Phil Ballard
Michael Moncur

Fifth Edition
Covers JavaScript 1.8+, Ajax, and jQuery

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Sams Teach Yourself JavaScript™ in 24 Hours, Fifth Edition

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About the Authors

Phil Ballard, the author of *Sams Teach Yourself Ajax in 10 Minutes*, graduated in 1980 with an honors degree in electronics from the University of Leeds, England. Following an early career as a research scientist with a major multinational, he spent a few years in commercial and managerial roles within the high technology sector, later working full time as a software engineering consultant.

Operating as "The Mouse Whisperer" (www.mousewhisperer.co.uk), Ballard has spent recent years involved solely in website and intranet design and development for an international portfolio of clients.

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We Want to Hear from You!

As the reader of this book, *you* are our most important critic and commentator. We value your opinion and want to know what we're doing right, what we could do better, what areas you'd like to see us publish in, and any other words of wisdom you're willing to pass our way.

We welcome your comments. You can email or write to let us know what you did or didn't like about this book—as well as what we can do to make our books better.

Please note that we cannot help you with technical problems related to the topic of this book.

When you write, please be sure to include this book's title and author as well as your name and email address. We will carefully review your comments and share them with the author and editors who worked on the book.

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Introduction

Who This Book Is For

If you're interested in learning JavaScript, chances are that you've already gained at least a basic understanding of HTML and web page design in general and want to move on to adding some extra interactivity to your pages. Or maybe you currently code in another programming language and want to see what additional capabilities JavaScript can add to your armory.

If you've never tinkered with HTML at all, nor done any computer programming, it would be helpful to browse through an HTML primer before getting into the book. Don't worry—HTML is very accessible, and you don't need to be an HTML expert to start experimenting with the JavaScript examples in this book.

JavaScript is an ideal language to use for your first steps in programming, and in case you get bitten by the bug, pretty much all of the fundamental concepts that you learn in JavaScript will later be applicable in a wide variety of other languages such as C, Java, or PHP.

The Aims of This Book

When JavaScript was first introduced, it was somewhat limited in what it could do. With basic features and rather haphazard browser support, it gained a reputation in some quarters as being something of a toy or gimmick. Now, due to much better browser support for W3C standards and improvement in the JavaScript implementations used in recent browsers, JavaScript is finally beginning to be treated as a serious programming language.

Many advanced programming disciplines used in other programming languages can readily be applied to JavaScript, for example, object oriented programming promotes the writing of solid, readable, maintainable, and reusable code.

So-called "unobtrusive" scripting techniques and the use of DOM scripting focus on adding interaction to web pages while keeping the HTML simple to read and well separated from the program code.

This book aims to teach the fundamental skills relevant to all of the important aspects of JavaScript as it's used today. In the course of the book, you start from basic concepts and gradually learn the best practices for writing JavaScript programs in accordance with current web standards.

Conventions Used

All of the code examples in the book are written to validate correctly as HTML5. In the main, though, the code avoids using HTML5-specific syntax because at the time of writing its support in web browsers is still not universal. The code examples should work correctly in virtually any recent web browser, regardless of the type of computer or operating system.

In addition to the main text of each lesson, you will find a number of boxes labeled as Notes, Tips, and Cautions.

NOTE

These sections provide additional comments that might help you to understand the text and examples.

TIP

These blocks give additional hints, shortcuts, or workarounds to make coding easier.

CAUTION

Avoid common pitfalls by using the information in these blocks.

TRY IT YOURSELF

Each hour contains at least one section that walks you through the process of implementing your own script. This will help you to gain confidence in writing your own JavaScript code based on the techniques you've learned.

Q&A, Quiz, and Exercises

After each hour's lesson, you'll find three final sections.

Q&A tries to answer a few of the more common questions about the hour's topic.

The Quiz tests your knowledge of what you learned in that lesson.

Exercises offer suggestions for further experimentation, based on the lesson, that you might like to try on your own.

