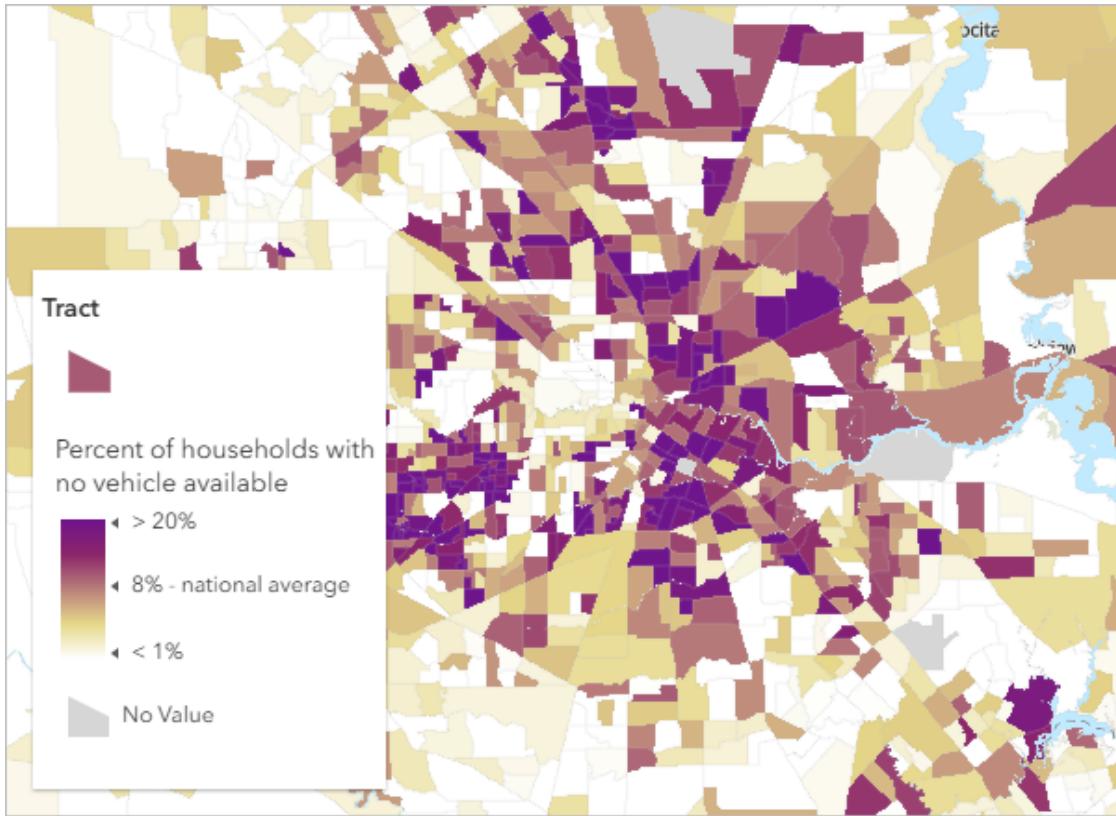
2. For **Symbol style**, click the color ramp



3. In the **Symbol style** window, for **Colors**, click the color ramp
4. In the **Ramp** window, choose **Purple 18**



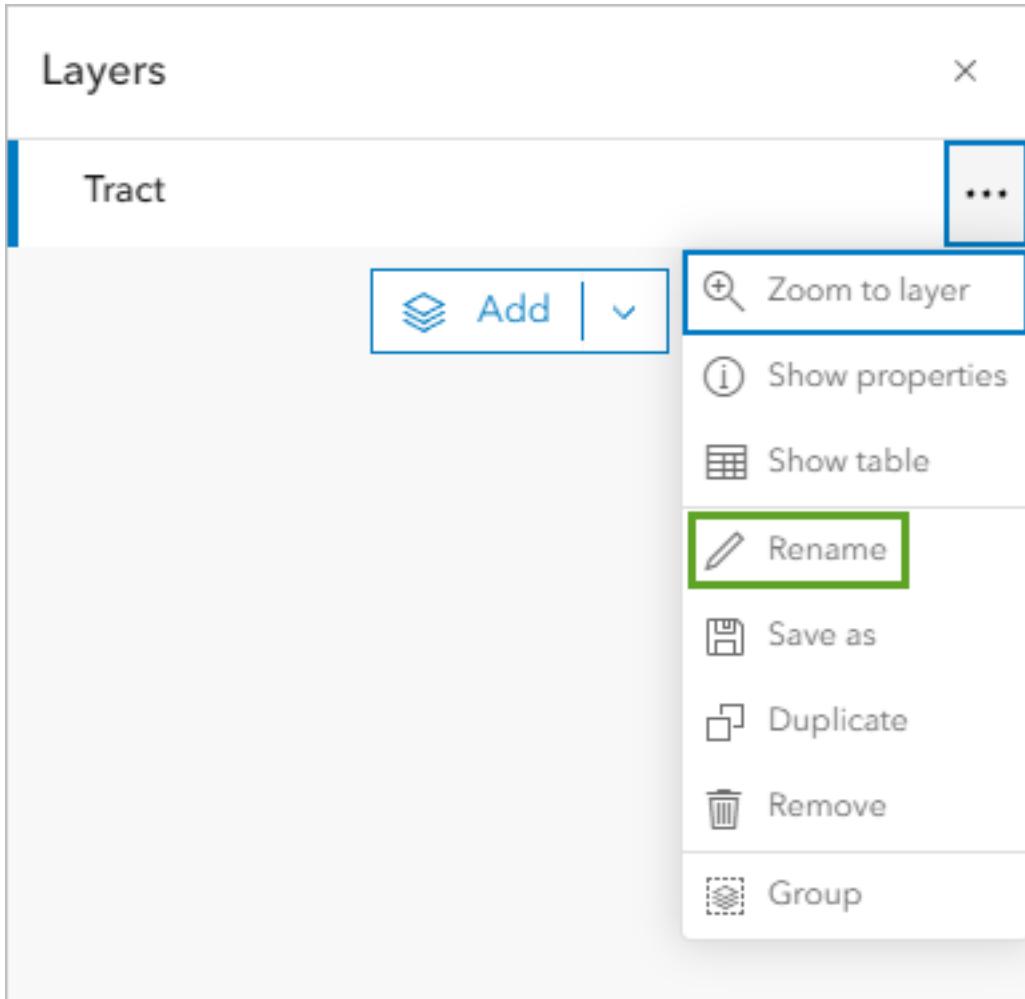
The new color ramp is applied to the map. Census tracts with high percentages are displayed in dark purple while low percentages are white.



5. If needed, click **Flip ramp colors** so high percentages show in dark purple
6. Click **Done** to close all style windows

### Step 3: Rename the Layer

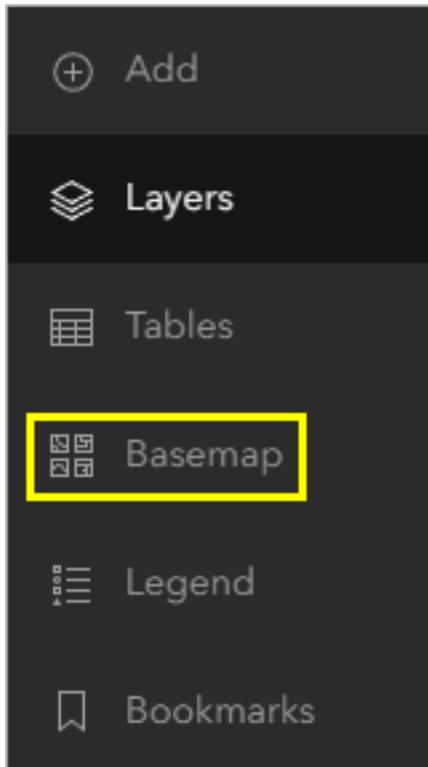
1. In the **Layers pane**, for the layer, click the **Options** button and choose **Rename**



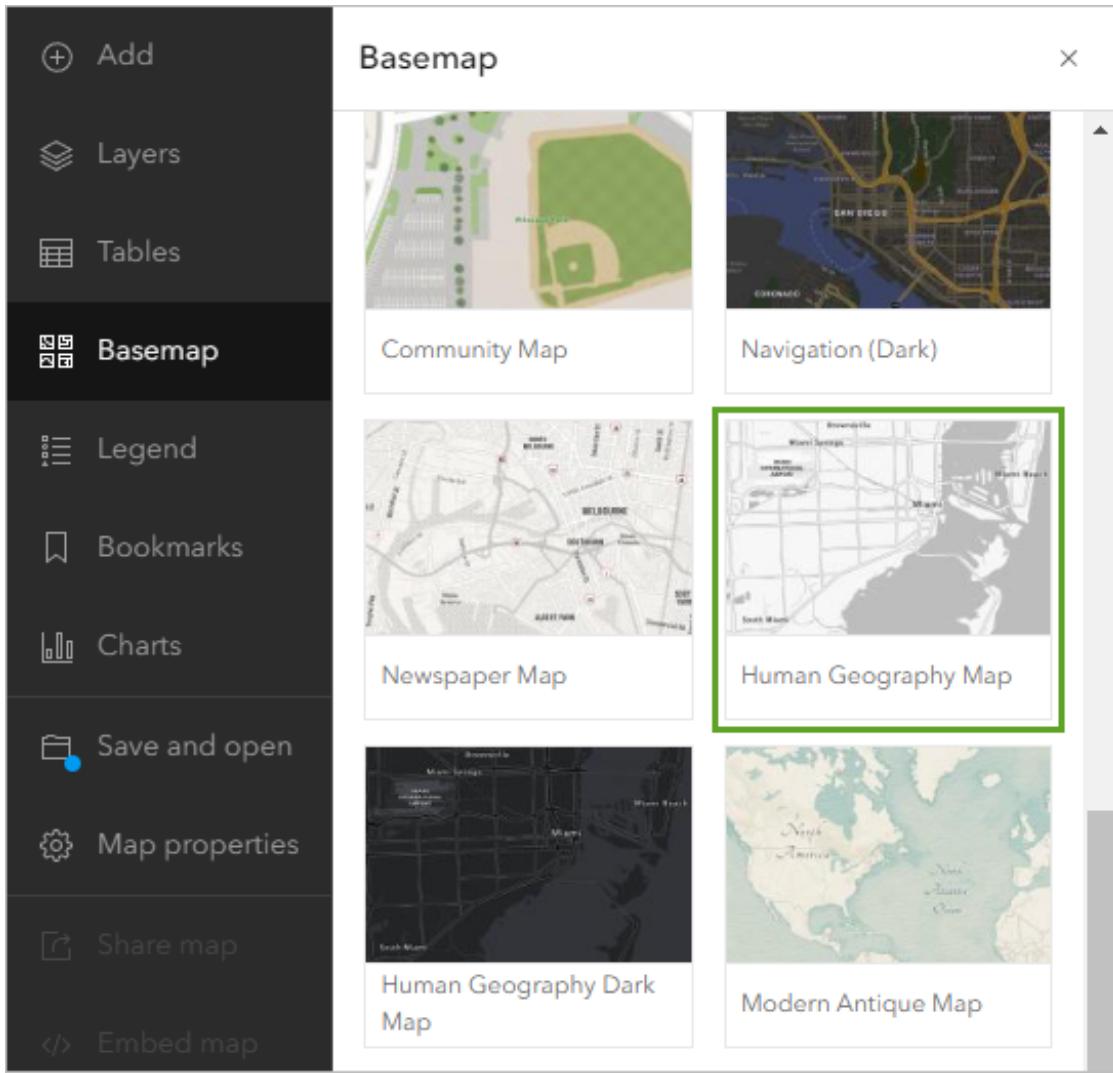
2. For **Title**, type **Percent of Households with No Vehicle Access**
  3. Click **OK**
- 

#### **Part 4: Change the Basemap**

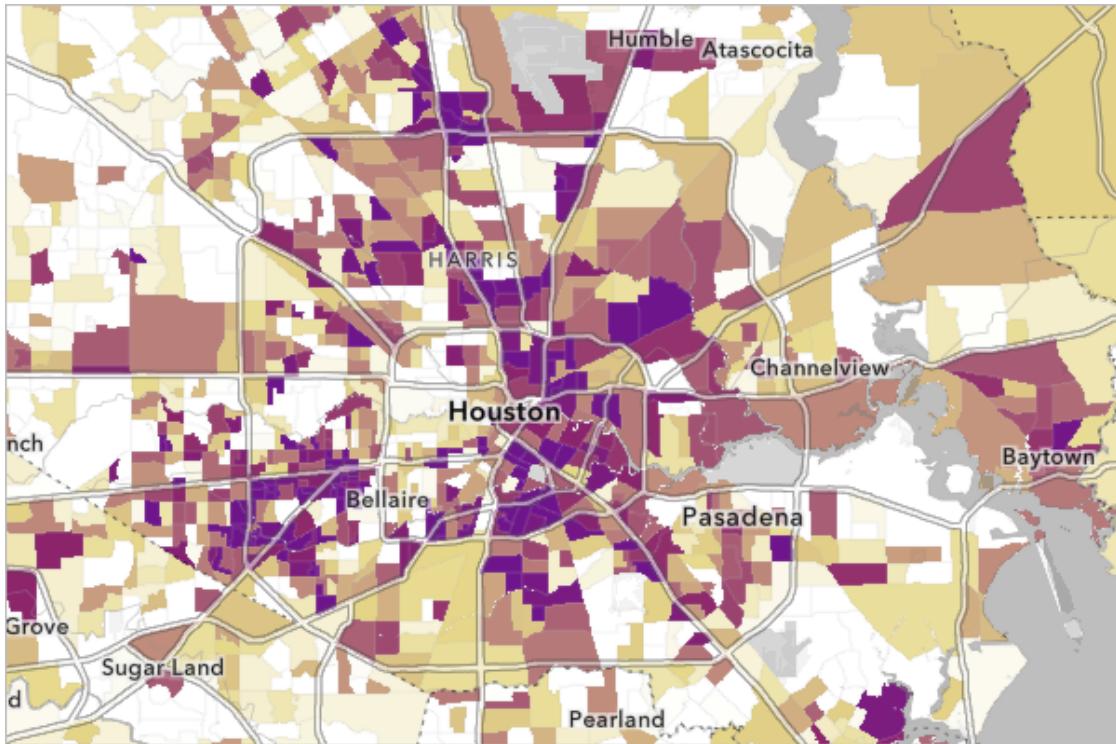
1. On the **Contents** toolbar, click **Basemap**



2. In the **Basemap** pane, find and choose **Human Geography Map**



3. On the **Contents toolbar**, click **Layers** to return to the Layers pane



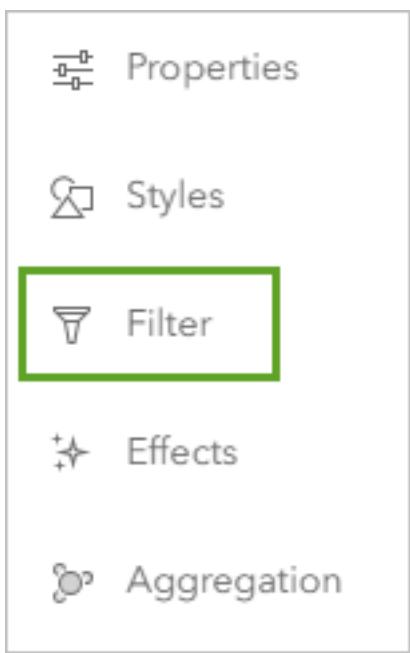
The new basemap shows labels and contextual information over the census data.

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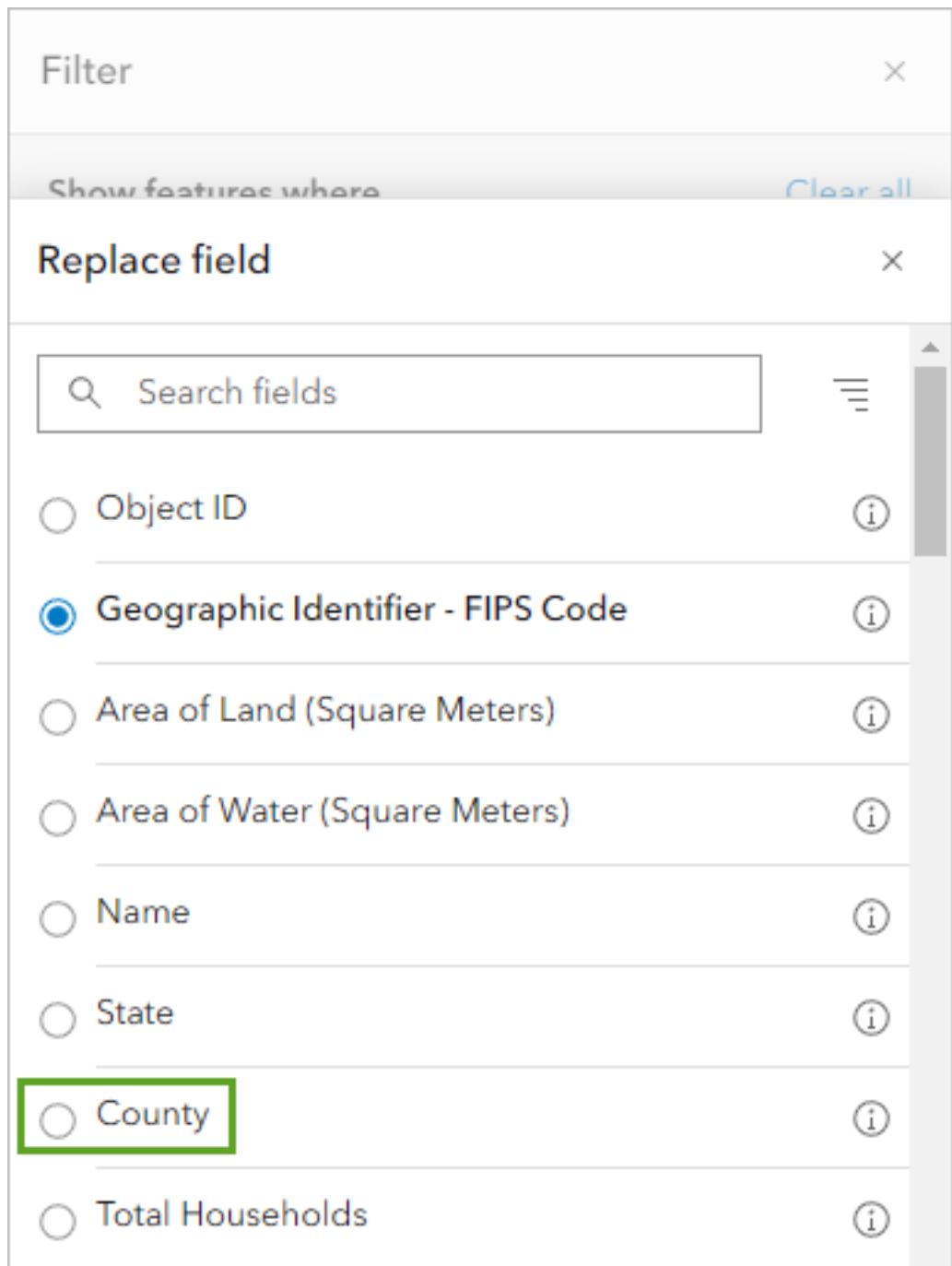
## Part 5: Filter the Map

### Step 1: Create a Geographic Filter

1. Ensure the **Percent of Households with No Vehicle Access** layer is selected
2. In the **Settings pane**, click **Filter**



3. In the **Filter pane**, click **Add new**
4. Under **Condition**, click the first box and choose **==County==**



5. Leave the operator as **is**
6. For the third box, click the drop-down arrow, type **==Harris County==** and select it

Condition ...

County ▼

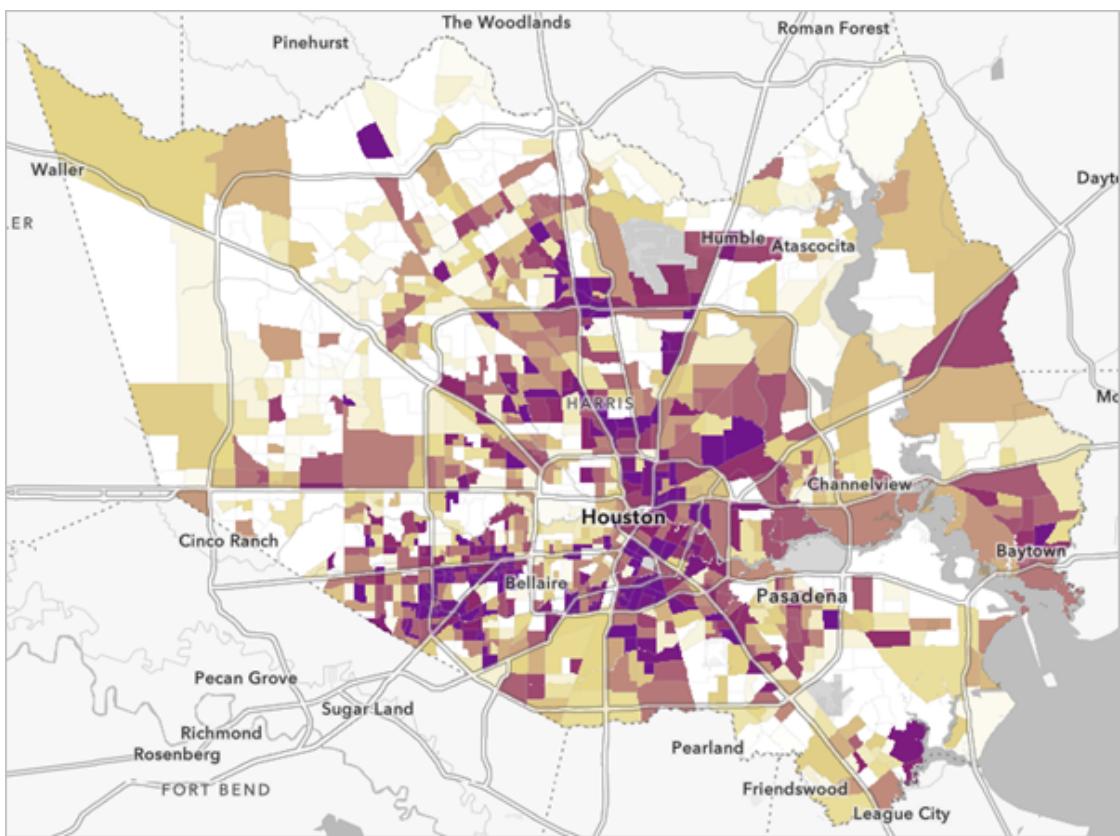
is ▼

Los Angeles County ▼

Harris County X ≡

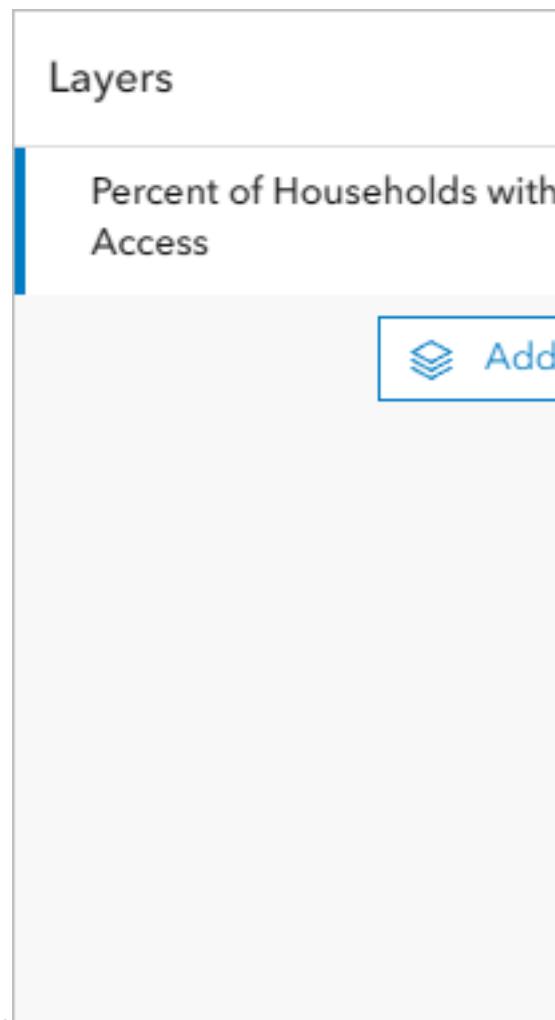
Harris County 1122

7. Click **Save** to apply the filter



## Part 6: Emphasize the Top Tracts

### Step 1: Examine the Attribute Table



1. For the layer, click the **Options** button and choose **Show table**

The layer's attribute table appears. The attribute table is a way of viewing all of the attributes that exist for each feature. Each row in the table represents a feature (in this case, a census tract area). The columns, or fields, provide information about the census tract features, such as the **County** attribute that you used to filter the data earlier.

