Contents

[**What You Will Learn** 1](#_Toc92360833)

[**Planning Your Schedule** 1](#_Toc92360834)

[JavaScript, Bootstrap, and UFOs 2](#_Toc92360835)

[Overview of ES6+ 2](#_Toc92360836)

[Benefits of the ES6 Update 2](#_Toc92360837)

[JavaScript in the Real World 3](#_Toc92360838)

[Writing JavaScript 4](#_Toc92360839)

[Case Sensitivity 5](#_Toc92360840)

[Semicolons 5](#_Toc92360841)

[Statements and Expressions 7](#_Toc92360842)

[JavaScript Components 8](#_Toc92360843)

[Variables 8](#_Toc92360844)

[Organize Your Repository 14](#_Toc92360845)

[JavaScript Objects 17](#_Toc92360846)

[Storyboarding 19](#_Toc92360847)

[Create a Storyboard 21](#_Toc92360848)

[**Align the Code** 23](#_Toc92360849)

[Getting Started with JavaScript Functions 25](#_Toc92360850)

Javascript – Module 11

* Is a front end development language
* Front end means you are focused on the appearance, look, feel for user who is interacting with the data
* Javascript allows for customizations that enhance user experience
* Has dashboards for data visualization
* Build a dynamic webpage by insert javascript into html
* Dynamic = accepts user input

**What You Will Learn**

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

* Explain the strengths and weaknesses of JavaScript "standard" and JavaScript version ES6+.
* Describe JavaScript syntax and ideal use cases.
* Build and deploy JavaScript functions, including built-in functions.
* Convert JavaScript functions to arrow functions.
* Build and deploy forEach (JavaScript for loop).
* Create, populate, and dynamically filter a table using JavaScript and HTML

**Planning Your Schedule**

Here's a quick look at the lessons and assignments you'll cover in this module. You can use the time estimates to help pace your learning and plan your schedule.

* Introduction to Module 11(15 mins)
* JavaScript Basics (1 hour)
* Building Webpages with JavaScript (1 hour)
* Functional JavaScript (1 hour)
* JavaScript for Loops (1 hour)
* Building Dynamic Tables (1 hour)
* Build the HTML (2 hours)
* Application (5 Hours)

**11.0.4**

# JavaScript, Bootstrap, and UFOs

Dana wants to create a website about UFO sightings from her home town

Use .js data file, create a table, filter, add to html file

Customize webpage using Bootstrap

**11.1.1**

# Overview of ES6+

ECMAScript, also referred to as "ES," is a scripting language designed to help standardize JavaScript, has given JavaScript Proper Synatax

There have been many updates to ES over the years, though the sixth update was a major one. You'll probably see "ES6+" mentioned out in the wild pretty often; this is a reference to the "big" update (ES6) as well as the later ones. It's also commonly known as "ES2015" or "ECMAScript 2015."

## Benefits of the ES6 Update

JavaScript after the ES6 update is like the newer computer. This update included many updates to the syntax, which streamlined the code and made it easier to both read and write. Additional, quality of life improvements were implemented as well, such as adding Python-like generators and for...of loops. Even functions were updated and streamlined!

for...of loops is a new syntax associated with JavaScript, so it's okay to not be familiar with it yet! We'll discuss this syntax in more detail as we learn more about the language.

In this module, our focus will be on basic JavaScript and ES6 capabilities such as arrow functions.

**11.1.2**

# JavaScript in the Real World

JavaScript is one of the powerhouse languages out in the wild today. While its strength is in creating visually appealing and dynamic content, it is starting to grow into other fields as well. Tensorflow, a popular machine learning tool, even has its own JavaScript library now.

It's pretty easy to start feeling daunted by everything JavaScript can do, so Dana is more interested in examples of similar websites—ones that use filters on lots of data.

* **Online shopping websites:** These are a great example of dynamic content. They contain filters for departments, and then filters for items within those departments. Filters on top of filters!
* **Ecological data:** The [National Ecological Observatory Network (NEON) (Links to an external site.)](https://data.neonscience.org/browse-data?showAllDates=true&showAllSites=true&showTheme=org) has very large and diverse datasets; these are also displayed on their website as dynamic tables with multiple filters.
* **Weather data:** [The National Snow & Ice Data Center (NSIDC) (Links to an external site.)](https://nsidc.org/data/search/#keywords=permafrost/sortKeys=score,,desc/facetFilters=%257B%257D/pageNumber=1/itemsPerPage=25) also has very large datasets presented in table format on their website. These tables include filters and parameters that can be applied to their table.

**11.1.3**

# Writing JavaScript

**While** JavaScript is clearly capable of a variety of tasks, Dana plans to start with something a bit more manageable. Instead of building an entire dashboard right away, first she'll create a filterable table to display the data. She decides to dig into the syntax of the language. It's very different from other languages Dana has encountered before, so she wants to be sure she understands the basics before she begins to build anything.

One major component of each coding language is its **syntax**. For example, Python is a pretty clean and easy-to-read language; there aren't many semicolons, and the indentation and spacing makes sense. SQL, on the other hand, includes semicolons, but it also has guidelines and requirements when it comes to indentation and spacing.

JavaScript is no different: there are guidelines and requirements for writing it. But because JavaScript can be added to an HTML page, there are more guidelines and requirements than for languages that can only live in a .js file or Jupyter notebook such as Python. There are a few important things to remember about JavaScript syntax. We'll start with the following:

* Case sensitivity
* Semicolons
* Statements and expressions
* Code blocks

We'll be sure to get in lots of practice so that Dana can feel 100% confident in her skills.

## Case Sensitivity

JavaScript is case sensitive. **Case sensitivity** means that JavaScript considers upper- and lower-case words to be different. For example, if we were to assign the words "data" and "Data" as variables, we would be able to save different information in each word. Of course, actually doing this with the word "data" could lead to confusion pretty quickly. Instead, just remember JavaScript cares about capital letters.

Similarly, JavaScript uses different naming conventions than Python that involve case sensitivity. Different languages utilize different methods to link words without using spaces, which is called a **case style**.

JavaScript's code style, according to coding guidelines and syntax, is camel case. You'll encounter this case often as you begin to practice your coding. It's especially useful when declaring variables.

**NOTE**

Camel case is the preferred naming convention in JavaScript. This is especially helpful in cases where Python data is used. For example, we would know that variables named with snake case originated from the Python side of things.

## Semicolons

Much like SQL, when coding in JavaScript it's good practice to end statements with a semicolon. Technically, they are optional when it comes to executing your code, but they are helpful because they tell JavaScript that a particular line or block of code is complete. It's considered a best practice to include semicolons throughout your code. You'll encounter many semicolons throughout this module.

