

## LAB 9

# JAVASCRIPT 2: DOM AND EVENTS

### What You Will Learn

- Accessing and modifying DOM HTML elements using JavaScript
- Creating event listeners to react to events
- Tools and tricks to help you develop JavaScript

### Approximate Time

The exercises in this lab should take approximately 90 minutes to complete.

## Fundamentals of Web Development, 3<sup>rd</sup> Ed

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# THE DOCUMENT OBJECT MODEL (DOM)

## PREPARING DIRECTORIES

- 1 If you haven't done so already, create a folder in your personal drive for all the labs for this book.
- 2 Copy the folder titled lab08 to your course folder created in step one. This lab09 folder could be provided by your instructor, or you could clone it from GitHub repo for this lab.

In the previous lab, you used the `document.write()` function as a way to manipulate markup using JavaScript. While fine from a learning JavaScript perspective, it is generally not how one typically uses JavaScript. In the first part of this lab, you will learn how to use the Document Object Model (DOM) with JavaScript as a “better” way of manipulating content.

## Exercise 9.1 — THE DOCUMENT OBJECT

- 1 Examine lab09-ex01.html in your browser and then in your editor of choice.  
*Notice that it references a JavaScript file at the end of the markup. To better understand the rest of the steps in this exercise, you should continually refer back to the markup.*
- 2 Display the JavaScript console in your browser and enter the following command in the console:  
**`console.dir(document)`**  
*This provides a hierarchical view of the document object, which allows you to examine the different properties and methods within this object.*
- 3 Examine some of these properties and methods. Notice that some of these properties are hierarchical themselves (e.g., the `all` property, which is a collection of all the elements in the document).  
*What you are doing when working with the DOM is work with the document object.*

## Exercise 9.2 — BASIC DOM SELECTION

- 1 Examine lab09-ex02.html in your browser. This is the same file except for the addition of a `<script>` element.
- 2 Edit js/lab09-ex02.js by adding the following and then testing lab09-ex02.html in browser.  
**`const msg = document.getElementById("msg");  
msg.value = "this text is generated by JavaScript";`**  
*This selects the `<textarea>` element and sets its value.*
- 3 Add the following code and test.  
**`const legend = document.getElementById("title");  
legend.textContent = "Dynamically generated";`**

The `textContent` property allows you to modify the content of an element.

- 4 Replace the two previous lines with the following single line and test:

```
document.getElementById("title").textContent = "Dynamically generated";
```

JavaScript developers often try to reduce the number of variables that get added into scope by using a technique similar to this.

- 5 Comment out the previous line and add the following code and test.

```
const legend = document.getElementById("title");  
legend.innerHTML = "Dynamic with <span>HTML</span> added";
```

Notice that you can “inject” HTML into the content of an element. As we shall see below, while easy, we often want to take a more complicated route when adding HTML elements to a document in order to ensure new content gets added to the DOM tree.

- 6 Modify the code as follows and test.

```
const legend = document.getElementsByTagName("legend");  
legend[0].innerHTML = "Dynamic with <span>HTML</span> added";
```

Here you are using a different selection method, that returns a list of `<Legend>` elements. It doesn't matter if there is only a single `<Legend>` element, the `getElementsByTagName` method always returns a node list (essentially an array).

- 7 Add the following and test:

```
const labels = document.getElementsByClassName("input-labels");  
for (let lab of labels) {  
  lab.style.backgroundColor = "#FFF0F0";  
}
```

Since `getElementsByClassName` returns a node list, we can iterate through it. In this example, we programmatically alter the `background-color` CSS property.

- 8 Add the following code and test.

```
document.querySelector("#msg").style.color = "#E4F0F5";
```

The `querySelector` method allows you to select a single element using a CSS selector.

- 9 Add the following code and test.

```
const inputs = document.querySelectorAll("input[type=text]");  
for (let inp of inputs) {  
  inp.style.backgroundColor = "#E4F0F5";  
}
```

The `querySelectorAll` method allows you to select multiple elements using a CSS selector.

**TEST YOUR KNOWLEDGE #1**

Examine lab09-test01.html and then open lab09-test01.js in your editor. Modify the JavaScript file to implement the following functionality.

- 1 Use `getElementById` to add a border via CSS to the `<ul>` element with the name "thumb-list".
- 2 Use `querySelector` to set the value property of the `<textarea>` to the text content of the `<p>` element.
- 3 Use `querySelectorAll` to add a box shadow to each of the `<img>` elements within the `<ul>` element. The CSS property name is `box-shadow` so the JavaScript DOM property name will be `boxShadow`. To see a sample box-shadow, look at the example for the `box` class in `lab09-ex01.css`. Remember that you will need to use a loop. The result should look similar to that shown in Figure 9.1.

