# Journal of Interdisciplinary Science Topics

## A Scientific Approach to Being "All About That Bass"

Osarenkhoe Uwuigbe
*The Centre for Interdisciplinary Science, University of Leicester*
06/03/2015

**Abstract**
This paper discusses the claim in the popular Meghan Trainor song that curvier people are more about the bass than thinner people. It has been taken that in the song, "bass" is referring to the bass range of hearing which has frequencies between 20Hz-200Hz. Using the DeBroglie wavelength, the wavelength for a range of masses were found then converted into frequencies and compared to the bass range. It was found that the maximum mass for a male and female to be within the bass range is 152kg and 128kg respectively. Comparing this to a height/weight chart, it was deduced that contrary to the song, relatively thinner people are more about the bass than curvier people.

**Introduction**
"*All About That Bass*" is a song by recording artist Meghan Trainor [1]. Lyrically the song discusses positive body image, using the word bass as a metaphor for a curvy size. Both the song and music video imply that curvier people are more about the bass when compared to thinner people. In order to discuss the validity of this claim, the DeBroglie wavelength of humans of a range of masses will be calculated, converted into frequencies and compared to the human range of hearing.

**Calibrating the Speed**
All matter can exhibit wave-like properties. The DeBroglie wavelength is used to calculate the wavelength of matter moving with a given momentum [2]. This is shown by the following equation:

$$\lambda = \frac{h}{p} = \frac{h}{mv} \qquad (1)$$

where $\lambda$ is wavelength, $h$ is Planck constant, $p$ is momentum, $m$ is mass and $v$ is velocity.

Once a wavelength is produced we can use the equation for wavelength for an electromagnetic wave to convert this value into a frequency. The equation for wavelength is:

$$\lambda = \frac{c}{f} \qquad (2)$$

where $c$ is speed of light in a vacuum and $f$ is frequency.

Combining equation 1 and 2 gives:

$$f = \frac{cv}{h}m \qquad (3)$$

in equation 3 it can be seen that frequency is proportional to mass and has gradient $\frac{cv}{h}$. At this point there are two variables in the equation. Velocity and mass. In order for the frequency to be solely dependent on the mass used in the equation, the velocity must be given a constant or calibrated value.

To calibrate the value of velocity used in the equation, the velocity at which a human of average mass (both male and female) must travel in order to be in the middle of the bass hearing range is calculated using a rearrange form of equation 3:

$$v = \frac{hf}{mc} \qquad (4).$$

Taking the bass range of hearing to be 20Hz – 200Hz [3] (therefore the middle of this bass range is 110Hz) and the average mass of a human male and female

to be 83.6kg and 70.2kg respectively [4]. The following velocities are produced:

$$v_{male} = \frac{6.626 \times 10^{-34} \times 110}{83.6 \times 2.998 \times 10^{8}}$$
$$v_{male} = 2.91 \times 10^{-42} ms^{-1}$$

$$v_{female} = \frac{6.626 \times 10^{-34} \times 110}{70.2 \times 2.998 \times 10^{8}}$$
$$v_{female} = 3.46 \times 10^{-42} ms^{-1}$$

**Determining the frequencies for a range of masses**

Using the velocities calculated and equation 3, the frequencies for a range of masses will be calculated and plotted. See figure 1:

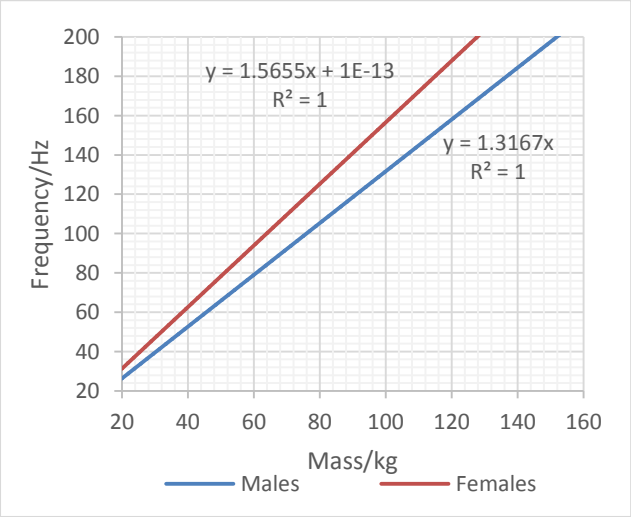


Figure 1 – A graph showing the frequencies for a range of masses calculated using equation 3 and the calibrated velocities. The best fit equation for the lines are next to their corresponding line.