Let's use a print statement as an example. In JavaScript, a print statement is called a **console log**. To print "Hello, world!" to the console, we would use this line:

// Printing a string with JavaScript

console.log("Hello, world!");

**NOTE**

While the print() function does exist in JavaScript, it will actually try to print to a printer instead of our console.

This statement is almost identical to a basic Python print statement, as shown below.

# Printing a string with Python

print("Hello, world!")

Both methods will print the string (in this case, "Hello, world!"). But in addition to switching "print" with "console.log," in JavaScript, a semicolon has been added at the end of the statement.

#### Testing Simple Statements

Simple JavaScript statements such as console.log() can be tested using DevTools. For example, follow these steps to test console.log("Hello, world!").

1. Go to a site like [Google (Links to an external site.)](http://www.google.com/) and activate your DevTools. This is where we'll access our console; the console is the command line interface tool we'll use to test JavaScript, much like our terminal is used to test Python.

You can use any site to open your DevTools; it isn't a requirement to use the Google search page.

1. Click the "Console" tab at the top of the screen.
2. Type console.log("Hello, world!"); on the first line and then press Enter.

The Console tab in DevTools will become a very important tool when we begin to code later on. The Console tab will allow us to see if an error has occurred and, if so, which line of code is causing the disruption.

## Statements and Expressions

When describing JavaScript code, the terms "statements" and "expressions" are both used, and often. Here's how to distinguish between the two:

* Statements perform actions.
* Expressions create values.

Assigning a variable is an example of a statement. Using arithmetic to create a new value is an expression.

#### Code Blocks

Code blocks, which we will see more often as we start writing functions, are denoted by curly brackets. Code inside the curly brackets are typically indented two to four spaces. This isn't required to run the code, but it does make reading it easier and follows the coding guidelines.

**11.2.1**

# JavaScript Components

**Now** that Dana knows where she'll encounter JavaScript in the wild—as well as some of the key differences between JavaScript and Python—it's time to get down to business. Understanding the basics of a programming language from text is one thing, but putting that understanding into practice is another. Dana is ready to dive in and start working with some of the basic components: variables and lists.

We're going to begin our practice by familiarizing ourselves with some basic JavaScript components: **variables** and **arrays**.

## Variables

Before ES6 came along, there was a single way to declare a variable: **var**. You've already worked with variables in Python, but this concept in JavaScript is a bit different. Let's compare a Python variable to a JavaScript variable:

|  |  |
| --- | --- |
| Python | JavaScript |
| y = 2 | var y = 2; |

Python's way of assigning a variable is quite simple: type the name of the variable followed by its value: y = 2.

JavaScript is similar, but with two additions: add var before the variable, and then add a semicolon after the value, like this: var y = 2;.

Let's test our JavaScript variable assignment using DevTools. If you still have your console open and ready to go, great! If not, go ahead and bring another up to practice with.

**SKILL DRILL**

If needed, visit a webpage such as [Google (Links to an external site.)](http://www.google.com/) and activate your DevTools. Click the Console tab to activate the console. Then do the following:

1. On the first line, type var y = 2;and press Enter.
2. On the next line, type console.log(y); and press Enter.

The value of y should print to your console.

End of text box.

Of the many additions that came along with ES6, two more ways to declare variables were also introduced: let and const.

This can be a bit trickier than it seems, because in JavaScript a variable isn't always just a variable. There are specific uses for different variables, and using let and const instead of var helps developers define what the uses are. Let's check them out in more detail.

*Each variable has its adv and disadv depending on application, for let and const, they are also considered block-scope, it will only work inside the braces it was declared in. Means you can declare variables with the same name within different blocks with different meanings.*

*Const cannot be either redefined or redeclared (hence constant within its block)*

*Let can be redefined but not redeclared*

*Var can be redefined and redeclared*

#### Create Variables with let

The biggest difference between var and let is that the var declaration is global, meaning it applies to the program instead of being contained in a block of code.

When a developer chooses to use let, it basically means "I might want to use this variable again later to hold different data, but in this code block I'll only use it once." In ES6+, let is typically used in place of var. We'll be using let in this module, but both are encountered out in the wild.

#### Create Variables with const

The const declaration is more specific than let. Instead of being contained within a block of code, const tells JavaScript that the variable won't be reassigned or redeclared, either in a block of code or within the program as a whole. The following table highlights the key differences of var, let, and const:

|  |  |  |
| --- | --- | --- |
| **Least specific** | var | Variable used in entire program |
|  | let | Variable used in a code block |
| **Most specific** | const | Variable used once |

Now that we've discovered three different ways to declare variables in JavaScript, let's take a look at arrays.

#### Arrays

When coding in Python, data can be grouped together in a **list**. The same is true of JavaScript. In fact, Dana was inspired to learn JavaScript because the data is already stored in a JavaScript array! Let's take a look at the data to see what we're working with. Start by downloading the JavaScript file below:

[Download data.js (Links to an external site.)](https://2u-data-curriculum-team.s3.amazonaws.com/dataviz-online/module_11/data.js)

**GITHUB**

This data.js file is a large part of this project. Save it in the new repository you cloned to your computer.

When you open the file, you'll see that it contains a lot of data. Look at the construction of this array.

First, the name of the array, data, is declared with var:

var data = [

The structure of the array begins much like a Python list: with a square bracket. But the data inside is arranged a bit differently.

Each entry is inside the square brackets, like a Python list. That's where the similarities begin to taper off.

In this particular JavaScript array, we're not recording a single item and moving on to the next, much like a simple list (such as [1, 2, 3]). However, here we're recording an entire event: date, location, type, and even comments are saved inside a single array. Not only that, but multiple events are recorded. Because we have so much information, the array looks more like a Python dictionary than a simple Python list. Take a look at the example below:

{

datetime: "1/1/2010",

city: "benton",

state: "ar",

country: "us",

shape: "circle",

durationMinutes: "5 mins.",

comments: "4 bright green circles high in the sky going in circles then one bright green light at my front door."

},

Within a set of curly brackets, we can see the key-value pairs such as the date, city, and state.

While this looks somewhat similar to a Python dictionary, there is one key difference. Scroll to the last link of the data file and see if you can spot the difference. You can use keyboard shortcuts to reach the bottom quickly, instead of scrolling through the whole file.

There's a lot going on in this file: for Dana's article to be a success, she will need to make these sightings easier for people to visually parse by converting them from their current state, a JavaScript array, into an HTML table.

#### Convert the Array to a Table

To convert the array to a table, we're going to take the following code and turn it into the table shown below:



The first step in transitioning the data from an array to a table is to create the appropriate variables using var, let, or const. Open VS Code and create a file in our repo folder named app.js. This is where we'll keep the code that builds the HTML table and fills it with data from data.js.