How the Book Is Organized

The book is divided into six parts, gradually increasing in the complexity of the techniques taught.

- **Part I—First Steps with JavaScript**

  Part I is an introduction to the JavaScript language and how to write simple scripts using the language's common functions. This part of the book is aimed mainly at readers with little or no prior programming knowledge and no knowledge of the JavaScript language.

- **Part II—More Advanced JavaScript**

  Here more sophisticated programming paradigms are introduced, such as program control loops and event handling, object oriented programming, JSON notation, and cookies.

- **Part III—Working with the Document Object Model (DOM)**

  This part of the book concentrates on navigating and editing the DOM (Document Object Model) tree, using CSS stylesheets, and styling and animating page elements. There is emphasis on using good coding practice such as unobtrusive JavaScript.

- **Part IV—Ajax**

  Here you learn how to make background calls to the server using the `XMLHTTPRequest` object and handle the server responses, build a simple Ajax library, and learn about debugging Ajax applications.

- **Part V—Using JavaScript Libraries**

  In this part, you learn how to simplify cross-browser development using third-party libraries such as Prototype and jQuery.

- **Part VI—Using JavaScript with Other Web Technologies**

  In the final part examples are given of how to use JavaScript to control multimedia, exploit HTML5 capabilities, write browser add-ons, and more.

Tools You'll Need

Writing JavaScript does not require any expensive and complicated tools such as Integrated Development Environments (IDEs), compilers, or debuggers.

The examples in this book can all be created in a text editing program, such as Windows' Notepad. At least one such application ships with just about every operating system, and countless more are available for no or low cost via download from the Internet.

NOTE

Appendix A, "Tools for JavaScript Development," lists some additional easily obtainable tools and resources for use in JavaScript development.

To see your program code working, you'll need a web browser such as Internet Explorer, Mozilla Firefox, Opera, Safari, or Google Chrome. It is recommended that you upgrade your browser to the latest current stable version.

The vast majority of the book's examples do not need an Internet connection to function. Simply storing the source code file in a convenient location on your computer and opening it with your chosen browser is generally sufficient. The exceptions to this are the hour on cookies and the section of the book about Ajax; to explore all of the example code will require a web connection (or a connection to a web server on your Local Area Network) and a little web space in which to post the example code. If you've done some HTML coding, you may already have that covered; if not, a hobby-grade web hosting account costs very little and will be more than adequate for trying out the examples in this book. (Check that your web host allows you to run scripts written in the PHP language if you want to try out the Ajax examples in Part IV. Nearly all hosts do).

HOUR 3
Using Functions

WHAT YOU'LL LEARN IN THIS HOUR

- How to define functions
- How to call (execute) functions
- How functions receive data
- Returning values from functions
- About the scope of variables

Commonly, programs carry out the same or similar tasks repeatedly during the course of their execution. For you to avoid rewriting the same piece of code over and over again, JavaScript has the means to parcel up parts of your code into reusable modules, called *functions*. After you've written a function, it is available for the rest of your program to use, as if it were itself a part of the JavaScript language.

Using functions also makes your code easier to debug and maintain. Suppose you've written an application to calculate shipping costs; when the tax rates or haulage prices change, you'll need to make changes to your script. There may be 50 places in your code where such calculations are carried out. When you attempt to change every calculation, you're likely to miss some instances or introduce errors. However, if all such calculations are wrapped up in a few functions used throughout the application, then you just need to make changes to those functions. Your changes will automatically be applied all through the application.

Functions are one of the basic building blocks of JavaScript and will appear in virtually every script you write. In this hour you see how to create and use functions.

General Syntax

Creating a function is similar to creating a new JavaScript command that you can use in your script.

Here's the basic syntax for creating a function:

```
function sayHello() {
    alert("Hello");
    // ... more statements can go here ...
}
```

CAUTION

The keyword `function` must always be used in lowercase, or an error will be generated.