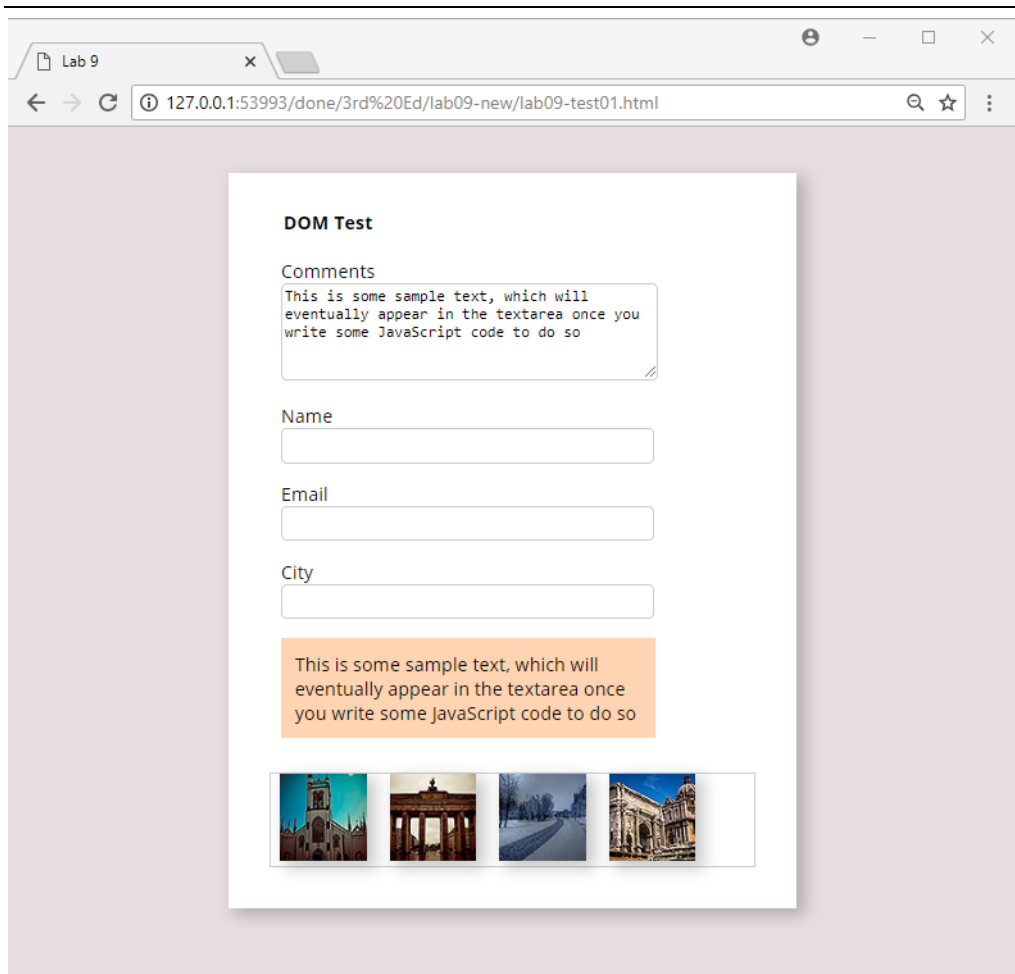


Figure 9.1 – Finished Test Your Knowledge #1

**EXERCISE 9.3 — MODIFYING THE DOM**

- 1 Examine lab09-ex03.html in your browser. This is the same file as previous exercise. Open lab09-ex03.js, add the following, and test.

```
// select the <ul>
const list = document.querySelector("#thumb-list");

// create list item <li>
const item = document.createElement("li");

// create <img> element and set its src attribute
const img = document.createElement("img");
img.setAttribute("src", "images/8710320515.jpg");

// nest the <img> in the <li>
item.appendChild(img);

// add the <li> to the already existing <li> elements
list.appendChild(item);
```

*This illustrates the proper way to dynamically add HTML elements to a document. As you can see, this code adds a new image to your list.*

- 2 Comment out the last line in the last step and add the following and test.

```
// add another one at the start of the list
list.insertAdjacentElement('afterbegin',img);
```

*As you can see, this adds the new image to the beginning of the list.*

- 3 Add the following lines and test.

```
// remove the last <li>
document.querySelector("#thumb-list li:last-child").remove();
```

*This deletes the last <li> elements.*

## EVENT HANDLING

One of the most common uses of JavaScript is to use it to respond to different user-initiated actions. These are generally referred to as **events** and the JavaScript that responds to these events are called **event handlers**. As the textbook indicates, the preferred approach is to use event listeners.

**EXERCISE 9.4 — SIMPLE EVENT HANDLING**

- 1 Examine lab09-ex04.html in your browser. Open lab09-ex04.js then add the following and test.

```
function simpleHandler(event) {
    alert("button was clicked");
}

var btn = document.getElementById("firstButton");
btn.addEventListener("click", simpleHandler);
```

*This defines an event handler function and assigns it to the click event of the first*

button. It is quite common to instead use an anonymous function for the event handler, as shown in the next steps.