**11.2.2**

# Organize Your Repository

**Dana** has started to get into a JavaScript coding rhythm. But before she begins to create code for real and then commit scripts to her repo, she needs to organize it.  
  
Building a page that contains JavaScript will require Dana to link additional JavaScript files to the index.html file that she'll be working on later. This means keeping track of multiple things at once: an HTML file, JavaScript files, images (for customizing the webpage) and a CSS style sheet. Therefore, it's a good idea for Dana to establish a solid folder structure now instead of when she's elbow deep in creating her JavaScript functions.

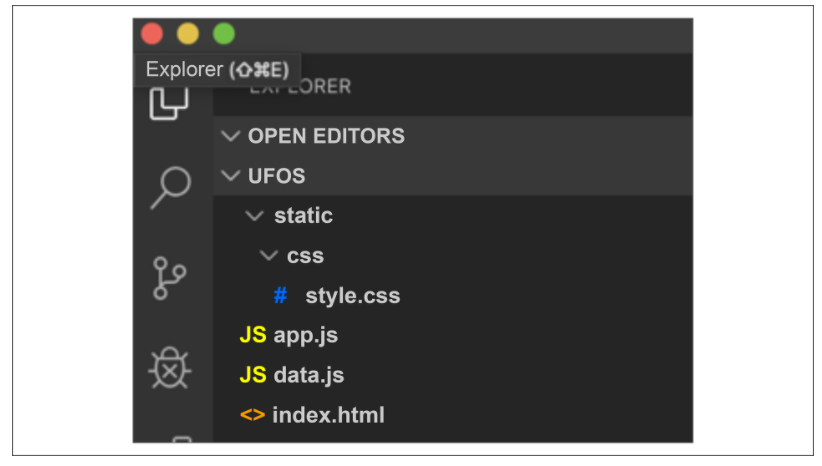
Before we get too far along with our coding, we need to set up a file organization system for our repo. The end result of this project will be an HTML page or application, so we need to establish the proper folder structure accordingly. At a high level, here's what we'll do:

* Create the index.html file.
* Create a subfolder to hold the CSS file (style.css).
* Create a subfolder for images.
* Create a subfolder to hold JavaScript.

First, in the repo folder we established earlier ("UFOs"), create the index.html file. This file is the window to our work: the table and Dana's article summary (along with titles and filters) will all be displayed through this file. We won't be coding it yet—that will come later—but we're creating it now so that it will be ready for us when it's time to build the page.

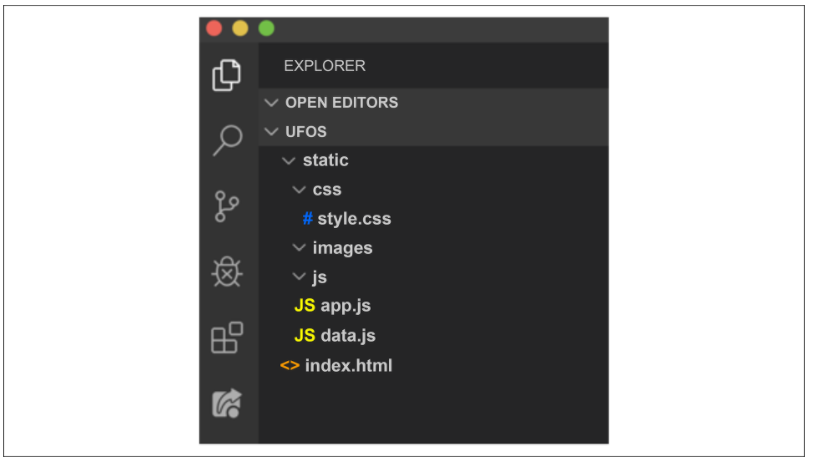
Next, create a subfolder in the repo folder named "static." This static folder will hold our static CSS file; this only means that it isn't being moved or altered externally. In VS code, right-click the menu and select "New Folder," and then name it "static."

Inside the static folder, create another subfolder named "css" to hold the style.css file. You can use the same right-click method to bring up the creation menu, but this time select "New File." We'll customize our webpage using the style.css sheet, but for now we can leave it blank. Here's what the folder structure should look like so far when viewing it in VS Code.



The next subfolder we'll create is our "static" folder to hold whatever images we want to add to our website when it's time to customize it. Create the folder now and name it "images." But for now, move on to the next step—we'll add images later.

The third and final subfolder we'll create is one to hold our JavaScript. Name the folder "js" and move the data.js and app.jsfiles into it so that your folder structure looks like this:



Establishing this folder structure is a best practice when creating webpages with JavaScript. It's important to keep things organized when creating a webpage using JavaScript components, as there are even more moving pieces than a static website. We'll be linking to images and a style sheet as well as JavaScript scripts. The organization presented here provides clearly designated spots to store the code we'll be working on, making it easier to locate them as we go.

**11.2.3**

# JavaScript Objects

**It's** been a good day of research. Dana is far more familiar with some of the basic components of JavaScript: she now knows that variable declaration can actually occur three ways, and the array she is working with is similar to a Python dictionary. It's a great start, but Dana's still a little fuzzy on the array. It looks like a JSON, or a dictionary, so it's more complex than a simple list, right?  
  
Dana's intuition has served her well: the JavaScript array is indeed a bit more than a simple list. Let's take a closer look at JavaScript objects and how to interact with them, which will help us as we begin to create our code.

Coding in JavaScript requires proficiency with JavaScript objects. And, in JavaScript, many different things can be considered an "object." We've actually already encountered one! Let's look at a snippet of code from ourdata.js array:

var data = [

{

datetime: "1/1/2010",

city: "benton",

state: "ar",

country: "us",

shape: "circle",

durationMinutes: "5 mins.",

comments: "4 bright green circles high in the sky going in circles then one bright green light at my front door."

},

As mentioned earlier, this looks very similar to a Python dictionary or something we'd find in a JSON file. In this code snippet, everything within the curly brackets is considered to be properties of a JavaScript object. The object is our variable: data.

There are several ways we can access the properties, also called key-value pairs or objects, in the array.

Also, objects are not limited to being contained within an array. In fact, an array itself is an object. Dates are also objects, as are functions; and Booleans can be objects. Basically, many things can be—or are—objects. We'll get plenty of practice with objects as we start to build our website.

Before building the website, we should plan it out. By using a storyboard and mapping the elements out beforehand, it will be easier to assemble them later.