You begin with the keyword `function`, followed by your chosen function name with parentheses appended, then a pair of curly braces {}. Inside the braces go the JavaScript statements that make up the function. In the case of the preceding example, we simply have one line of code to pop up an `alert` dialog, but you can add as many lines of code as are necessary to make the function…well, function!

To keep things tidy, you can collect together as many functions as you like into one `<script>` element:

```
<script>
    function doThis() {
        alert("Doing This");
    }
    function doThat() {
        alert("Doing That");
    }
</script>
```

TIP

Function names, like variable names, are case-sensitive. A function called `MyFunc()` is different from another called `myFunc()`. Also, as with variable names, it's really helpful to the readability of your code to choose meaningful function names.

Calling Functions

Code wrapped up in a function definition will not be executed when the page loads. Instead, it waits quietly until the function is *called*.

To call a function, you simply use the function name (with the parentheses) wherever you want to execute the statements contained in the function:

```
sayHello();
```

TIP

You've already seen numerous examples of using the *methods* associated with JavaScript objects, such as `document.write()` and `window.alert()`.

Methods are simply functions that "belong" to a specific object. You learn much more about objects in Hour 4, "DOM Objects and Built-In Objects."

For example, you may want to add a call to your new function `sayHello()` to the `onClick` event of a button:

```
<input type="button" value="Say Hello" onclick="sayHello()" />
```

Putting JavaScript Code in the Page `<head>`

Up to now, our examples have all placed the JavaScript code into the `<body>` part of the HTML page. Using functions lets you employ the much more common, and usually preferable, practice of storing our JavaScript code in the `<head>` of the page. Functions contained within a `<script>` element in the page head, or in an external file included via the `src` attribute of a `<script>` element in the page head, are available to be called from anywhere on the page. Putting functions in the document's head section ensures that they have been defined prior to any attempt being made to execute them.

Listing 3.1 has an example.

LISTING 3.1 Functions in the Page Head

```
<!DOCTYPE html>
<html>
<head>
    <title>Calling Functions</title>
    <script>
        function sayHello() {
            alert("Hello");
        }
    </script>
</head>
<body>
    <input type="button" value="Say Hello" onclick="sayHello()" />
</body>
</html>
```

In this listing, you can see that the function definition itself has been placed inside a `<script>` element in the page head, but the call to the function has been made from a different place entirely—on this occasion, from the `onClick` event handler of a button in the body section of the page.

The result of clicking the button is shown in Figure 3.1.

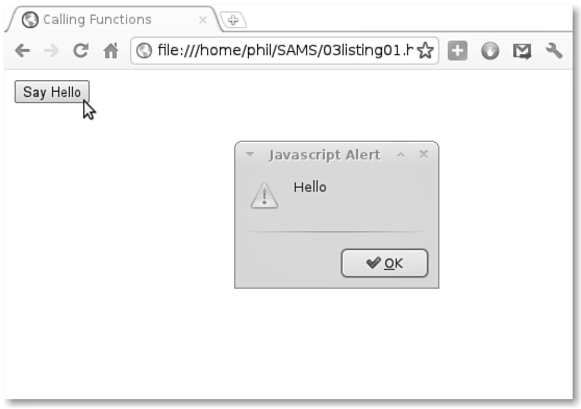


FIGURE 3.1
Calling a JavaScript function

Arguments

It would be rather limiting if your functions could only behave in an identical fashion each and every time they were called, as would be the case in the preceding example.

Fortunately, you can extend the capabilities of functions a great deal by passing data to them. You do this when the function is called, by passing to it one or more *arguments*:

```
functionName(arguments)
```

Let's write a simple function to calculate the cube of a number and display the result:

```
function cube(x) {
    alert(x * x * x);
}
```

Now we can call our function, replacing the variable *x* with a number. Calling the function like this

```
cube(3);
```

results in a dialog box being displayed that contains the result of the calculation, in this case 27.

NOTE

You'll sometimes see or hear the word *parameters* used in place of arguments, but it means exactly the same thing.

