TEST YOUR KNOWLEDGE #1

Modify **lab07-test01.html** by adding CSS in **lab07-test01.css** to implement the layout shown in Figure 7.16 (some of the styling as already been provided).

1. Set the background image on the `<body>` tag. Set the `height` to `100vh` so it will always fill the entire viewport. Set the `background-cover` and `background-position` properties (see Chapter 4 for a refresher if needed).
2. For the header, set its display to `flex`. Set `justify-content` to `space-between` and `align-items` to `center`. This will make the `<h2>` and the `<nav>` elements sit on the same line, but will expand to be aligned with the outside edges.
3. To center the form in the middle of the viewport, set the `display` of the `<main>` element to `flex`, and `align-items` and `justify-contents` to `center`. Do the same for the `<form>` element.
4. Fine-tune the size of the form elements by setting the `flex-basis` of label to 16em, the search box to 36em, and the submit button to 10em. The final result should look similar to that shown in Figure 7.16.

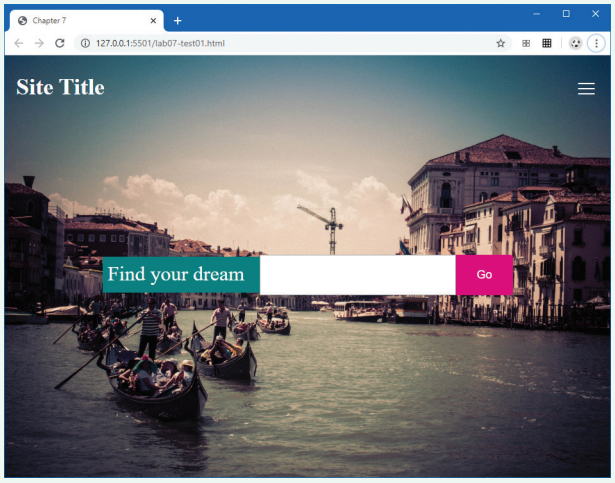


FIGURE 7.16 Completed Test Your Knowledge #1

HANDS-ON EXERCISES

LAB 7
Using Grid
Nested Grids
Using calc ( )
Grid Areas
Grids and Flex Together

7.3 Grid Layout

Designers have long desired the ability to construct a layout based on a set number of rows and columns. In the early years of CSS, designers frequently made use of HTML tables as way to implement these types of. Unfortunately this not only added a lot of additional non-semantic markup, but also typically resulted in pages that didn't adapt to different sized monitors or browser widths. CSS Frameworks such as Bootstrap became popular partly because they provided a relatively painless and

dependable way of creating grid-based layouts. Nonetheless, designers have long wanted an easier way to create grid layouts in native CSS, and for this reason, when CSS Grid finally had wide-spread browser support by mid-2017, it was greeted with enthusiasm.

Grid layout is adjustable, powerful, and, compared to floats, positioning, and even flexbox, is relatively easy to learn and use. It allows you to divide any container into a series of cells within rows and columns. Block-level child content will by default be automatically placed into available cells; you can also instead manually indicate which content will appear in which cells.

7.3.1 Specifying the Grid Structure

Figure 7.17 illustrates how grid layout works with block-level elements. Each block-level child in a parent container whose `display` property is set to `grid` will be

