# Building Spreadsheet Skills Using An Interactive Textbook


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## Fully interactive content

Many engineers work with spreadsheets daily

Students click to provide new information and feedback

Introduces new concepts in manageable chunks (Cognitive load theory)

Auto-graded problems provide 'big data'

Define → Demonstrate → Practice → Challenge → Repeat

## Definitions and question sets engage students

Table 9.3.1: Example spreadsheet functions.

| Function | Example |
|---|---|
| **SUM** adds the numerical values of all selected cells. | =SUM(A1:A5) adds the values of cells A1 to A5. |
| **MAX** returns the value of the largest number from the selected cells. | =MAX(B1:D1) identifies the largest value of cells B1, C1, or D1. |
| **MIN** returns the value of the smallest number from the selected cells. | =MIN(B3:B5) finds the smallest value of cells B3 to B5. |
| **COUNT** determines the number of cells containing a numerical value. | =COUNT(C5:E7) finds the number of cells containing a number within the range of cells from C5 to E7. |
| **AVERAGE**calculates the mean of the selected cells. | =AVERAGE(A5:A11) averages the values of cells A5 to A11. |
| **PI()** returns the mathematical constant and irrational number π. | =PI() returns 3.14159, which can be used to find the area of a circle. |

Manageable amounts of text

Indexed, defined terms

Tables focus concepts + examples

Matching exercises apply new concepts and definitions

Number of cells in a group.

A6, B5, C4, D3 | B3:B7 | C3:E3 | E1, B4:F4, G6 | A2:C5

5 cells
12 cells
4 cells
3 cells
7 cells

Reset

2) The formula in cell C1 is =A$1 + 9. The formula is copied to cell D1, so the formula in D1 is:
- =B$1 + 9
- =B$2 + 9
- =$A$1 + 9

**Correct**
Since cell D1 is one column from the original cell C1, unanchored column locations should also move one column. Therefore, cell A$1 becomes B$1 and the correct formula is=B$1 + 9.

2) The formula in cell C1 is =A$1 + 9. The formula is copied to cell D1, so the formula in D1 is:
- =B$1 + 9
- =B$2 + 9
- =$A$1 + 9

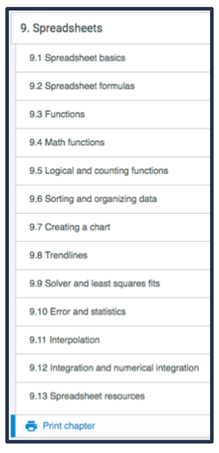
**Incorrect**
The $ anchors the row position in the formula to row 1, so B$2 is incorrect. The correct formula should have a cell anchored in row 1.

2) The formula in cell C1 is =A$1 + 9. The formula is copied to cell D1, so the formula in D1 is:
- =B$1 + 9
- =B$2 + 9
- =$A$1 + 9

**Incorrect**
Copying formulas to new cells should not add $, so the correct answer should have a single $ in the correct formula.

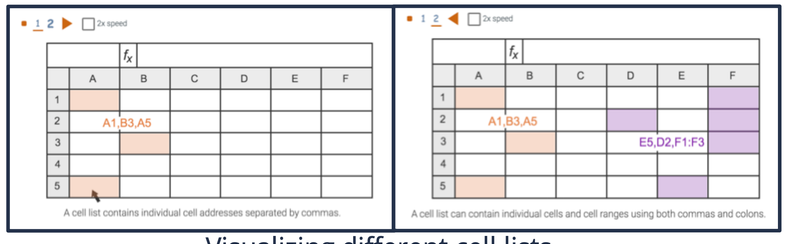
Multiple choice questions provide unique explanations with every choice

## The basics




Reading completion + Challenge activity success + Challenge activity attempts

## Animations – click, watch, repeat




Visualizing different cell lists

Over 40 animations about spreadsheets

104% watch rate = over 150 re-watched animations

Formulas using $ = most watched video (118% watch rate)

