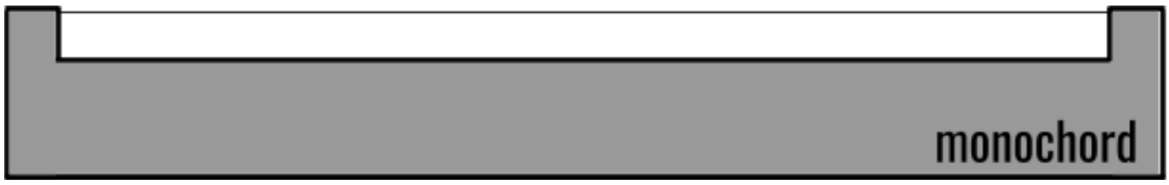
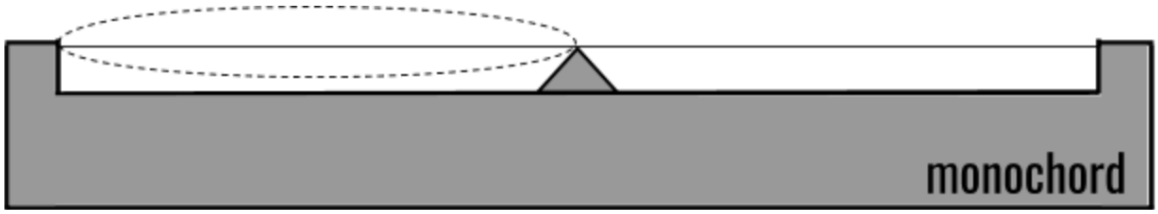
Handout - Calculating the Pythagorean Scale

Greek mathematician Pythagoras and his followers calculated the 7-note "Pythagorean Scale" using a monochord, a simple instrument consisting of a single string tied to a piece of wood. Pythagoras created this scale by dividing the string on the monochord by different ratios. This scale is still a foundation of Western music today.



The first thing they noticed is how the pitch changed when the string is divided in half.



Question 1:

a. Look at the monochord above. What is the ratio of one of the parts of the string to the total number of parts?

b. If the frequency of the open string on the monochord is 261.63 Hz ("middle C"), what is the frequency of the note when the string is divided in half, creating a 1:2 ratio with middle C?

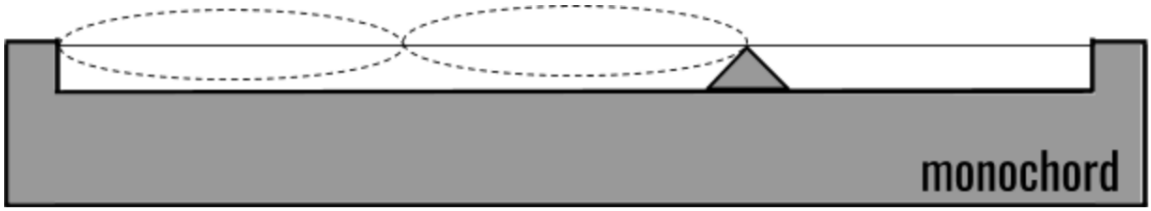
c. In your own words, what happens to the pitch of the string when the string is divided in half?

Pythagoras realized that strings at a 1:2 ratio sounded very similar. Today, two pitches at a 1:2 ratio are called an **octave**, *and most collections of notes used to create music are built within an octave.*

Question 2:

Scales are built within an octave, meaning all the pitches must be between two notes with a 1:2 relationship. Based on your calculations in Question 1, what are the lower and upper limits, in Hertz, that one could build a C scale?

After splitting a string on a monochord in half, Pythagoras and his followers split the string into 2/3rds, to produce a new pitch.



Question 2:

Calculate the resulting frequency if a string playing middle C (261.63 hz) is split into ⅔.

The scale Pythagoras developed is based on repeatedly dividing a string by 2/3. In other words, there is a 2:3 ratio between the first note Pythagoras found and the next note. Each new note Pythagoras found was assigned a letter. Below, you will recreate the scale using the same method.

Directions:
Fill out the chart on the next page using the following rules. Use the workspace below to write in your calculations.