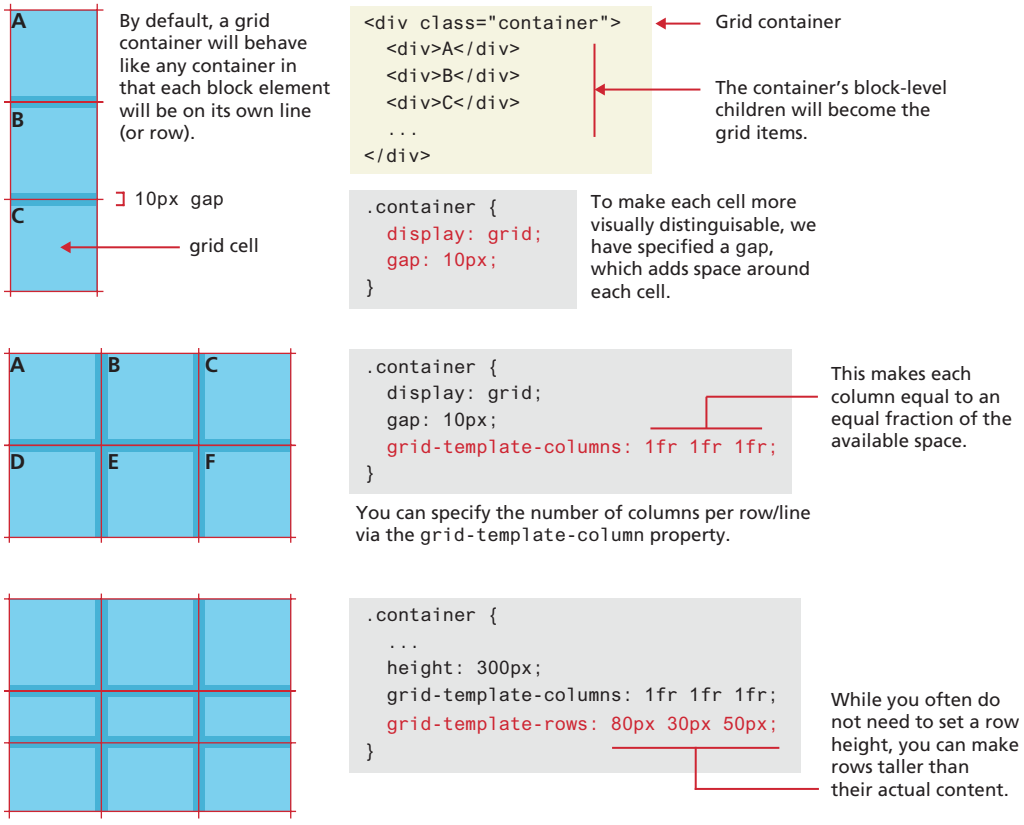


FIGURE 7.17 Introducing grid display

automatically placed into a grid cell (this automatic placement into cells is often referred to as an **implicit grid**). If no `grid-template-columns` property is set, then the grid will only contain a single column, and thus the output will be more or less similar to normal block layout flow. Notice that rows will automatically be added to the grid based on the content.

The `grid-template-columns` is used for adding columns to the parent container by specifying each column's width. There are a lot of possible options for this property. In the middle example in Figure 7.17, column widths are specified using the `fr` unit. This unit provides a way to flexibly size a column based on available space. It indicates a width that is a fraction of the available space in the grid container. So, for instance, imagine the following two examples:

```
grid-template-columns: 1fr 1fr;
grid-template-columns: 3fr 1fr;
```

In the first example, each of the two columns will be equal in size. But in the second example, the first column will take up ¾ of the available space and the second will take up ¼.

Figure 7.17 also illustrates that you can specify row heights via the `grid-template-rows` property. Just like with specifying columns, you can also use the `fr` unit.

Figure 7.18 illustrates some of the additional sizing flexibility available with grids. Column widths (or row heights, since the same techniques can be used with `grid-template-rows` as well) can be specified in a wide range of sizing units, including `px` and %. The CSS `repeat()` function provides a way to specify repeating patterns of columns. In conjunction with the CSS `minmax()` function, you can easily lay out a repeated pattern of objects (for instance, images or cards) into rows and columns. To do the same thing in older CSS frameworks like Bootstrap typically required adding multiple row `<div>` elements as well as explicit column `<div>` elements. CSS grids provide a much cleaner solution. Listing 7.1 contrasts the markup needed in Bootstrap with the markup (and CSS) needed for CSS grids to implement a grid of images with two rows and three columns. The listing doesn't show you the many lines of CSS that Bootstrap uses for its own `container`, `row`, and `col` classes. In Listing 7.1, why is the last line of CSS required? Remember, unlike flexbox, which works the same with inline and block elements, grid layout automatically puts block elements into grid cells, so the last line of CSS is required to turn the `<img>` elements into block-level elements.