The top of the table indicates that there are 1,122 census tracts in Harris County.

2. Scroll right to find the ==Percent of households with no vehicle available== column

Open tabs: 1

Percent of Households with No Vehicle Access X

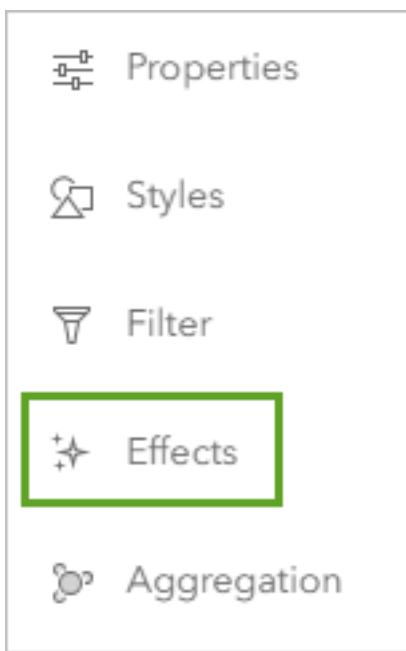
	Percent of households with no vehicle available	Percent of househ
14.5		Sort ascending
21.5		Sort descending
17.1		Information
3.3		Hide field
18.0		8.9

The table is sorted so that the **Percent of households with no vehicle available** field shows tracts in order of highest to lowest values. The highest value is 48.9 percent.

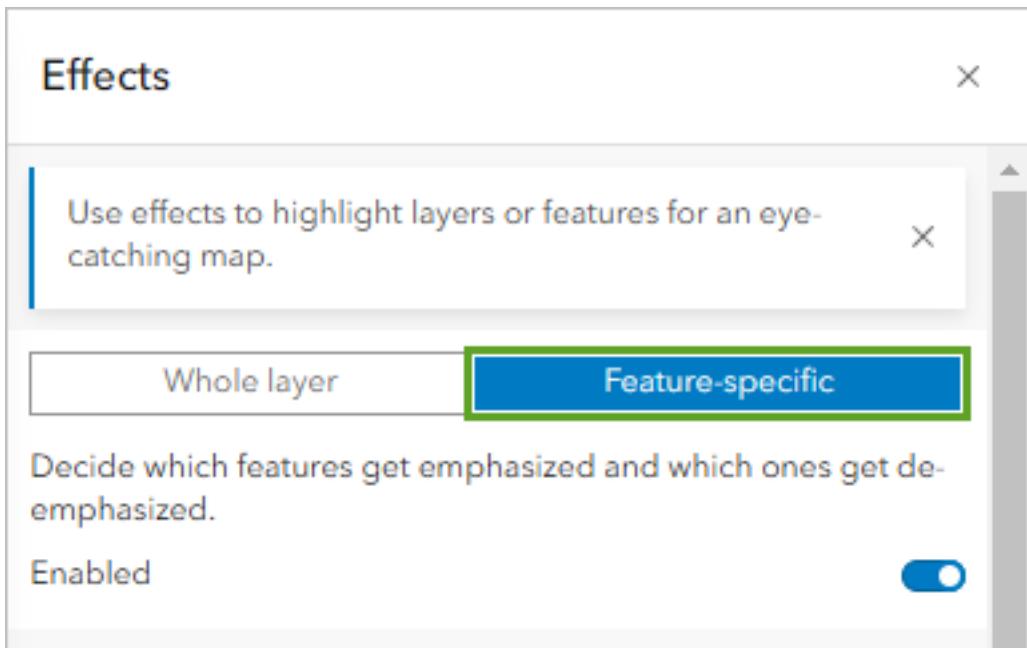
3. Click the **Menu** button for this column and choose **Sort descending**
4. Identify the 10 highest values in the table
5. Close the table

## Step 2: Apply Visual Effects

1. In the **Settings pane**, click the **Effects** button



2. In the **Effects** pane, click **Feature-specific**



3. Click the **Drop Shadow + Transparency** effect

**Effects**

Whole layer      Feature-specific Feature-specific

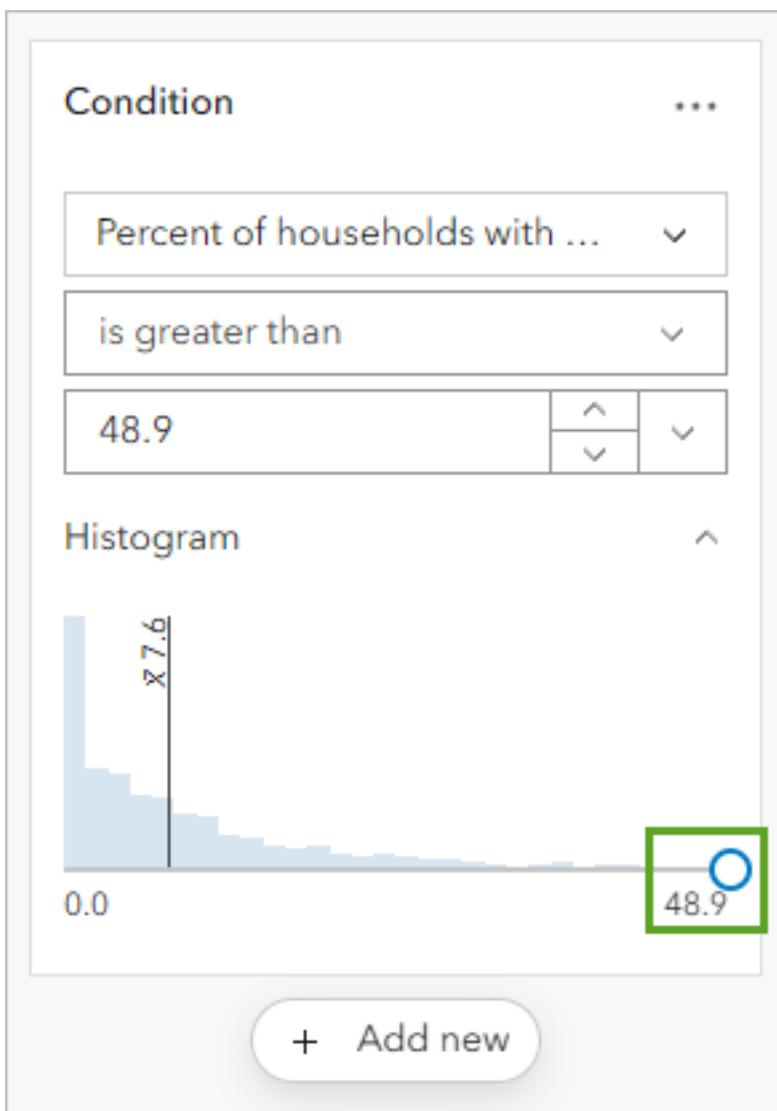
Decide which features get emphasized and which ones get de-emphasized.

Enabled

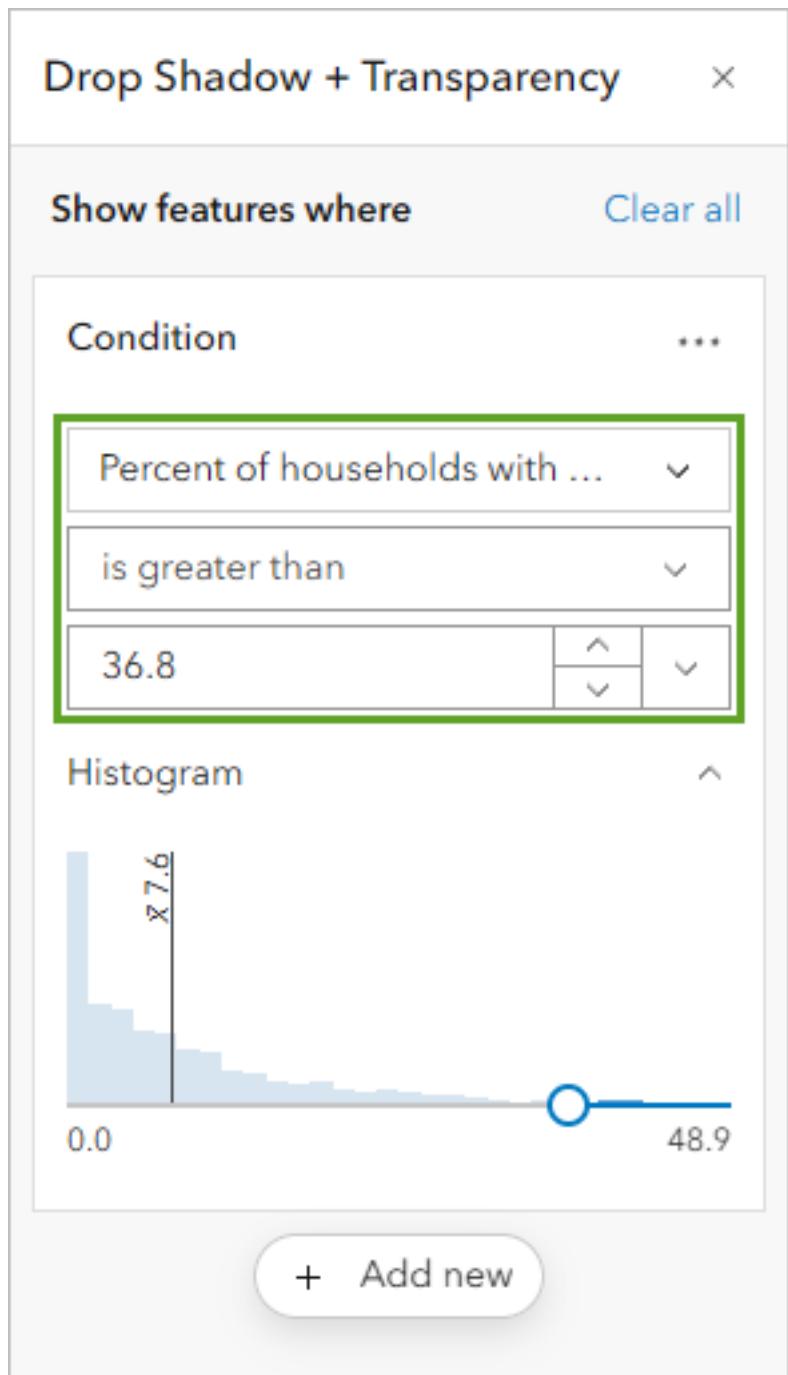
Recommended for light basemaps

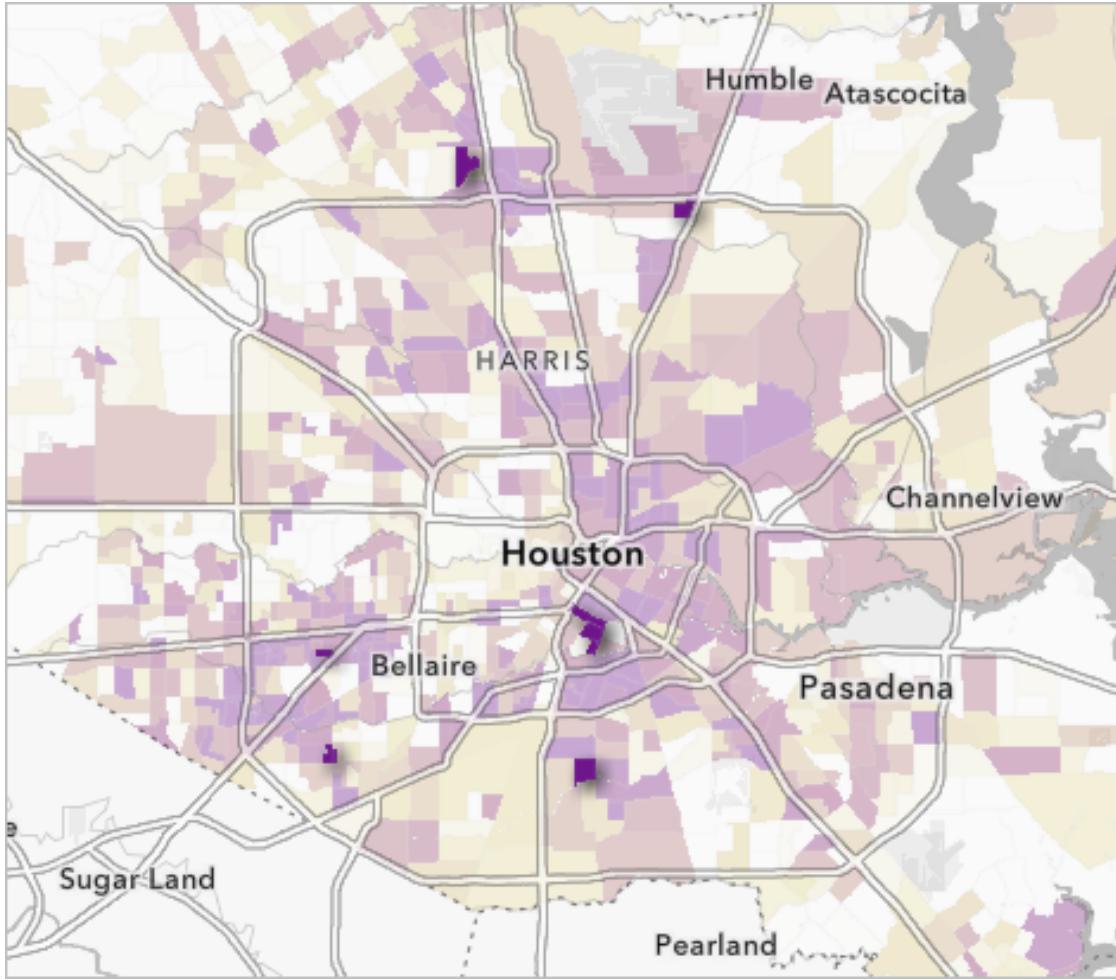
-  **Drop Shadow + Gray**  
Apply drop shadow to emphasize some features and grayscale to de-emphasize others.
-  **Strong Drop Shadow**  
Apply strong drop shadow to emphasize some features.
-  **Drop Shadow + Transparency**  
Apply drop shadow to emphasize some features and semi-transparency to de-emphasize others.
-  **Drop Shadow + Blur**  
Apply drop shadow to emphasize some features and blur to de-emphasize others.

4. In the **Drop Shadow + Transparency** pane, drag the histogram slider to the **48.9** label. This will adjust the histogram slider to emphasize the top 10 tracts



5. Modify the logical expression to highlight areas above your identified threshold. Change the logical expression to read **Percent of households with no vehicle available is greater than 36.8**.





6. Close the effects windows
- 

## Part 7: Final Documentation and Submission

### Step 1: Save Your Map

1. On the **Contents** toolbar, click **Save and open** and choose **Save as**
2. For **Title**, type: ==Census tracts in Houston with low vehicle access==
3. For **Tags**, add the following (press Enter after each):

- ==Hurricanes==
  - ==Evacuation Assistance==
  - ==Houston==
4. For **Summary**, type: ==This map shows census tracts in Houston, Texas, that have many households without access to a vehicle. These areas may need to be considered for evacuation assistance in case of a hurricane or other natural disaster.==

The map is saved. It now appears in your account's content. You can access your content by clicking the options button next to the map's name and choosing **Content**. For now, you'll set the sharing permissions.

By default, your content is private and only visible to you and your organization's administrator. You can share content to different groups of viewers depending on the level of privacy you want to maintain and the content's audience and purpose. For example, if you choose to share it with your organization, only users with accounts in the same organization as you can access your content. For this tutorial, you've created a public information map and you want it to be available to everyone, so you'll share it publicly.

1. Click **Save**

## Step 2: Submission Requirements

**IMPORTANT:** Instead of sharing your map publicly, you must provide descriptions of your completed work.

**Take a screenshot that includes:** - Your complete computer screen - The ArcGIS Online map you created - The system date and time visible (usually in the taskbar/menu bar) - All relevant map elements (legend, layers panel, styled data)

1. Ensure your map displays all required elements: - Properly filtered census data - Appropriate styling with color scheme - basemap - Applied effects highlighting top areas - Descriptive layer name.
2. Take a full-screen screenshot showing:
  - Your completed map
  - Current date and time from your system
  - ArcGIS Online interface with your map title visible
3. The date-time stamp allows the marker to validate when the work was completed

## Additional Resources

- [ACS Vehicle Availability Variables - Boundaries data](#) is from the American Community Survey.
- [Topographic](#) map sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, OpenStreetMap contributors, and the GIS User Community
- [Human Geography Map](#) sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, OpenStreetMap contributors, and the GIS User Community

To extend your learning with ArcGIS Online: - Create interactive apps from web maps - Learn advanced styling techniques - Explore spatial analysis tools - Access the ArcGIS tutorial gallery for more exercises

- To learn how to transform your web map into an interactive app, check out the tutorial [Create an app](#).
- To learn useful tips and tricks for web maps, check out the series [Common skills for working with data in ArcGIS Online](#).
- To learn about performing spatial analysis, check out the series [Perform analysis in Map Viewer](#).
- To learn more advanced techniques for styling your map, check out the series [Cartographic creations with web maps](#).

# **Lab No 2: Create a Map Lab**

This tutorial is inspired from ArcGIS Online Learning resources available at:

<https://learn.arcgis.com/en/projects/create-a-map/>

## **Overview:**

The idea of this tutorial is you learn how to create a web map using ArcGIS Online, Add a data layer to a new map and start visualizing patterns. You will see how to add new data from external sources, format your charts, and then be able to filter and structure your map to only read and illustrate what you need.

**Estimated time of completion:** 45 Minutes

## **Download and Examine the Data**

First, you will download a .csv file that contains general information about public high schools in Detroit, Michigan.

1. Download the [DetroitSchoolCharacteristics.csv](#) file to your computer and open it in Microsoft Excel or another spreadsheet program like Google Sheets.

The screenshot shows a Microsoft Excel spreadsheet titled "DetroitSchoolCharacteristics". The ribbon menu is visible at the top, with "Home" selected. The table below contains data for various schools, with the first row showing column headers. The "OBJECTID" column is highlighted with a green border.

OBJECTID	Unique Sc	School na	Location a	Location a	Location c	Location s	Location 5	Telep
42940	2.6E+11	Cesar Cha	1761 WATERMAN ST	DETROIT	MI	48209	(313)5	
42966	2.6E+11	Detroit Cc	12675 BURT RD	DETROIT	MI	48223	(313)5	
43015	2.6E+11	Voyageur	4366 Military St	Detroit	MI	48210	(313)3	
43021	2.6E+11	Detroit Ed	3402 St Aubin	Detroit	MI	48207	(313)8	
43029	2.6E+11	Old Redfo	8001 WEST OUTER DF	DETROIT	MI	48235	(313)5	
43095	2.6E+11	Covenant	1450 25th St	Detroit	MI	48216	(313)2	

You will see a table with columns of longitude, latitude, school name, total students eligible for free and reduced meal plans, and race and ethnicity data. This data comes from the National Center for Education Statistics' (NCES) Education Demographic and Geographic Estimate (EDGE) program.

It's hard to visualize where these schools are located or any patterns in the information from the table alone. Making a map is a better way to understand your data than viewing it as a table, so that's your next task.

**Note:** You can find data about public schools across the United States in the [Public School Characteristics - Current](#) layer.

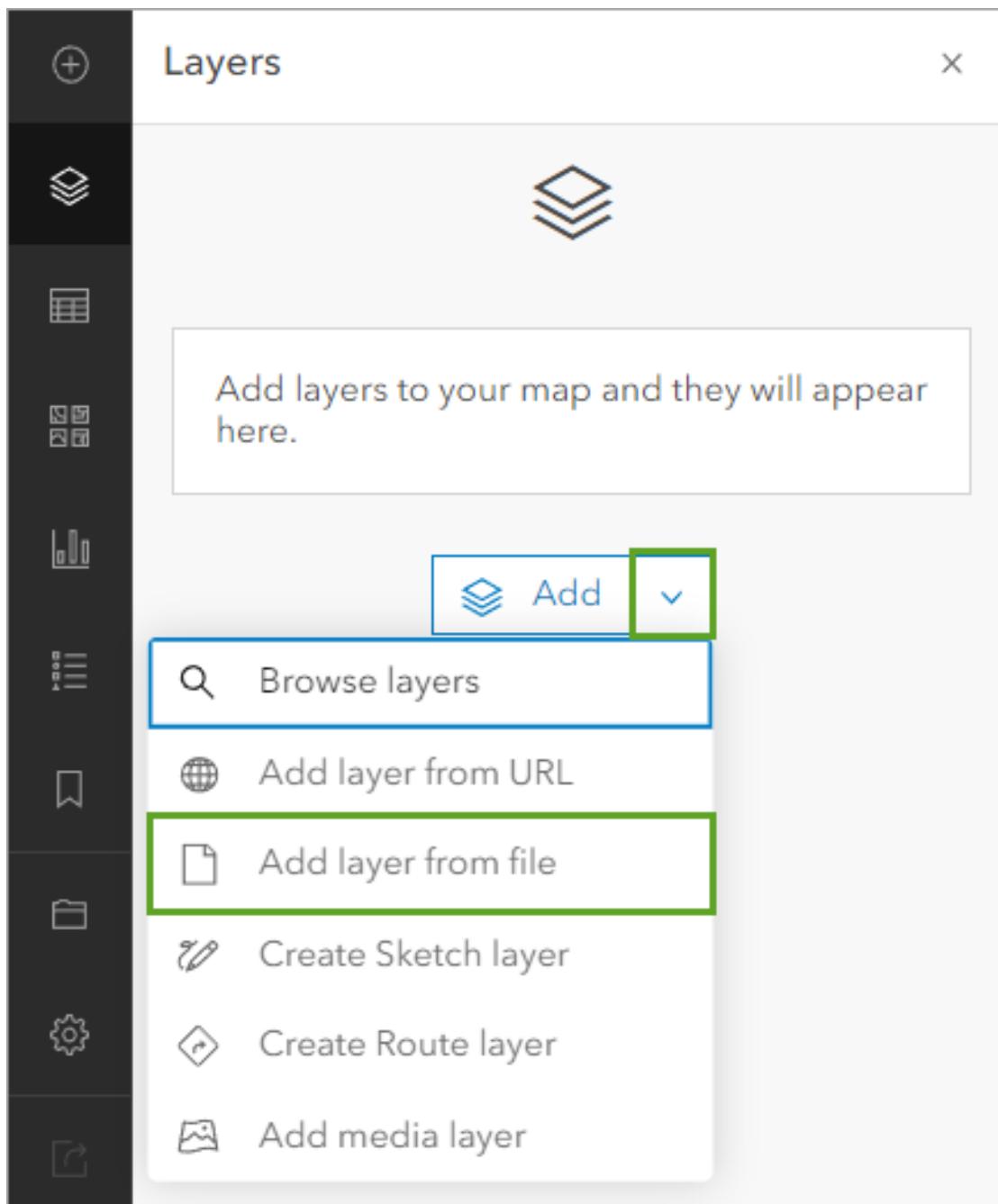
2. Close the .csv file.

