VISUALIZING DATA WITH TABLEAU

A DATA DOZEN WORKSHOP

BUILT FOR THE STRATEGIC DATA PROJECT
2019 WINTER WORKSHOP

DATA DOZEN
DATA VISUALIZATION EDUCATION

LET'S GET STARTED

This engaging, two hour workshop will demystify Tableau Software, introduce key data visualization fundamentals, and jumpstart your ability to create interactive dashboards with your data. With an emphasis on Tableau's key functionalities and practical applications, we'll progress from basic charts to dynamic dashboards that incorporate interactive filters and design theory. We'll use a data set about the Atlanta Public School District and Tableau Public (which is completely free!) to explore the very best of what this data visualization tool has to offer.

WELCOME

- Personal introductions: what's your name, where do you work, and what are you hoping to learn?
- Laptop Check: Be sure you've download Tableau Public and download the data set.
- Our agenda has four major sections, all of which will last about 30 minutes:
    - Data + Tableau
    - Dashboard 1
    - Dashboard 2
    - Dashboard 3
- We have three primary goals today:
    - Play, alot. This is like art class. Your mug will not come out of the kiln looking identical to your neighbors'.
    - Set you up to keep learning. You won't be a jedi master at the end of the class, but you'll be on your way.
    - Breakdown the qualitative v. quantitative division. Lean into the direction that's new to you.
- Why Tableau:
    - Doesn't require coding
    - Exploratory and explanatory
    - Dynamic Output
    - Free Version

HELPFUL LINKS

- Companion Website
  We move quickly during the workshop. There's a lot to cover in just two hours. If you miss a step or link, don't worry. Everything we cover today is available in the workshop's companion website.
- Tableau Workbook
  A complete version of the sample workbook you're seeing today is available here. You can download your own copy and deconstruct each dashboard and sheet.

DATA + TABLEAU

WHAT MAKES A VISUALIZATION

When we distill visualizations down to their basic form, we get two things: some type of mark and some way to tell multiple marks apart.

- There are three basic types of marks we use to represent our data:
  - Points: scatter plots, box plots, dot maps
  - Lines: bar chart, histograms, line chart, gantt chart
  - Area: treemap, area chart, filled maps,
- Then we tell these marks apart by leveraging:
  - Position: up, down, left, right
  - Size: length, width, angle
  - Color: categorial, saturation
  - Shape: icons, polygons