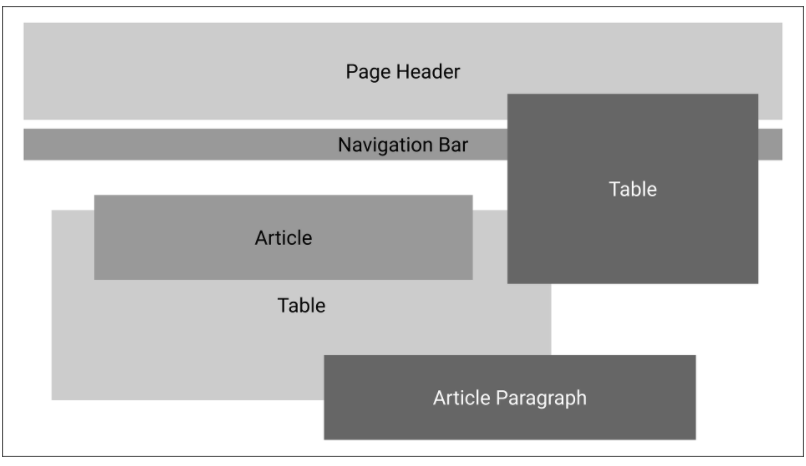
**11.2.4**

# Storyboarding

**Dana** has grown more familiar with JavaScript syntax and her basic code is gaining momentum. She's ready to start putting it to use!  
  
Dana's goal is to create an interactive webpage that allows readers to parse the data around UFO sightings. So, she essentially needs to build two things: the webpage that will allow users to view the data (HTML) and a dynamic table that will present it (JavaScript).  
  
Dana wants to storyboard her website to have an idea of what her readers will see when they view the final product. Storyboarding is incredibly useful in determining the layout of a webpage, so it's important to complete this step early in order to save time later. It's like building a house. You need to know how it's all going to fit together before you start building!  
  
Once the template has been created, Dana can begin to code the JavaScript portion by first importing the data and then referencing it with a variable.

Typically, developers build HTML and JavaScript elements somewhat simultaneously because they complement each other. For example, the JavaScript table will be referenced within the HTML code, and different HTML components will be referenced within the JavaScript code. Because these files are so closely linked, Dana will switch between building the JavaScript table (within the app.js file) and the HTML page (within an index.html file).

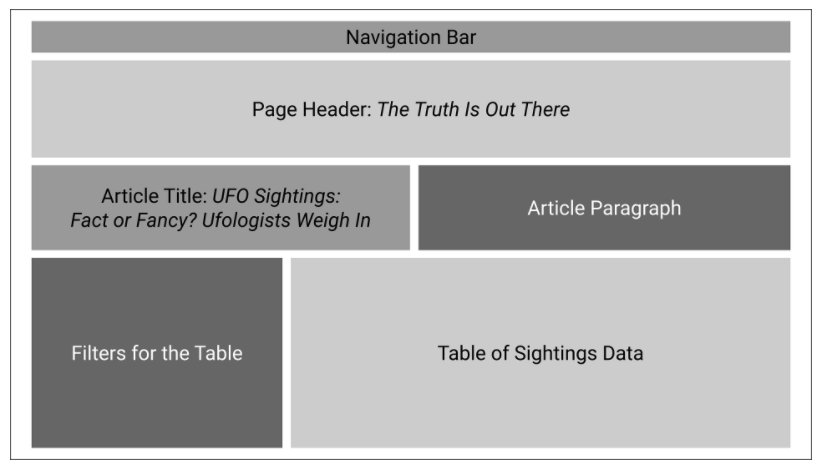
Dana also has a solid idea of how she wants her webpage to look, but it's easy to get lost in the details of building a webpage without a visual reference. A visual reference such as a storyboard will help Dana outline all of the elements she wants included, such as the article title, a summary, and the table itself. Then, when she begins creating JavaScript code to include the table, she'll know exactly which HTML components she'll be connecting to her table. Dana already knows she'll have several individual components on the webpage, shown below:



Now she just needs to figure out how to assemble them. This is where a storyboard comes in.

## Create a Storyboard

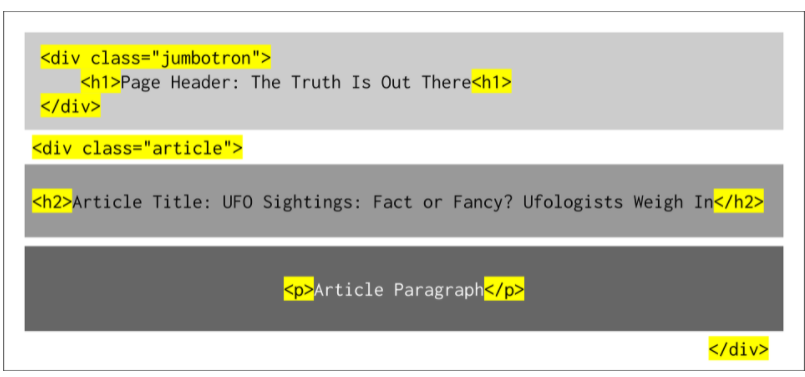
A **storyboard** serves as a kind of blueprint for your site and helps with the transition from idea to finished product. Think of it as a map of the webpage.



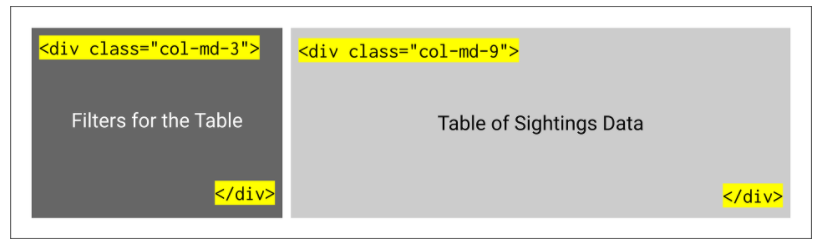
This step is key for a couple of reasons.

First, knowing how we want the webpage to look before building it will save us time later. Second, it helps us make sure we've captured everything we want displayed. Sometimes, seeing the map of the website helps us ensure that all the elements we want displayed are included.

We already know what components we want to use, such as a Jumbotron for the header, and the grid system for the filters and table. See the following image:



We also have an idea of how many columns we want each table component to use.



Now that a storyboard is in place, we can really get going! Let's align our code.

**Align the Code**

When we align our code, we're putting our plans into action, such as when we start transitioning our storyboard into a webpage. We'll start by building our components. The first one will be the table we generate with JavaScript. Open your app.js file with VS Code. The first thing we're going to do is import the data. This won't look like an import from Python. For starters, the double backslash ( // ) is how you comment your code in JavaScript.

In your code editor, type the following to declare a variable, tableData, using const.

// import the data from data.js

const tableData = data;

Next, we need to point our data to our HTML page. Specifically, we need to tell JavaScript what type of element the data will be displayed in. We already know that the data will be displayed in a table, so in our code editor we'll reference the tbody HTML tag using D3.