7.3.2 Explicit Grid Placement

By default, child block-level elements are placed into grid cells automatically, or implicitly. It is possible however to populate grid cells explicitly. Figure 7.19 illustrates one of the ways this can be achieved: by setting grid row and column properties within individual cells. In the first example in Figure 7.19, notice that the first

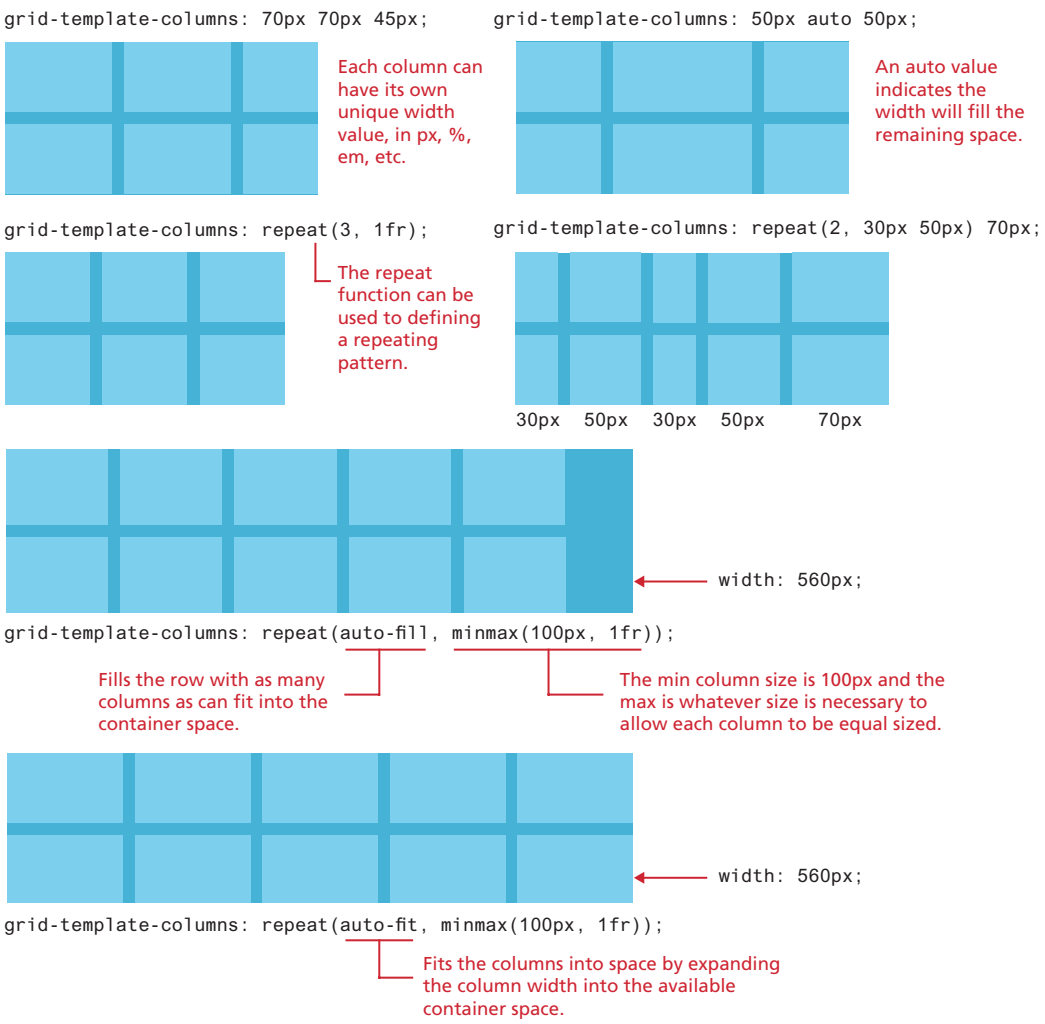


FIGURE 7.18 Specifying column widths

child element within the grid container has explicit `grid-column-start` and `grid-column-end` properties (set using line numbers), which makes the content span two cells. In the second example, the "B" child element is pulled out of its "normal" position, and explicitly placed into the second row and second column, while in the third example, the "C" child element spans two rows. Notice that in the third example, a new row is added to the grid using its auto-placement algorithm, in which the height of a new row is determined by its content if there isn't a `grid-template-row` setting already set for it.

```
<!-- Bootstrap 4 Approach -->
<div class="container">
  <div class="row">
    <div class="col"><img src=1.gif /></div>
    <div class="col"><img src=2.gif /></div>
    <div class="col"><img src=3.gif /></div>
  </div>
  <div class="row">
    <div class="col"><img src=4.gif /></div>
    <div class="col"><img src=5.gif /></div>
    <div class="col"><img src=6.gif /></div>
  </div>
</div>

<!-- CSS Grid Approach -->
<div class="container">
  <img src=1.gif />
  <img src=2.gif />
  <img src=3.gif />
  <img src=4.gif />
  <img src=5.gif />
  <img src=6.gif />
</div>
<!-- CSS for grid approach -->
.container {
  display: grid;
  grid-template-columns: repeat(auto-fit, minmax(100px, 1fr);
}
.container img { display: block; }
```

LISTING 7.1 Comparing Bootstrap grid with CSS Grid