CONNECT TO DATA

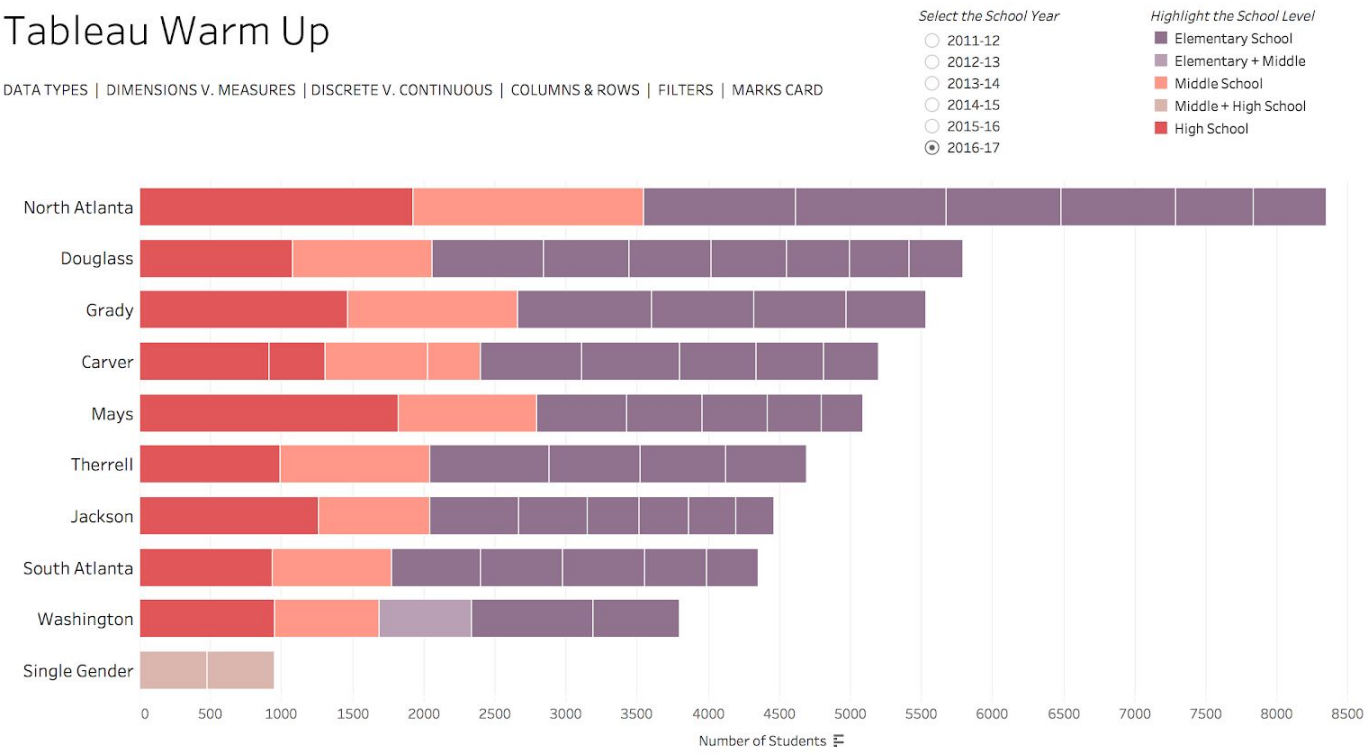
Before we can build any visualizations, we need to connect our data to Tableau. (Well actually before that, we need to gather and structure our data, which is easily 95% of the work, but we'll set that aside for today and enjoy the last 5%.) We will open a new Tableau Public workbook, connect it to the data set we've downloaded, join the two sheets in that workbook to create our data set, and then go to our first Tableau worksheet.

- Connect to Data
  - Launch Tableau Public.
  - Under Connect and To a File, click Excel Spreadsheet.
  - Find the Atlanta Public School District data set you've downloaded and click Open.
  - Drag the Table 1 - Clusters sheet onto the orange Drag Sheets Here text.
  - The data will load in the preview area. You will have 68 rows and 8 columns.
- Join to Table 2
  - Now drag in Table 2 - Attendance.
  - We need to establish the join, or connection, between these two tables.
  - Under the Data Source dropdown menu, select Institutional Number (Cluster Data).
  - Under the Table 2 - Attendance dropdown menu, select Institutional Number (Attendance Data).
  - Make sure the join is still set to an Inner Join (the venn diagram with the very center shaded in.)
  - You will now have 450 rows by 18 columns.
- Click the orange tab labeled Sheet 1 to go to Tableau's building environment.

TABLEAU WORKSHEET ENVIRONMENT

Welcome to Tableau's worksheet environment! This is where we build all our visualizations. On the left side of the screen, you'll see all of your variables are now data pills sitting in the data pane. There are three things to note about these data pills and three places we'll talk about dragging and dropping them in order to create visualizations. (If the Show Me menu is showing on the right hand side, just click the words to collapse the menu. That will make everything easier to see.)