**IMPORTANT**

D3 is a JavaScript library that produces sophisticated and highly dynamic graphics in an HTML webpage. It is often used by data professionals to create dashboards, or a collection of visual data (such as graphs and maps), for presentation.

Return to your code editor and type the following:

// Reference the HTML table using d3

var tbody = d3.select("tbody");

With this code, we:

1. Declare a variable, tbody
2. Use d3.select to tell JavaScript to look for the <tbody> tags in the HTML

Although we aren't building the HTML right now—we'll do this after we put together the code—we already know that the data will fit into that tag because it's a standard table tag that is used often in HTML, with or without JavaScript enhancements.

**11.3.1**

# Getting Started with JavaScript Functions

**Dana** has started to build her code, which is really exciting! When she imported the data, she took the first step in building her website. The next step is to build the table to sort and store the data.  
  
Dana knows that building this table will introduce a new level of complexity involving for loops and functions. Thankfully, JavaScript and Python have similar logic, so after Dana reviews and practices with code similar to what she'll use in her project, she'll be ready to start integrating it into her code.

Functions in Python and JavaScript have similar logic: we provide the language with a set of instructions to follow, which can then be reused as needed. Watch the following video to learn more about JavaScript functions.

In Python, a simple print statement looks like this:

# Simple Python print statement

def print\_hello():

print("Hello there!")

In this code, the function is declared with the keyword def followed by the name of the function, a set of parentheses, and a colon, with the indented code below.

To write a print statement in JavaScript, we begin the same way: by declaring the function. To do this, we use the keyword function. (**Note:** Remember that the JavaScript syntax uses console.log instead of print.)

// Simple JavaScript console.log statement

function printHello();

At this point, the process diverges from Python. The next step is to add a set of curly brackets, and then add the indented code between them.

// Simple JavaScript console.log statement

function printHello() {

console.log("Hello there!");

}

**SKILL DRILL**

Return to the console tab of your DevTools and run the JavaScript function you just reviewed.

End of text box.

Get more practice with Python and JavaScript functions in the following activity.

Let's take a closer look at basic functions in JavaScript.

**11.3.2**

# Simple JavaScript Functions

**Even** though Python and JavaScript are logically similar, it's becoming more and more apparent to Dana that they have many syntactical differences. It's a lot to take in, so Dana wants more practice creating and calling functions. She wants to know if arguments are passed in the same way, as well as how functions are called.

Arguments can be passed into both Python and JavaScript functions. Let's take a look at another Python function as an example. Look at the following code:

# Takes two numbers and adds them

def addition(a, b):

return a + b

In this function, we've added the ability to input two numbers and add them. Let's convert this same function to JavaScript in the DevTools console. Type the following on a new line in your console:

// Takes two numbers and adds them

function addition(a, b) {

return a + b;

}

To test the new function, type console.log(addition(4, 5));. This is the equivalent of using a print statement in Python to print the function. Like Python, we can condense the code even further by typing only addition(4, 5); to execute the function as well.

**IMPORTANT**

In the "addition" function created above, the items within the parentheses are referred to as **parameters**. For example:

function addition(a, b) { return a + b; }

In this function, data points a and b are the parameters. Think of them as placeholders for the values we will add later, such as 4 and 5.

Functions in JavaScript can have any number of parameters. However, from a practical standpoint, it's not a good idea to have more than two parameters per function. Too many arguments can significantly slow down and even crash your code.

Now practice functions in the following Skill Drill.

**SKILL DRILL**

Practice executing the addition function in your console. Try switching up the numbers and printing it with and without the use of console.log();.

End of text box.

Functions are a versatile tool in any coding language, and JavaScript is no different. Functions can also call other functions. The code below creates a new function that includes our simple function within it. In your console, type the doubleAddition function below:

// Functions can call other functions

function doubleAddition(c, d) {

var total = addition(c, d) \* 2;

return total;

}

Let's run the new function, doubleAddition, with the same figures we used earlier: 4 and 5. Within this function, we're calling our original function (addition) and multiplying the sum of 4 and 5 by 2. We've assigned a variable to the function we've already created, so that we can print the total using a return statement.

So far, we've created a function that performs simple addition and a second function that calls our original function, which is a great introduction to JavaScript functions.

**NOTE**

If the code and output in your console is getting cluttered, type clear() and press Enter to clear the working area of your console.

Once cleared, you won't be able to see the code anymore, but you can still access what you've written by using the up arrow key on your keyboard. This allows you to cycle through the different lines of code you've already executed.

Like functions in Python, JavaScript functions are very versatile and can incorporate many other actions, such as incorporating for loops, which we will explore shortly.

First, let's explore one of the key improvements to JavaScript functions introduced by ES6: arrow functions.

**11.3.3**

# From Simple Functions to Arrow Functions

**Having** been introduced to JavaScript functions, Dana is now feeling a bit more confident about her JavaScript coding skills. She's excited to explore a shortcut followed by JavaScript insiders: arrow functions, which JavaScript experts use to convert standard functions into a single line of code. That's right: a single line.  
  
Dana is excited about this insider trick because her collection of UFO data is somewhat extensive, and she has a feeling that her code will be complex. She also knows that arrow functions are one of the most popular aspects of the ES6 update, so she's eager to further integrate into the JavaScript community by mastering this function type.

Functions in JavaScript can easily become bulky and difficult to understand. Thankfully, any standard function in JavaScript can be refactored into an arrow function. **Arrow functions** complete the same functions as regular functions, but they use a more compact and concise syntax that makes a code script shorter and easier to read. Watch the following video to learn more about arrow functions.

**NOTE**

**Arrow functions** are also known as fat arrow functions because they are introduced with a "fat arrow": =>

This type of function is very similar to how a Python lambda function is written.

Let's take a look at a simple function.

// Simple JavaScript log statement

function printHello() {

return "Hello there!";

}

This function, while already fairly short and sweet, can be condensed even further. In the console, type the following code and then press Enter.

printHello = () => "Hello there!";

When the function is called, our statement will be printed to the console. This is a pretty big change from traditional JavaScript functions.

Let's break down the differences in a bit more detail.

1. The arrow function collapses the function from 3 lines to 1 line, which is a significant reduction in characters.
2. The function keyword is not part of the arrow function. This is because the arrow symbol (=>) indicates that this block (or line) of code is a function.
3. The return keyword and console.log() are removed because with this new syntax, JavaScript inherently knows what will be returned.