- 3 Add the following code and test.

```
const btn = document.getElementById("firstButton");
btn.addEventListener('click', function () {
    alert("a different approach but same result");
});
```

While this takes a bit of getting used to, it is an extremely common way of doing JavaScript event coding.

- 4 What if we wanted the same event handler for all three buttons? Add the following code and test.

```
// illustrates one event handler for multiple events
const buttons = document.querySelectorAll(".card button");
for (let btn of buttons) {
    btn.addEventListener('click', function () {
        alert("now just one handler");
    });
}
```

Notice how this selects a collection of elements and then loops through them to assign event handlers. But what if we wanted to know more about the element that generated the event?

- 5 Modify the code as follows and test.

```
for (let btn of buttons) {
    btn.addEventListener('click', function (e) {
        let para = e.target.previousElementSibling;
        alert(para.textContent);
    });
}
```

Notice the use of the event object parameter (the variable named *e*). It provides us with information about the generating event.

- 6 Add the following code and test by moving mouse in and out of the images.

```
// illustrates the assigning of multiple handlers to the same object
const images = document.querySelectorAll(".card img");
for (let img of images) {
    img.addEventListener('mouseover', function (e) {
        e.target.classList.add('sepia');
    });
    img.addEventListener('mouseout', function (e) {
        e.target.classList.remove('sepia');
    });
}
```

This applies a CSS filter dynamically to the card image when you mouse over the image, and removes the filter when the mouse is moved out of the image.

## EXERCISE 9.5 — RESPONDING TO LOAD EVENTS

- 1 You are going to continue working with the file from the previous exercise. In lab09-ex04.html move the `<script src="js/lab09-ex04.js"></script>` from the end of the document to within the `<head>` element instead.
- 3 Test. Display the JavaScript console in your browser  
*Depending on your browser and version, you may or may not get a console error. The code will likely no longer work. Why?*
- 4 The reason it no longer works is that the script is now executed **before** the DOM is fully loaded. To make the script execute **after** the DOM is loaded we must make use of the `onload` event. Try this yourself by moving the event handling code inside of a listener for the `load` event as follows (and then test):

```
// don't set up event handlers until DOM is loaded
window.addEventListener('load', function () {

    // illustrates one event handler for multiple events
    const buttons = document.querySelectorAll(".card button");
    for (let btn of buttons) {
        btn.addEventListener('click', function (e) {
            let para = e.target.previousElementSibling;
            alert(para.textContent);
        });
    }

    // illustrates the assigning of multiple handlers to the same object
    const images = document.querySelectorAll(".card img");
    for (let img of images) {
        img.addEventListener('mouseover', function (e) {
            e.target.classList.add('sepia');
        });
        img.addEventListener('mouseout', function (e) {
            e.target.classList.remove('sepia');
        });
    }

});
```

## TEST YOUR KNOWLEDGE #2

Examine lab09-test02.html, view in browser, and then open lab09-test02.js in your editor. Modify the JavaScript file to implement the following functionality.

- 1 Add an event handler for the click event of each `<div>` with the `panel` class. Be sure to assign this event handler after the DOM is loaded (i.e., after the `window load` event).

In this event handler you are going to either add or remove the class `'open'` from the clicked panel (this will either expand or shrink the panel back to its original size. This can be achieved easily using the `toggle()` method of the `classList` property (see <https://developer.mozilla.org/en-US/docs/Web/API/Element/classList> for more information). The result should look similar to Figure 9.2 when panel is opened with a click.