- Data Pane
  - Dimensions vs. Measures: Tableau has split up your variables into dimensions, which are descriptive pieces of data, and measures, which are the numbers that you would do math on.
  - Discrete vs. Continuous: You'll notice some of the data pills are blue, indicating they're discrete pieces of data, think categorical boxes, as opposed to the green pills, which represent continuous data, or data that exists on some sort of pre-existing spectrum, like numbers do.
  - Data Types: Tableau has made it's best guess about each variables correct data type: numer (decimal), number (whole), date and time, date, string, or geographic data.
- Where to Drag-and-Drop
  - Columns and Rows: Placing data pills here function as your typical x and y axes.
  - Filters Card: Placing data pills here allow you to filter your visualization by different variables.
  - Marks Card: This is Tableau's secret sauce. By adding variables to color, size, text, detail, and tooltips, Tableau enables you to layer additional information on top of your standard x and y axes.
- Data Pane Clean Up
  - Data Type
    - Change the Fiscal Year data type from Number (whole) to Date.
    - Select all the three Institution Numbers that have been classified as measures and drag them up to be classified as dimensions. (We'll never do math on these variables, just like a student ID; they function like institutional names.)
  - Group By
    - Click the dropdown menu to the right of Dimensions and change the Group By function from Data Source Order to Group By folder.
    - Select the following data pills, right click, hover over folder, and create a folder called Additional Information, which will include: Grades Served, Institution Name - Short, Institution Number (Attendance Data), Institution or Program Name (Attendance Data), Institution or Program Number (Attendance Data).