Of course, you could equally pass a variable name as an argument. The following code would also generate a dialog containing the number 27:

```
var length = 3;
cube(length);
```

Multiple Arguments

CAUTION

Make sure that your function calls contain enough argument values to match the arguments specified in the function definition. If any of the arguments in the definition are left without a value, JavaScript may issue an error, or the function may perform incorrectly. If your function call is issued with too many arguments, the extra ones will be ignored by JavaScript.

Functions are not limited to a single argument. When you want to send multiple arguments to a function, all you need to do is separate them with commas:

```
function times(a, b) {
    alert(a * b);
}
times(3, 4); // alerts '12'
```

You can use as many arguments as you want.

It's important to note that the names given to arguments in the definition of your function have nothing to do with the names of any variables whose values are passed to the function. The variable names in the argument list act like placeholders for the actual values that will be passed when the function is called. The names that you give to arguments are only used inside the function definition to specify how it works.

We talk about this in more detail later in the hour when we discuss variable *scope*.

TRY IT YOURSELF ▼

A Function to Output User Messages

Let's use what we've learned so far in this hour by creating a function that can send the user a message about a button he or she has just clicked. We place the function definition in the `<head>` section of the page and call it with multiple arguments.

Here's our function:

```
function buttonReport(buttonId, buttonName, buttonValue) {
    // information about the id of the button
    var userMessage1 = "Button id: " + buttonId + "\n";
    // then about the button name
    var userMessage2 = "Button name: " + buttonName + "\n";
    // and the button value
    var userMessage3 = "Button value: " + buttonValue;
    // alert the user
    alert(userMessage1 + userMessage2 + userMessage3);
}
```

The function `buttonReport` takes three arguments, those being the `id`, `name`, and `value` of the button element that has been clicked. With each of these three pieces of information, a short message is constructed. These three messages are then concatenated into a single string, which is passed to the `alert()` method to pop open a dialog containing the information.

To call our function, we put a button element on our HTML page, with its `id`, `name`, and `value` defined:

```
<input type="button" id="id1" name="Button 1" value="Something" />
```

We need to add an `onClick` event handler to this button from which to call our function. We're going to use the `this` keyword, as discussed in Hour 2, "Writing Simple Scripts":

```
onclick = "buttonReport(this.id, this.name, this.value)"
```

TIP

You may have noticed that the first two message strings have an element `"\n"` appended to the string; this is a "new line" character, forcing the message within the alert dialog to return to the left and begin a new line. Certain special characters like this one must be prefixed with \ if they are to be correctly interpreted when they appear in a string. Such a prefixed character is known as an *escape sequence*. You learn more about escape sequences in Hour 5, "Different Types of Data."

▼ TRY IT YOURSELF

A Function to Output User Messages

continued

The complete listing is shown in Listing 3.2.

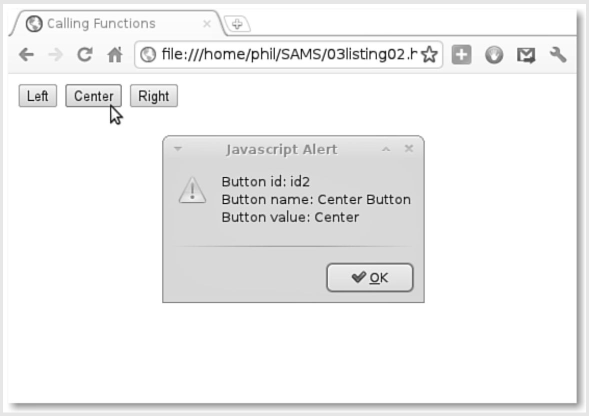
LISTING 3.2 Calling a Function with Multiple Arguments

```
<!DOCTYPE html>
<html>
<head>
    <title>Calling Functions</title>
    <script>
        function buttonReport(buttonId, buttonName, buttonValue) {
            // information about the id of the button
            var userMessage1 = "Button id: " + buttonId + "\n";
            // then about the button name
            var userMessage2 = "Button name: " + buttonName + "\n";
            // and the button value
            var userMessage3 = "Button value: " + buttonValue;
            // alert the user
            alert(userMessage1 + userMessage2 + userMessage3);
        }
    </script>
</head>
<body>
    <input type="button" id="id1" name="Left Hand Button" value="Left"
➥onclick = "buttonReport(this.id, this.name, this.value)"/>
    <input type="button" id="id2" name="Center Button" value="Center"
➥onclick = "buttonReport(this.id, this.name, this.value)"/>
    <input type="button" id="id3" name="Right Hand Button" value="Right"
➥onclick = "buttonReport(this.id, this.name, this.value)"/>
</body>
</html>
```