7.3.3 Cell Properties

Just as flexbox introduced new layout properties to elements within a flex container, so too does grid have properties for child elements. Figure 7.20 illustrates two of the main cell properties: `align-self` and `justify-self`, which control the cell content's horizontal and vertical alignment within its grid container.

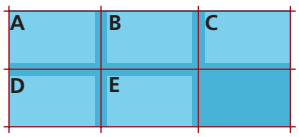
You can also control cell alignment within a grid container using `align-items` and `justify-items`, as shown in Figure 7.21.

7.3.4 Nested Grids

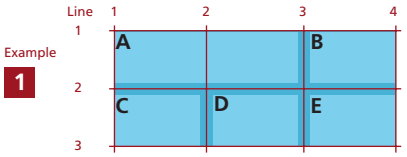
Any container element can have its `display` property set to `grid`. This means that grids can be nested within one another. Indeed, this is quite common. Figure 7.22 illustrates just how easy and flexible grid layout can be. The `<main>` container uses

```
<div class="container">
  <div class="a">A</div>
  <div class="b">B</div>
  <div class="c">C</div>
  <div class="d">D</div>
  <div class="e">E</div>
</div>
```

```
.container {
  display: grid;
  gap: 10px;
  grid-template-columns: repeat(3,1fr);
  grid-template-rows: repeat(2,200px);
}
```



With implicit layout, grid items are placed automatically.

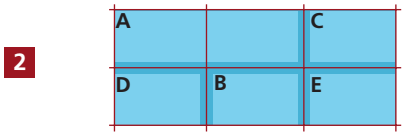



```
.a {
  grid-column-start: 1;
  grid-column-end: 3;
}
```

The start and end numbers refer to the line number not the column number.

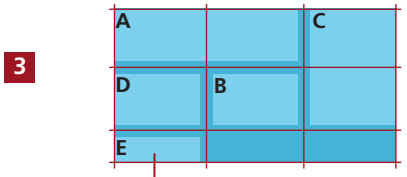
The same effect also possible using either of the following:

```
grid-column: 1 / 3;
grid-column: 1 / span 2;
```




```
.b {
  grid-row: 2;
  grid-column: 2;
}
```

Grid cells can be placed into any row and column.



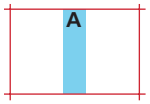

```
.c {
   grid-row-start: 1;
   grid-row-end: 3;
   grid-column: 3;
}
```

A new row is needed now to fit in the fifth child element.