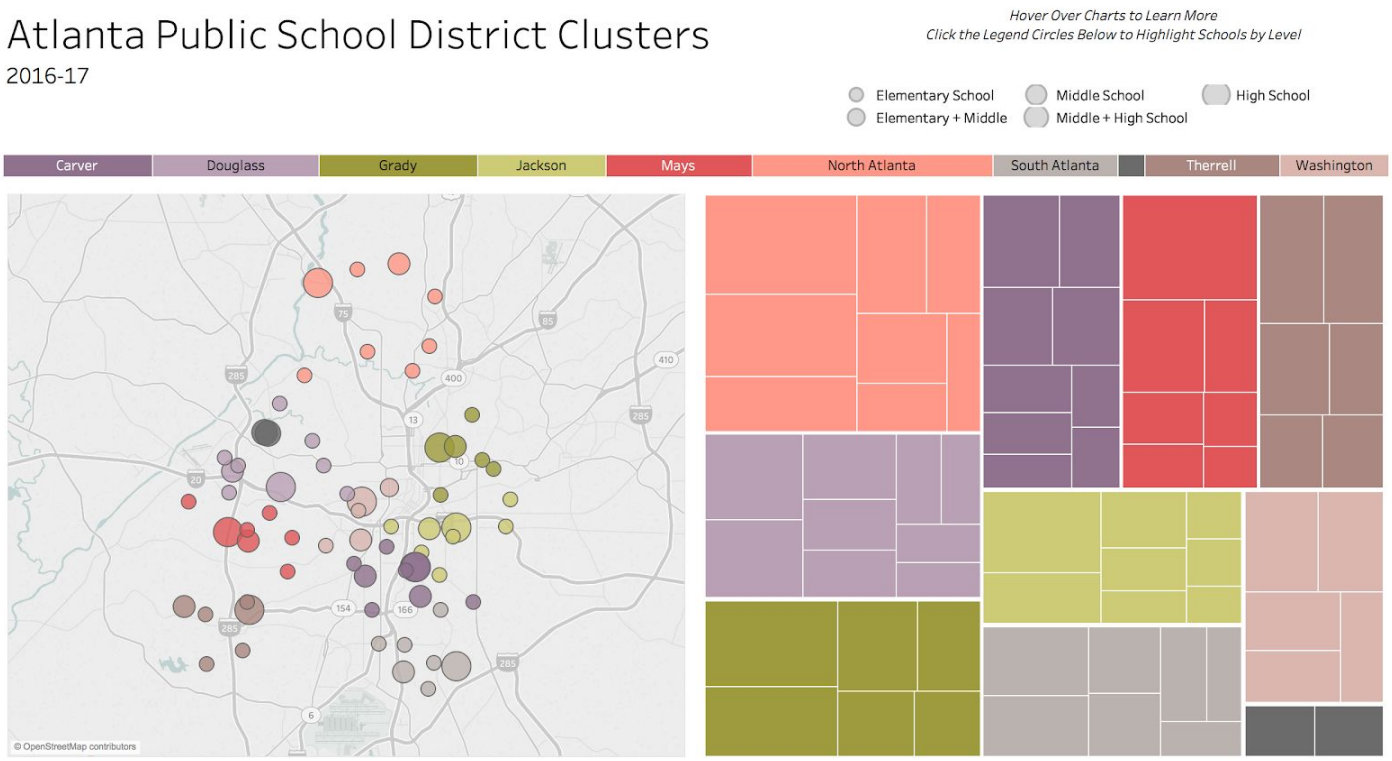


WARM UP: BAR CHART

Let's start building! We'll get to know Tableau's environment by warming up with a bar chart. Notice how we use each key piece of the Tableau environment: the rows and columns cards, the filters card, and the marks card.

- Rows and Columns
  - Drag Cluster to Rows.
  - Drag Student Count to Rows.
  - Hover over the X axis and click the sort icon once to arrange the bars from biggest to smallest.
  - Change the view with the dropdown menu from Standard to Entire View.
- Filters Card
  - Look at the bottom left hand corner of the screen. The sum for this visualization is nearly 300,000 students. What's wrong with this? (Hint: Atlanta proper has roughly 500,000 people.)
  - Drag Long School Year to Filters and select 2016-17.
  - Click the dropdown menu on the Long School Year data pill on the Filters Card and select Show Filter.
  - Click the dropdown arrow on the filter that just appeared and change the filter type to Radio Buttons.
  - Click the dropdown menu again, select Customize, and deselect Show "All" Value.
- Marks Card
  - Drag Level to Color.
  - Adjust the Level pill in the Data Pane.

        - Go to the Data Pane, click the dropdown menu on the Level data pill and select Default Properties and Sort.
        - Change the Sort By selection to Manual and arrange the values like this: E, E+M, M, M + H, H, and press OK.
        - Click on the same arrow on the Level data pill and select alias, and replace each E, M, and H with Elementary School, Middle School, and High School.
    - Click on Color to change the color palette to the Winter Palette. Assign the colors as you'd like.
    - Drag Institution Number to Detail.
        - Click on Color and add a white border between each slice.
        - Click on the dropdown menu on Institution Number on the Marks Card, select sort, and sort by the sum of the Student Count.
    - Drag the Institution Name - Long and the Long School Year to Tooltips.
    - Click on Tooltip and tidy up the information and formatting. Start by making the font bigger and use bold sparingly.
- Name Your Sheet
    - Double click on the bottom tab where you see Sheet 1 and name your sheet to something easy to recognize, like Warm Up or Bar Chart.



DASHBOARD 1

This first dashboard serves as a basic primer for understanding the Atlanta Public School (APS) District. It provides a general sense of the number of schools in the district, where they are located throughout the city, and how many students each one serves. This dashboard also emphasizes the Cluster taxonomy which is how the district groups, and often analyzes, its schools. The highlight actions help teach our end user how the dashboard works, and the URL actions allow our end user to learn more about any one school by visiting their website with just one click.

100% BAR CHART

The first piece of our dashboard is the 100% bar chart. It shows the size of each cluster while also doubling as our color legend for the entire dashboard.

- Basic Bar Chart
  - Create a new sheet and name it 100% Bar Chart.
  - Drag Student Count to Rows.
  - Drag Long School Year to Filters and select 2016-17.
  - Drag Cluster to Color.
  - Adjust the Color to the Winter Palette and add a white border.

- Reverse the order of the Clusters by dragging each one on the Color Legend. This will put the clusters in alphabetical order.
- Drag Cluster to Label.
- Click on Label and allow the labels to overlap with other marks.

- 100% Bar Chart
  - Click the dropdown menu on the SUM(Student Count) pill on Columns.
  - Hover over Quick Table Calculation and select Percent of Total.
  - Right click on the x axis, select Edit Axis, and change it to a Fixed axis that goes from 0 to 1.
- Tooltip
  - Drag the Student Count to the tooltip.
  - Let's also add the number of schools in each cluster to the tooltip. Here's how.
  - Drag Institution Number to Tooltip. Click the dropdown menu, measure, and select Count(Distinct).
  - Clean up the tooltip. Look for opportunities to use full sentences.