## Perpetual practice with challenge activities

Find the minimum value of all of the cells. Hint: Copying the given values into a spreadsheet may speed up calculations.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | 75 | 43 | 40 | 55 | 64 |
| 2 | 47 | 72 | 70 | 42 | 74 |
| 3 | 73 | 27 | 42 | 64 | 29 |
| 4 | 71 | 63 | 27 | 24 | 36 |
| 5 | 51 | 21 | 38 | 21 | 61 |
| 6 | 73 | 58 | 71 | 71 | 28 |
| 7 | 78 | 40 | 55 | 75 | 79 |
| 8 | 29 | 65 | 32 | 71 | 78 |
| 9 | 48 | 24 | 22 | 71 | 14 |
| 10 | 39 | 21 | 62 | 54 | 49 |

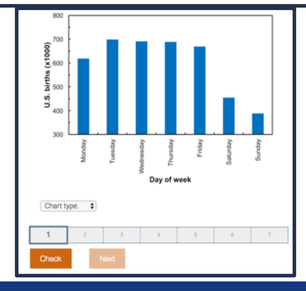
Ex:9

The formula in cell C3 can be copied to fill cells D7 and D8. Enter the calculated value in cell D8 and the pasted formula into cell D7.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | 36 | 77 | | | |
| 2 | 47 | 61 | | | |
| 3 | 25 | 75 | =A$3-2 | | |
| 4 | 17 | 58 | | | |
| 5 | 21 | 54 | | | |
| 6 | 25 | 55 | | | |
| 7 | 17 | 31 | | =A1+B1 | |
| 8 | 47 | 30 | | 102 | |
| 9 | 36 | 45 | | | |
| 10 | 29 | 25 | | | |

In cell E1, report the number of cells containing a numerical value. Hint: Copying the given values into a spreadsheet may speed up calculations.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | 54 | 33 | 24 | 52 | Ex:11 |
| 2 | 35 | 75 | 62 | 63 | |
| 3 | 22 | 25 | 16 | 48 | |
| 4 | 65 | 17 | 28 | 87 | |
| 5 | 93 | 65 | 61 | 49 | |
| 6 | | 96 | | 93 | |
| 7 | | 35 | | 51 | |
| 8 | | 77 | | 97 | |
| 9 | | | | | |
| 10 | | | | | |




Randomized cell locations, formulas, etc. and rolling numbers

Question levels progress in difficulty, vary in type

## High reading rate and challenge activity success

Comparing clicks for reading (n = 98 students)

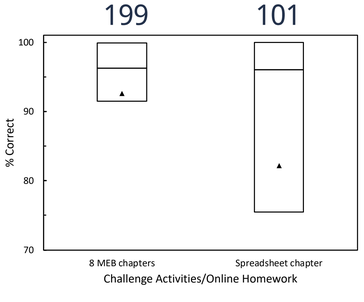
| Topic | Sections | Clicks | Median (%) | 1st quartile (%) |
|---|---|---|---|---|
| Spreadsheets | 12 | 250 | 100 | 100 |
| Material and energy balances | 68 | 1100 | 99 | 91 |

Higher reading rate for spreadsheets compared to other chapters or previous results


Liberatore, M.W., Chemical Engineering Education, 2017. **51**(3): p. 109-118.

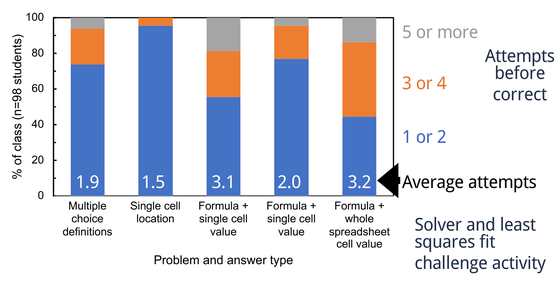

After completing spreadsheets during first half of course, spreadsheets are used to solve problems during second half of course

Auto-graded problems




Broader distribution of 2nd quartile for spreadsheets vs. MEB

Attempts data identify "hard" problems




> 490 attempts after correct, so students use auto-graded problems for additional practice

## Spreadsheets, not Excel version X

Software normally taught by demonstration can be replaced by interactive participation

Spreadsheets are a commodity; most features are independent of version or program (Excel, Sheets, Numbers)

High reading rate and success on auto-graded problems for 2018 cohort

Future updates based on click and success data as well as faculty/student feedback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