Let's convert another function, this time with parameters. Here's the original function:

// Original addition function

function addition(a, b) {

return a + b;

}

In your code editor, type the following:

// Converted to an arrow function

addition = (a, b) => a + b;

Once again, a multi-line function has been reduced to a single line. We have removed the function keyword, the curly brackets, and the return statement, and added a fat arrow to indicate that "addition" is a function. It's clear and easy to read—and it performs the same way as the original function!

Now let's step it up one more time and convert the doubleAddition function, shown below.

// Original doubleAddition function

function doubleAddition(c, d) {

var total = addition(c, d) \* 2;

return total;

}

Even this function can be refactored into a single line. Let's begin the process by following the standard syntax: the name of the function, an equals sign, and then the parameters.

doubleAddition = (c, d)

The next step in refactoring is to add the fat arrow followed by the argument. In this case, the argument is the second function.

=> addition(c, d) \* 2;

**SKILL DRILL**

Use the newly refactored doubleAddition function to find the total of 33 and 25.

End of text box.

Familiarity with both types—traditional functions and arrow functions—is important. Both are used often in development, and by the time we're done with this project, we'll have used a combination of the two.

Also, keep in mind that while arrow functions are clear and readable, there are still cases in which traditional functions are necessary. For example, when we want to place a function within another function, we would need to use a traditional function.

**11.4.1**

# Use a JavaScript for Loop

**The** array containing UFO sightings is huge. Dana knows that iterating through it is inevitable, which means she will definitely need for loops. Feeling bolstered by her practice with arrow functions, Dana is ready to up the difficulty a bit by exploring how to create for loops in JavaScript.

All coding and scripting languages have a way to iterate through items, such as names in a list. In JavaScript, this process is initiated by the keyword "for" and works in the same manner as a Python for loop. Let's see how this works.

Add the following array to your console.

let friends = ["Sarah", "Greg", "Cindy", "Jeff"];

**IMPORTANT**

Like Python, JavaScript uses zero-based indexing. This means that the first item in an array will be assigned an index placement of 0.

As soon as you press Enter, the words "undefined" will appear directly below your line of code. This is how you know that you've successfully executed the line of code and the array has been saved locally.

**NOTE**

Code executed through the console is saved locally, within your system's memory. If you close your console and reopen it, the code will have been erased and you'll need to start over.

To iterate through each name in JavaScript, we can create a for loop. First, type the following in your console:

function listLoop(userList) {

for (var i = 0; i < userList.length; i++) {

console.log(userList[i]);

}

}

Wow, this for loop is pretty involved! Let's compare it to a Python loop and examine the differences.

|  |  |
| --- | --- |
| JavaScript for loop | Python for loop |
| for (var i = 0; i < userList.length; i++) { console.log(userList[i]); } | for i in user\_list: print(i) |

These two loops do the same thing: they iterate through a list and then print each item within it individually. The for keyword at the beginning of the loop is the biggest similarity here, so let's start there.

The keyword for is the trigger that indicates we'll be iterating through a list. The next line in the JavaScript loop does a few different things, though. This one line can be broken down into three sections.

The following actions occur in this one line:

1. var i = 0 We assign an iterable variable and set its value to zero. In this loop, think of the letter 'i' to mean 'iterate.' When we assign a zero value, we're starting a counter from the beginning. You can also think of it in terms of list comprehension–the first name of the list has an index value of zero, for example.
2. i < userList.length; Here we're basically saying, "If this iterable (i) is still smaller than the total number of iterables in the list (userList), then move on to the next step."

So if we're on the second name, but the list is four names long, the for loop will continue to loop through it.

1. The final step, i++, increases the iterable by 1. We're using list comprehension here; the for loop knows to iterate to the next name because the index number has increased by 1.

When the length of i is equal to the total number of items in the list, the for loop will complete its iterations and the next line of code will be executed. For example, Jeff's index position is 3; when i is equal to 3, the loop is complete. This is because there are no names after Jeff's, nothing with an index value of 4.

Since our code says to log, or print, each iteration, the names in the array are printed to the console one at a time.



**11.4.2**

# Practice Using for Loops in JavaScript

**It** took a bit of work to build the code that iterates through an array, so Dana will create a few more to practice the for loop syntax.

First, let's create a for loop to iterate through an array of vegetables. Here's our array:

let vegetables = ["Carrots", "Peas", "Lettuce", "Tomatoes"];

Now we're going to build the for loop. The syntax is exactly the same as it was earlier.

for (var i = 0; i < vegetables.length; i++) {

}

We're using the keyword for to initiate the loop. We also start the loop at the beginning by assigning an iterable as zero with var i = 0;.

Next, we tell the loop to continue working through the array as long as the iterable ("i") is less than the number of vegetables in our array: i < vegetables.length;.

Finally, we increase our iterable by 1 by adding i++; which tells JavaScript to move to the next item in the array until there are no more items.

Let's say we also want each item in the array to be printed to the console. To do this, we'll add a console.log statement inside the curly brackets. Let's add a message to go with each item, too, so it will read "I love [vegetable]" with each iteration.

The final code looks like this:

var vegetables = ["Carrots", "Peas", "Lettuce", "Tomatoes"];

for (var i = 0; i < vegetables.length; i++) {

console.log("I love " + vegetables[i]);

}

Let's practice with one more. This time we'll loop through numbers without using an array.

for (var i = 0; i < 5; i++) {

console.log("I am " + i);

}

The only difference between this loop and the previous one is that we aren't referring to an array. Instead, we are explicitly telling JavaScript to count up to a fifth value.

**11.5.1**

# Introduction to Dynamic Tables

**Dana** is making some headway. She's more familiar with objects and arrays, and she created a few functions, both traditional JavaScript functions and the faster arrow functions. Comparing and writing for loops was a bit challenging; logically, they work in the same manner as a Python for loop, but the code to create one in JavaScript is far more involved! Dana is realizing that becoming proficient in JavaScript requires a lot of practice and patience.  
  
Practice is progress, though, and Dana is now ready to create her table.

Dana's code is somewhat modest right now, but it's about to get a lot more interesting. Now we're going to help her build the table to display all of the UFO sightings. We'll need to iterate through the array of objects in our data file and then append them to a table row. All of this will happen within a function, which makes the code self-contained.

Creating self-contained code makes it easier to reuse the code and keeps us organized: the code in this function will be used to fill the table with data **only**.

Let's get started by returning to our app.js file in the editor and, on a new line, creating a new function.

Typically, functions are named after what they do. We're building a table, so we'll name the function "buildTable." We'll also pass in "data" as the argument. Remember that we used the variable "data" earlier to import our array of UFO sightings? This is the first step in actually working with the data.

In our editor, we should have the start of a new function:

function buildTable(data) {

}

We're using a standard JavaScript function instead of an arrow function because of what we'll be inserting inside the function (hint: another function!). Let's start building out the rest of the function.