MAP

Now we'll build the map for our dashboard. We'll create a circle for each school, colored by its cluster in the district and sized based on whether it is an elementary school, middle school, or high school.

- Map
  - Create a new sheet and name it Map.
  - Double click latitude and longitude. A map will appear. (Before proceeding, what does this dot represent mathematically?)
  - Drag Institution Number to Detail.
  - Click on Maps, Map Layers, and select Base and Streets and Highways.
  - Change the Background Style from Light to Normal.
- Marks Card
  - Drag Cluster to Color, adjust the opacity to 80%, and add a grey border.
  - Add Level to Size.
  - Double click the Size legend to move the range up a bit. We want the Elementary Schools to be the smaller, but not tiny dots, and we want the high schools to be slightly larger.
  - Drag Institution Name - Long to Tooltips and tidy up the tooltip.
  - Drag Link to Detail. We'll use this when we build the Dashboard to create a URL Action.

TREEMAP

The last visualization on Dashboard 1 is our treemap. Treemaps do a good job of visualizing the whole picture of a data set when a bar chart starts to get too big to be helpful.

- Treemap
  - Create a new sheet and name it Treemap.
  - Filter the view to just 2016-17.

- Drag Institution Number to Detail.
- Drag Student Count to Size.
- Drag Cluster to Color.
- Change the view size from Standard to Entire View.
- Drag Link to Detail.

- Tooltip
  - To the tooltip, drag: Institution Name - Long and Student Count.
  - Click the dropdown menu on Student Count and change it to a Quick Table Calculation, Percent of Total.
  - Double check that the calculation is computing Table (Across).
  - Change the number format of the Percent of Total to a percent with just one decimal.
  - Format your tooltip.

DASHBOARD 1

Now it's time to stitch our three visualizations together into a single dashboard.

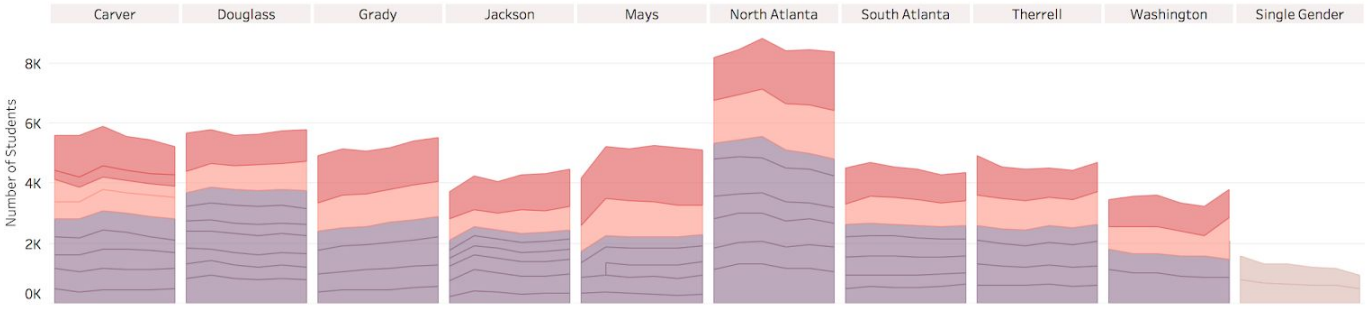
- Dashboard Elements
  - Click the button that looks like a window pane just to the right of the New Worksheet button to create a New Dashboard.
  - Change the Size from a min to max to Automatic with the dropdown menu on the left side of the screen.
  - Drag out the 100% Bar Chart, the Map, and the Treemap onto the dashboard. We'll arrange the more fundamental visualizations towards the top (100% bar chart) and left hand side (map) with the supporting visualizations (treemap) and legends on the right hand side.
- Dashboard Actions: Highlights
  - Click on the tiny highlighter symbol on the size legend to enable your end user to highlight by Level.
  - Add the bar chart highlight by click on Dashboard in the menu, Actions…, Add Action, Highlight.
  - Set the Source sheet to just the 100% bar chart and set the Target sheets to be the Map and Treemap.
  - Change the Run action on: setting from Select to Hover.
  - Now set up the same effect between the map and the treemap: Dashboard, Actions, Add Action, Highlight.
  - Set the Sources sheets and Target sheets to the Map and Treemap. Run the action on Hover.
  - To make sure this highlight only looks at the schools (instead of the entire cluster), change the Target Highlighting from All Fields to Selected Fields and click just Institution Number.
- Dashboard Actions: URLs
  - Remember when we were building the map and treemap, we added the Link variable to Detail? Now we can turn that into a dashboard action so that when your end user click on a school's mark on the map or treemap and get taken directly to the school's website.
  - One more time, click on Dashboard, Actions, Add Action and this time select Go to URL.
  - Set the Source sheets to the Map and Treemap, and then run the action on Select, so that your end user has to click to be taken to the website. (We wouldn't want to trigger that on a hover, or websites would be popping up left and right.)
  - Now click the arrow to the right of the URL box and select the variable Link.