FIGURE 7.19 Using explicit grid item placement

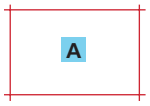

```
align-self: stretch;
justify-self: stretch;
```


```
align-self: stretch;
justify-self: start;
```

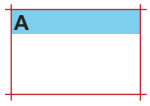



```
align-self: stretch;
justify-self: center;
```


```
align-self: stretch;
justify-self: end;
```




```
align-self: center;
justify-self: center;
```




```
align-self: start;
justify-self: stretch;
```


```
align-self: start;
justify-self: stretch;
```


```
align-self: end;
justify-self: stretch;
```


```
align-self: end;
justify-self: end;
```

FIGURE 7.20 Aligning content within grid cell

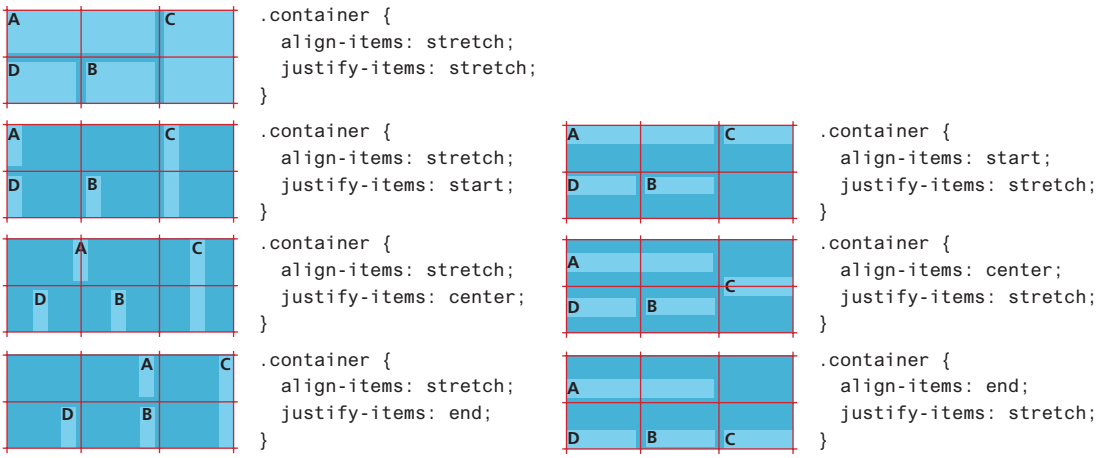


FIGURE 7.21 Aligning content within grid container

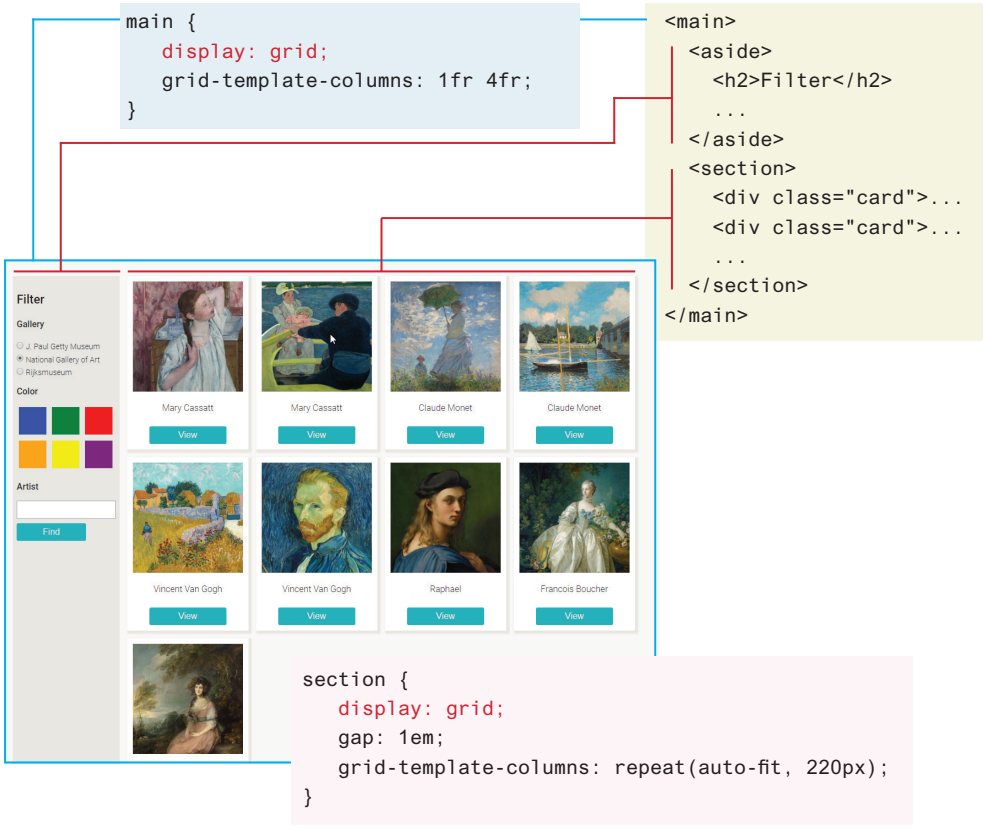


FIGURE 7.22 Nested grids

grid and contains just two columns, one for the filters and one for the cards. The `<section>` contain uses grid to layout the painting cards. As can be seen in the figure, it only takes a few lines of CSS to create a flexible nested grid. Using the CSS `repeat()` function with `auto-fit` means the number of card grid items will grow or shrink depending on the space available. If the browser window is wide, then five or six or more cards will be shown; if the window is mobile width, only one or two cards will be visible.

DIVE DEEPER

You might wonder why the card grid column width in Figure 7.22 is 220px. In this case, it is due to the image width being 200px and the left and right padding being 10px each (200+10+10). Undocumented constant values such as the 220px in Figure 7.22 are one of the reasons why CSS can be difficult to maintain and modify over time.

Instead of hard coding such constants, a more maintainable approach is to use the CSS `calc()` function to calculate values. The following CSS illustrates how the CSS in Figure 7.22 could be improved using `calc()` in conjunction with CSS variables.

```
:root {
   --gapSize: 0.5em;
   --paintingWidth: 200px;
   --cardWidth: calc(var(--gapSize) + var(--paintingWidth) +