In the next line, we'll want to use code to clear existing data.

Clearing the existing data creates a fresh table in which we can insert data. If we didn't clear existing data first, then we would find ourselves reinserting data that already exists, thus creating duplicates and making a bit of a mess. It's good practice to clear the existing data first to give ourselves a clean slate to work with.

The line we'll use to clear the data is tbody.html("");. But how exactly is this code clearing data?

* tbody.html references the table, pointing JavaScript directly to the table in the HTML page we're going to build.
* The parentheses with empty quotes (("");) is an empty string.

Basically, this entire line—tbody.html("");—tells JavaScript to use an empty string when creating the table; in other words, create a blank canvas. This is a standard way to clear data.

Here is what our code looks like with the addition of this line:

function buildTable(data) {

tbody.html("");

}

Now that we have the start of a clean table, let's apply the forEach function.

**11.5.2**

# Add forEach to Your Table

**Now** Dana is ready to start adding data to her table. To do so, she'll need to create another function specifically for building the table. Data from the data.js file will be inserted into the table, row by row. This sounds like iterating through an array using a for loopforEach, doesn't it?  
  
This time, we'll use a forEach function, which loops through the array in the same way as a for loop. The difference is that forEach works only with arrays. Another benefit is that forEach can be combined with an arrow function, once again making the code more concise and easy to read.

In the next step, we'll incorporate a forEach function that loops through our data array, and then adds rows of data to the table. The following video provides an overview of how forEach functions work.

## Add the forEach Function

This function works in the same way as a for loop. In your code editor, type the following:

data.forEach((dataRow) => {

});

Notice the fat arrow? We're using an arrow function here because it's a cleaner way to write a forEach loop. There's nothing wrong with using a traditional for loop—the code would behave in the exact same manner—but it is neater and easier to read.

With this new function, we have essentially chained a for loop to our data. We also added an argument (dataRow) that will represent each row of the data as we iterate through the array. Now we want to create a variable that will append a row to the table body. Within this forEach function, add the following code:

let row = tbody.append("tr");

**NOTE**

Notice that we're using let instead of var to declare the row variable. That's because this variable is limited to just this block of code. It's more appropriate to use var when we want the variable to be available globally, or throughout all of the code.

This single line of code is doing a lot. It tells JavaScript to find the <tbody> tag within the HTML and add a table row ("tr").

We'll get back to HTML when it's time to display our table, but for now keep in mind that the <tr> tags are used for each row in a table. Each object, or UFO sighting, in the array will be wrapped in a <tr> tag.

## Loop Through Data Rows

Next, we'll add code to loop through each field in the dataRow argument. These fields will become table data and will be wrapped in <td> tags when they're appended to the HTML table. It gets a little confusing here, but we're going to set up another function within our original function for the forEach loop.

Below the line where we appended table rows, we'll set up another function:

Object.values(dataRow).forEach((val) => {

});

We're already working with an array of objects, where each object is a UFO sighting. By starting our line of code with Object.values, we're telling JavaScript to reference one object from the array of UFO sightings. By adding (dataRow) as the argument, we are saying that we want the values to go into the dataRow. We've added forEach((val) to specify that we want one object per row.

Let's think of it this way: we're telling our code put each sighting onto its own row of data. The val argument represents each item in the object, such as the location, shape, or duration.

In the next two lines of code, we'll append each value of the object to a cell in the table. In our editor, the next few lines of code will go inside our new function. Let's first create a variable to append data to a table:

let cell = row.append("td");

With this line, we've set up the action of appending data into a table data tag (<td>). Now, in the next line we'll add the values.

cell.text(val);

Let's take a look at our fully assembled function:

data.forEach((dataRow) => {

let row = tbody.append("tr");

Object.values(dataRow).forEach((val) => {

let cell = row.append("td");

cell.text(val);

}

);

});

With this function, we have done the following:

* Looped through each object in the array
* Appended a row to the HTML table
* Added each value from the object into a cell

For example, this is the very first object in our array:

{

datetime: "1/1/2010",

city: "benton",

state: "ar",

country: "us",

shape: "circle",

durationMinutes: "5 mins.",

comments: "4 bright green circles high in the sky going in circles then one bright green light at my front door."

},

The code we just wrote will turn this object into a clean table like the one below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Date | City | State | Country | Shape | Duration | Comments |
| 1/1/2010 | benton | ar | us | circle | 5 mins | 4 bright green circles high in the sky going in circles then one bright green light at my front door. |

Also, because we've added forEach, every object in the array will be added to its own row in the table. We'll be able to test it fully soon, but first we need to add filters to the table. (We'll get to this step soon.)

The complete buildTable function we created should match the one below. It's also a good idea to add comments to help us keep track of what our code is doing.

function buildTable(data) {

// First, clear out any existing data

tbody.html("");

// Next, loop through each object in the data

// and append a row and cells for each value in the row

data.forEach((dataRow) => {

// Append a row to the table body

let row = tbody.append("tr");

// Loop through each field in the dataRow and add

// each value as a table cell (td)

Object.values(dataRow).forEach((val) => {

let cell = row.append("td");

cell.text(val);

}

);

});

}

The first step of our code is complete: we've created a table!

**ADD/COMMIT/PUSH**

Be sure to save your work and add

**11.5.3**

# Add Filters

**The** code we helped create will add every object in ou data.js file to the table. Bundled into one tidy package, every sighting will be available for Dana (and her readers) to view! There are a lot of objects, though, which will make the table huge! There will be hundreds of rows of sightings in the table, which is entirely too much for one person to reasonably look through and study. Therefore, the next step is to add the ability to filter the data. We'll be using D3.js to help Dana with this part.  
  
Data-Driven Documents (D3 for short) is a JavaScript library that adds interactive functionality, such as when users click a button to filter a table. It works by "listening" for events, such as a button click, then reacts according to the code we've created.  
  
Dana thinks that she would like to filter by date, so she'll add code to create a date filter.

We'll need to add a second function to our code that will focus on filtering the table we just built. We'll use a popular library, D3.js, to equip our website to "listen" for events, such as a user clicking a button.

In our code, we're going to use D3 to handle an action from a user, such as a button click. This means that we'll add an actual button to our HTML page to filter the table. When the button is clicked, D3 will detect the click and react accordingly. Building out user-driven data visualizations is an essential part of the data visualization job; it can be tricky at first, but oh-so-satisfying when it works! Let's get started.

Return to VS Code and our app.js file and start a new function. We'll name this one "handleClick" because it will be handling what to do after an input is given, such as filtering the table by date.

Let's go ahead and set up the function.