- Click OK to exit out and give all your dashboard actions a try! Now that our dashboard is fully functional, it's time to clean up the layout and design. There are three steps to take with each dashboard you build.

- Step 1: Eliminate Unnecessary Elements
  - We want to create emphasis by eliminating unnecessary or duplicative items from our dashboard.
  - Click on the Color Legend and click on the X to remove it. Our 100% bar chart doubles as our color legend.
  - Right click on each of the sheet titles and hide them.
  - Right click on the x axis on the 100% bar chart and uncheck show header.
  - Click on the Single Gender school cluster label, right click, select Mark Labels, and click Never Show.
  - Right click on the 100% bar chart and select Format. Turn off the Column grid lines.
- Step 2: Maximize Real Estate
  - Make sure each visualization view is set to Entire View, not Standard.
  - Move the Size legend above the 100% bar chart so it can stretch all the way across.
- Step 3: Create Instructions for Your End User
  - Drag in a text box to the left of the Size Legend and add a title for your Dashboard.
  - Change the title of your Size Legend to instructions about how the dashboard works.
  - Double check that all of your tooltips have helpful information and instructions.

Atlanta Public School District Enrollment

2012-2017



	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Carver	5,573	5,594	5,876	5,557	5,443	5,199
Douglass	5,649	5,793	5,583	5,639	5,741	5,793
Grady	4,916	5,126	5,050	5,187	5,411	5,531
Jackson	3,724	4,221	4,064	4,276	4,305	4,463
Mays	4,150	5,220	5,157	5,251	5,194	5,089
North Atlanta	8,166	8,443	8,822	8,412	8,455	8,348
Single Gender	1,589	1,328	1,306	1,206	1,160	950
South Atlanta	4,515	4,678	4,555	4,453	4,284	4,355
Therrell	4,900	4,551	4,464	4,487	4,427	4,689
Washington	3,459	3,581	3,586	3,341	3,228	3,796
Grand Total	**46,641**	**48,535**	**48,463**	**47,809**	**47,648**	**48,213**

DASHBOARD 2

Our second dashboard offers a strategy for easing stakeholders into visual representations of the data they've traditionally consumed as spreadsheets. Both the area chart and the text table contain the exact same set of data: enrollment numbers for each school in the district from the 2011-12 to the 2016-17 school year. By creating a flexible table, connecting the two charts with dynamic highlights, and including functionality and data information with the icons, we're setting up our end user to understand and explore this dashboard with ease.

TEXT TABLE

Let's start by building out the text table first. We'll create a flexible table by adding in hierarchies in the data pane. This will also help us avoid unwieldy subtotals.

- Establishing Hierarchies
  - Create a new sheet and name it Text Table.
  - In the data pane, drag Level on top of Cluster until you see a rectangle box appear. Then release.
  - A pop up box will ask you if you want to establish a hierarchy. Click OK.
  - Now drag the Institution Name - Long data pill just below the Level pill in the hierarchy that now shows up in the data pane.