## Create a Map Layer

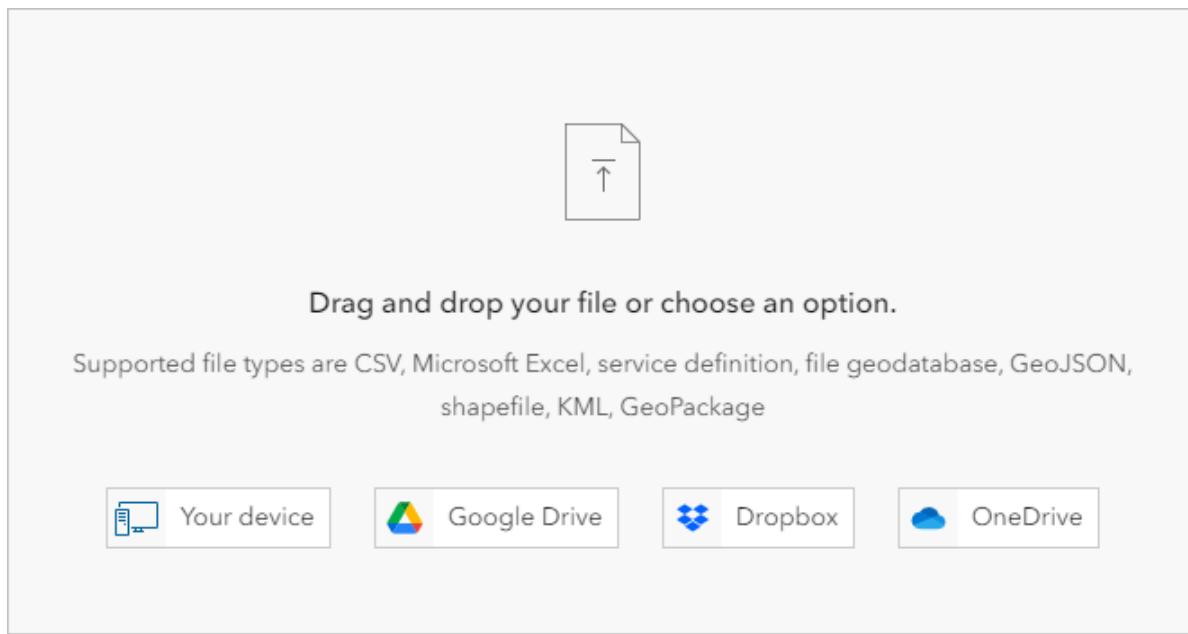
Layers are the way geographic data is organized and combined to create maps. For example, a map may consist of a roads layer, a lakes layer, and buildings layer. These layers are also the basis for geographic analysis to aid in decision making. You will create a map layer by adding your .csv file to an empty map.

1. Sign in to your [ArcGIS account](#) using your university credentials.

2. On the ribbon, click the **Map** tab.
3. In Map Viewer, in the Layers pane, click the arrow next to the **Add** button and click **Add layer from file**.



The Add Layer window appears.



4. Drag the DetroitSchoolCharacteristics.csv file to the Add Layer window.

**Tip:** Alternatively, click **Your device** and browse to the .csv file.

5. For **How would you like to add this file**, choose **Create a hosted feature layer and add it to the map**. Click **Next**.

A list of fields appears. Map layers consist of spatial and tabular information. The table will contain the same columns—also called fields or attributes—as the .csv file. On this page, you can choose which fields from the .csv file you want to include, provide display names, and data type information.

The software automatically detected the fields and produced default display name and data types. This page is an opportunity for you to review that the automatic assignments are accurate.

**Add Layer** X

### Fields

Select the fields that will be included in the hosted feature layer. Optionally, update the display name and field type.

Search for field	All types <span style="font-size: small;">▼</span>	
<span style="margin-right: 10px;">21 selected</span> <a href="#">Clear selection</a>		
Field name	Display name	Type
<input checked="" type="checkbox"/> OBJECTID	<input type="text" value="OBJECTID"/>	Integer <span style="font-size: small;">▼</span>
<input checked="" type="checkbox"/> Unique_School_ID	<input type="text" value="Unique School ID"/>	Big Integer <span style="font-size: small;">▼</span>
<input checked="" type="checkbox"/> School_name	<input type="text" value="School name"/>	String <span style="font-size: small;">▼</span>

[Back](#) Cancel [Next](#)

In this example, you will choose to include all the fields, so you won't adjust the check boxes.

**Display name** sets a nickname or shortened name of the field name that is more readily understandable to others. Field names cannot include spaces or numbers, so sometimes you may want these in the display name. Setting Display name allows you to provide meaningful names without changing the Field name text.

**Type** describes the data you will store in the field: - **Date**—Date and time. - **Double**—Numbers with decimal places. - **Integer**—Whole numbers from -2,147,483,648 to 2,147,483,647 (long integer). - **Big Integer**—Whole numbers between -( $2^{53}$ ) and  $2^{53}$ . - **String**—Any sequence of characters. The default length is 256 characters.

You will accept all the default settings and continue.

6. Click **Next**.

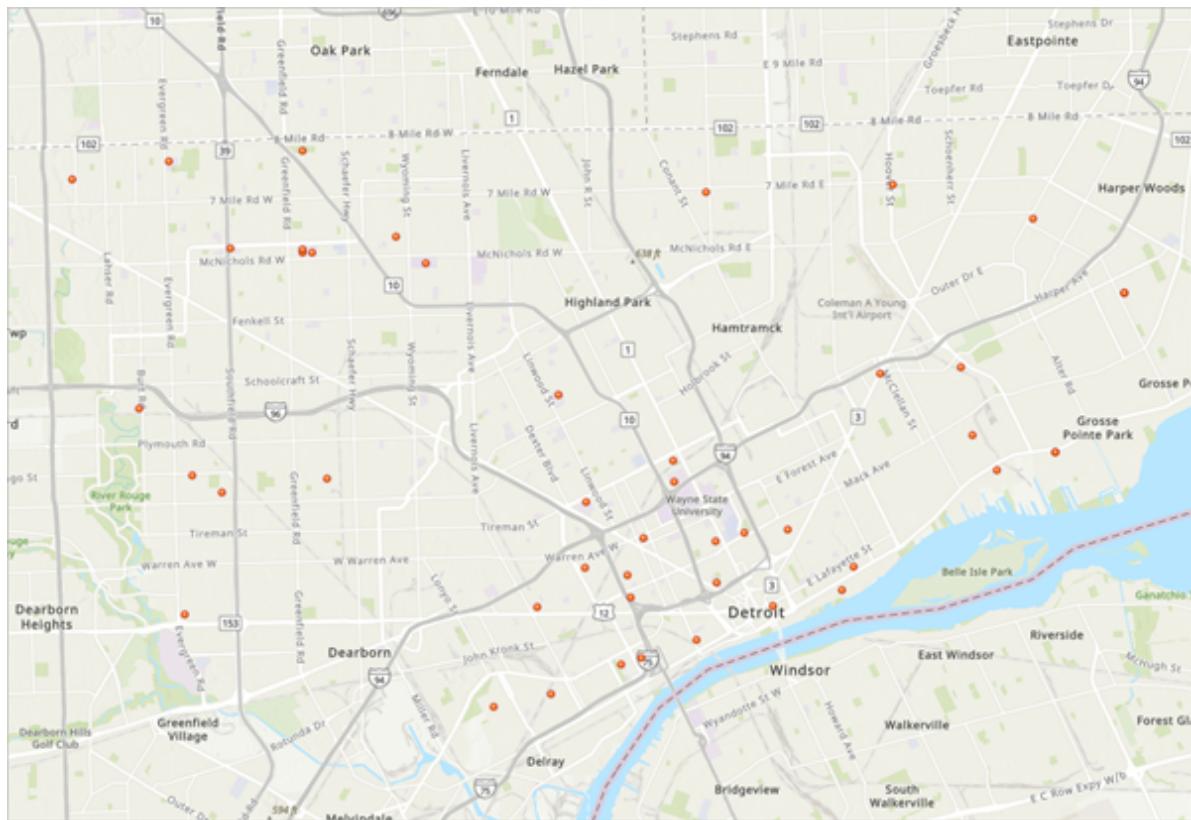
The Location settings page appears. Spatial information for the layer will be derived from the Latitude and Longitude columns in the .csv file.

**Note:** If your table contains the names or addresses of locations (like Paris or 15 Central St. Bethlehem, PA) instead of latitude and longitude fields, try this tutorial about geocoding data: [Convert a list of historic places into a map](#).

7. Click **Next**.
8. For **Title**, type “Detroit high schools” followed by your name or initials (for example “Detroit high school (Your name)”).

**Note:** You cannot create two layers in an ArcGIS organization with the same name. Adding your initials to a layer name ensures that other people in your organization can also complete this tutorial. Once a layer has been created, you can rename it in the map to remove your initials, which will not affect the name of the underlying data layer.

9. Click **Create and add to map**.

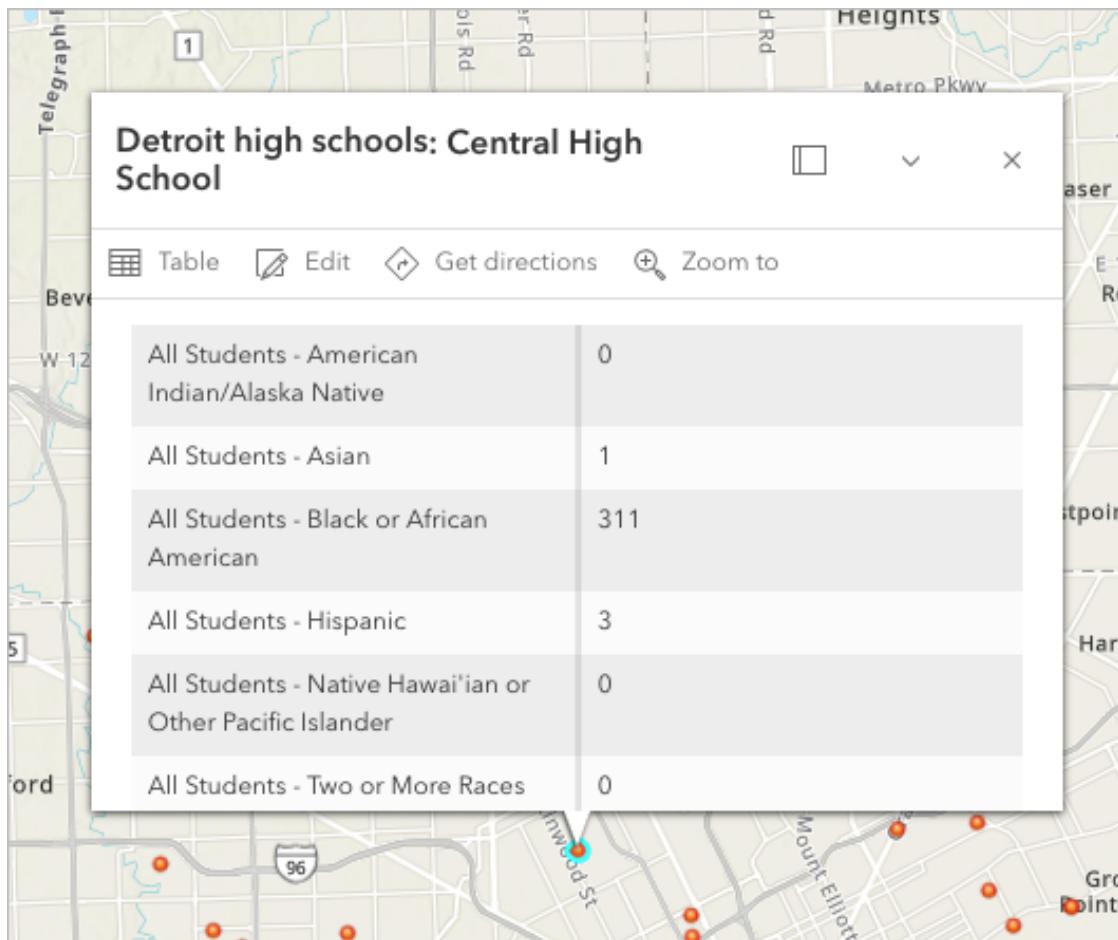


The new layer appears on the map. The map displays the locations of the schools listed in the .csv file. Each school is considered a feature in the layer. You have access to the descriptive information, or attributes, by viewing pop-ups for features on the map.

10. On the map, click any circle.

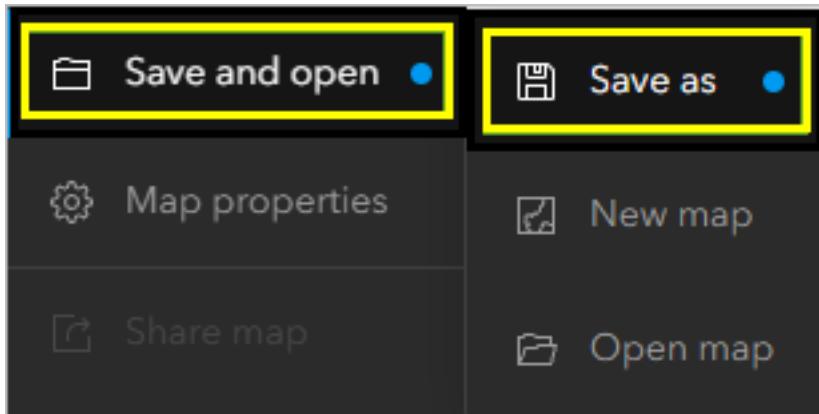
A pop-up window appears with information about the school from the layer's table.

11. Close the pop-up.



Before you continue, you will save the map.

12. In the Contents pane, click **Save and open** and click **Save as**.



13. In the Save map window, enter the following:

- For **Title**, type “Public high schools in Detroit”.
- For **Summary**, type “Map of public high schools and student body race and ethnicity data in Detroit, Michigan”.

Save map X

Title  
Public high schools in Detroit

Folder  
Your Folder

Categories  
Assign categories

Tags  
Add tags

Summary  
Map of public high schools and student body race and ethnicity data in Detroit, Michigan.  
Characters left: 1959

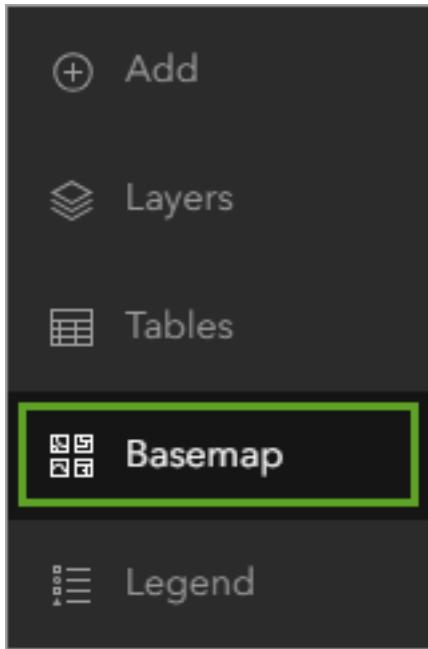
Save Cancel

14. Click Save.

## Change the Basemap and Layer Style

Maps in ArcGIS Online consist of layers. You added the Detroit high schools layer, but the map also has a basemap layer by default. Next, you'll change the basemap layer and the style of the feature layer.

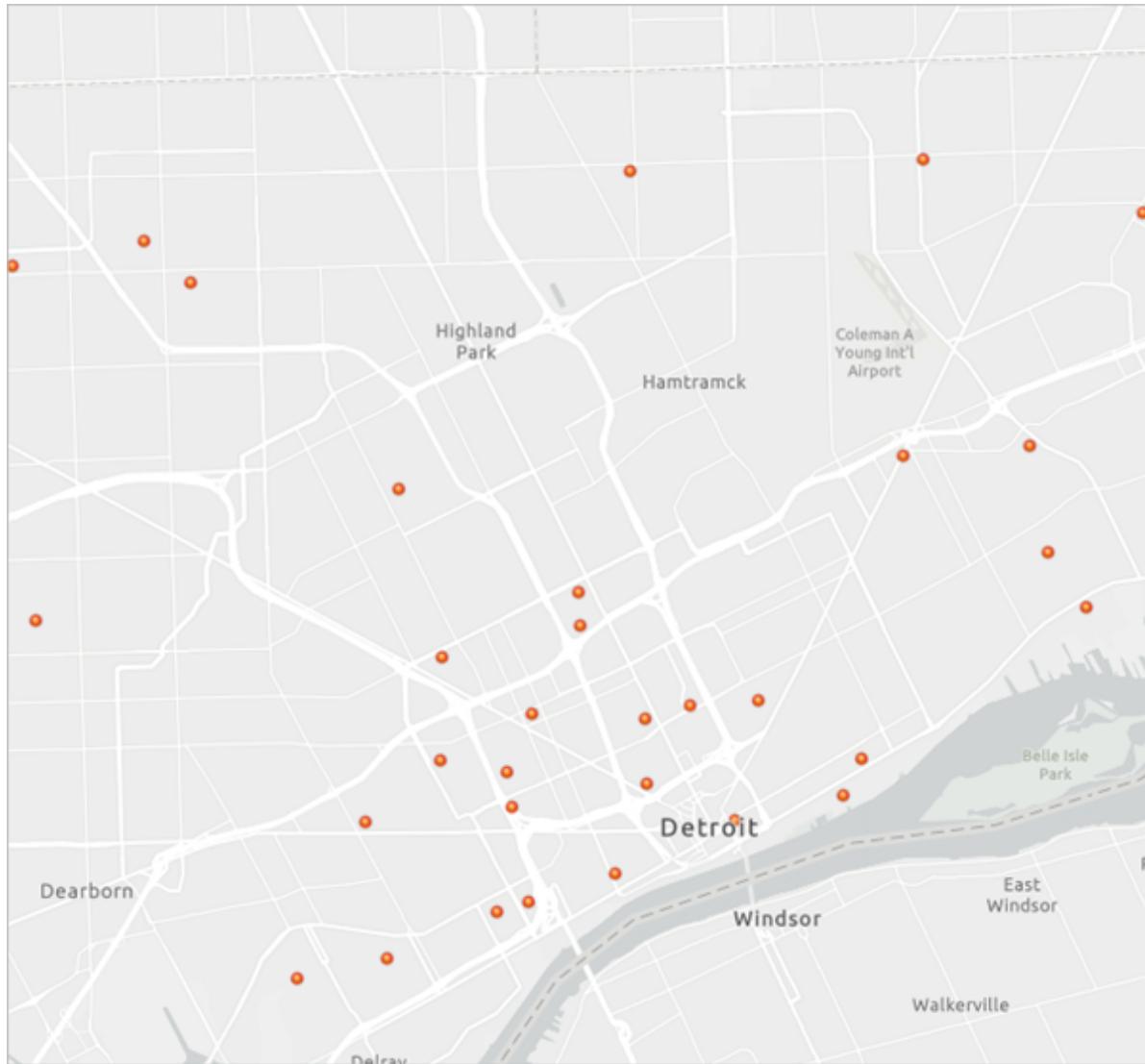
1. On the Contents (dark) toolbar, click **Basemap**.



The Basemap pane appears. The Topographic basemap is selected. This basemap looks good but is better suited for a reference map. You'll choose a more minimally designed basemap so it does not distract from the school data.

2. In the Basemap pane, click **Light Gray Canvas**. Close the Basemap pane.

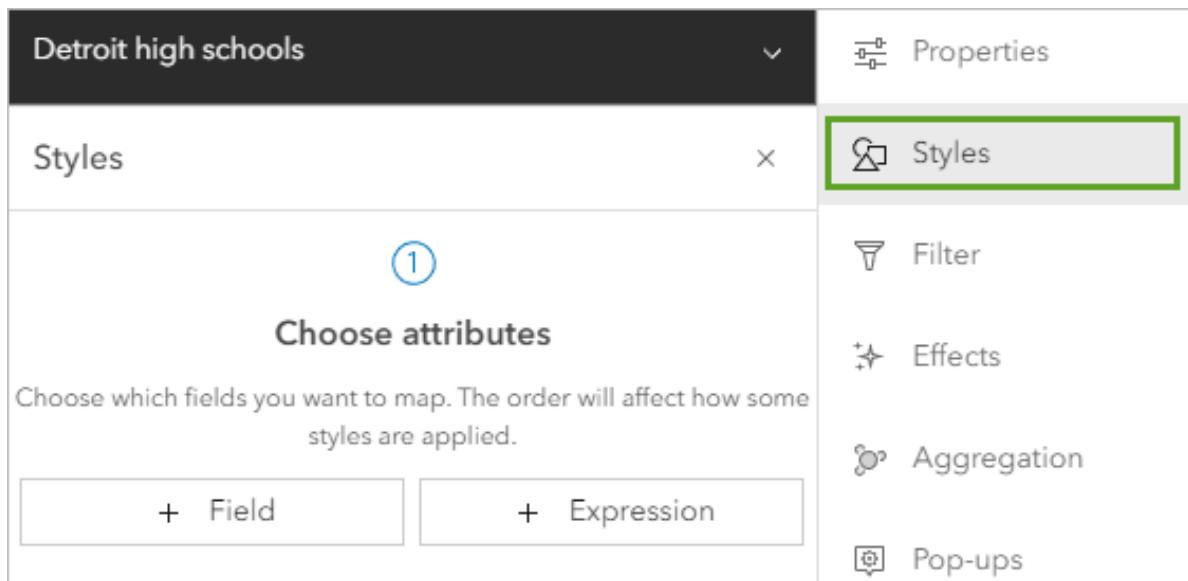
**Note:** You may see different basemaps depending on the configuration of your organization. If the Light Gray Canvas basemap is not available, skip to the next step without changing the basemap.



Next, you'll configure the high school layer's symbols so they are sized based on the number of students at each school eligible for free and reduced meal plan programs.

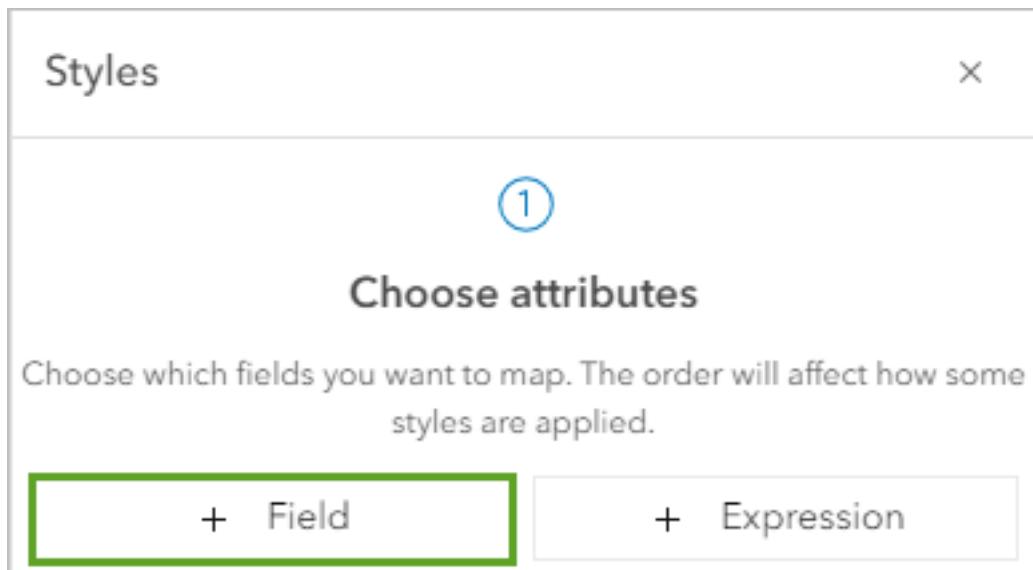
3. On the Settings (light) toolbar, click **Styles**.

**Note:** If the Settings toolbar is unavailable, on the Contents toolbar, click **Layers**. In the Layers pane, click **Detroit high schools** to select the layer.



The Styles pane appears. Currently, the style is based on the data's location only. You'll configure the symbols to convey both location and one of the data's attributes.

4. In the Styles pane, click the **Field** button.



You will choose to style the map by the number of students at each high school who are eligible for free and reduced price meal (FRPM).

Eligibility for FRPM is set by U.S. Department of Agriculture Child Nutrition Programs and is based on Federal poverty guidelines issued by the Department of Health and Human Services.

The number or percent of students eligible for FRPM is often used as an equity indicator to understand the needs of school-aged children.