Use your editor to create a file buttons.html and enter the preceding code. You should find that it generates output messages like the one shown in Figure 3.2, but with different message content depending on which button has been clicked.

TRY IT YOURSELF ▼

A Function to Output User Messages
continued



```
Button id: id2
Button name: Center Button
Button value: Center
```

FIGURE 3.2 Using a function to send messages

Returning Values from Functions

Okay, now you know how to pass information to functions so that they can act on that information for you. But how can you get information back from your function? You won't always want your functions to be limited to popping open a dialog box!

Luckily, there is a mechanism to collect data from a function call—the *return value*. Let's see how it works:

```
function cube(x) {
    return x * x * x;
}
```

Instead of using an `alert()` dialog within the function, as in the previous example, this time we prefixed our required result with the `return` keyword. To access this value from outside the function, we simply assign to a variable the value *returned* by the function:

```
var answer = cube(3);
```

The variable `answer` will now contain the value 27.

NOTE

The values returned by functions are not restricted to numerical quantities as in this example. In fact, functions can return values having any of the data types supported by JavaScript. We discuss data types in Hour 5.

TIP

Where a function returns a value, we can use the function call to pass the return value directly to another statement in our code. For example, instead of

```
var answer = cube(3);
alert(answer);
```

we could simply use

```
alert(cube(3));
```

The value of 27 returned from the function call `cube(3)` immediately becomes the argument passed to the `alert()` method.

Scope of Variables

We have already seen how to declare variables with the `var` keyword. There is a golden rule to remember when using functions:

"Variables declared inside a function only exist inside that function."

This limitation is known as the *scope* of the variable. Let's see an example:

```
// Define our function addTax()
function addTax(subtotal, taxRate) {
    var total = subtotal * (1 + (taxRate/100));
    return total;
}
// now let's call the function
var invoiceValue = addTax(50, 10);
alert(invoiceValue); // works correctly
alert(total);  // doesn't work
```

If we run this code, we first see an `alert()` dialog with the value of the variable `invoiceValue` (which should be 55 but in fact will probably be something like 55.000000001 as we have not asked JavaScript to round the result).

We will not, however, then see an `alert()` dialog containing the value of the variable `total`. Instead, JavaScript simply produces an error. Whether you see this error reported depends on your browser settings—we learn more about error handling later in the book—but JavaScript will be unable to display an `alert()` dialog with the value of your variable `total`.

This is because we placed the declaration of the variable `total` *inside* the `addTax()` function. Outside the function the variable `total` simply doesn't exist (or, as JavaScript puts it, "is not defined"). We used the `return` keyword to pass back just the *value* stored in the variable `total`, and that value we then stored in another variable, `invoice`.

We refer to variables declared inside a function definition as being *local* variables, that is, *local to that function*. Variables declared outside any function are known as *global* variables. To add a little more confusion, local and global variables can have the same name, but still be different variables!

The range of situations where a variable is defined is known as the *scope* of the variable—we can refer to a variable as having *local scope* or *global scope*.