1. Begin with middle C (261.63 Hz). To find the next note (G) find the value that makes a ⅔ ratio with 261.63.

2. Write your answer in the chart on the next page in the box that corresponds with the note name.

3. Continue to find the ratio of each note by finding the value that makes a ⅔ ratio with the previous note you found.

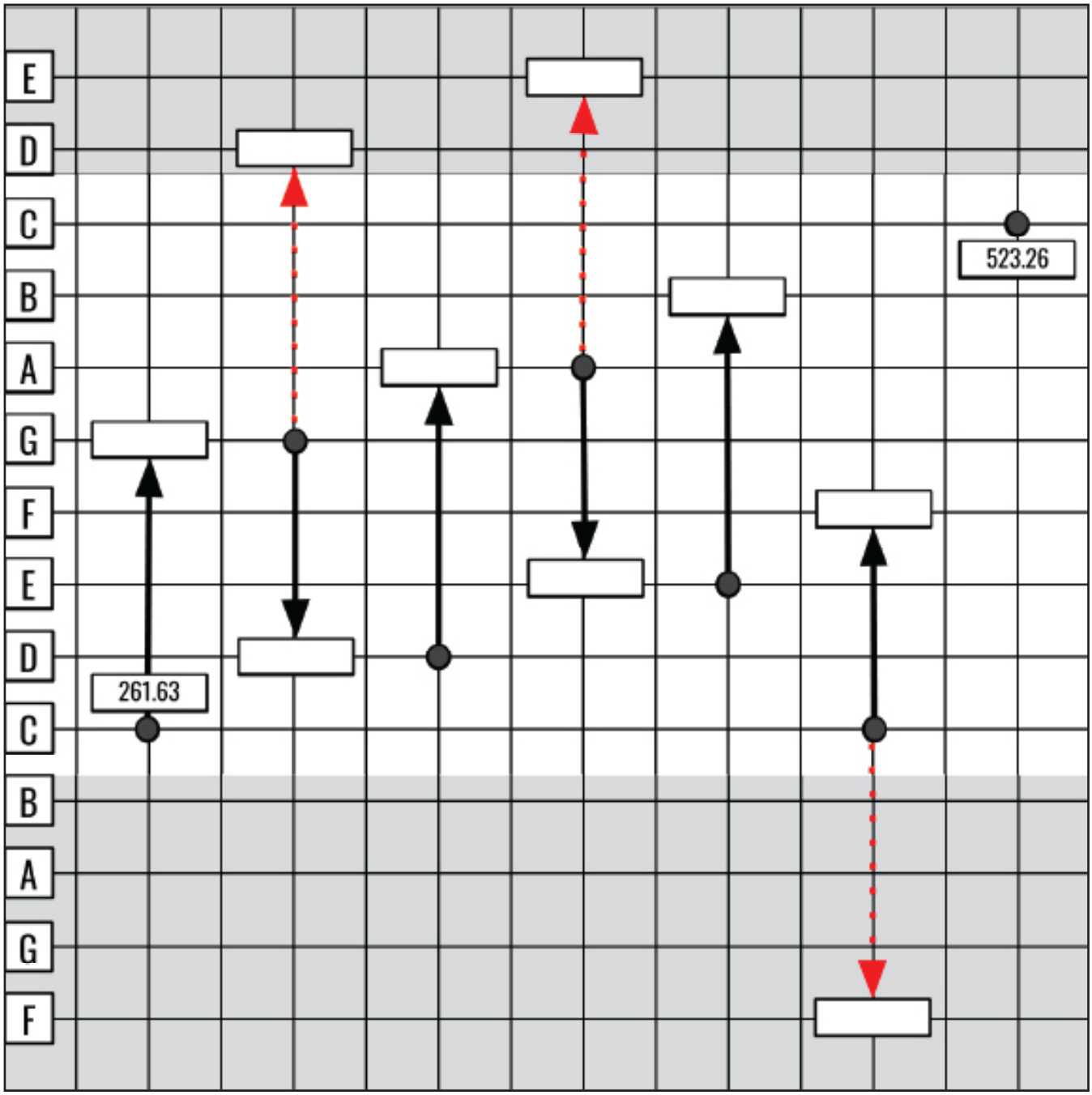
4. Note: the "starting note" for the calculation of F is Middle C (not B) and is ⅔ below C (not above).

5. Note: If you find a frequency that is above the octave, divide the frequency by 2 so that it fits within the C octave. If you find a frequency that is below the octave, multiply the frequency by 2 so that it fits within the C octave.

Pythagorean Scale Calculation Worksheet

1. C:G	**4. A:E**
2. G:D	**5. E:B**
3. D:A	**6. C:F**

Pythagorean Scale Calculation Chart



Now that you found the frequency of each note using Pythagoras' method write the scale in order:

Pythagorean C Scale Frequencies

C	261.63 Hz
D	
E	
F	
G	
A	
B	
C	523.26 Hz