5. On the Select fields menu, choose **Total of free lunch and reduced-price lunch eligible** and click **Add**.

## Select fields

X

Search fields



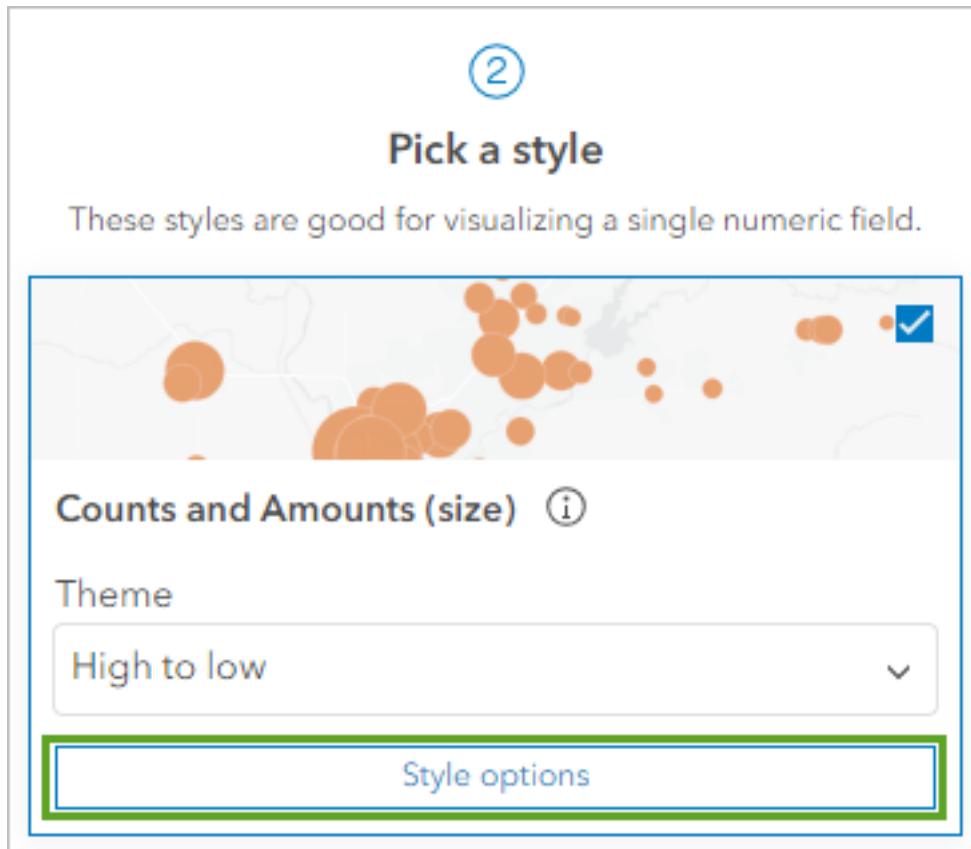
- |                                     |  |     |
|-------------------------------------|--|-----|
| <input type="checkbox"/>            | Unique School ID                                     | (i) |
| <input type="checkbox"/>            | School name  | (i) |
| <input type="checkbox"/>            | Location address, street 1                           | (i) |
| <input type="checkbox"/>            | Location address, street 2                           | (i) |
| <input type="checkbox"/>            | Location city  | (i) |
| <input type="checkbox"/>            | Location state                                       | (i) |
| <input type="checkbox"/>            | Location 5 digit ZIP code                            | (i) |
| <input type="checkbox"/>            | Telephone number                                     | (i) |
| <input type="checkbox"/>            | County Name  | (i) |
| <input checked="" type="checkbox"/> | Total of free lunch and reduced-price lunch eligible | (i) |
| <input type="checkbox"/>            | Total elementary/secondary students (excludes AE)    | (i) |
| <input type="checkbox"/>            | All Students - American Indian/Alaska Native         | (i) |

Add

Cancel

The options under Pick a style update to reflect choices that are suitable for the Total of free lunch and reduced price lunch eligible field. **Counts and Amounts (size)** is selected and the map updates to reflect this style. This style reveals some new patterns in the data. The larger the circle, the more students are eligible for FRPM at the school.

6. On the **Counts and Amounts (Size)** card, click **Style options**.



7. In the Counts and Amounts (size) pane, for **Symbol style**, click the current symbol.

**Counts and Amounts (size)**

Total of free lunch and reduced-price lunch eligible

Theme

**High to low**  
Vary the size of features from high to low.

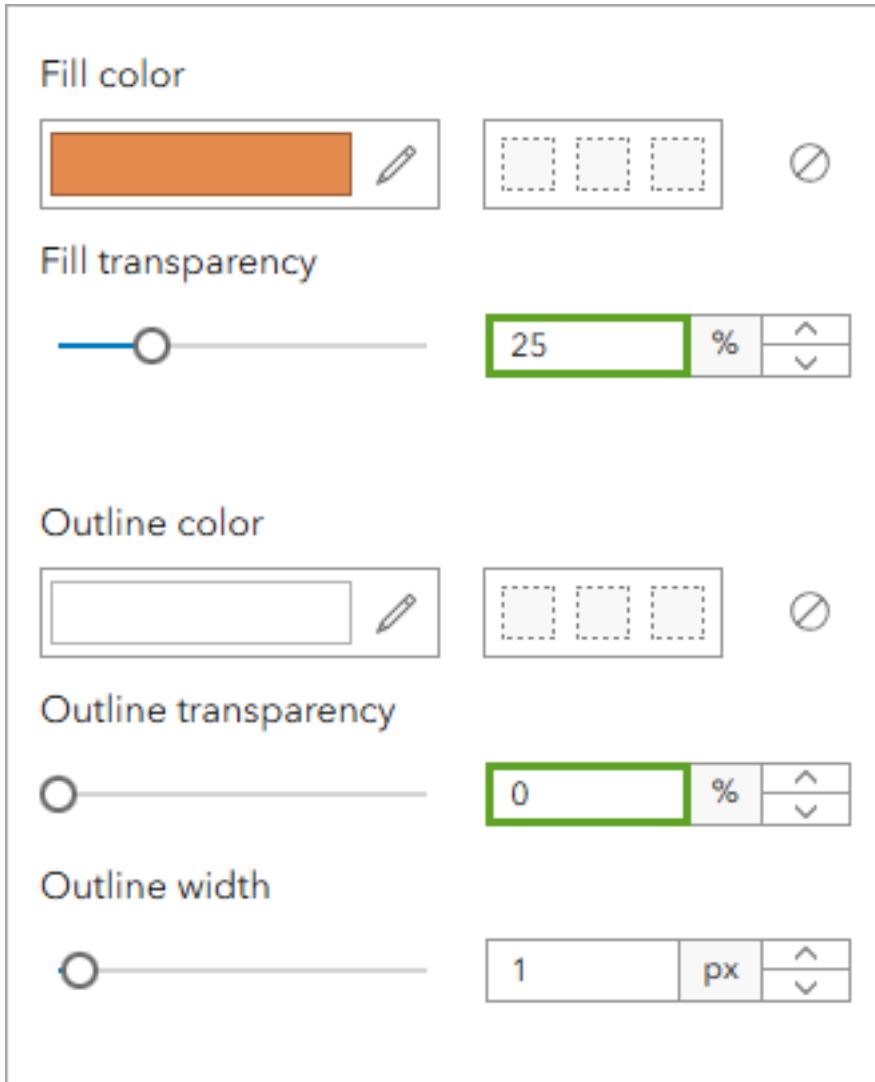
Divided by

Choose a field

Symbol style

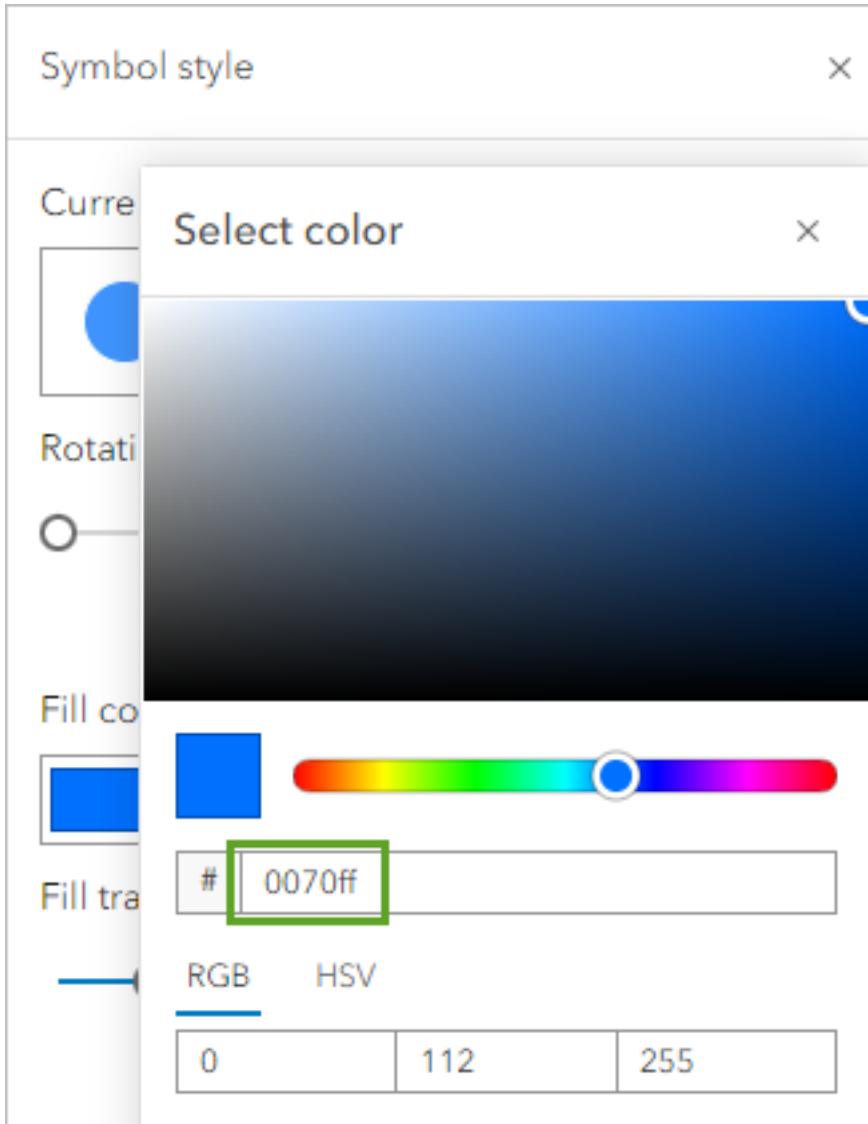
The Symbol style window appears. You'll adjust the symbol's properties so circles can be seen even when they are overlapping.

8. Set **Fill transparency** to 25. Set **Outline transparency** to 0.



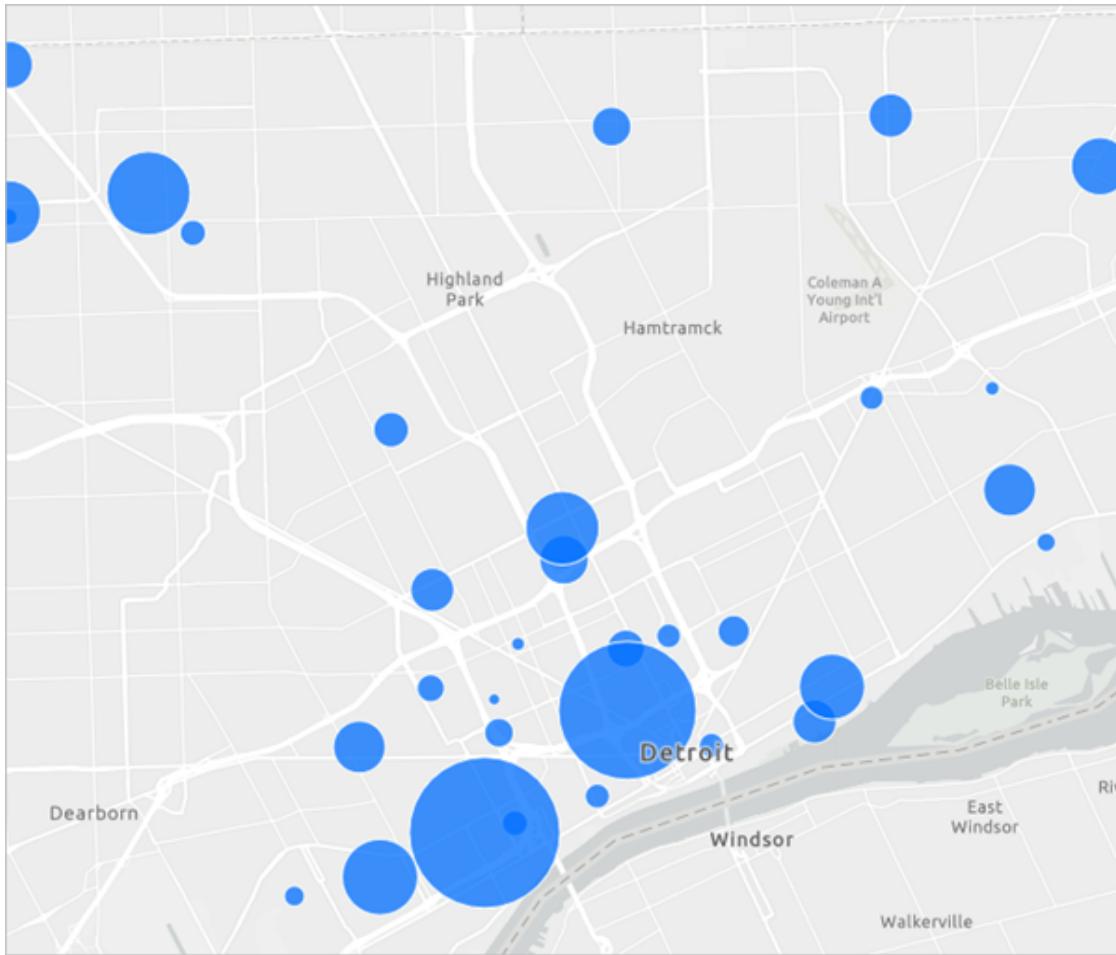
The symbols on the map update. It is now easier to see overlapping circles.

9. In the Symbol style window, for **Fill color**, click the current color. In the Select color window, for **#**, type **0070FF** and press Enter.



The color of the map symbols changes to blue.

10. Click **Done** in the Select color window, the Style options pane, and the Styles pane.



The map shows the number of students at each high school who are eligible for FRPM programs. The schools with more students who are eligible for FRPM programs are represented by larger circles. Schools represented with smaller circles have fewer students who are eligible for FRPM programs.

11. On the Contents pane, click **Save and open** and click **Save** to save your map.

## Configure Pop-ups and View a Table

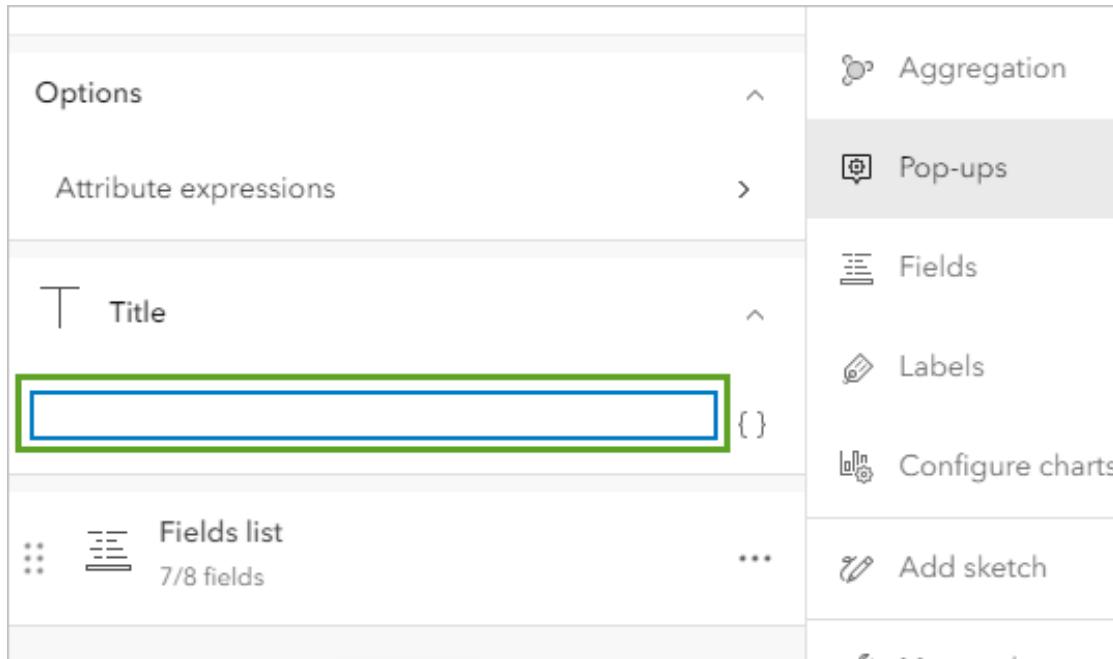
The pop-up that you viewed earlier displayed all the attributes for the features, which may be unnecessary for your map. You can configure pop-ups to show only those attributes that are important to your map. In this example, you want to show only the name of the school and the number of students eligible for FRPM programs.

1. In the Layers pane, ensure that the **Detroit high schools** layer is selected.

2. On the Settings toolbar, click **Pop-ups**.

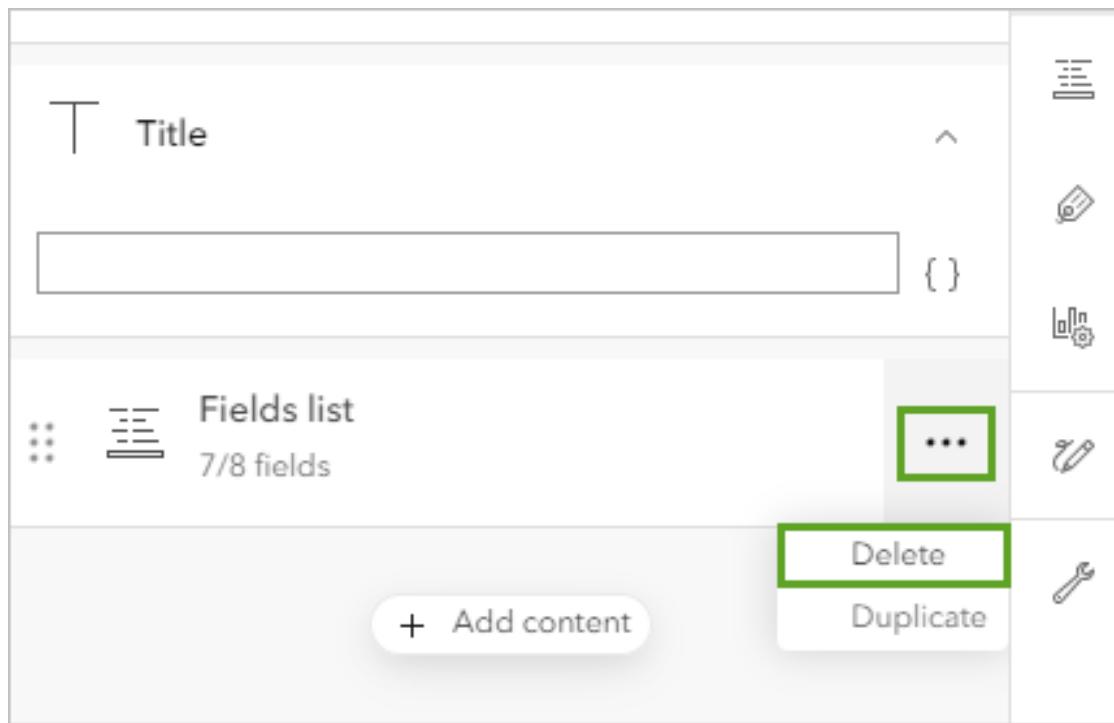
The Pop-ups pane appears and a sample pop-up appears on the map. The pop-up's title contains the name of the layer and the name of the school. This title is unnecessary for your map, so you'll remove it.

3. In the Pop-ups pane, click **Title**. Erase the text in the box.

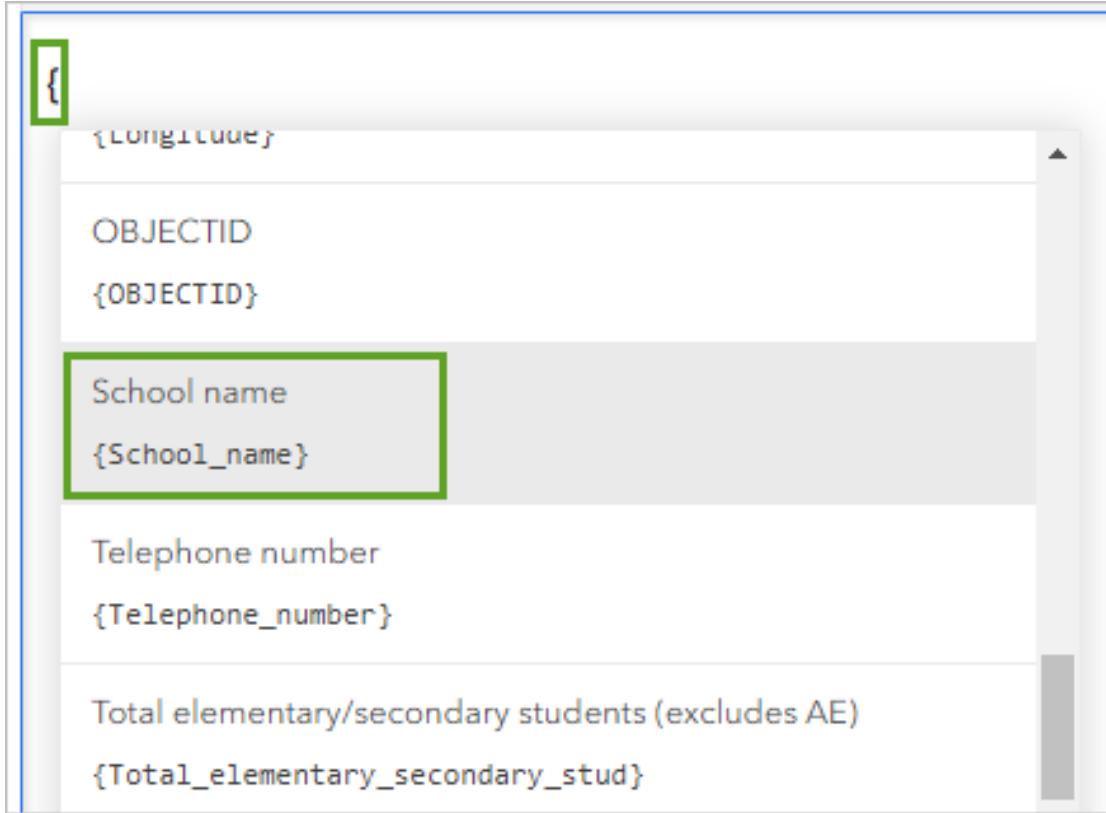


The title text disappears from the sample pop-up. You'll replace the list of fields with a sentence that includes the relevant information.

4. Next to **Fields list**, click the **Options** button. Click **Delete**.



5. Click **Add content** and click **Text**.
6. In the text editing window, type **{**. In the menu that appears, scroll almost to the bottom and click **School name**.

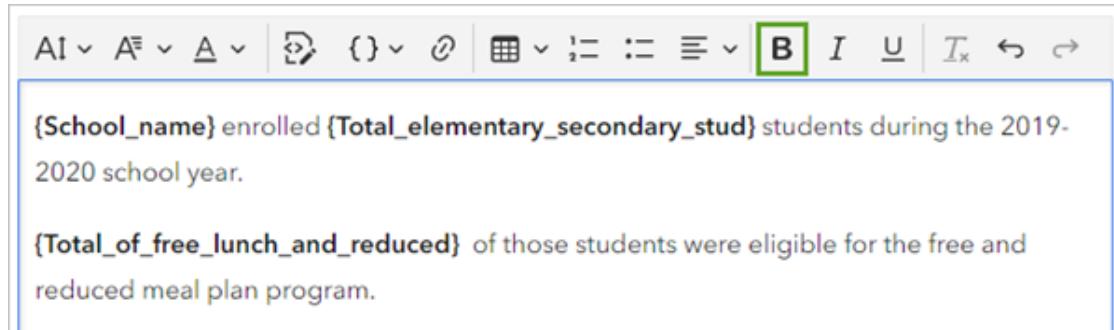


The School\_name field was one of the fields in the .csv file you used to create the feature layer. By setting the dynamic text to this field, the pop-up that displays for each school point will display the corresponding School\_name field.

