



## Spreadsheet for Fret Spacing

This two-part activity allows for students to learn about fret spacing for a stringed instrument with a 12 semi-tone octave. The first part of the activity is a worksheet that asks students to explore the Rule of 18 for scale length and fret spacing. The second part of the activity has students learning spreadsheet functions with which to devise a tool for determining fret positioning as a function of scale length.

### Learning Objectives:

1. Students will calculate fret positions for a given scale length using the Rule of 18.
2. Students will write a spreadsheet for computing all fret positions for a guitar, given the instrument's scale length.

### Standards:

[CCSS.Math.Content.HSF.BF.A.1.a](#) - Determine an explicit expression, a recursive process, or steps for calculation from a context.

[CCSS.Math.Content.HSN.Q.A.3](#) - Choose a level of accuracy appropriate to limitations on measurement applications

### Materials Required:

1. *Fret Spacing: The Rule of 18* worksheet (attached)
2. Sample spreadsheet from [guitarbuilding.org](http://guitarbuilding.org)
3. Pencil and calculator for *Rule-of-18* calculations
4. Computer access with a spreadsheet application for each student
5. Means with which to project/display an example/model spreadsheet for the class
6. Tape measure
7. Guitar fretboard (finished or pre-slotted fretboard blank for the build)



### Safety:

N/A

### References:

Calculating Fret Positions - Liutaiio Mottola Lutherie Information Website for Builders of Stringed Musical Instruments: <http://www.liutaiomottola.com/formulae/fret.htm>

ExcelFunctions.net: Relative vs. Absolute Cell Referencing: <http://www.excelfunctions.net/ExcelCellReferences.html>

### Activity:

The first part of the activity is a worksheet that asks you to explore the Rule of 18 for scale length and fret spacing. Use the internet, or any other available reference material, to assist you in answering the series of questions. The last question requires that you make a series of calculations having to do with the fret spacing on an instrument having a particular scale length. Your calculations for this portion of the worksheet will be used as the foundation for the second part of the activity.

The second part of the activity will involve the creation of a spreadsheet to make the same calculation that was performed on the worksheet. Unlike the worksheet, the spreadsheet will calculate the fret positioning for the entire fretboard, and will be made adjustable for any scale length you wish to enter. Your instructor will lead you through the steps for creating the spreadsheet, including summation and absolute reference commands. Make sure to do a terrific job, since you will be asked to put your spreadsheet to work during the follow-up quiz! Also, definitely take a few minutes with a tape measure to test the results of your spreadsheet against your 25.5" scale fretboard!



Name \_\_\_\_\_

### Assessment Spreadsheet for Fret Spacing

1. If we were to **double** the distance from the front edge of the string nut to the center of the 12th fret, the result would be:
  - A. One Octave
  - B. The Instrument's Scale Length
  - C. One Semi-Tone
  - D. None of the Above
2. What **scale length** is used for the guitars we are building in this course?
  - A. 24.75"
  - B. 25"
  - C. 25.5"
  - D. 26"
3. Which of the following statements is **FALSE** about the Rule of 18 for fret spacing?
  - A. The "18" used in "The Rule of 18" is measured in inches
  - B. The Rule of 18 is used to calculate fret spacing on a stringed instrument having a 12 semi-tone octave.
  - C. The Rule of 18 tells us that the distance from the string nut to the first fret will be approximately equal to the scale length divided by 18
  - D. The Rule of 18 will place the 12th fret at a distance that is HALF the scale length from the front edge of the nut.
4. In Excel, what is accomplished by the following operation?

*Click-and-hold the small block at the lower-right corner of a formula cell, drag down the column to highlight, then release.*

- A. Copies the formula to the highlighted cells in the column
- B. Applies the formula to the contents of the highlighted cells in the column
- C. Moves the formula from the original cell to each of the highlighted cells in the column
- D. None of the Above





5. Which of the following Excel formula entries would make an **absolute cell reference** to A11?

- A. =%A%11
- B. =\$A11
- C. =\$A\$11
- D. =%A11

6. Fill in the blank: “The Rule of 18,” to the **nearest thousandth**, is actually more like:

“The Rule of \_\_\_\_\_.”

7. Use your **Fret Spacing Spreadsheet** to calculate the distance from the nut to fret #4 for a guitar having a scale length of **25.00** inches. Please report your answer to the nearest thousandth of an inch.

\_\_\_\_\_ inches

8. Use your **Fret Spacing Spreadsheet** to calculate the distance from the nut to fret #6 for a guitar having a scale length of **24.75** inches. Please report your answer to the nearest thousandth of an inch.