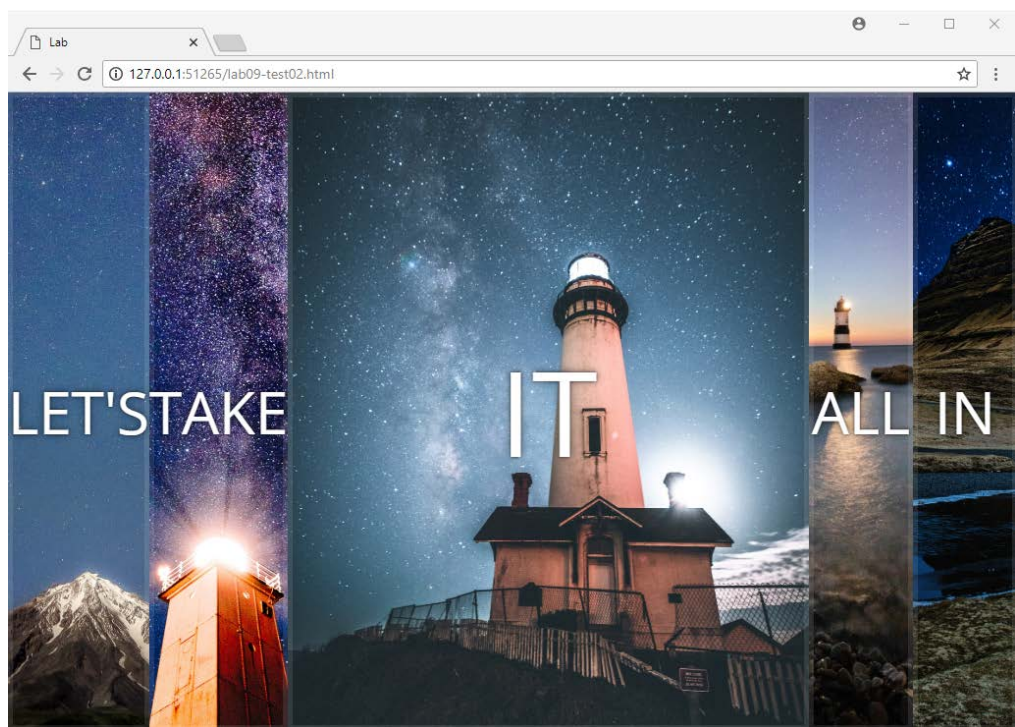


Figure 9.2 – Finished Test Your Knowledge #2

### EXERCISE 9.6 — RESPONDING TO KEYBOARD EVENTS

- 1 Examine lab09-ex06.html in your browser.

Notice the series of `<audio>` elements. Each of these elements contains a `data-key` attribute. The `data-*` attribute is a mechanism within HTML5 for adding custom information to an element. In this example, it will be used by our JavaScript for looking up the appropriate sound to play.

- 2 Open lab09-ex06.js and add the following code and test by pressing the 'g' key.

```

window.addEventListener('load', function() {
    // when key is pressed play a sound if correct key
    document.addEventListener('keypress', playSound);

    function playSound(e) {
        // initially let's just play the sound for data-key=g
        const audio = document.querySelector(`audio[data-key="g"]`);
        // since audio sound takes some time to play, we can reset the
        // current time to zero so that it is more responsive to multiple
        // fast key presses
        audio.currentTime = 0;
        // now play sound at beginning
        audio.play();
    }
}

```

There is not a lot of keyboard handling here: instead the focus is on selecting an `<audio>` element and playing the sound file specified in the element.



- 3 Modify the code as follows and test by pressing the keys a, s, d, f, g, h, j, k, l

```
function playSound(e) {
  // first determine the key that was pressed from event arg
  const keyPressed = e.key;

  // select the <audio> element corresponding to the pressed key
  const audio =
    document.querySelector(`audio[data-key="${keyPressed}"]`);

  // if key doesn't have <audio> element then exit
  if (!audio) return;

  ...
  audio.play();
}
```

All nine sounds sound play when their associated key is pressed. Right now, there is no visual cue for the key being pressed. The next steps will make use of some already existing CSS classes to add some visual transition effects.

- 4 Modify the code as follows and test.

```
// if key doesn't have <audio> element then exit
if (!audio) return;

// select the <div> element corresponding to the pressed key
const div =
  document.querySelector(`div.key[data-key="${keyPressed}"]`);

// add glowing box class to it
div.classList.add('playing');
```

A glowing yellow box should now be showing up around the <div> on screen associated with the pressed key. The <div> also grows a bit in size. However the effects never goes away.

- 5 You can make the yellow box go away by responding to another event. Before doing that, open lab09-ex06.css and look at the .key and .playing CSS classes. Notice the transition property? It specifies the length of time for all changes in visual state in the element assigned to this class. It is assigned to the <div> elements with the key and sound name (e.g., <div data-key="g" class="key">). The code in the previous step dynamically assigned the .playing class to the same <div> element, which means the scale, border-color, and box-shadow properties transitioned across .07sec. The ending of that transition is an event that can be responded to in JavaScript.

- 6 Modify the code as follows and test:

```

window.addEventListener('load', function() {
  // when key is pressed play a sound if correct key
  document.addEventListener('keypress', playSound);

  // to remove the box around the div for the key, we will listen for any
  // transition-end event (in this case, used by the .key class elements)
  const keys = document.querySelectorAll('.key');
  for (let key of keys) {
    key.addEventListener('transitionend', removeTransition)
  }

  function removeTransition(e) {
    // skip if not a transform transition
    if (e.propertyName !== 'transform') return;
    // right transition so remove the .playing class from .key
    this.classList.remove('playing');
  }
}

```

This exercise inspired from Wes Bos's JavaScript 30 sample project (<https://javascript30.com/>), and is used with permission.