7. After {School\_name}, type enrolled {Total\_elementary\_secondary\_stud} students during the 2019-2020 school year.

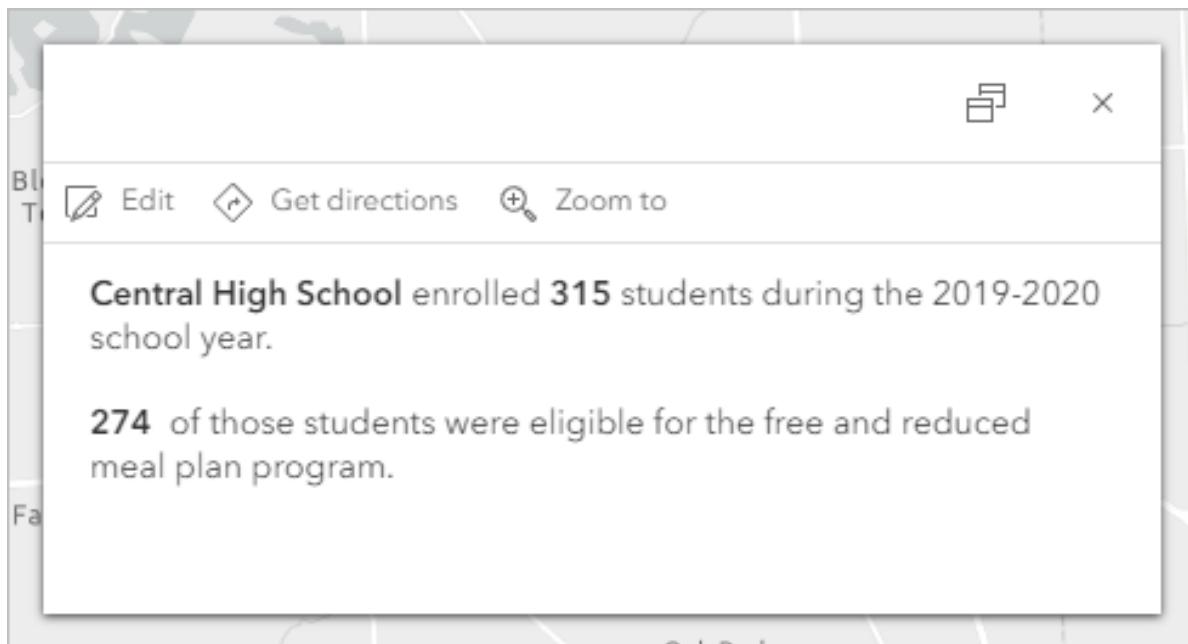
You can add fields by typing their names inside of curly brackets or by choosing them from the list that appears when you type a curly bracket.

8. Press Enter to start a new paragraph. Type {Total\_of\_free\_lunch\_and\_reduced} of those students were eligible for the free and reduced meal plan program.
9. Use the **Bold** button on the toolbar to add bold formatting to {School\_name}, {Total\_elementary\_secondary\_stud}, and {Total\_of\_free\_lunch\_and\_reduced}.



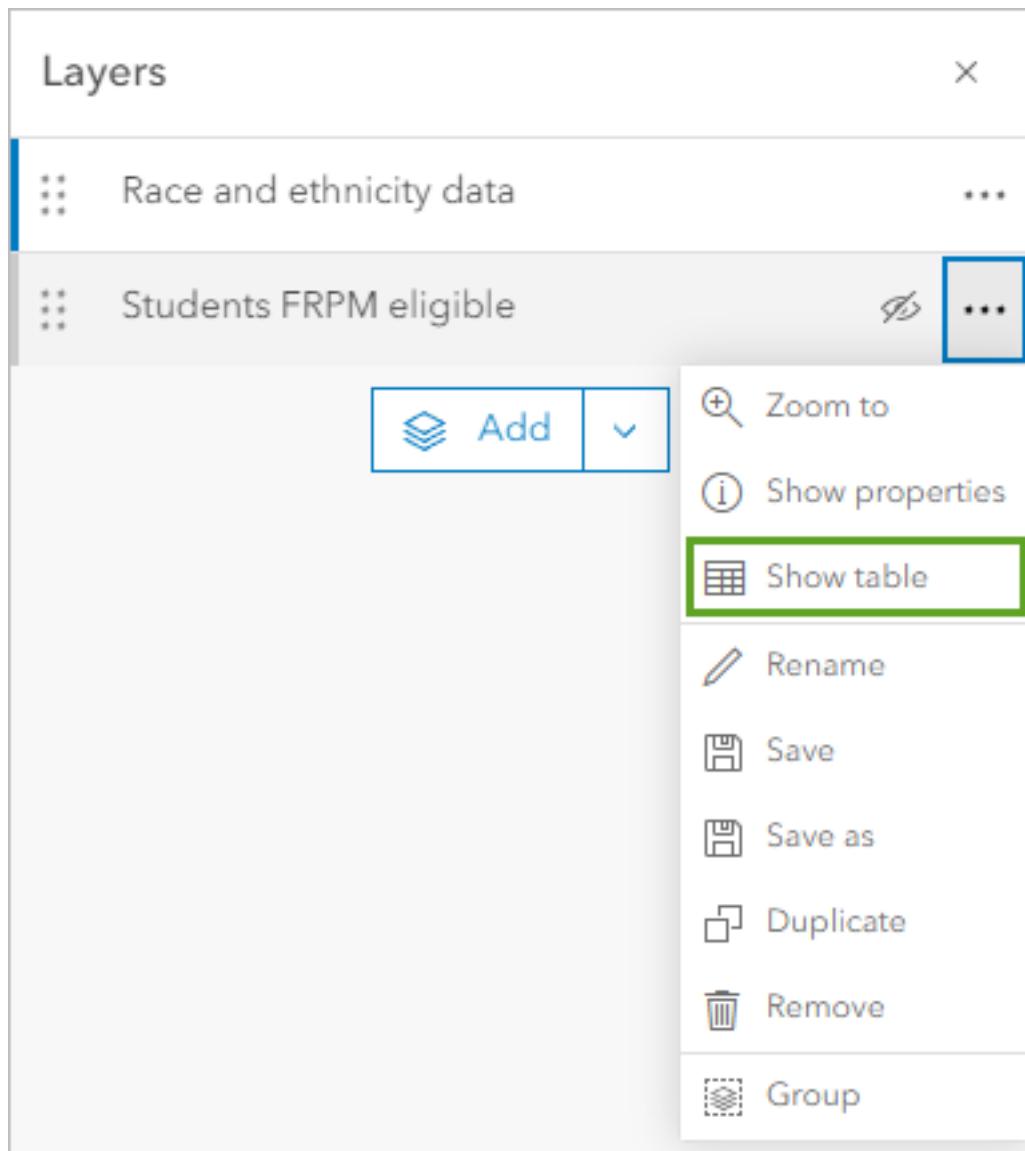
10. Click **OK**.

The preview pop-up replaces the field names with the attribute values of one of the features.



All the fields still exist in the data table, but they don't display in the pop-up. You can modify the contents of the pop-up at any time. You can still see all the attributes by showing the table.

11. In the Layers pane, next to **Detroit high schools**, click the **Options** button. Click **Show table**.



The layer's table appears below the map.

12. Review the data in the table. Close the table when you are finished.
13. Close the Pop-ups pane.
14. Save the map.

## Style the Layer in Another Way

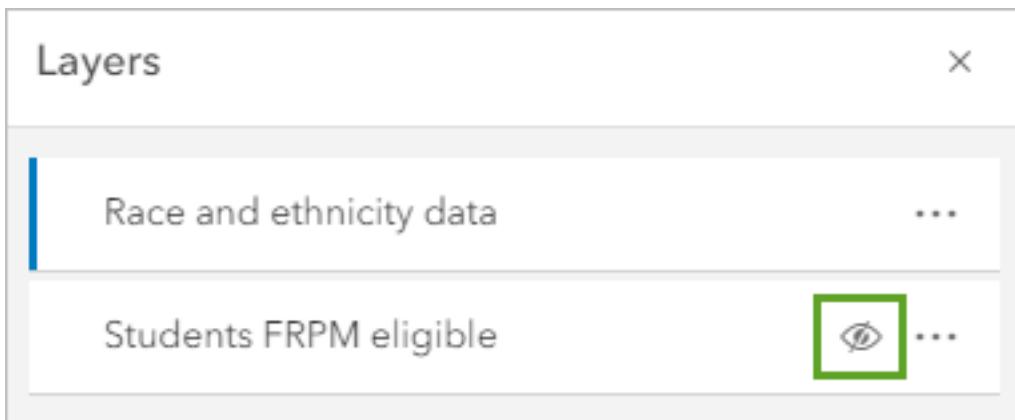
Your goal is to identify which schools would most benefit from more after-school programs. You have styled the school data by the number of students eligible for FRPM. But there are other aspects of equity that are also important to consider. Due to historic and present-day practices, race and ethnicity can play a critical role in how many resources and opportunities students have at their schools. Practices like segregation in schools and neighborhoods have widened inequities in resource allocation to schools.

Next, you will style the schools to show the race and ethnicity of the student body. First, you will rename the layer you had previously styled to show FRPM eligibility.

1. In the Layers pane, for the **Detroit high schools** layer, click the **Options** button and click **Rename**.
2. For **Title**, type **Students FRPM eligible** and click **OK**.

Next, you will make a copy of the layer.

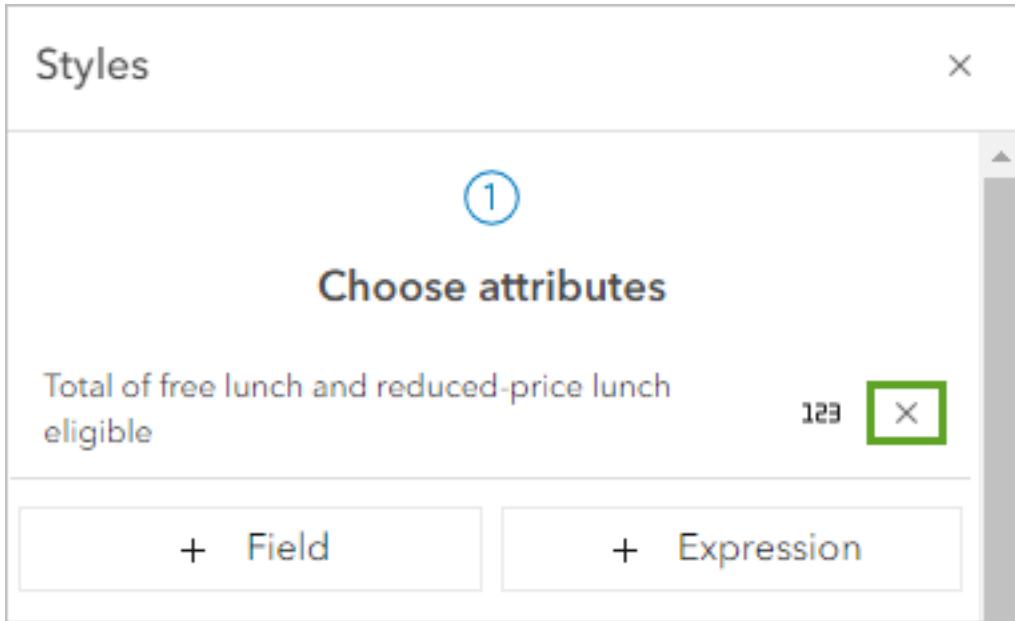
3. For the **Students FRPM eligible** layer, click the **Options** button and click **Duplicate**.



4. Rename the copied layer to be **Race and ethnicity data**.
5. Next to **Students FRPM eligible**, click the **Visibility** button to hide the layer on the map.

Next, you will style the Race and ethnicity data layer with race and ethnicity attributes.

6. Ensure that the **Race and ethnicity data** layer is selected in the Layers pane. In the Styles pane, remove the **Total FRPM eligible** attribute.



7. Click the **Field** button.
8. In the Add fields window, check the following fields:
  - All students - American Indian/Alaska Native
  - All students - Asian
  - All Students - Black or African American
  - All Students - Native Hawai'iian or Other Pacific Islander
  - All Students - Hispanic
  - All Students - Two or More Races
  - All Students - White

## Select fields

X

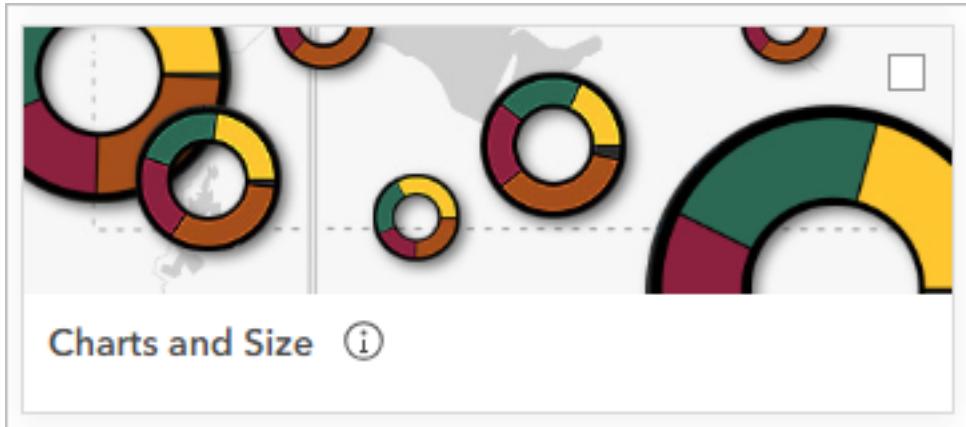
Search fields

- Location 5 digit ZIP code (i)
- Telephone number (i)
- County Name (i)
- Total of free lunch and reduced-price lunch eligible (i)
- Total elementary/secondary students (excludes AE) (i)
- All Students - American Indian/Alaska Native (i)
- All Students - Asian (i)
- All Students - Black or African American (i)
- All Students - Native Hawaiian or Other Pacific Islander (i)
- All Students - Hispanic (i)
- All Students - Two or More Races (i)
- All Students - White (i)

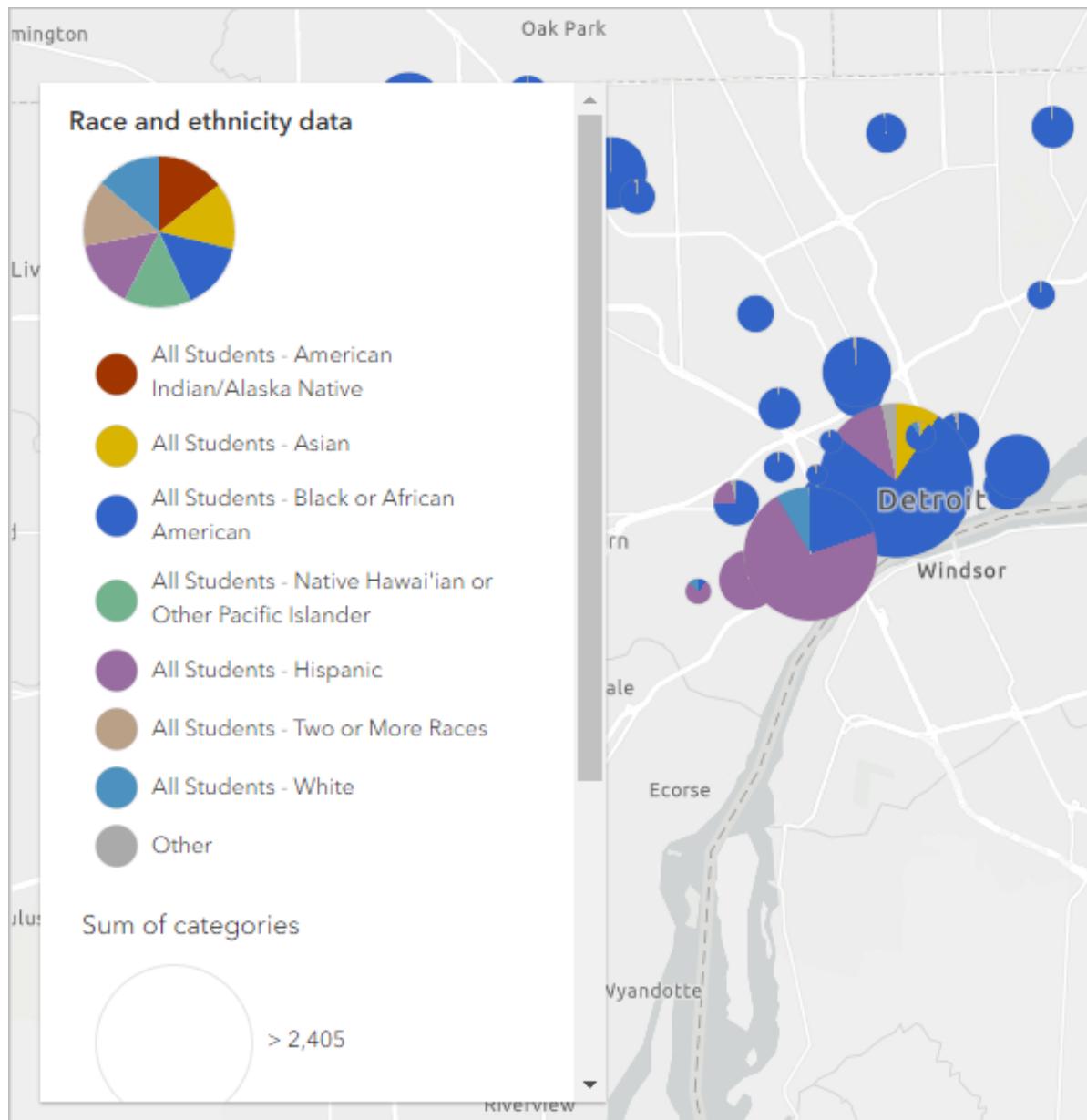
Add

Cancel

9. Click **Add**.
10. Under **Pick a style**, click the **Charts and Size** style.



The layer style updates.



The map now shows pie charts of the student body's race and ethnicity categories. The sizes of the pie charts represent the number of students at the schools.

11. Save the map.

## **Update the Item Details**

Your map now tells a story about the locations and some socioeconomic attributes of public high schools. For example, the school with the largest number of students eligible for FRPM programs is Western International High School in southwest Detroit. Many of the schools have a high percentage of students who identify as Black or African American. In southwest Detroit, there are more schools with higher percentages of Hispanic or Latino students.

By saving your map, you also created a corresponding item page that contains information, actions, options, and settings for the map.

1. On the Contents toolbar, click **Map properties**. In the Map Properties pane, click **Item details**.

Map properties X

Background ^

Enable background color

Indoor layers ▼

Map view ^

Preserve map scale  ⓘ

Time ^

Time zone  ⓘ

Device time zone

Specific time zone

Data's time zone (no adjustments)

Time slider options >

[Item details ↗](#)

Your map's item page opens in a new browser tab. The item details are missing important attribution and descriptive information that you will fill in before you share the map. For example, you must give credit to the data providers.

2. Scroll to the bottom of the page. Next to **Credits (Attribution)**, click **Edit**.
3. Type **National Center for Education Statistics' (NCES) Education Demographic and Geographic Estimates (EDGE)**. Click **Save**.
4. Close the item page's tab.

## **Submit Your Work**

To demonstrate completion of this lab, take a screenshot that includes your entire computer screen showing your completed map. Ensure that the date and time are visible on your screen (either in the system taskbar or by opening the system clock). This screenshot will allow the instructor to validate that you have successfully completed the mapping exercise.

Submit your screenshot through the designated course submission portal.

## **What's Next?**

You have created a web map with a .csv file of school location and demographic data. Now that you have the data mapped, you have more ideas for how to share and explore potential after-school program needs in your city.

You can create a web app to display your map data in an interactive way so viewers can explore the data without editing the map. There are many ways you can use your web map to visualize data, understand problems, determine informed solutions, and discover what else is possible.

You can find more tutorials in the [tutorial gallery](#).

# **Lab No 3: Mapping Meaningful Places in Your Community**

## **Overview**

In this lab, you will learn to identify and map meaningful places in your community using ArcGIS Survey123. This project involves designing a research study, collecting data through surveys, and analyzing the results to understand what places contribute to your community's identity and resilience.

## **Learning Objectives**

By the end of this lab, you will be able to:

- Design a research project with clear objectives and methodology
- Create digital surveys using ArcGIS Survey123
- Collect and analyze spatial data about community places
- Visualize data patterns using heat maps and other analytical tools
- Draw conclusions about community identity and important places

**Estimated time of completion:** 45 Minutes

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## **Part 1: Design Your Project**

### **Step 1: Formulate a Research Question**

Before collecting any data, you need to establish a clear research question that will guide your entire project. Your research question should address: **Why are you collecting data? What do you want to know?**

**Task: Write a research question to guide your project about important places in your community.**

**Examples:** - What places in my community have social, economic, and political value and add to my community's identity? - What places in my community contribute to its identity?

**Scottish Context Examples:** - What places in Edinburgh contribute most to the city's cultural identity beyond the obvious tourist attractions? - How do community spaces in Glasgow neighborhoods support local resilience and social cohesion? - What locations in the Scottish Highlands are most valued by local residents for their cultural and economic importance?

**Step 2: Plan Your Data Collection**

Now that you have your research question, consider what kinds of data you need to collect. **Think about the who, what, when, where, and why of your data collection.**

**Task: Write five sample questions that you can use to collect data to answer your research question.**

**Example Questions:** - What is the name of this place? - Why is it important to you? - What activities do you do at this place? - How often do you visit here? - Who is there with you? - How many people are typically there with you?

**Step 3: Consider Data Types**

Different types of questions collect different types of data (numbers, text, dates, rating scales, images). Planning your data types in advance will make analysis easier later.

**Task: Write 5-8 survey questions, keeping in mind your research question and the types of data you want to collect about each location.**

Sample Survey Questions Table:

Question	Options	Data Type
What is the name of this place?		Text
Where is this place?		Map

Question	Options	Data Type
What kind of place is this?	School, Neighborhood, Park or open space, Library, Market, Shopping center, Religious space, Community center, Memorial or historic site, Restaurant, Performing Arts space, Other community space	Single select
How do you interact with this space?	To spend time with family, To spend time with friends, To exercise, For recreation, To shop, To learn, To worship, Other	Multiple select
How important is this place to you?		Rating
How many times per week do you visit this place?		Number
What kinds of challenges might this place face?	Climate threats and adaptability, Funding challenges, Land use change and development, None	Multiple select
Upload a photo of this location		Image

**Scottish Context Examples:** - For “What kind of place is this?” you might add: Village hall, Distillery, Castle/Historic site, Farmers market, Pub, Community sports club, Gaelic cultural center - For challenges: “Highland depopulation,” “Tourism pressure,” “Language preservation needs,” “Weather-related access issues”

#### Step 4: Determine Sample Size

Consider how many responses you need to answer your research question effectively. Also consider potential data bias - does your sample represent the population you’re trying to understand?

**Task:** - Decide how many data points you need to collect and from how many different people - Set a goal as a class for how many data points you need to collect and how many people you should survey

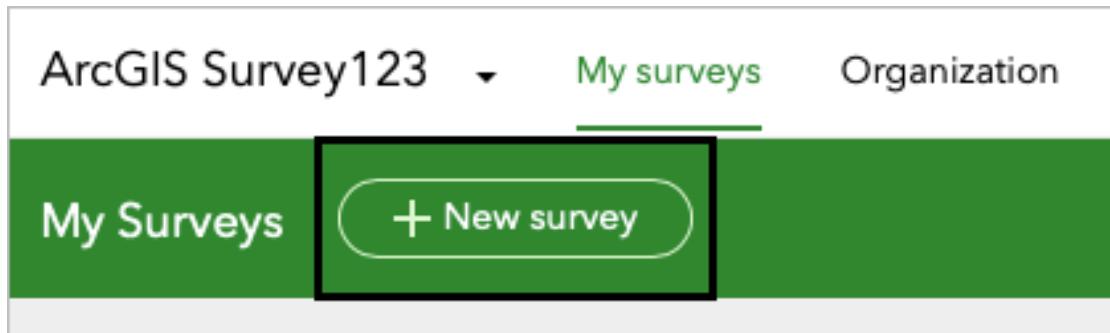
**Important Note:** Be aware of data bias. If you only survey your classmates, your data will tell you what's important to people your age, but may not represent the broader community.