- Text Table
  - Drag Cluster to Rows. Notice the new plus sign that appears on the data pill. If you click it, the levels appear. Click it again and the names of each school nested in that hierarchy will appear too.
  - Drag Long School Year to Columns.
  - Drag Student Count to Text.
  - Add a Column total by clicking on Analysis, Totals, and select Show Column Grand Totals
  - Click on Tooltips and uncheck Show Tooltips. (Sometimes you actually want to turn these off.)
- Formatting
  - Text tables deserve the same formatting attention as any other type of visualization. Look for opportunities to lighten up the aesthetic and emphasize the most important information.
  - Change the view from Standard to Fit Width.
  - Adjust the height of the bars at each level of the hierarchy as well as the column width.
  - Lighten up the font weight.
  - Emphasize the year by making the font a bit bigger.
  - Adjust the row banding color to match the general tone of the winter color palette we've been using.

AREA CHART

Now we'll visualize that data. Since we're looking at similarly sized groups of data over time, we'll use an area chart to prevent the overplotting we'd get with a line chart.

- Area Chart
  - Drag Fiscal Year to Columns.
  - Drag Student Count to Rows.
  - Drag Cluster to Columns and set it just before the Fiscal Year Pill.
  - Change the Mark Type from an automatic line to an Area Chart.
  - Change the View from Standard to Entire View.
- Color, Detail, Tooltip
  - Drag level to Color.
  - Reorder the Color Legend so that it's reversed, with the Elementary Schools at the bottom of the chart and the High Schools at the top.
  - Drag the Single Gender Cluster to the far right of the column labels.
  - Add the Long School Year to the tooltip and tidy up the text.
- Formatting
  - Hide the Cluster label and all the information on the x axis at the bottom of the chart.
  - Double click on the Y axis and change the label to read Number of Students.
  - Click Format and get rid of all Column and Row dividers under the Borders section.
  - Right click on one of the Cluster Names, select Format, click on the paint bucket, select Columns, and change the header fill to a light salmon color.
  - Then click on the Borders icon, select Columns, and under Header, add a thick white border.

ICONS

We've added two icons in the top right corner of our dashboard to provide our end user a bit of information about how our dashboard works and where the data comes from. This can be a helpful strategy when you want to provide certain users more information without crowding the dashboard. Here's how you do it.

- Create a new sheet and name it something like Functionality Icon.
- Drag any variable, like Number of Records, to Detail.
- Change the Mark Type from Text to Shape.
- Click on Shape and select an icon you like. (In the example, we had actually imported the cog and the i).
- Click on Tooltip, delete all of the information that's already there, and type up any information you'd like to give the end user about how the dashboard works, where they data came from, etc.
- Turn the Icon (or the background) a bright color that will catch the eye of your end user. You could even add a title, such as Hover Here, to ensure that your end user gets this information.

DASHBOARD 2

Now it's time to assemble our second dashboard. Once you've followed the instructions for setting up the functionality, documented below, return to the three formatting decisions we made in Dashboard 1 and look for opportunities to tighten up the aesthetics.

- Create a new dashboard.
- Drag out the Area Chart and drag out the Text Table below it.
- Drag out a Text object to the top for your title and add the Icon sheet to the right of the title box.
- Add a Dashboard Action Highlight. Set the source sheets and target sheets as the Area Chart and Text Table. Run the action on a Hover, and set the Selected Fields to the three levels of the table: the Cluster, the Level, and the Institution Name - Long.

DASHBOARD 3

Our final dashboard examines attendance patterns for the 10 middle schools over six years. Attendance is reported in three categories each year: the percentage of students who missed 5 or less days, the percentage who missed 6-15 days, and the percentage the missed 15 or more days. By using a diverging bar chart to visualize this data, we can easily see the trend over time, regardless of the direction it's moving. (This is a more complicated type of chart to build. You'll notice it's not in the Show Me button!)