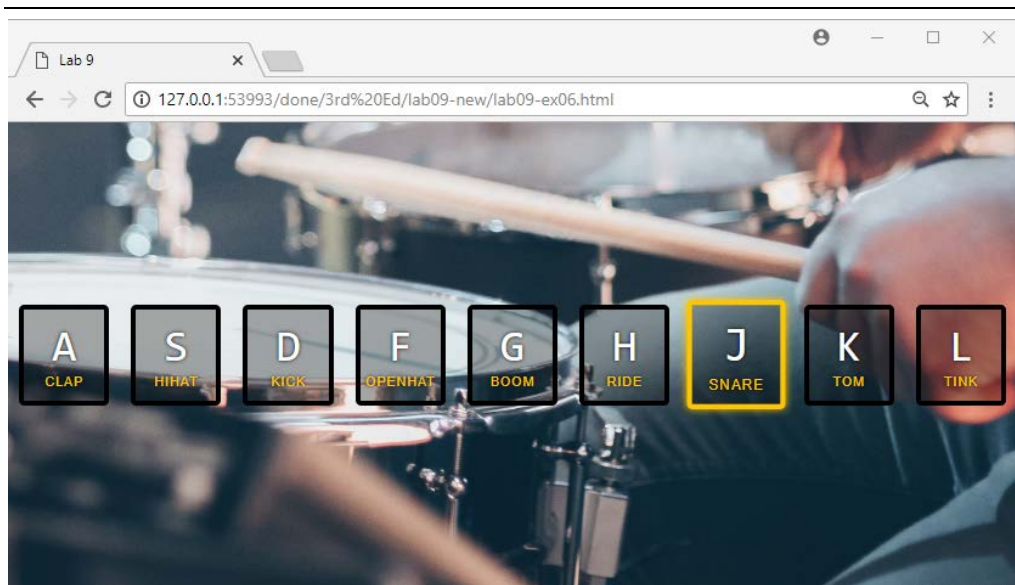


Figure 9.3 – Finished Exercise 9.6

## EXERCISE 9.7 — DEBUGGING EVENTS

- 1 You are going to continue working with the file from the previous exercise.
- 2 In Chrome, to access the debugger, you have to click on the Sources tab within the Console and then open the JavaScript file (lab09-ex06.js) that you wish to debug. You will now add a breakpoint to your script by clicking to the left of the first non-comment line within `playSound()` function.
- 3 Try refreshing the page and then pressing the 'g' key. The line with the breakpoint will be highlighted as shown in Figure 9.4. You can now examine the state of local and global variables.

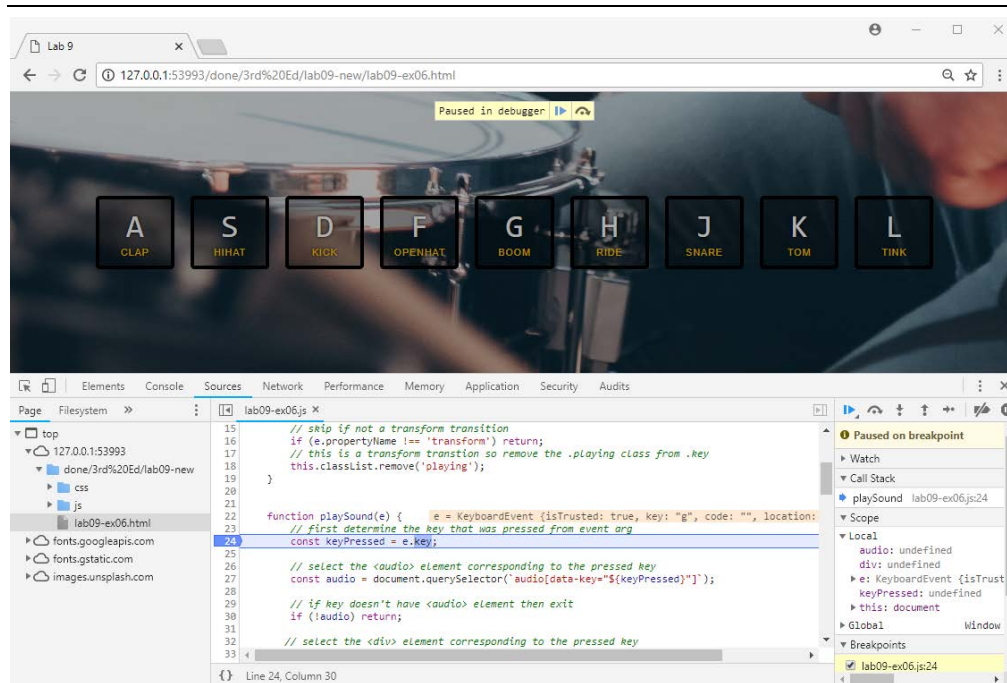




Figure 9.4 – Chrome Debugging

- 4 Once you have set a breakpoint, you can resume execution of the script or continue execution line-by-line using the execution buttons:



- 5 Execute the next line of the code by pressing the Step button  (or pressing F11). Notice the `keyPressed` variable in the Scope panel now shows a value.
- 6 Add another breakpoint on the last line of the function.
- 7 Press the Resume button  (or press F8). The intervening lines will be executed and will stop at the new breakpoint. Notice how you can open up and examine the object variables `audio` and `div`.
- 8 Remove breakpoints by clicking on each of the blue breakpoint indicators and refresh the page.