---

## Part 2: Create the Survey

### Step 5: Set Up ArcGIS Survey123

1. Go to the [ArcGIS Survey123](#) website and sign in with your ArcGIS Online account
2. Click New survey



3. For Blank survey, click **Get started**

## USING THE WEB DESIGNER



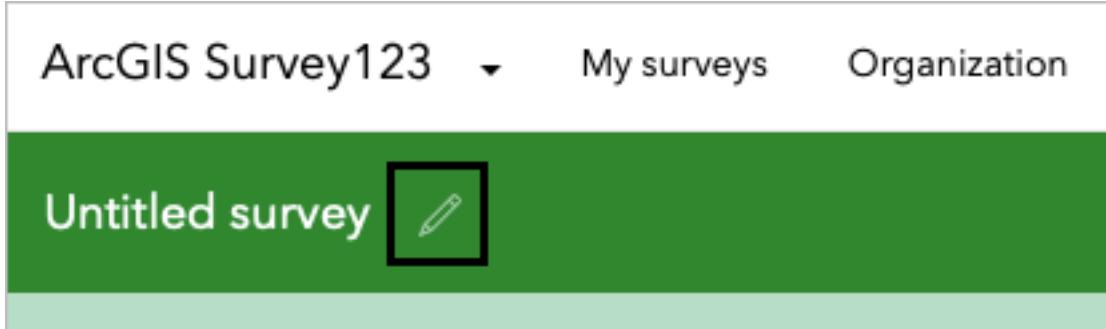
### Blank survey

- Start from scratch
- Design your own survey
- Use a drag-and-drop editor

[Get started](#)

### Step 6: Configure Survey Information

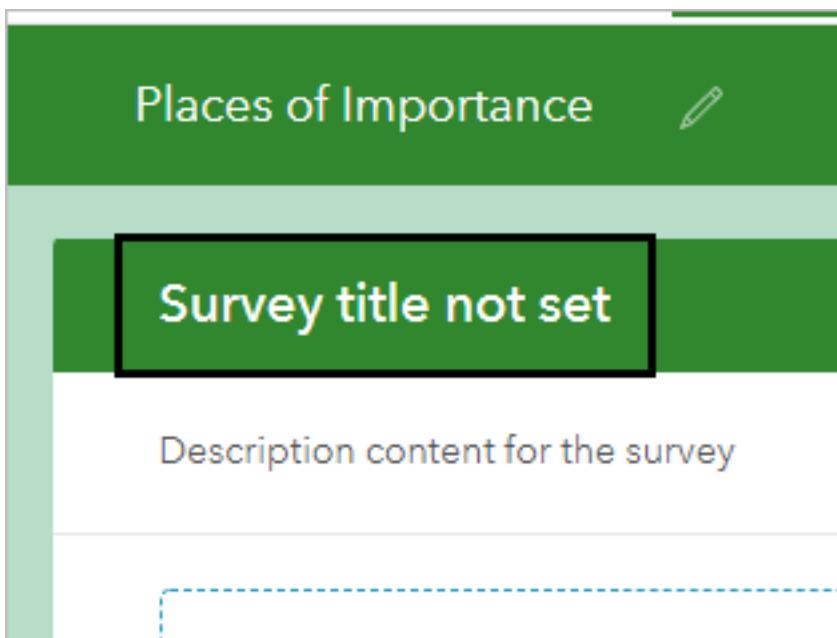
1. On the ribbon, click the **Edit survey info** button



2. In the Edit survey info window, for Name, delete “Untitled survey” and type “Places of importance”
3. Click **OK**

#### Step 7: Add Survey Title and Description

1. Click **Survey title not set**



2. In the Survey header pane, delete the existing text and type “Places of importance in our community”

**Survey header**

Text       Image

Text

Places of importance in our community

Alignment:

Tip: Header background and text color can be changed in the Appearance -> Theme section.

3. In the survey builder pane, click **Description content for the survey**

Places of importance in our community

Description content for the survey

4. In the Survey description pane, delete the existing text and type:

What places in the community have social, economic, or political value and add to my com

## Step 8: Add Questions to the Survey

### Add Text Question

1. In the Survey description pane, click the **Add** tab

The screenshot shows a software interface for creating a survey. At the top, there is a horizontal toolbar with four tabs: 'Add' (highlighted with a black border), 'Edit', 'Appearance', and 'Options'. Below the toolbar, the text 'Survey description' is displayed. Underneath this, there is a rich text editor toolbar with various formatting options like bold (B), italic (I), underline (U), and font size (x-small). To the right of the toolbar, there is a text input field containing the question: 'What places in the community have social, economic, or political value and add to my community's resilience?'

2. Find the **Singleline text** question and drag it into the survey pane

The screenshot shows a survey creation interface. At the top right are 'Add' and 'Edit' buttons. The main area displays a question: 'What is your favorite place?' followed by a note: 'You can add more questions by clicking on the right panel to add your first question.' Below the note is a 'Submit' button. To the right is a sidebar titled 'Text, number, date, and time' containing four options: 'Singleline text' (selected), 'Email', 'Number', and 'Time'. At the bottom of the sidebar is a 'Choice' button.

What is your favorite place?  
You can add more questions by clicking on the right panel to add your first question.

Submit

Text, number, date, and time

Singleline text

Email

Number

Time

Choice

3. On the Edit tab, for Label, type “What is the name of this place?”
4. For Validation, check the box for “This is a required question”

The screenshot shows the 'Validation' tab settings. It includes a checked checkbox labeled 'This is a required question', a 'Constraint' section with a 'Use an expression to restrict the answer' input field, and a 'Set input mask' section with a dropdown menu.

Validation

This is a required question

Constraint

Use an expression to restrict the answer

Edit

Set input mask ?

## Add Map Question

1. In the Add pane, find the **Map** question type and drag it into the survey pane below the first question

The screenshot shows the ArcGIS Survey123 interface. On the left, there is a survey form with a question about landmarks in a community. On the right, there is an 'Add' pane containing various question types: Single choice, Single choice grid, Likert scale, Ranking, Location, Map, File, Image, and Signature. A large arrow points from the 'Map' button in the 'Add' pane to the 'Map' icon in the survey form's question row.

Survey Form Content:

- Question: What landmarks in our community have social, economic, or political value and add to my sense of place?
- Label: Where is this place?\*
- Hint: (empty)
- Submit button

Powered by ArcGIS Survey123

Add Pane Content:

- Single choice
- Single choice grid
- Likert scale
- Ranking
- Location
- Map** (highlighted with a black border and an arrow pointing to it from the 'Add' button)
- File
- Image
- Signature

2. For Label, type “Where is this place?”
3. For Hint, type: “Keep in mind with maps that some information is personal: you probably shouldn’t share your home’s location nor other personal locations. But you can safely share locations like your city or a major intersection.”

## Map

### Label

Where is this place?



### Hint

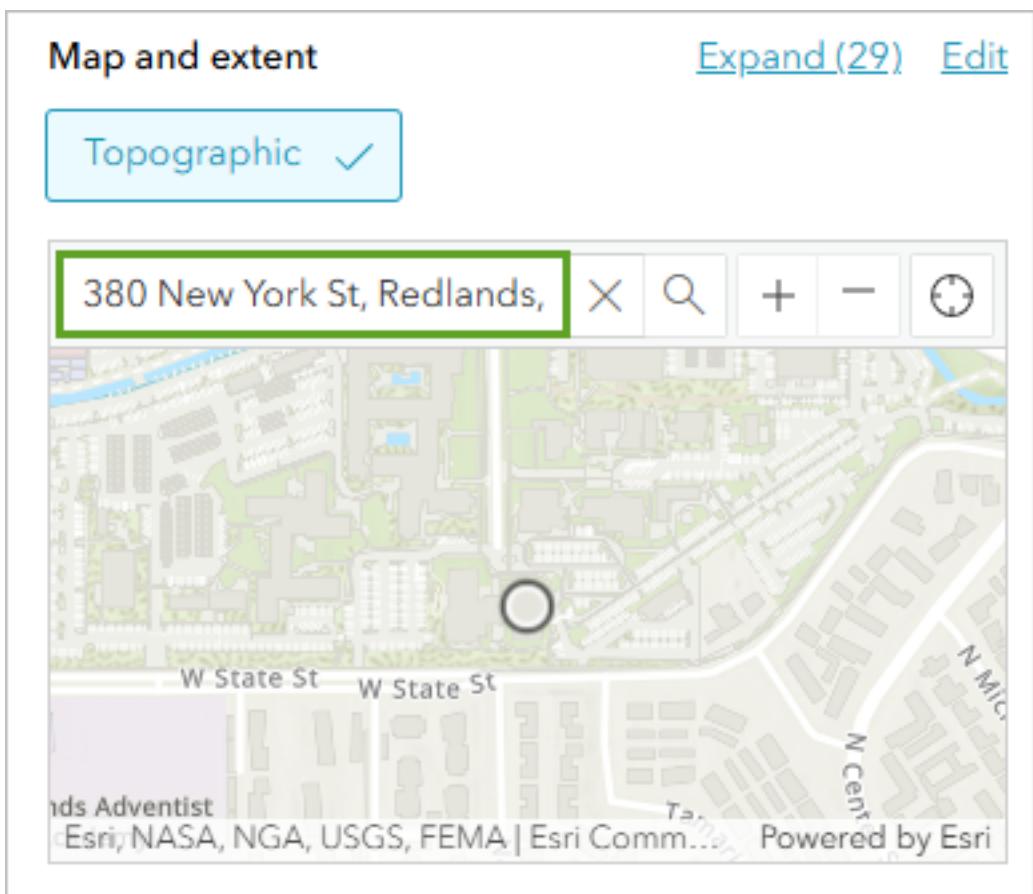
B A

≡ ≡ ≡ ≡

✖ ↕

Keep in mind with maps that some information is personal: you probably shouldn't share your home's location nor other personal locations. But you can safely share locations like your city or a major

4. For Drawing tools, make sure **Point** is selected
5. For Map and extent, type the address of your school and press Enter, or zoom and pan until you find your campus



6. For Default location, choose “Center of the map extent specified above”

## Locator

[Edit](#)

This question uses your organization's locators

ArcGIS World Geocoding Service

### Default location

- No default location
- Center of the map extent specified above
- Use device location and ask for location when answering this question 
- Use device location and ask for location when opening this survey 

7. For Validation, check the box for “This is a required question”

## Places of importance in our community

What places in the community have social, economic, or political value? How do these places contribute to the community's resilience?

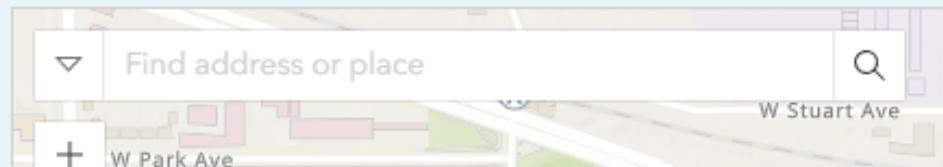
1

What is the name of this place? \*

2

Where is this place? \*

Keep in mind with maps that some information is personal: you probably don't want to share your home's location nor other personal locations. But you can safely share the location of a park, a school, or a major intersection.



### Add Additional Questions

1. Click the **Add** tab and add the rest of the questions you've formulated
2. Test various question types to see what will get you the best survey results
3. When you're finished adding your questions, at the bottom of the design pane, click **Save**

### Step 9: Publish Your Survey

1. Review your work to ensure everything's in the correct order, spelled correctly, and properly configured

2. Click **Publish** two times
  3. The survey may take a few minutes to publish
- 

## Part 3: Collect Data

### Step 10: Share Your Survey

1. In the Survey123 site, click the **Collaborate** tab



2. For “Who can submit to this survey,” check the box **Members of my organization (University of St Andrews)**

Who can submit to this survey?

Everyone (public)  
 Members of my organization (University of St Andrews)  
 Members of the following groups:

3. Click **Save**
4. For “Share this survey,” copy and share the link, or click “Show the QR code” to allow your class to open the survey

**Link**

<https://arcg.is/0na4PP>   

Open the survey in browser directly  
 Ask the user how to open the survey, in browser or in the Survey123 field app  
 Open the survey in the Survey123 field app directly. (Learn more about this option)

## **Step 11: Gather Survey Responses**

1. Have your classmates fill out and submit the survey. Ask your classmates to fill up your survey, you will need at least 20 replies to get enough data to analyse in the next part.
  2. Monitor the number of responses to ensure you meet your data collection goal
  3. Remember to consider data quality and potential bias as responses come in
- 

## **Part 4: Analyze Data**

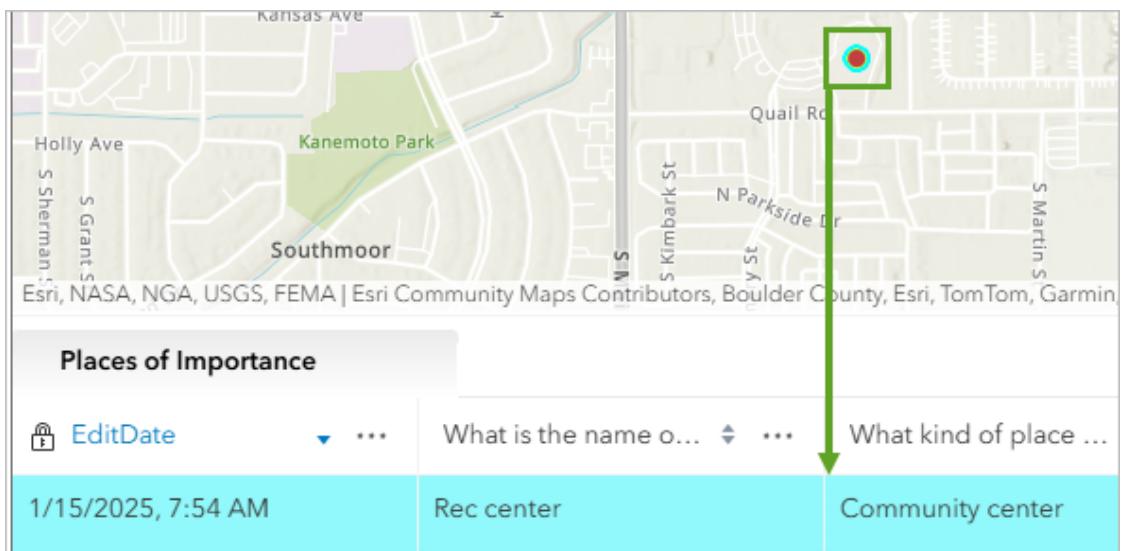
### **Step 12: Review Your Data**

1. Click the **Data** tab



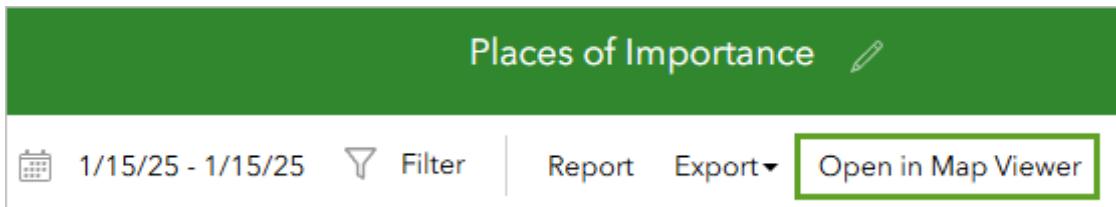
The **Data** tab shows two main components—a map of the data points you've collected, and an attribute table. An attribute table is a table that organizes all the data about each point.

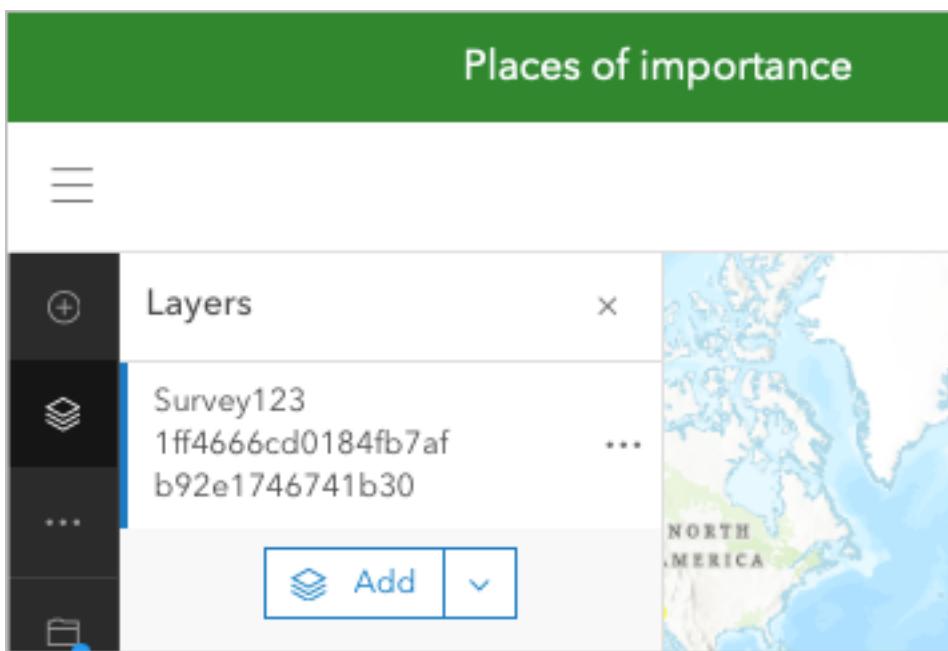
2. Examine both the map view and the attribute table
3. Click a point on the map to see the corresponding record highlighted in the attribute table



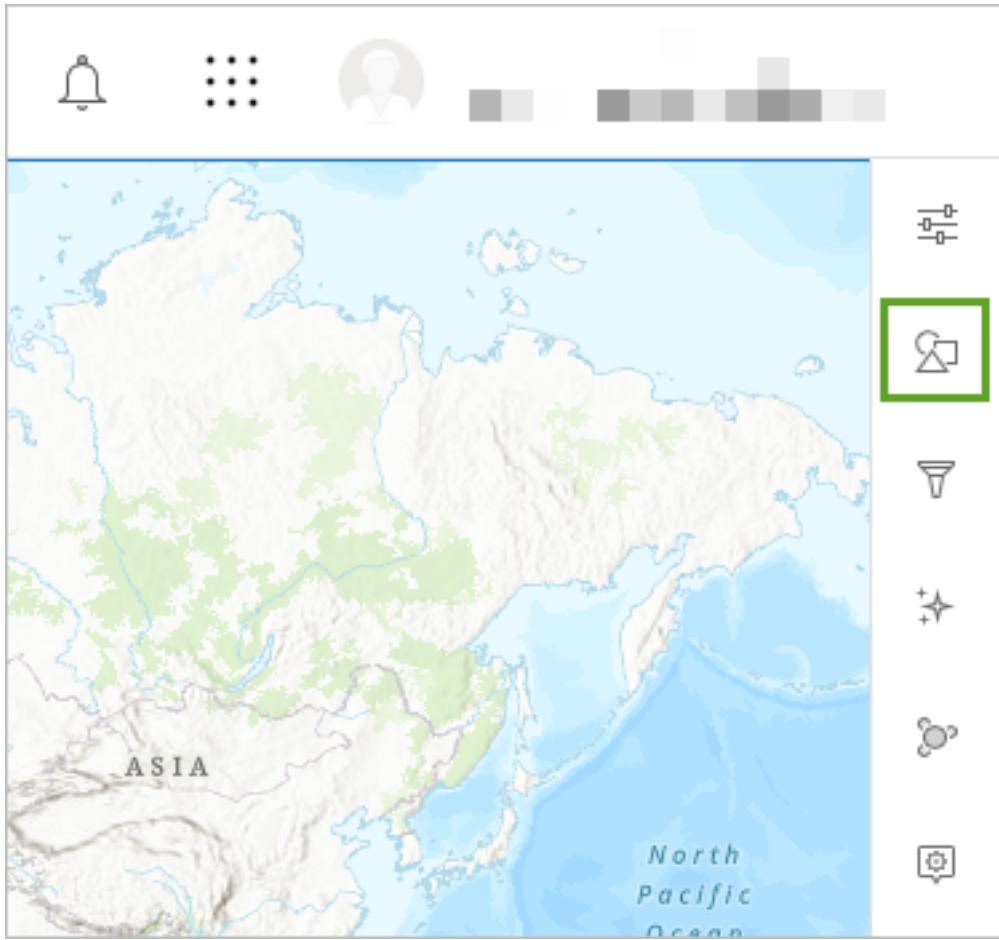
### Step 13: Create a Heat Map

1. On the Data ribbon, click **Open in Map Viewer**





2. On the Settings toolbar, click the **Styles** button



3. Under “Pick a style,” click **Heat map**, and click **Done**

Survey123 1ff4666cd0184fb7afb92 ✓

Styles X

Select the attribute or expression you want to style.

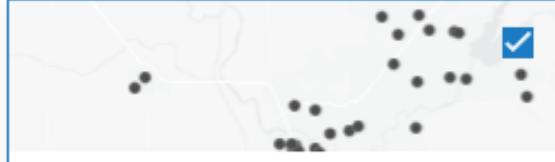
+ Field + Expression

💡 Add a field to start smart mapping. X

(2)

### Pick a style

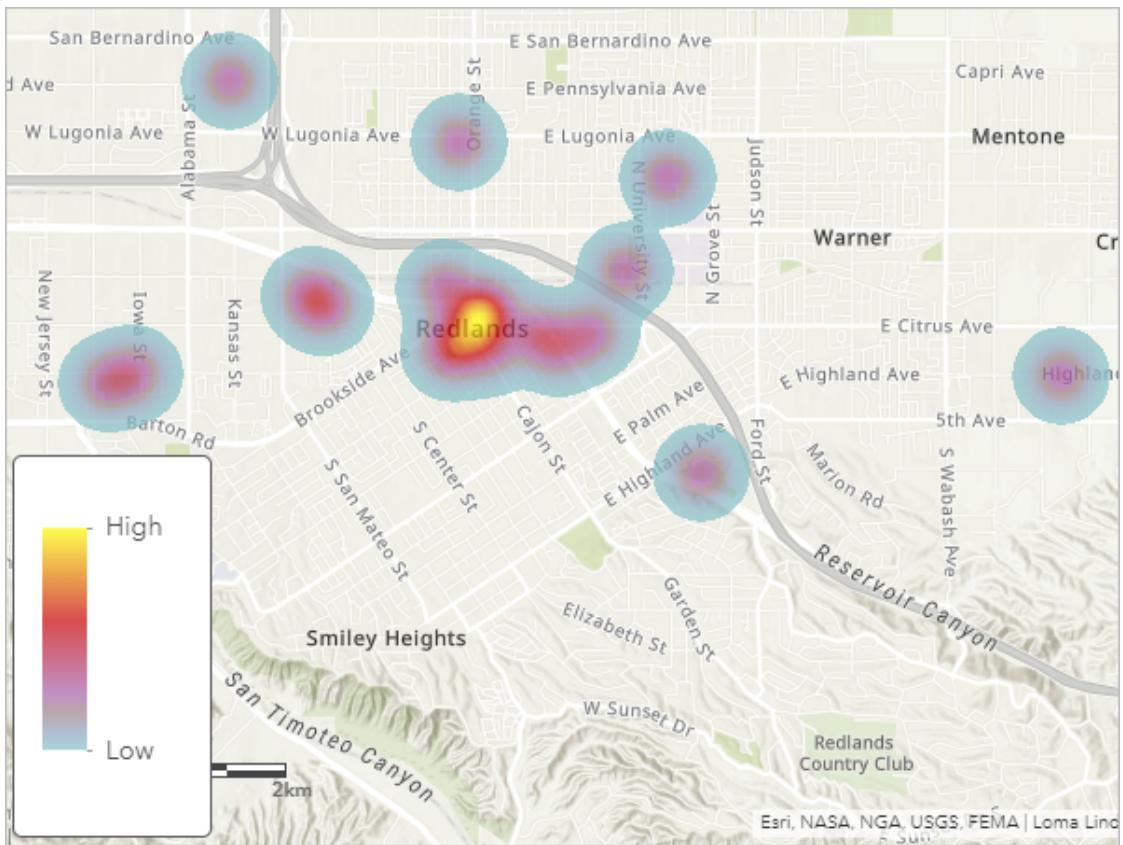
Choose attributes above for more styles.