                     var(--gapSize));
}
.card {
   padding: var(--gapSize);
   ...
}
.card img {
   width: var(--paintingWidth);
}
section {
   ...
   grid-template-columns: repeat( auto-fit, var(--cardWidth) );
}
```

By using these calculated variables, you can modify the painting width variable, and the layout will keep working regardless of the image size. Notice also that you can use `calc()` with different measurement units (the `cardWidth` calculation here uses both px and em units).

You could do the same with font sizes (or colors) as well.

```
:root {
   ...
   --is-size-1: 14px;
   --is-size-2: calc(var(--is-size-1) * 1.2);
   --is-size-3: calc(var(--is-size-1) * 1.4);
   --is-size-4: calc(var(--is-size-1) * 1.6);
}
h2 { font-size: var(--is-size-3); }
```

When working with CSS, there is a tendency to set values somewhat arbitrarily. "I'll make the padding here 5px, the margin there 6px, the grid gap in this container 8px, and so on." While there is nothing intrinsically wrong with doing so (indeed when you are first creating a design it's quite common), a more "designed" look will generally result if you take care to use consistent values for common CSS properties. The use of CSS variables and the `calc()` function can help in this regard.

7.3.5 Grid Areas

Figures 7.18 and 7.19 illustrate how to define grid structure using row and column line numbers. As an alternative, you can instead use names.

You assign your own names to grid items using the `grid-area` property, and then define the structure of your grid using the `grid-template-areas` property. You can still use `grid-template-columns` and `grid-template-rows` for specifying sizes. The key rule to remember for `grid-template-areas` is that you must describe the entire grid; that is, every cell in the grid must either have a name or be explicitly specified as empty using one or more period (".") characters (you can use multiple periods to make them more noticeable). Listing 7.2 provides an example of using grid areas.