\_\_\_\_\_ inches

9. Use your **Fret Spacing Spreadsheet** to calculate the distance from the nut to fret #8 for a guitar having a scale length of **25.50** inches. Please report your answer to the nearest thousandth of an inch.

\_\_\_\_\_ inches



Name \_\_\_\_\_

**STEM GUITAR BUILDING  
FRET SPACING: THE RULE OF 18**

This homework assignment is intended to lay the groundwork for an upcoming activity, which will be a spreadsheet having to do with fret positioning. Here goes...

Scale Length and Fret Positioning Explored

1. What is meant by the “*scale length*” of a stringed instrument?

---

---

Source: \_\_\_\_\_

2. What *tonal qualities* are affected by the scale length of a stringed instrument? For example, what type of sound characteristics would one expect from a shorter scale-length instrument vs. a longer scale-length instrument?

---

---

---

Source: \_\_\_\_\_

3. Look back to #3 and give some thought to the WHY behind your response. A guitar string is tightened by its tuning machine to bring it to the desired pitch. Would a longer string need to be tighter than a shorter string of the same thickness in order to achieve the same pitch?

YES / NO

*Why* do you suppose this is so?

---

---





4. Find the *common scale length* used by these electric guitar manufacturers:

FENDER: \_\_\_\_\_

GIBSON: \_\_\_\_\_

P.R.S.: \_\_\_\_\_

Source: \_\_\_\_\_

5. Now, down to business! Look up “*The Rule of 18*” for fret placement, and summarize it below:

---

---

---

---

Source: \_\_\_\_\_

6. You've probably seen in your researching of the “Rule of 18” that it's actually more like the “Rule of *17.817*,” so let's use that figure in the following calculations. Start out with the scale length of the instruments you are building in this class, 25.50”...

Nut to 1st Fret =  $25.50$  divided by  $17.817$  = \_\_\_\_\_ in.

1<sup>st</sup> Fret to 2<sup>nd</sup> Fret =  divided by  $17.817$  = \_\_\_\_\_ in.

2<sup>nd</sup> Fret to 3<sup>rd</sup> Fret =  divided by  $17.817$  = \_\_\_\_\_ in.

3<sup>rd</sup> Fret to 4<sup>th</sup> Fret =  divided by  $17.817$  = \_\_\_\_\_ in.

...





## "Fret Spacing - The Rule of 18" - Worksheet Answer Key

1. The **scale length** of an instrument is the distance between the edge of the nut and the nominal bridge saddle position. For guitars and other fretted instruments the placement of the frets is based on the **scale length**. - [www.liutaiomottola.com](http://www.liutaiomottola.com)
2. All things being equal, a guitar with a longer **scale length** will **sound** a bit brighter, with a quicker attack and more defined bass notes. The **sound** will be more chime-like. The short-scaled guitar will be sweeter and warmer sounding. The basses may be rounder (some might say 'muddier') but the highs will be more lyrical - [www.lmii.com](http://www.lmii.com)
3. YES - If you have two difference speaking lengths of **string** (scale length), put identical **strings** on each, and tune them to the same notes, the one with the **longer** scale length will **require greater tension** (pull) on the **string**. - [www.harmonycentral.com](http://www.harmonycentral.com)
4. Fender (Strat, Tele): 25.5", Gibson (Les Paul): 24.75", PRS: 25" - [www.stewmac.com](http://www.stewmac.com)
5. Luthiers use a mathematical formula - **the Rule of 18** - to calculate the **placement** of the **frets**. - [www.educationcloset.com](http://www.educationcloset.com)
6. Nut to 1st Fret =  $25.5'' \text{ divided by } 17.817 = \underline{1.431''}$   
1st Fret to 2nd Fret =  $(25.500'' - 1.431'') \text{ divided by } 17.817 = \underline{1.351''}$   
2nd Fret to 3rd Fret =  $(24.069'' - 1.351'') \text{ divided by } 17.817 = \underline{1.275''}$   
3rd Fret to 4th Fret =  $(22.718'' - 1.275'') \text{ divided by } 17.817 = \underline{1.204''}$



Assessment Key:

1. B - The Instrument's Scale Length
2. C - 25.5"
3. A - The "18" used in "The Rule of 18" is measured in inches
4. A - Copies the formula to the highlighted cells
5. C - =\$A\$11
6. 17.817
7. 5.158"
8. 7.249"
9. 9.436"

**Reviewing Faculty Cohort Members:**

Chad McCormack, Wells High School, Wells, ME (12/17)

Dave Parker, Noble High School, North Berwick, ME (3/18)