 Location (single symbol) ⓘ

 Heat Map ⓘ

**Done** **Cancel**

4. Zoom in to your study area to examine the heat map patterns

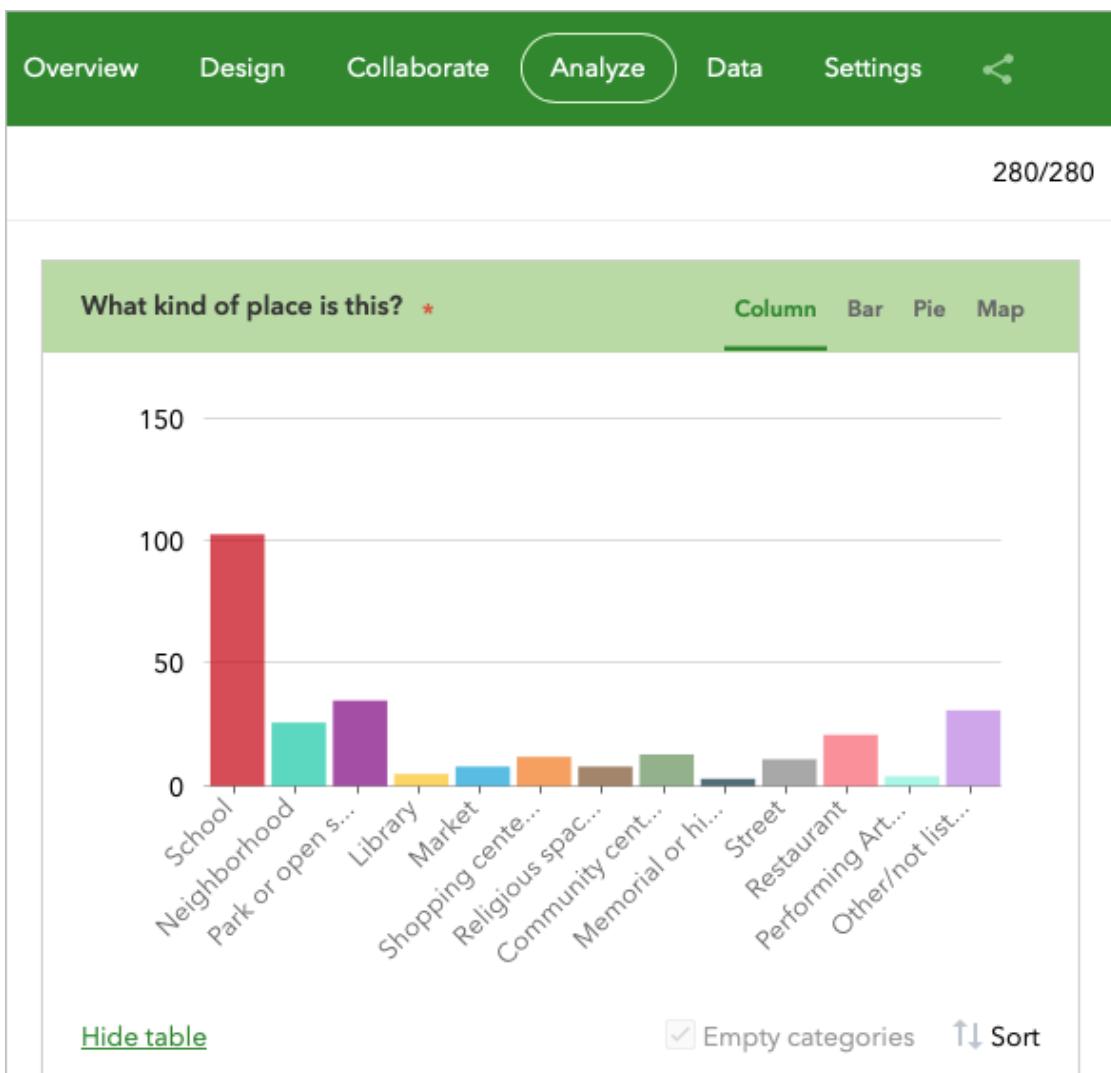


**Analysis Questions:** - Does your heat map show that many students think the same places are important? - Are there many different places that are important to students? - What patterns do you notice in the spatial distribution of important places?

**Scottish Context Analysis:** - Are important places clustered in city centers or distributed across neighborhoods? - Do rural and urban areas show different patterns of meaningful places? - Are there differences between places important to different age groups or communities?

#### Step 14: Analyze Survey Responses

1. Close the Map Viewer window
2. On the ribbon, click the **Analyze** tab



3. Review how each question was answered
4. Look for patterns, similarities, and differences in responses

**Analysis Questions:** - What similarities do you notice about your class's answers? - What differences stand out? - Are there any surprising results? - Do the results vary by demographic characteristics?

---

## **Part 5: Draw Conclusions**

### **Step 15: Evaluate Your Research Question**

Return to your original research question and consider whether your data adequately answers it.

**Questions to Consider:** - Does your data answer your research question? - What places in your community appear to have the most social, economic, or political value? - What contributes to your community's identity based on your findings? - Are there gaps in your data that need to be addressed?

### **Step 16: Consider Data Limitations**

Reflect on potential limitations in your data: - Who was surveyed and who was not? - What biases might exist in your sample? - What additional data might strengthen your conclusions?

**Scottish Context Considerations:** - Does your data represent different Scottish communities (urban/rural, Highland/Lowland)? - Are there cultural or linguistic factors that might affect responses? - How might seasonal variations affect the importance of certain places?

---

## **Part 6: Submit Your Work**

### **Step 17: Document Your Results**

Instead of sharing your map online, you will submit a comprehensive screenshot for assessment.

**Task:** Take a screenshot that includes your entire computer screen showing: 1. Your completed survey results and analysis 2. The date and time display from your computer 3. Your ArcGIS Survey123 interface with your data

**Requirements for Screenshot:** - Must show the complete screen (not just the browser window) - Date and time must be clearly visible in the system tray/menu bar - Your survey data and analysis should be displayed - Image should be clear and readable

**File Naming:** Save your screenshot as "YourLastName\_MeaningfulPlaces\_[Date].png"

### **Step 18: Written Reflection**

Along with your screenshot, provide a brief written reflection (300-500 words) addressing:

- Your research question and methodology
- Key findings from your data analysis
- Limitations of your study
- How your findings relate to community identity and resilience
- Specific examples relevant to Scottish communities if applicable

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### **Conclusion**

This lab demonstrates the complete process of spatial data collection and analysis, from research design through data interpretation. The skills you've learned can be applied to any research question involving spatial data and community analysis. Consider how similar methodologies might be used to study other aspects of community life, cultural heritage, or environmental issues in Scottish contexts.

# Lab No 4: Examine Global Poverty Using UN Sustainable Development Goals

*Tutorial inspired on: [ArcGIS Online blog entry](#)*

**Estimated time of completion:** 70 Minutes

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## Overview

Have you ever considered where pockets of poverty exist and who is most affected? Unfortunately, global trends show that children are most impacted by poverty. Around the world **385 million children** live in extreme poverty, and in 2013 the World Bank found that **19.5 percent of children** in 89 countries lived in a household that survived on U.S. \$1.90 per day per person or less.

## Key Learning Outcomes

By completing this tutorial, you should now be able to:

- **Access and download** UN SDG data from official portals
- **Prepare and clean** spatial data for analysis
- **Create feature layers** in ArcGIS Online through geocoding
- **Perform spatial joins** to combine multiple datasets
- **Create choropleth maps** to visualize quantitative data
- **Develop bivariate maps** to compare multiple indicators
- **Configure effective pop-ups** and legends for data communication
- **Apply spatial analysis techniques** to real-world policy questions

These skills are transferable to many other contexts, including local and national policy analysis, environmental monitoring, public health studies, and economic development planning.

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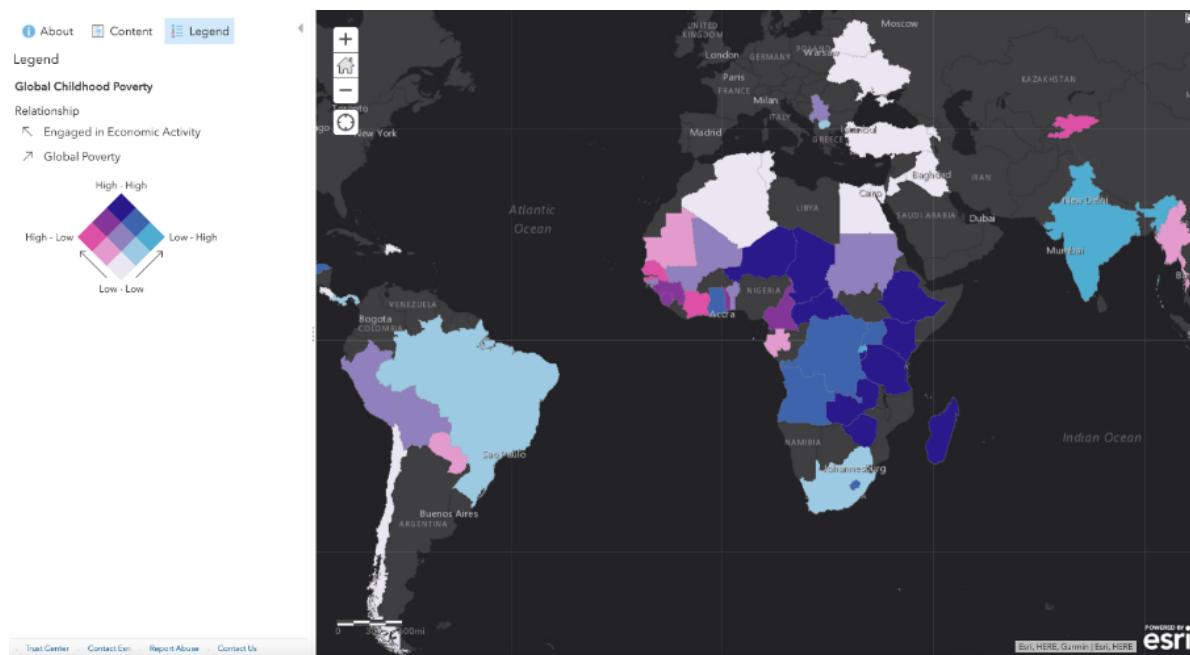
## Why is poverty such a critical issue?

Because it relates to the overall well-being of a person. Those living in poverty may lack access to basic food, housing, and healthcare. Growing up without consistent nutrition, shelter, and safety can have long-lasting developmental impacts on children and can cause lifelong problems.

**Scottish Context Example:** In Scotland, child poverty affects approximately 24% of children (around 240,000 children), with particular concentrations in areas like Glasgow, Dundee, and parts of Edinburgh. The Scottish Government has committed to reducing child poverty to less than 10% by 2030 through the Child Poverty (Scotland) Act 2017.

In 2015, the United Nations and world leaders developed a series of goals to improve situations for people, places and environments globally. In total, there are **17 Sustainable Development Goals** that nations are striving to meet by 2035. This activity focuses on **Goal 1: No Poverty** and corresponding indicators that can be used to measure poverty.

## Protecting Children with UN Sustainable Development Goals



## **Step 1: Visualize Global Poverty**

Sustainable Development Goal 1, “**No Poverty**” is achieved when we “End poverty in all its forms everywhere,” and “should be understood as deprivation beyond the lack of income and resources to ensure a sustainable livelihood.”

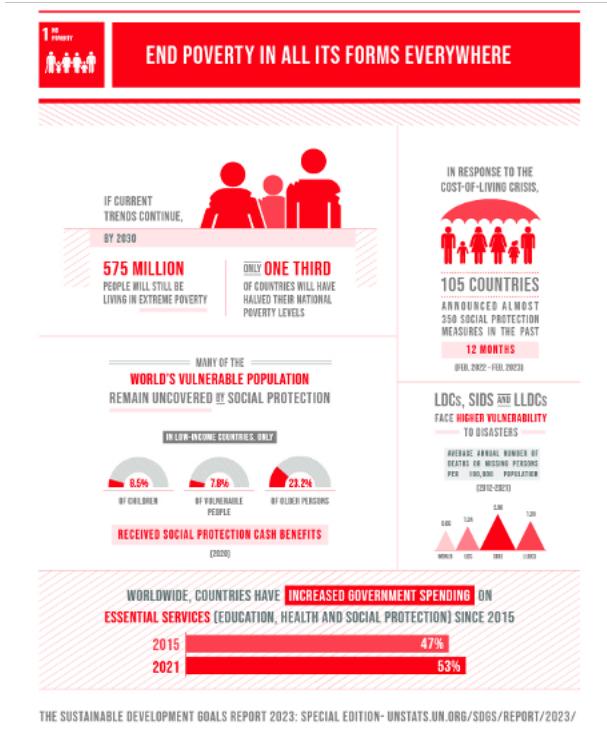
**Key Definition:** Poverty is felt through hunger, malnutrition, limited access to basic services and educational opportunities, social discrimination and exclusion. In order to secure a future of sustainable economic growth, it is essential for countries to promote economic equality.

### **Task 1.1: Understanding SDG Goal 1**

1. Visit the [UN Sustainable Development](#) site.

Most of the data for the Sustainable Development Goals is curated and maintained by the UN Statistics Division. There are also countries that host their own open data portals featured on the data page.

2. Scroll down and find the section called **Sustainable Development Goals**, click the first goal, **No Poverty**.
3. **Familiarize yourself** with this goal - take some time to understand **what this goal is about** and **why it is the first goal**.



THE SUSTAINABLE DEVELOPMENT GOALS REPORT 2023: SPECIAL EDITION- UNSTATS.UN.ORG/SDGS/REPORT/2023/

**Scottish Policy Example:** Scotland's approach to SDG 1 includes the Scottish Child Payment (£25 per week per child under 16), free school meals, and targeted support for families in the most deprived areas. The Scottish Index of Multiple Deprivation (SIMD) is used to identify areas requiring priority intervention.

### Task 1.2: Accessing UN Data Portal

- After you get a better understanding about the main facts that you can measure within this goal, now let's apply the geographical approach to create web maps and apps that help you represent spatial data related to this goal.

Go to <https://unstats.un.org/sdgs/databoarding/database> and get the data related to the **1.1.1 indicator**. Which corresponds to **Proportion of population below international poverty line (%) – \$2.15 per day**. Once you are in the portal, follow the next options to get the required data.

- In the **Data Series** type or select the **1.1.1** Indicator, in the **Countries, areas or Regions** section, click on **Countries or Areas**, and for **Period** make sure you selected only the **2017** year. (you should have around 783 observations). Click **Show Results**.

Data Series (Selected 2 of 693)  
1.1.1 ×  
+ Select

Countries, areas or regions (Selected 211 of 211) All Groupings Countries or areas  
Afghanistan × Albania × Algeria × American Samoa × Andorra × Angola × Anguilla × +255 ...  
By default "All" is selected.  
+ Select

Period Range Years (1 of 61)  
2017 ×  
You can select single year or multiple years

783 observations [Show Results](#)

**Expected Result:** You will see a couple of tabs open up at the bottom corresponding to:

- Proportion of population below international poverty line (%) SI\_POV\_DAY1
- Employed population below international poverty line, by sex and age (%) SI\_POV\_EMP1 indicators

Expand the **SI\_POV\_DAY1** tab. At this point you should have a preview of a table that includes countries and 2017 poverty values. Now click **Download XLS**.

SI\_POV\_DAY SI\_POV\_EMP1

Indicator 1.1.1, Series - Proportion of population below international poverty line(%) SI\_POV\_DAY1

Disaggregated by  Age  Location  Sex

Country	2017
Albania	0.41 <sup>n/a</sup>
Algeria	-
Angola	-
Argentina	0.61 <sup>n/a</sup>
Armenia	0.81 <sup>n/a</sup>
Australia	-
Austria	0.31 <sup>n/a</sup>

Previous 1 2 3 4 5 ... 24 Next 7 / page Go to

488 observations [Download XLS](#)

### Task 1.3: Data Preparation

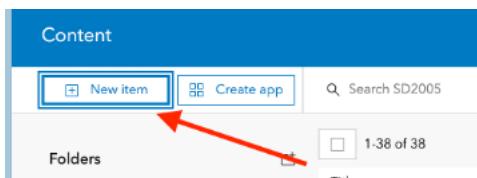
6. Open the downloaded file - you will see several countries are duplicated, due to data being collected at different scales (e.g., Sex, Location, Age). Filter the data to show only:
  - **Sex:** BOTHSEX
  - **Location:** ALLAREA
  - **Age:** ALLAGE

Now you should have **75 records**. Save the filtered table as a new Excel file (name it **1\_1\_1\_indicator\_filtered.xlsx**).

**Important Note:** Data filtering is crucial for accurate spatial analysis. In Scotland, similar filtering would be applied when working with data from the Scottish Government's statistics portal, ensuring consistency across geographic areas and demographic groups.

### Task 1.4: Creating a Feature Layer in ArcGIS Online

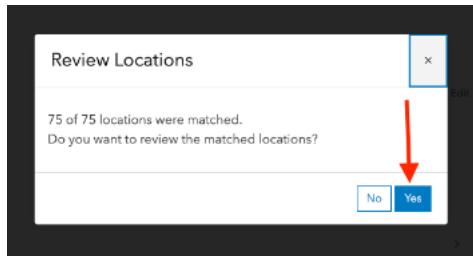
7. Go to **ArcGIS Online**, sign up with your university credentials and go to **Content**. Now you will upload the filtered Excel file and create a **Feature Layer** with the data you downloaded and filtered.
8. Click **New Item**



9. Drag and drop your file or choose **Device** option and select the filtered Excel file (e.g., `1_1_1_indicator_filtered.xlsx`)
10. When ArcGIS Online asks “**How would you like to add this file?**” Select the first option: *Add and create a hosted feature layer or table*. Click **Next**.
11. In the **Field Box**, the 13 columns are selected - no need to do anything here, just click **Next**.
12. In the **Location Settings**, select **Addresses or place names**. Open the **Advanced location settings** and select **World** in the **Region** box. Now in **Location fields**, make sure **Location information is in one field** is selected. Then in front of **Address or Place**, select the Field **GeoAreaName**, click **Next**.

**Credit Usage Warning:** You will use approximately 3 Credits from your ArcGIS Online Account for this geocoding process.

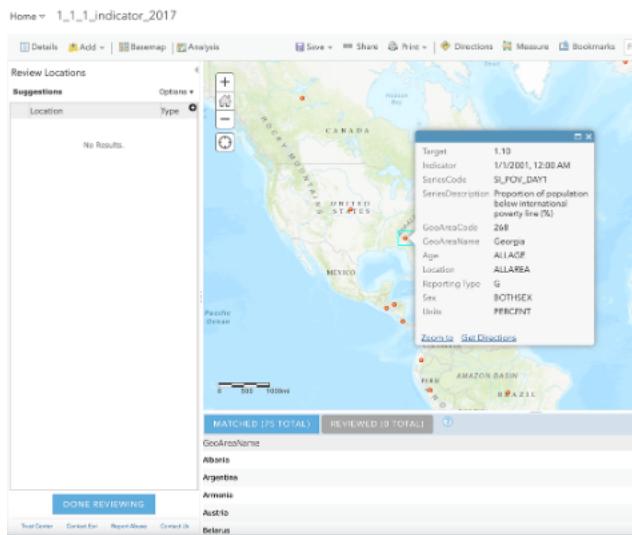
13. Finally, provide a **title**, **tag**, and **summary** of the feature layer you are creating. Click **Save**.
14. ArcGIS Online will host your Excel file, geocode all the rows based on the name of the country (that's why it uses credits) and then create a feature layer (the spatial data) that you can use to create web maps based on that indicator.
15. If you get a warning/notification, please click **YES**.



## Task 1.5: Correcting Geocoding Errors

**Common Issue:** One common problem in geocoding when using names is that you could get locations in places that do not correspond to the intended place. ArcGIS Online provides a way to correct those mislocated places.

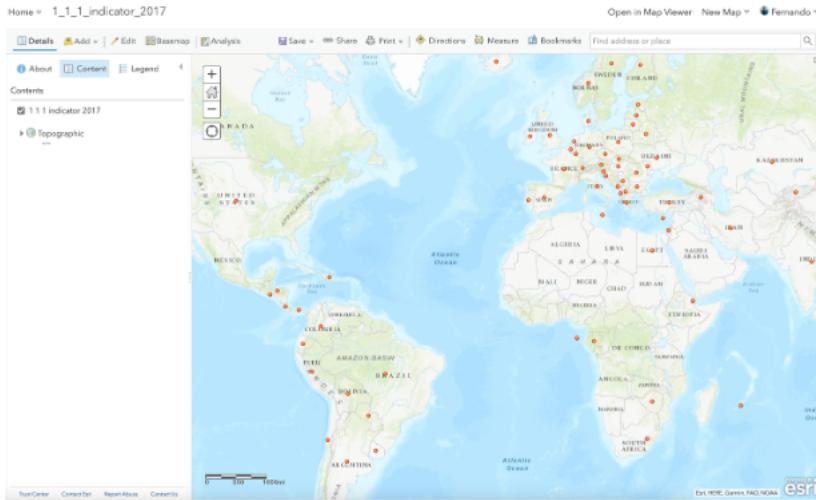
- Once you have the Map Viewer open, you will notice that **Georgia** has been automatically coded to be in the USA.



- Using the table at the bottom, locate **Georgia** and select it. You will see on your left a list of all the potential candidates that ArcGIS Online used to geocode Georgia. If you click on the **third option**, you will realize that one is the correct match (the country Georgia, not the US state). Click **Match** and then **Done Reviewing**.

**Scottish Example:** Similar geocoding issues might occur with place names like “Perth” (which could be matched to Perth, Australia instead of Perth, Scotland) or “Hamilton” (which might be matched to Hamilton, Canada instead of Hamilton, Scotland).

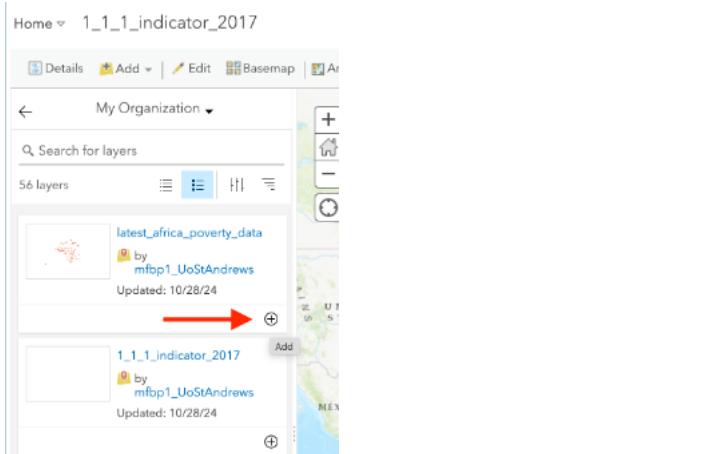
18. Once your geocoding process has finished, your map should look like this:



**Observation:** You will notice that most of the African countries have not reported any data, but here is when we can use and merge other data sources. We can use data reported by the [World Bank](#) to merge with the data you have geocoded.