DIVERGING BAR CHARTS

To build this type of chart, we need to make a negative version of any variable we want to appear on the left side (or negative side) of the chart. Then we'll use Measure Names and Measure Values to line these three variables up to create each slice of our bar chart.

- Create a new sheet and name it Diverging Bar Chart - Row 1
- 0 to 5 Days (Positive Side)
  - Let's start by filtering the entire visualization down to just one school while we build it. Drag Institution Name to Filter and select Brown Middle School.
  - Drag Fiscal Year to Rows and change it to a Discrete Year.
  - Drag Absences - Five or Fewer Percent to Columns.
  - Change the Mark type from a line to a bar.

- 6 to 15 Days (Negative Side)
  - Now we need to create the left side, or negative side, of our diverging bar chart. Let's start with the 6-15 Days absent.
  - Right click in an empty spot in your data pane and select Calculated Field.
  - Name your calculated field: 6 to 15 Days.
  - In the empty box below for the calculation, type a negative sign and drag in the 6-15 Absences variable from the original data set. Then click OK. You'll see this variable appear in the data pane.
  - Drag your new variable, 6 to 15 Days, on to the visualization, hovering over the x axis until you see a double car appear. Then release.
  - Drag the Measure Names variable that has just appears from Rows to Color. Now these variables will share an axis and be distinguishable by color.
  - Change the Default Properties for the Number Format for your new variable to Custom: #,##0.0;#,##0.0 (This will keep the negative sign from showing up on the tooltip.)
- 15 or More Days (Negative Side)
  - Duplicate your 6 to 15 Days variable by clicking the dropdown menu and selecting Duplicate.
  - Edit the new copy by changing the name to 15 or More Days and replacing the variable with the 15 or More Percent variable from the original data set.
  - Drag your new 15 or More Days Variable to the top of the Measure Values card that has appeared.
- Format
  - Adjust your color palette to a grey for the 0 to 5 days and a light pink and dark pink for the other two variables. We're setting up a visual split and an intensity this way.
  - Right click on the X axis and fix it to -100 to 100. Then hide the axis.
  - Right click on the chart and select Format. Remove all gridlines, leaving just the zero line.
  - Clean up your tooltip.
- Small Multiples
  - Since we want to create a dashboard with one of these diverging bar charts for each of the ten middle schools we'll need to duplicate our work.
  - Replace the Filter for Institution Name with Level and filter to just middle schools.
  - Drag Cluster and Institution Name to Columns and set them before Measure Values.
  - Show the Filter for Cluster. To make the top row of our dashboard, we'll filter to just Carver, Douglass, Grady, and Jackson.
  - Now we'll Duplicate the entire sheet and change our filter to Mays, North Atlanta, South Atlanta, Therrell, and Washington. Name this sheet Diverging Bar Chart - Row 2.

DASHBOARD 3

With our diverging bar charts ready to go, this final dashboard is simple to assemble.

- Create a new Dashboard and change the size to Automatic.
- Drag out your first and second row of your diverging bar charts.
- Eliminate the filters that show up.
- Add a text object for your title and move the color legend up top to the right of the title.

- Hover over the color legend and click the small highlighter icon that appears. Test that your highlighter works.
- Make sure both diverging bar charts are set to Entire View and hide their titles.
- Look for any final adjustments you would like to make.

SAVE YOUR WORKBOOK

The final step is to save your workbook! If you haven't already created a Tableau Public account, return to the Companion Guide website for instructions to make one. Once you've done that, here's how you save your workbook.

- Go to File, Save to Tableau Public As, and then enter your Tableau Public account credentials.
- Name your workbook.
- Edit the workbook details on your Tableau Public page. You can control whether the workbook appears on your profile page and whether someone else can download the workbook and data.
- Note that you should NEVER save anything private on Tableau Public. This is a place to only save work you've done with public data, like we've done here. To save your work locally, you will need Tableau Desktop, which costs approximately $70 a month.

TAKE THE SURVEY

Now that you're all done with the workshop, we'd so appreciate your feedback so that we can continue to improve our workshops for future attendees. Just click here to answer a few quick questions. Thank you!