The results, shown in Figure 7.23, illustrates just how flexible and powerful grid areas can be once you're comfortable with the syntax (note that the figure uses two periods to indicate empty cells in order to line up the area names). As you can see, you can modify just the `grid-template-areas` property and get very different layouts.

7.3.6 Grid and Flexbox Together

Sometimes grid and flexbox layout are considered as competing solutions to implementing a layout. A more helpful way to thinking about these two layout modes is that they each have their strengths and these strengths can be combined.

```
<style>
.container {
   grid-gap: 10px;
   display: grid;
   grid-template-rows: 100px 150px 100px;
   grid-template-columns: 75px 1fr 1fr 1fr 1fr;
   grid-template-areas: ". a1 a2 a3 a4"
                        "b1 b2 b2 b2 b3"
                        "b1 c1 c2 c2 c2";
}
.a1 { grid-area: a1; }
.a2 { grid-area: a2; }
.a3 { grid-area: a3; }
.a4 { grid-area: a4; }

.b1 { grid-area: b1; }
.b2 { grid-area: b2; }
.b3 { grid-area: b3; }

.c1 { grid-area: c1; }
.c2 { grid-area: c2; }
</style>
...
<section class="container">
  <div class="yellow a1">A1</div>
  <div class="yellow a2">A2</div>
  <div class="yellow a3">A3</div>
  <div class="yellow a4">A4</div>
  <div class="orange b1">B1</div>
  <div class="orange b2">B2</div>
  <div class="orange b3">B3</div>
  <div class="cyan c1">C1</div>
  <div class="cyan c2">C2</div>
</section>
```

LISTING 7.2 Using grid areas

Most web page layouts are focused on two axes, on both rows and columns. As such, grid layout is ideal for constructing the layout structure of your page (or your container's layout). Flexbox is ideal for layout along a single axis, either a row or a column. As you saw in Section 7.2.2, flexbox is perfect for centering elements within a container or making a container's content stretch to fill its available space. Thus, flexbox is often ideal for laying out the contents of a grid cell.

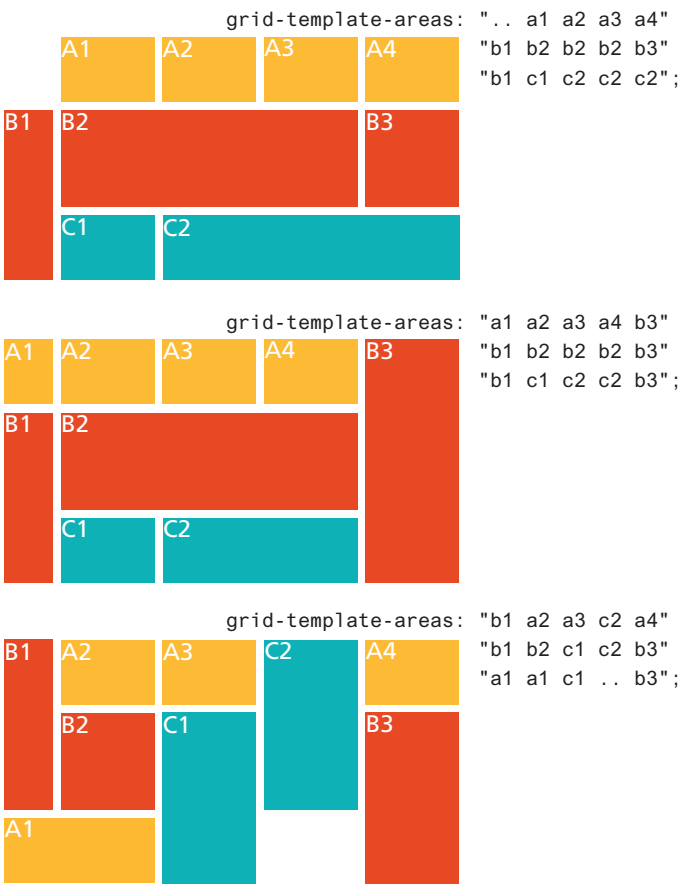


FIGURE 7.23 Using grid areas

Figure 7.24 illustrates an example of combining the two layout modes. Grid is used to create the four column by two row layout (though with different browser widths the number of rows and columns will vary) shown in the first screen capture. Notice that in the first screen, the cells vary in their height. In the second screen, Flexbox is used to ensure that each grid cell has the same height along with center alignment.