### Task 1.6: Adding Additional Data Sources

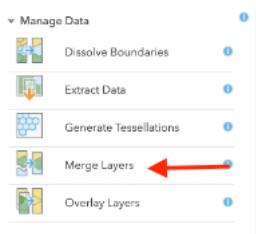
- Click **Add** and **Search For Layers** to look for a published service. Make sure you have **My Organization** selected, and then type `latest_africa_poverty_data`, and add the layer published by `mfbp1_UoStAndrews`.



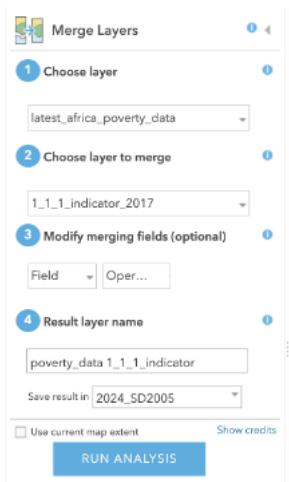
- Click **Details** again to see the table of contents with the two layers you have added to your map or click the back arrow to close the pane. In the **Contents** pane, hover over your `latest_africa_poverty_data` layer and click the **Perform Analysis** button.



21. Then in **Manage Data**, select **Merge Layers**.

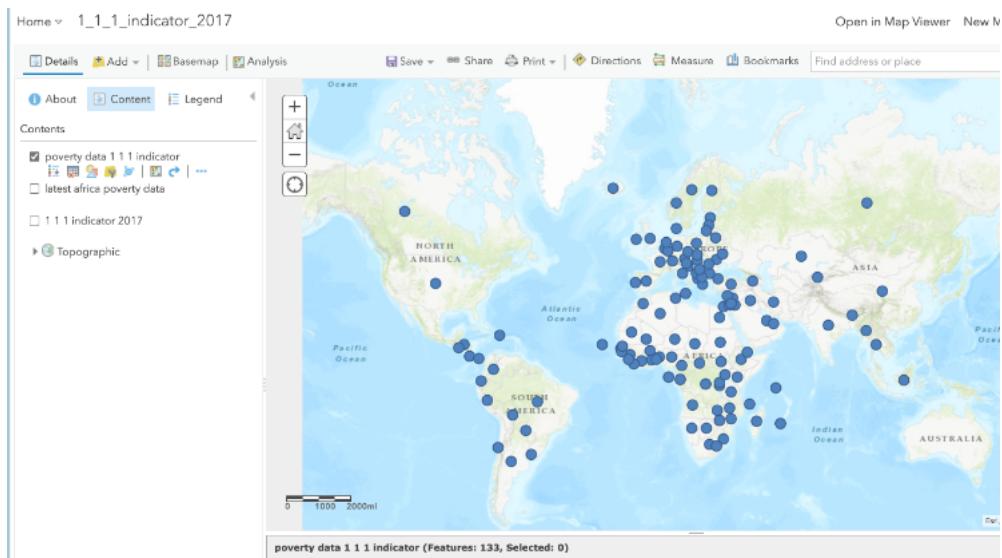


22. Make sure you have selected your poverty data layers and add a clear title (e.g., *poverty\_data\_1\_1\_1\_indicator*). **Important:** Don't forget to uncheck the “Use current map extent” option. Click **Run Analysis**.



**Processing Note:** Give ArcGIS Online some time to process your analysis, and you will have a single layer that joins the poverty data for most of the countries.

**Technical Tip:** A key aspect you need to consider for future data joins is ensuring how the attributes will be joined. In this case, both poverty values are included as integers and the heading is called “2017”, which has allowed us to have one single column with the values we need to plot a **world poverty map**.

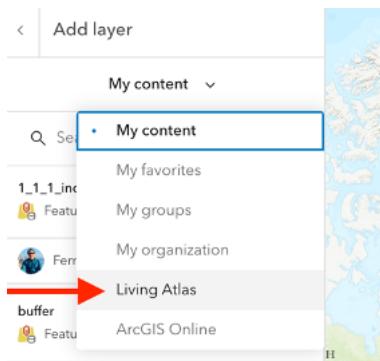


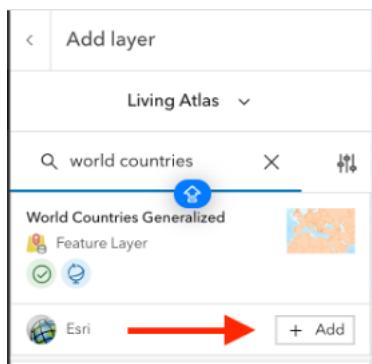
23. Click **Save** to save the current web map to your account. Add the title: “**Indicator 1.1.1: Proportion of population below the international poverty line (percent)**”

### Task 1.7: Converting Points to Polygons

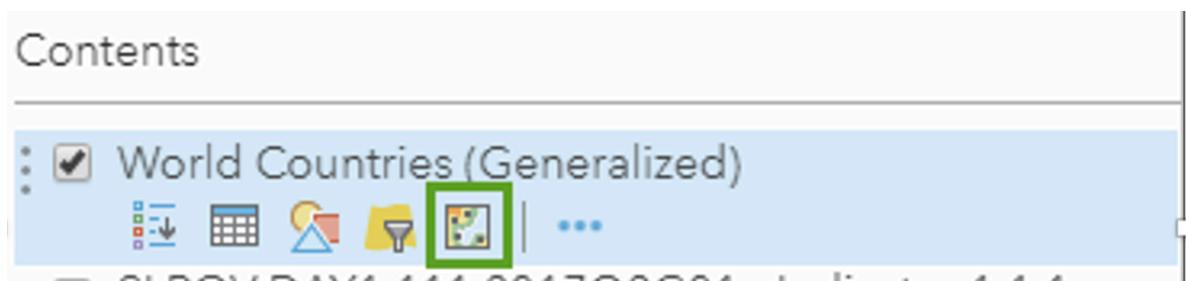
**Current Issue:** The data appears as points, but to better visualize it, the data should be converted to polygons.

24. On the ribbon **Layers**, click **Add**, then click **Living Atlas Layers**. Search for “*world countries*” and add one of Esri’s World Countries layers by clicking the plus.



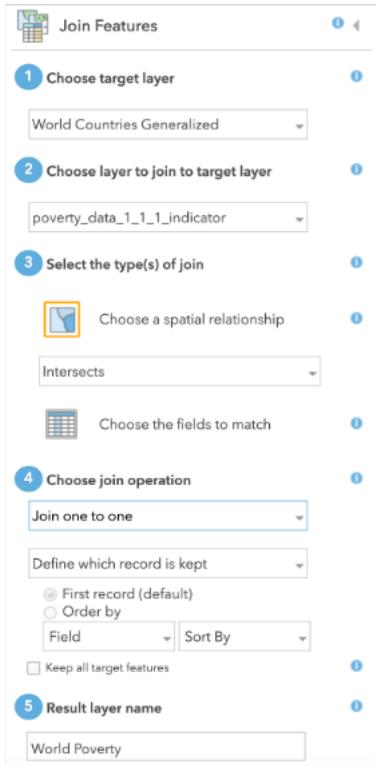


25. Click the back arrow to close the pane. In the **Contents** pane, hover over your **World Countries** layer and click the **Perform Analysis** button.



25. On the **Perform Analysis** pane, expand **Summarize Data**, then click **Join Features**.
26. Configure the join as follows:

- **Number 1, Choose target layer:** Set to **World Countries**
- **Choose layer to join to target layer:** Choose the **Indicator 1.1.1** layer
- **Select the type(s) of join:** Click **Choose a spatial relationship** and choose **Intersects**
- **Choose join operation:** Make sure **Join one to one** is selected

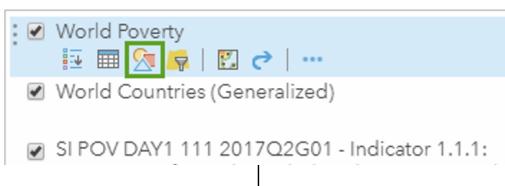


28. Name the layer **World Poverty**, uncheck the “Use current map extent” box, and click **Run Analysis**.

**Result:** When the analysis finishes, the layer will be added to the map. By default, all the countries are shown in the same color. To see the data, you’ll change the symbology to show a choropleth map.

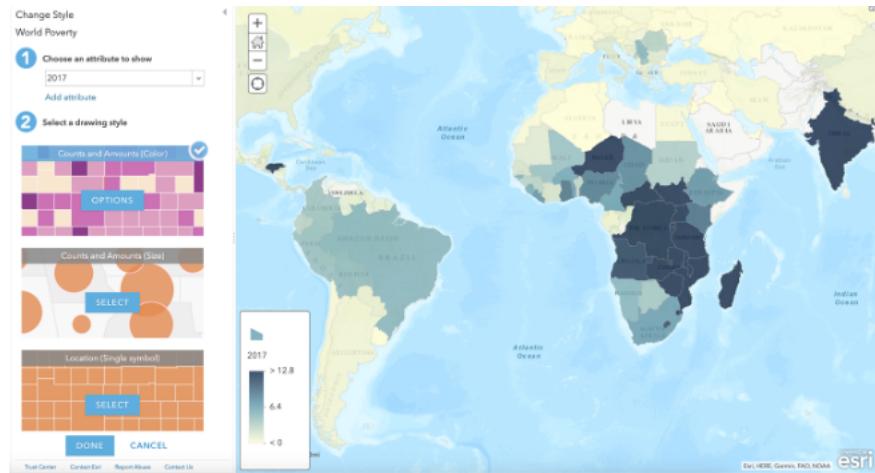
### Task 1.8: Creating a Choropleth Map

29. Uncheck all layers except for **World Poverty**, then hover over the **World Poverty** layer and click the **Change Style** button.

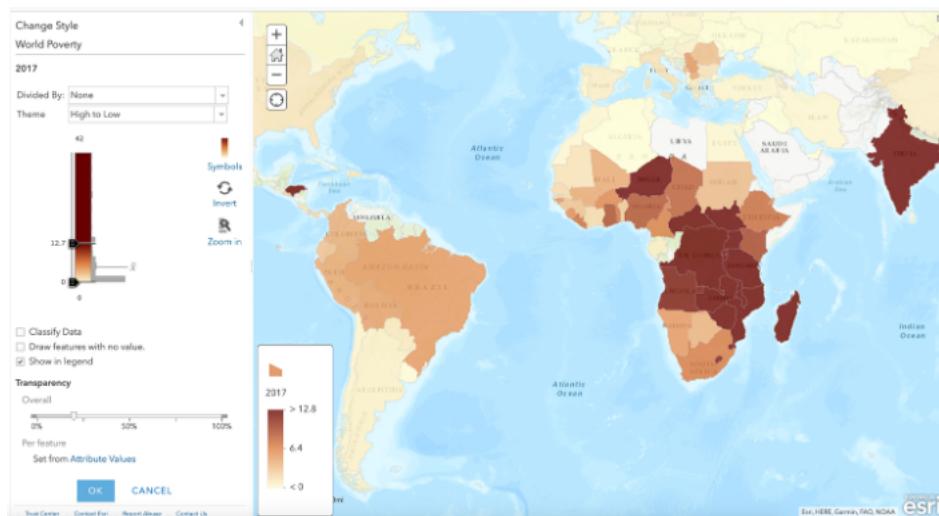


30. On the **Change Style** pane, expand the **Choose an attribute to show** menu and choose **2017**.

**Understanding the Data:** “2017” is the attribute that shows the latest reported value for any country that has reported data. The countries are symbolized with a default graduated color scheme that shows low values in light yellow and high values in dark blue. The light yellows blend into the basemap, so before analyzing the map, you’ll change the symbology.



- For **Counts and Amounts (Color)** click **Options**, then click **Symbols**. Choose a color ramp that stands out from the basemap. If necessary, click **Invert** to show the higher values in darker colors.



## Initial Analysis Results

**Visual Analysis Findings:** From a visual analysis, it appears that: - Europe, North America, and South America (partially) have the **lowest levels of poverty** - Several

African countries report high levels of poverty - Some countries (such as Libya and Saudi Arabia) haven't reported data for this metric

**Scottish Context:** Scotland, as part of the UK, would appear in the low poverty category on this global map, but this masks internal variations. Areas like the Glasgow conurbation, parts of Dundee, and some rural Highland communities experience higher poverty rates that would be visible in a more detailed, national-scale analysis.

32. Click **OK**, then **Done** and **save the map**.

**Important Reminder:** Always remember to save your map - ArcGIS Online does not automatically save your work, so constantly remember to save your progress!

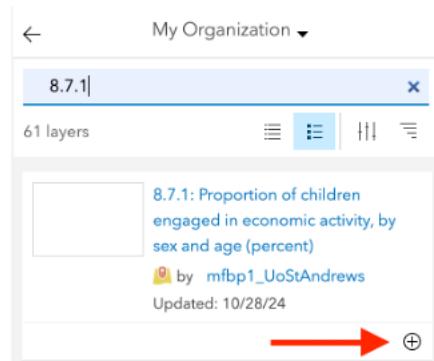
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## Step 2: Compare Child Poverty

Now that you've mapped global poverty, you'll map reported data for **percentage of children involved in economic activity**. This indicator is measured with the goal of eradicating forced labor and ending modern slavery and use of child soldiers.

### Task 2.1: Adding Child Labor Data

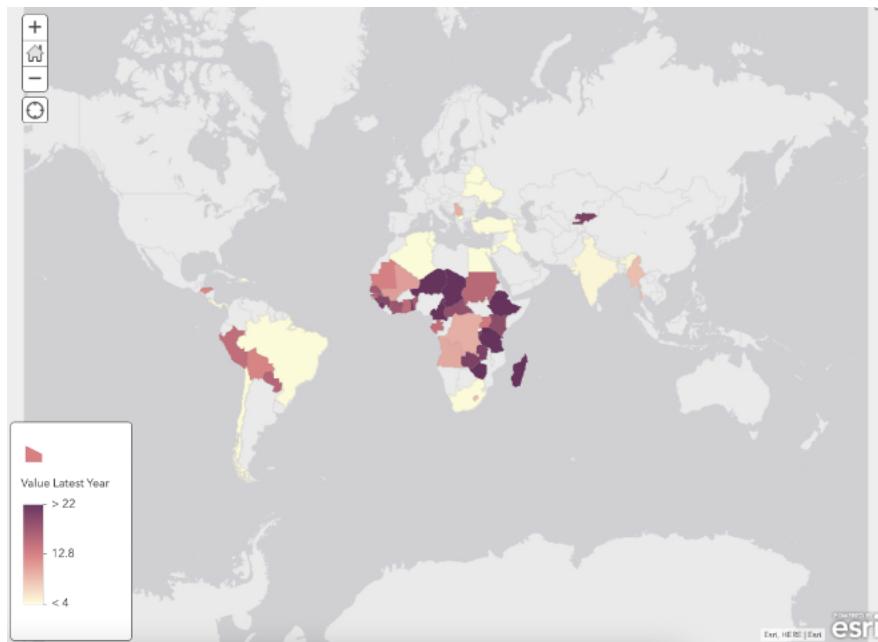
1. On the ribbon, click **Add** and choose **Search for Layers**. (At this point you should know how to do it)
2. Click **My Content** and choose **My Organization**, then search for **8.7.1**
3. Click the **plus** to add the result **Indicator 8.7.1: Proportion of children engaged in economic activity, by sex and age (percent)** to the map.



## Task 2.2: Joining Child Labor Data with Poverty Data

4. Hover over the **World Poverty** layer and click **Perform Analysis**.
5. Expand **Summarize Data** and choose **Join Features**. Enter the parameters as follows:
  - **Choose target layer:** World Poverty
  - **Choose layer to join to target layer:** Indicator 8.7.1
  - **Join type:** Spatial relationship – Intersects
  - **Join operation:** one to one
  - **Result layer:** *Childhood Poverty*
6. **Uncheck** “Use current map extent” and click **Run Analysis**.
7. **Turn off** all layers except for **Childhood Poverty**.
8. Hover over the **Childhood Poverty** layer and click **Change Style**.
9. Change the attribute to show to **Value Latest Year**.

**Technical Note:** Because you joined the datasets for global poverty and children in the workforce together, there will be many similar attribute names. Later, you’ll edit the names to make them clearer, but for now, remember that any attributes with a ‘1’ appended are from the economic labor layer.



**Observation:** Already, you can see that more countries have reported data for poverty rates. ArcGIS Online offers an easy way to visualize and compare relationships where data is present.

10. Click **Done**.
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## Step 3: Compare Data to Find Patterns

### Task 3.1: Creating a Bivariate Map

1. Hover over the **Childhood Poverty** layer and click the *ellipses (three dots)*. In the **More Options** menu, click **Copy**.

**Result:** An identical layer is added to the map.

2. Turn off the original layer, then open the **Change Style** pane for the **Childhood Poverty - copy**.

**Current State:** The layer currently shows Value Latest Year from Indicator 8.7.1: Children engaged in economic activity. Now you'll add the Value Latest Year attribute from Indicator 1.1.1: Global poverty for comparison.

3. Under **Choose an attribute to show**, click **Add attribute** and choose **2017**.

**Question for Understanding:** Do you remember what that attribute represents and what layer it comes from?

4. Under **Select a drawing style**, scroll down to **Relationship** and click **Select**, then click **Options**.



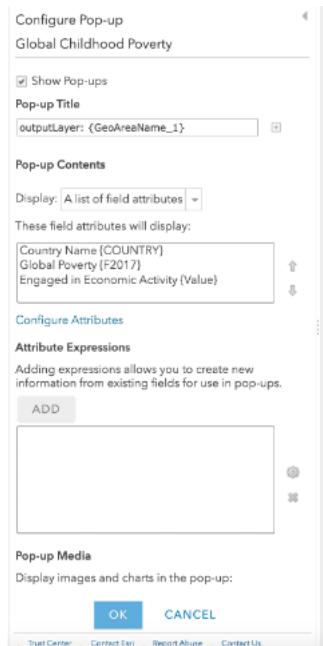
5. Click **Symbols** and choose the **blue-pink-purple** color palette. Click **OK**, then **Done**.

**Understanding Bivariate Maps:** The relationship symbology style is a way of creating **bivariate maps** that lets you easily compare two topics on a single map because only the countries with data for both indicators are shown.

### Task 3.2: Improving Data Labels and Pop-ups

6. Hover over the **Childhood Poverty - copy** layer and click the three-dots. In the **More Options** menu, click **Rename** and replace the default name with **Global Childhood Poverty**.
7. Click the ellipses again and click **Configure Pop-up**.
8. Under **Pop-up Contents**, click **Configure Attributes**.
9. In the **Configure Attributes** window, **uncheck everything except for Country, Value Latest Year, and 2017**.
  6. In the **Field Alias** column:
    - Click **2017** and type **Global Poverty**
    - Scroll down, click **Value** and type **Engaged in Economic Activity**

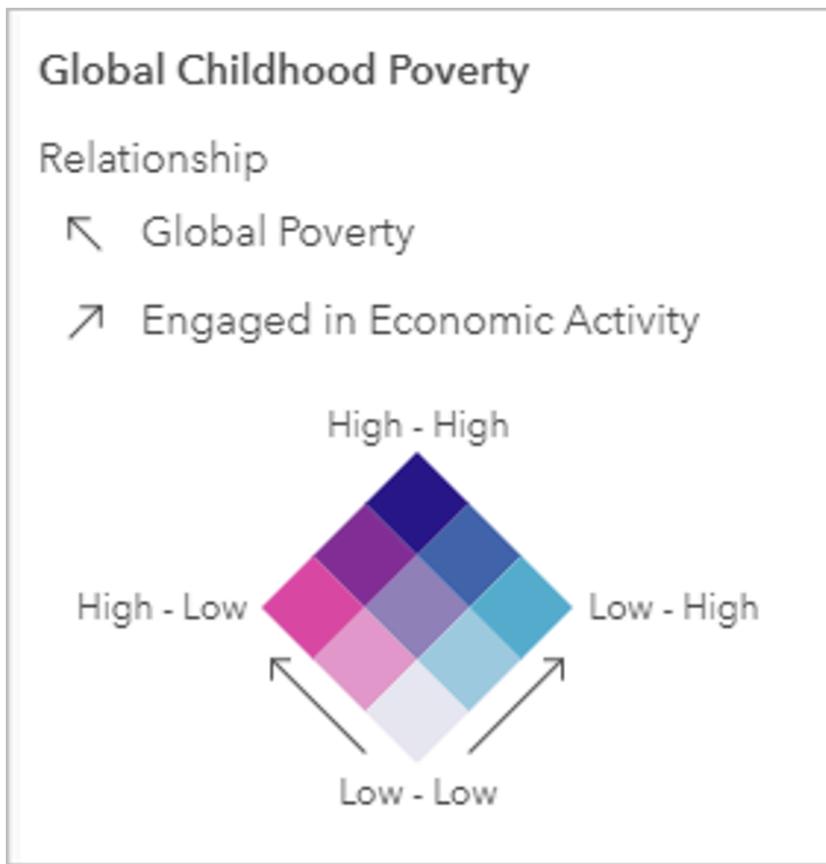
In the Configure Pop-up pane, click **OK**.



**Result:** Now when you click on a country, the pop-up shows only those three attributes with clear, understandable names.

### Task 3.3: Analyzing the Legend and Patterns

- At the top of the **Contents** pane, click **Legend**.



**Understanding the Legend:** The Legend pane shows the symbology for all the layers that are turned on, and your changes will be reflected here. By comparing the legend to the map, you can see the two extremes of the spectrum:

- Countries shaded purple have a **high poverty rate** and **large proportions of children working** to support themselves or their families
- Countries in light pink have **low poverty rates** and **small proportions of children at work**

**Complex Patterns:** In between there are countries with mixed patterns: - Countries like Senegal with relatively **low poverty rates** but **high proportions of children working**

- Countries like India with high poverty rates but small proportions of children contributing to the economy

**Scottish Analysis Example:** If we were to apply this analysis to Scotland at a regional level, we might find that: - **Urban areas like Edinburgh and Aberdeen** might show low poverty but some youth employment in service sectors - **Rural Highland areas** might show different patterns due to agricultural work and seasonal employment - **Post-industrial areas like parts of Glasgow or Dundee** might show higher poverty rates with different youth employment patterns

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## Analysis Questions and Policy Applications

If you toggle between layers in the Contents pane, the legend will help you perform more visual analysis on the countries. If you were looking at ways to base policy on this information, you could use the maps you created to answer the following questions:

### SDG 1: No Poverty Questions

- Which countries have the highest poverty rates?
- Where does it appear that children are protected from labor?
- Where should international efforts to alleviate poverty be targeted?
- Within individual countries, what are some ways of improving the situation for children facing challenges associated with poverty?

### Questions Pertaining to Both Indicators

- Where do you see overlaps in patterns between the two maps that you have created for each indicator?
- Where are the most affected areas that efforts should be focused toward helping improve the condition for children?
- What sorts of place-based policies could be designed to help improve the conditions for children?

**Scottish Policy Application Example:** Using similar spatial analysis techniques, Scottish policymakers could: - **Target the Scottish Child Payment** to areas with highest concentration of child poverty (using SIMD data) - **Design place-based interventions** for areas like Inverclyde, West Dunbartonshire, or

parts of Glasgow where multiple deprivation indicators overlap - **Develop rural-specific policies** for Highland and Island communities where geographic isolation compounds poverty challenges - **Create youth employment programs** in areas where high poverty correlates with limited economic opportunities for young people

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## **Next Steps: Share Links to Story Map - Optional.**

You now have three maps showing UN Sustainable Development Goals data. With a little extra work, there are several ways you can share these:

- **Embed the maps in a Story Map** using [Get Started with Story Maps](#)
- **Create dashboard applications** to allow interactive exploration of the data
- **Export the data** for use in other analytical tools or reports
- **Share the web maps** directly with stakeholders or the public

**Scottish Implementation Example:** The Scottish Government could use similar techniques to create: - **Story maps showing progress** toward SDG targets at local authority level - **Interactive dashboards** for community planning partnerships - **Public-facing visualizations** showing how local areas contribute to national SDG commitments - **Policy briefings** that combine spatial analysis with targeted interventions

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## References

- Knuth, Donald E. 1984. “Literate Programming.” *Comput. J.* 27 (2): 97–111. <https://doi.org/10.1093/comjnl/27.2.97>.