**EXERCISE 9.8 — WORKING WITH FORMS**

- 1 Examine lab09-ex08.html in your browser.
- 2 Add the following function to lab09-ex08.js:

```
function setBackground(e) {
  if (e.type == "focus") {
    e.target.style.backgroundColor = "#FFE393";
  }
  else if (e.type == "blur") {
    e.target.style.backgroundColor = "white";
  }
}
```

*This function is going to get called every time the focus or blur events are triggered in one of our form's input elements.*

- 3 Add the following code:

```
window.addEventListener("load", function(){
  const cssSelector = "input[type=text],input[type=password]";
  const fields = document.querySelectorAll(cssSelector);

  for (let field of fields) {
    field.addEventListener("focus", setBackground);
    field.addEventListener("blur", setBackground);
  }
});
```

*This assigns an anonymous function to the load event of the browser. The function assigns the setBackground() to the blur and focus events of the relevant <input> elements.*

- 4 Test in browser. Tab between the different elements.

**EXERCISE 9.9 — FORM VALIDATION**

- 1 You are going to continue working with the file from the previous exercise.
- 2 Examine lab09-ex09.html and then add the following code to lab09-ex09.js.

```
for (let field of fields) {
  field.addEventListener("focus", setBackground);
  field.addEventListener("blur", setBackground);
}

// when user submits form, check for empty fields
document.querySelector('#sampleForm').addEventListener('submit',
  checkForEmptyFields);

/* ensures form fields are not empty */
function checkForEmptyFields(e) {
  // Loop thru the input elements looking for empty values
  const errorList = [];
  for (let field of fields) {
    if (field.value == null || field.value == "") {
      // since a field is empty prevent the form submission
      e.preventDefault();
      errorList.push(field);
    }
  }
}
```

```

// now display the error message if any
var msg = "The following fields can't be empty: ";
if (errorList.length > 0) {
  for (let errorField of errorList) {
    msg += errorField.id + ", ";
  }
  alert(msg);
}
});

```

2 Test in browser. Experiment by filling in different fields.

3 Modify the `checkforEmptyFields()` function by adding the following:

```

const errorList = [];
for (let field of fields) {
  if (field.value == null || field.value == "") {
    // since a field is empty prevent the form submission
    e.preventDefault();
    errorList.push(field);
  }
}

// hide the error message element
const errorArea = document.getElementById("errors");
errorArea.className = "hidden";

// now display the error message if any
var msg = "The following fields can't be empty: ";
if (errorList.length > 0) {
  for (let errorField of errorList) {
    msg += errorField.id + ", ";
  }
  errorArea.innerHTML = "<p>" + msg + "</p>";
  errorArea.className = "visible";
}

```

Instead of displaying the error message inside an alert box this places it within a `<div>` element. The result should look similar to that shown in Figure 9.6.