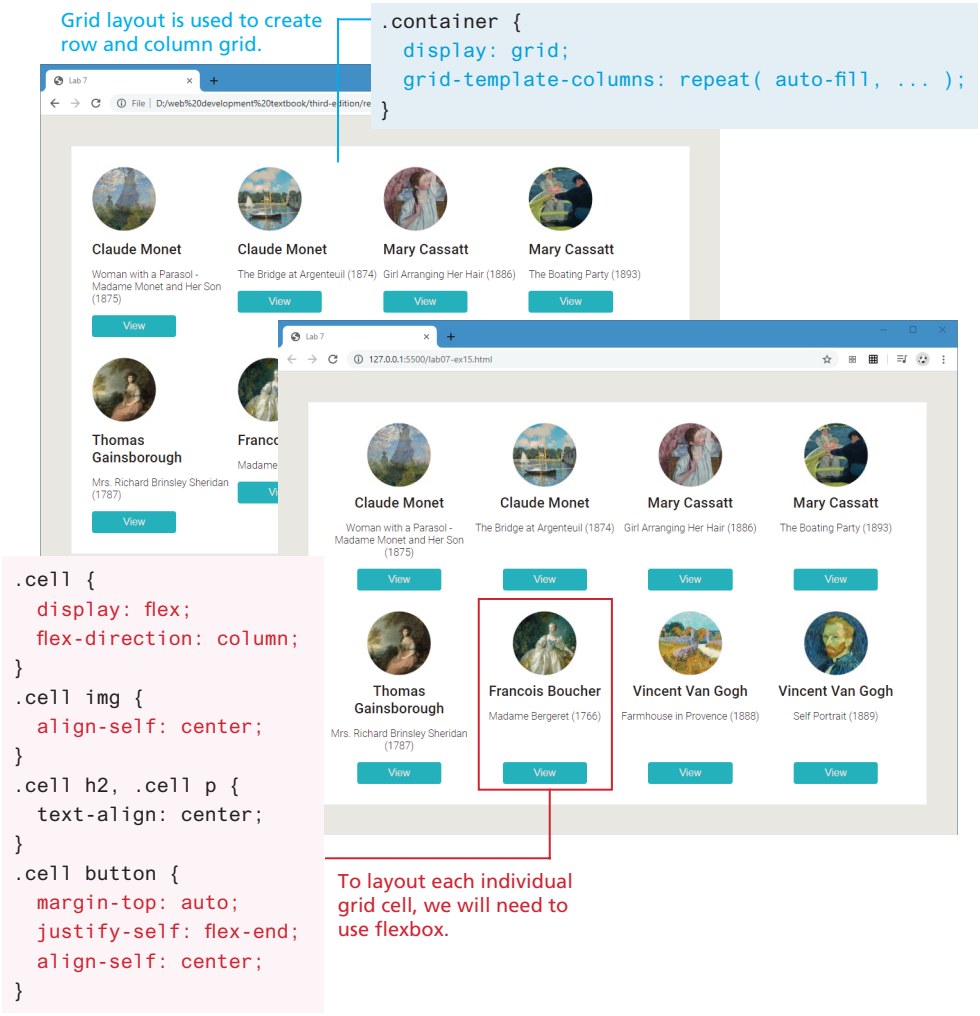


FIGURE 7.24 Using grid and flex together

TEST YOUR KNOWLEDGE #2

Modify **lab07-test02.html** by adding CSS in **lab07-test02.css** to implement the layout shown in Figure 7.25 (some of the styling as already been provided).

1. This layout will require two nested grids. Create the outer grid that will have one row and three columns containing the `<nav>`, `<aside>`, and `<main>` elements. There should be no grid gap, and the first two columns should have a minimum size of 80px and a maximum size of 200px. The third column should