TRY IT YOURSELF ▼

Demonstrating the Scope of Variables

To illustrate the issue of a variable's scope, take a look at the following piece of code:

```
var a = 10;
var b = 10;
function showVars() {
    var a = 20; // declare a new local variable 'a'
    b = 20;     // change the value of global variable 'b'
    return "Local variable 'a' = " + a + "\nGlobal variable 'b' = " + b;
}
var message = showVars();
alert(message + "\nGlobal variable 'a' = " + a);
```

Within the `showVars()` function we manipulate two variables, `a` and `b`. The variable `a` we define inside the function; this is a local variable that only exists inside the function, quite separate from the global variable (also called `a`) that we declare at the very beginning of the script.

The variable `b` is not declared inside the function, but outside; it is a *global* variable.

Listing 3.3 shows the preceding code within an HTML page.

LISTING 3.3 Global and Local Scope

```
<!DOCTYPE html>
<html>
<head>
    <title>Variable Scope</title>
</head>
<body>
    <script>
        var a = 10;
        var b = 10;
        function showVars() {
            var a = 20; // declare a new local variable 'a'
            b = 20;     // change the value of global variable 'b'
            return "Local variable 'a' = " + a + "\nGlobal variable 'b' =
➥" + b;
        }
        var message = showVars();
        alert(message + "\nGlobal variable 'a' = " + a);
    </script>
</body>
</html>
```

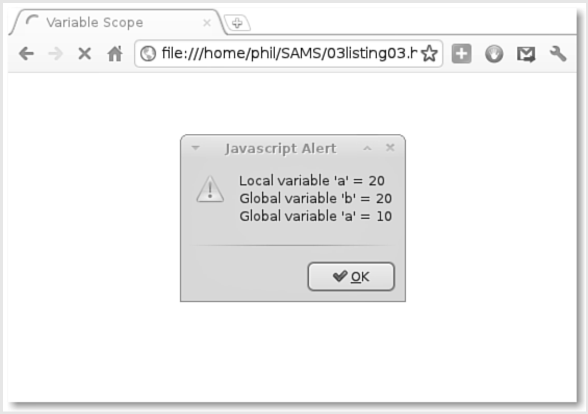
When the page is loaded, `showVars()` returns a message string containing information about the updated values of the two variables `a` and `b`, as they exist inside the function—`a` with local scope, and `b` with global scope.

▼ TRY IT YOURSELF

Demonstrating the Scope of Variables
continued

A message about the current value of the other, *global* variable `a` is then appended to the message, and the message displayed to the user.

Copy the code into a file scope.html and load it into your browser. Compare your results with Figure 3.3.



```
Local variable 'a' = 20
Global variable 'b' = 20
Global variable 'a' = 10
```

FIGURE 3.3
Local and global scope

Summary

In this hour you learned about what functions are and how to create them in JavaScript. You learned how to call functions from within your code and pass information to those functions in the form of arguments. You also found out how to return information from a function to its calling statement.

Finally, you learned about the local or global scope of a variable and how the scope of variables affects how functions work with them.

Q&A

Q. Can one function contain a call to another function?

A. Most definitely; in fact, such calls can be nested as deeply as you need them to be.

Q. What characters can I use in function names?

A. Function names must start with a letter or an underscore and can contain letters, digits, and underscores in any combination. They cannot contain spaces, punctuation, or other special characters.

Workshop

Try to answer all the questions before reading the subsequent "Answers" section.

Quiz

1. Functions are called using
   - **a.** The function keyword
   - **b.** The `call` command
   - **c.** The function name, with parentheses

2. What happens when a function executes a return statement?
   - **a.** An error message is generated.
   - **b.** A value is returned and function execution continues.
   - **c.** A value is returned and function execution stops.

3. A variable declared inside a function definition is called
   - **a.** A local variable
   - **b.** A global variable
   - **c.** An argument

Answers

1. c. A function is called using the function name.
2. c. After executing a return statement, a function returns a value and then ceases function execution.
3. a. A variable defined within a function has local scope.

Exercises

Write a function to take a temperature value in Celsius as an argument and return the equivalent temperature in Fahrenheit, basing it on the code from Hour 2.

Test your function in an HTML page.

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