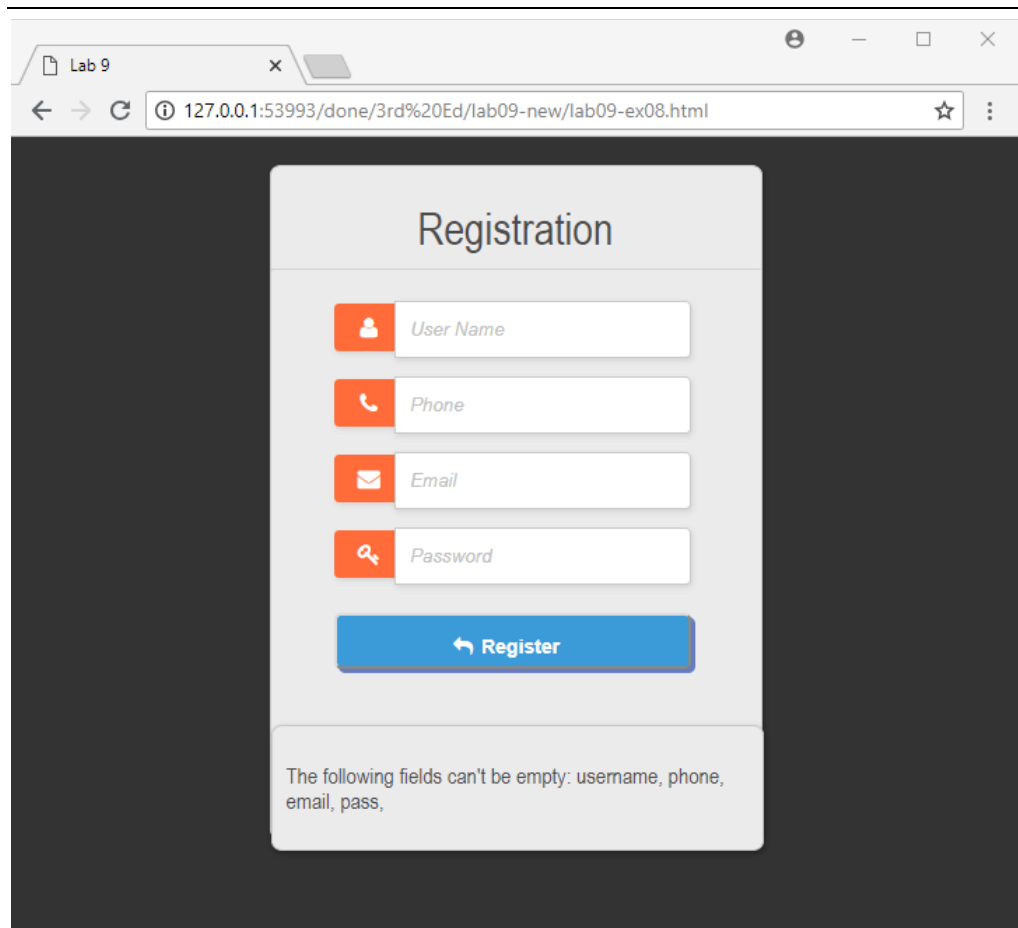


Figure 9.5 – Finished Exercise 9.8

### EXERCISE 9.10 — JSON DATA AND EVENT DELEGATION

- 1 Examine `js/stocks.json` in your browser. Recall from Chapter 8 that JSON format is often used to transport data for JavaScript consumption. Here we will simply be reading the JSON data from a file. Next chapter we will be receiving it from an external API.

- 2 Add the following code to `lab09-ex10.js` and then test.

```
const stocks = JSON.parse(stockData);
console.dir(stocks);
```

You should be able to see `stocks` is an array of objects, each one representing a single stock symbol.

- 3 Add the following and test.

```
window.addEventListener("load", function() {
  const main = document.querySelector('main');
  // Loop through stock data and output each one in a div
  for (let stock of stocks) {
    // create img and div container for img
    let img = document.createElement('img');
    img.setAttribute('src', `images/logos/${stock.symbol}.svg`);
    img.setAttribute('title', stock.symbol);
```

```

    let div = document.createElement('div');
    div.setAttribute('class', 'item');

    // add img to div and div to <main>
    div.appendChild(img);
    main.appendChild(div);
  }
});

```

You should now see about 70 company logos.

- 4 When the user clicks on a logo, we want to display more information about that company. Instead of looping through each image and assign event handlers to each, we will instead use event delegation. Add the following after the code from previous step:

```

// use delegation to handle click events for all the images
document.querySelector('main')
  .addEventListener('click', function (e) {
    // verify user has clicked on image within <main>
    if (e.target && e.target.nodeName.toLowerCase() == "img") {
      populateAside(e);
    }
  });

```

- 5 Now write the action for the click. In our case, you are going to populate the table in the <aside> element with the relevant company data contained in our stocks array. Add the following and test.

```

function populateAside(e) {
  // determine the clicked symbol name from clicked image
  let clickedSymbolName = e.target.getAttribute('title');

  // search through stocks array looking for symbol that matches
  var foundSymbol = stocks.find(function(element) {
    return element.symbol === clickedSymbolName;
  });

  // display aside (hidden initially)
  let aside = document.querySelector('aside');
  aside.style.display = "block";

  let logo = document.querySelector('#logo img');
  let symbol = document.querySelector('#symbol');
  let name = document.querySelector('#name');
  let sector = document.querySelector('#sector');
  let sub = document.querySelector('#sub');

  // populate table with data
  logo.setAttribute('src', `images/logos/${foundSymbol.symbol}.svg`);
  symbol.textContent = foundSymbol.symbol;
  name.textContent = foundSymbol.name;
  sector.textContent = foundSymbol.sector;
  sub.textContent = foundSymbol.subIndustry;
}