From figure 1 it can be seen that the upper limit of masses to be within the bass range is 128kg for females and 152kg for males.

**Comparison with a Height/Weight Chart**

For simplicity, in this model curvier people will be considered obese or greater and the weight ranges below that will be grouped as relatively thinner. A height/weight chart will categorise the weight ranges, for a given height, into groups: underweight, healthy weight, overweight, obese and very obese (see figure 2) [5]. Comparing figure 1 with these categories it can be seen that for a range of heights (4' 10'' to 6' 7'') and weights (40kg to 128kg – for females, 40kg to 152kg – for males), there is a higher proportion of relatively thinner people within the bass range of hearing when compared to curvier (obese) people.

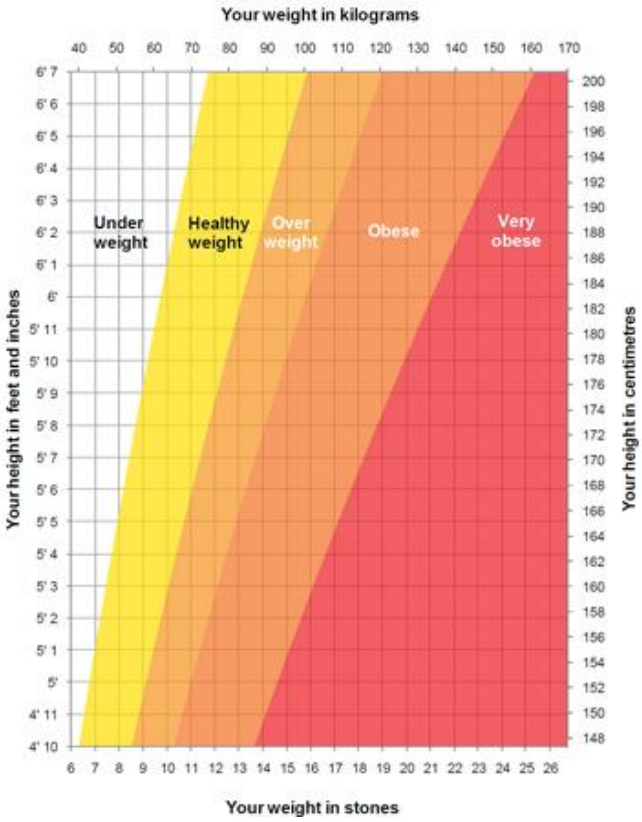


Figure 2 – A height/weight chart [5].

**Conclusion**

It was found that to have a frequency within the bass range of hearing, the maximum mass a male and female could be is 152kg and 128kg respectively. From this it was deduced that contrary to the popular chart song by Meghan Trainor, relatively thinner people are actually more about the bass than curvier people as there is a higher proportion of relatively thinner height/mass ratios that would produce a DeBroglie wavelength with a frequency within the bass range of hearing.

**References**

[1] Trainor, M. & Kadish, K. (2014). *All About That Bass*, on 'Title' (CD), Epic Records. Available at: https://www.youtube.com/watch?v=7PCkvCPvDXk, [Accessed 27/01/2015]

[2] Tipler, P.A. & Mosca, G., (2008), *Physics for Scientist and Engineers*. 6th ed, pp 1289

[3] Independent recording network, (2006). *The Musical Audio Frequency Spectrum*, Available at: http://www.independentrecording.net/irn/resources/freqchart/main_display.htm, [Accessed 27/01/2015]

[4] BBC, (2010). *Statistics reveal Britain's 'Mr and Mrs Average',* Available at: http://www.bbc.co.uk/news/uk-11534042 [Accessed 27/01/2015]

[5] NHS, (2013). *Height/weight chart*, Available at: http://www.nhs.uk/Livewell/healthy-living/Pages/height-weight-chart.aspx [Accessed 27/01/2015]