Since we're adding a date function, we need to create a couple of variables to hold our date data, both filtered and unfiltered.

function handleClick() {

let date = d3.select("#datetime").property("value");

So what's going on in this code? D3 looks a little different from what we're used to seeing, but that's because it's closely linked to HTML.

The .select() function is a very common one used in D3. It will select the very first element that matches our selector string: "#datetime". The selector string is the item we're telling D3.js to look for.

With d3.select("#datetime"), for example, we're telling D3 to look for the #datetime id in the HTML tags. We haven't created our HTML yet, but we know that the date value will be nested within tags that have an id of "datetime."

By chaining .property("value"); to the d3.select function, we're telling D3 not only to look for where our date values are stored on the webpage, but to actually grab that information and hold it in the "date" variable.

Now we need to set a default filter and save it to a new variable. Our default filter will actually be the original table data because we want users to refine their search on their own terms. Let's add the new variable on the next line.

let filteredData = tableData;

Here's a variable we haven't seen in a while: tableData. This is the original data as imported from our data.js file. By setting the filteredData variable to our raw data, we're basically using it as a blank slate. The function we're working on right now will be run each time the filter button is clicked on the website. If no date has been entered as a filter, then all of the data will be returned instead.

The next step is to check for a date filter using an if statement.

**11.5.4**

# Use the “If” Statement

**Navigating** through functions and for loops in JavaScript has helped Dana feel more comfortable with coding in this new language. The next part she'll start working on is adding an if statement.  
  
The if statement in JavaScript is similar to the Pythonic if statement, though the syntax is a little alien in comparison. Dana will need to explore how to create if statements in JavaScript and then incorporate it into her code as part of the filtering component.

Much like in Python, an if statement in JavaScript will check for conditions before executing the code. Our code will check for a date filter, so our if statement should read as follows; "If there is a date already set, then use that date as a filter. If not, then return the default data."

Look at a basic JavaScript if statement, but just for practice as this won't be part of our app.js code.

// if-statement syntax

if ( condition ) { code to execute }

In its most basic form, the if statement looks similar to a function. Write pseudocode about what we want our code to do.

// pseudocode practice

if (a date is entered) {

Filter the default data to show only the date entered

};

That makes a little more sense. We want JavaScript to check for a date. If one is present, we want it to return only the data with that date. Now return to our app.js file to add our if statement.

if (date) {

filteredData = filteredData.filter(row => row.datetime === date);

};

Take a closer look at the line that's inside our if-statement.

Take a look at the syntax for the .filter() method: row => row.datetime === date);. This line is what applies the filter to the table data. It's basically saying, "Show only the rows where the date is equal to the date filter we created above." The triple equal signs test for equality, meaning that the date in the table has to match our filter exactly.

**IMPORTANT**

There are two ways to test for equality in JavaScript: == and ===. While they look similar, there are differences. A triple equal sign (===) is checking for **strict equality**. This means that the type and value have to match perfectly.

A double equals sign (==) is checking for **loose equality**. This means that the type and value are loosely matched. For more information about equality in JavaScript, read [JavaScript — Double Equals vs. Triple Equals (Links to an external site.)](https://codeburst.io/javascript-double-equals-vs-triple-equals-61d4ce5a121a).

When we look at our complete if statement, it should appear as follows:

if (date) {

filteredData = filteredData.filter(row => row.datetime === date);

};

This is great! Our handleClick() function tells the code what to do when an event occurs (such as someone clicking a filter button), and it can apply that filtered data using an if statement. Being able to do all of this is great, especially since it involves creating functions written in a syntax that isn't the easiest to learn. There is one more step to complete with this function, though: building the table using the filtered data.

## Build the Filtered Table

Thankfully, we've already set up a function to build a table: buildTable();. Now we just need to call it. Remember, we're building the function with the filtered data, so we'll use that variable as our argument.

Under our if-statement, let's call the buildTablefunction.

After we pass filteredData in as our new argument, our full handleClick() function should look like the one below:

function handleClick() {

// Grab the datetime value from the filter

let date = d3.select("#datetime").property("value");

let filteredData = tableData;

// Check to see if a date was entered and filter the

// data using that date.

if (date) {

// Apply `filter` to the table data to only keep the

// rows where the `datetime` value matches the filter value

filteredData = filteredData.filter(row => row.datetime === date);

};

// Rebuild the table using the filtered data

// @NOTE: If no date was entered, then filteredData will

// just be the original tableData.

buildTable(filteredData);

};

## Listen for the Event

Our code is almost ready to be attached to the HTML component of our webpage. There are just a couple of loose ends to tie up. One is the clicking that will happen when someone filters the table. We have a function that handles a click, but how does the code know when a click happens?

Another aspect of D3.js is that it can listen for events that occur on a webpage, such as a button click. The next code we add will be tied to the filter button we'll build on our webpage.

Under our handleClick() function, add the following line of code:

d3.selectAll("#filter-btn").on("click", handleClick);

Our selector string contains the id for another HTML tag. (We'll assign a unique id to a button element in the HTML called "filter-btn".) This time it'll be included in the button tags we create for our filter button. By adding this, we're linking our code directly to the filter button. Also, by adding .on("click", handleClick);, we're telling D3 to execute our handleClick() function when the button with an id of filter-btn is clicked.

**NOTE**

A "click" isn't the only event that D3.js can listen for—there are a variety of actions that can be listened for and handled. For example, a tooltip displays when you place your mouse over a specific element on a webpage.

Events aren't limited to mouse events, either. They can include keyboard, text composition, forms—the list is lengthy and some of the events are quite advanced.

## Build the Final Table

There is only a single step left before we can build the HTML component of the webpage: making sure the table loads as soon as the page does. Dana's readers will need to see the original table to even begin to use the filter we've set up. At the very end of the code, we'll call our buildTable function once more—this time using the original data we've imported. Type the following code:

buildTable(tableData);

Once this function is called, it will create a basic table filled with row upon row of unfiltered data pulled straight from our array.

All together, our code in the app.js file will look as follows:

function handleClick() {

// Grab the datetime value from the filter

let date = d3.select("#datetime").property("value");

let filteredData = tableData;

// Check to see if a date was entered and filter the

// data using that date.

if (date) {

// Apply `filter` to the table data to only keep the

// rows where the `datetime` value matches the filter value

filteredData = filteredData.filter(row => row.datetime === date);

}

// Rebuild the table using the filtered data

// @NOTE: If no date was entered, then filteredData will

// just be the original tableData.

buildTable(filteredData);

}

// Attach an event to listen for the form button

d3.selectAll("#filter-btn").on("click", handleClick);

// Build the table when the page loads

buildTable(tableData);

Now you're ready to start building your webpage!

**ADD/COMMIT/PUSH**

Make sure to save your work and add, commit, and push it to your repo!