```

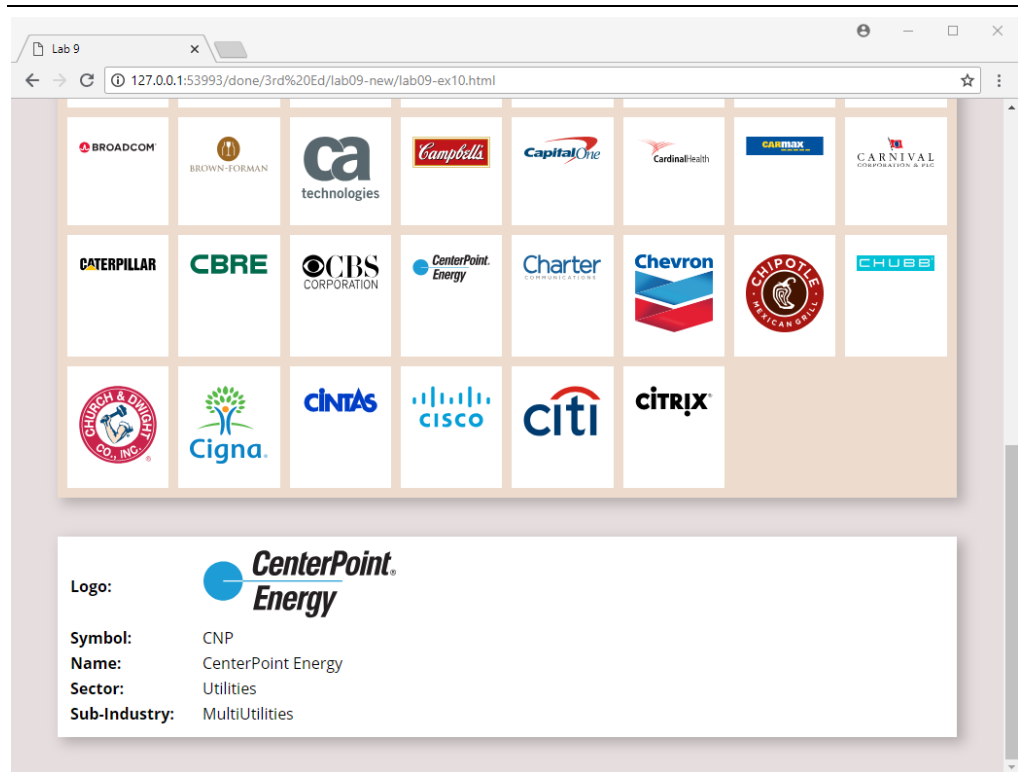


Figure 9.6 – Finished Exercise 9.10

### TEST YOUR KNOWLEDGE #3

Examine `lab09-test03.html`, view in browser, and then open `lab09-test03.js` in your editor. Modify the JavaScript file to implement the following functionality.

- 1 You are going to need three event handlers. The first will be a click handler for each thumbnail image. In the handler, replace the `src` attribute of the `<img>` element in the `<figure>` so that it displays the clicked thumbnail. Hint: get the `src` attribute of the clicked element and then replace the `small` folder name with `medium` folder name
- 2 As well, change the `<figcaption>` so that it displays the newly clicked painting's title and artist information. This information is contained within the `alt` and `title` attributes of each thumbnail.
- 3 Set up an event listener for the input event of each of the range sliders. The code is going to set the filter properties on the image in the `<figure>`. Recall from Chapter 7 that if you are setting multiple filters, they have to be included together separated by spaces. This listener must use event delegation.
- 4 Add a listener for the click event of the reset button. This will simply remove the filters from the image by setting the filter property to none.



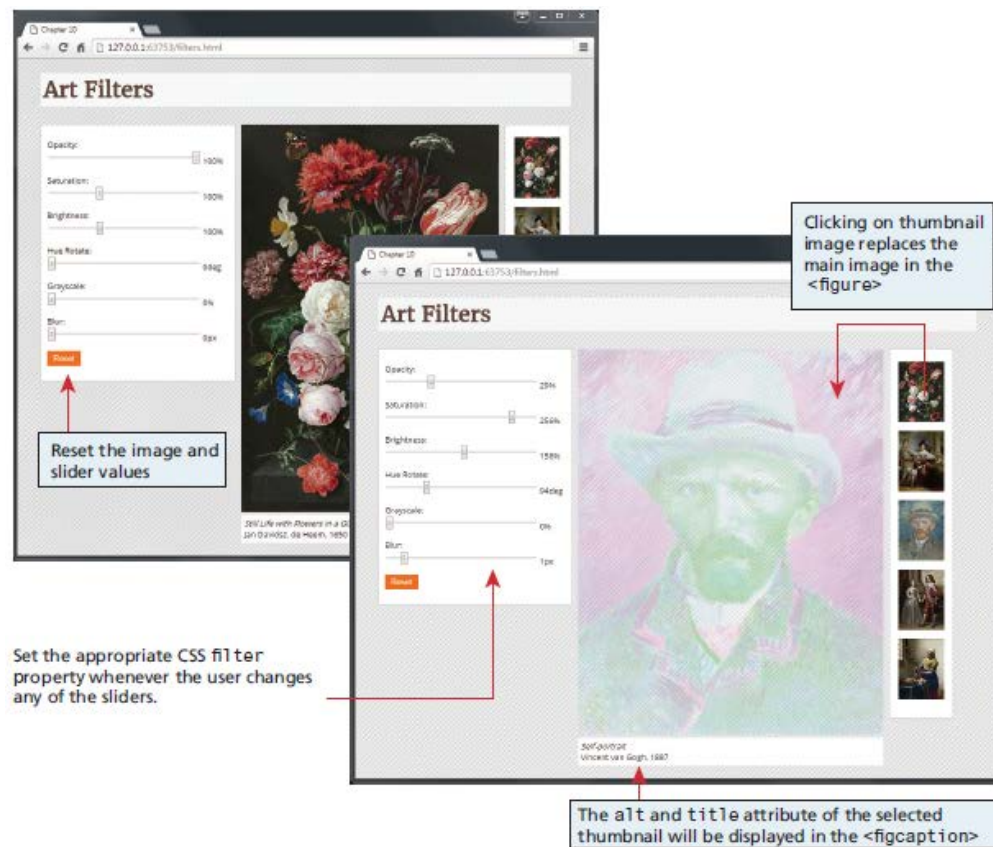


Figure 9.7 –Test Your Knowledge #3