Perfect pitch Additional notes for teachers including possible solutions.

A notes

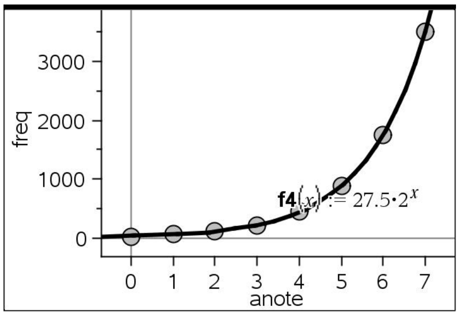
Separating out the A notes makes it much easier to spot that the frequency doubles when the note goes up one octave (fromA0 to A1 etc)

A 'Data and Statistics' page could be used with 'plot function' to test out a possible rule.

Students could then go on to try to predict and test rules for sequences of other notes such as C.

	A anote	B afreq	C
◆			
1	0	27.5	
2	1	55	
3	2	110	
4	3	220	
5	4	440	
6	5	880	

A1 =0



All notes

If doubling the frequency takes the note up one octave or 12 semitones, what would you need to multiply the frequency by to raise the note by just one semitone?

There are several possible approaches.

- One would be to use '**exponential regression'** to fit an equation to the graph and then to look at the significance of the numbers in the graph equation.
- Another would be to try to calculate the common ratio (r) between successive terms and then use this to '**fit a function**' to the graph. Note that r = $\sqrt[12]{2}$

	A allnote	B allfreq	C allwave	D
◆				
1	12	16.35	2100	
2	13	17.32	1990	
3	14	18.35	1870	
4	15	19.45	1770	
5	16	20.6	1670	
6	17	21.83	1580	

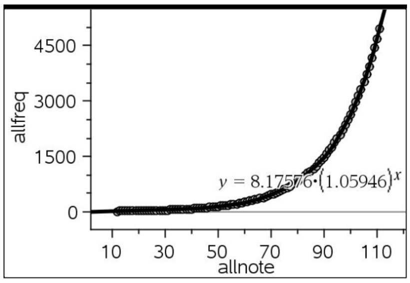
A1 12

$\left(2^{\frac{1}{12}}\right)$ ▸Decimal 1.05946

$2^{\frac{-1}{12}}$ $\frac{2^{\frac{11}{12}}}{2}$

$\frac{2^{\frac{11}{12}}}{2}$ ▸Decimal 0.943874

6/99



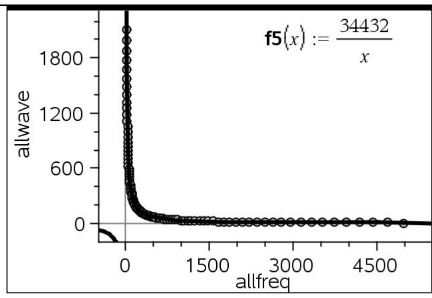
Wavelength and frequency

Hopefully students will recognise at least some of these features

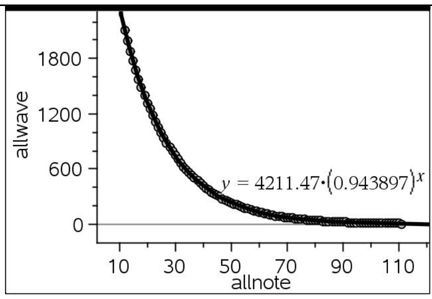
- As frequency increases wavelength decreases
- One is inversely proportional to the other
- The graph will be similar to that of the reciprocal function y = 1/x
- An alternative form of the equation of the graph would be x*y = constant
- frequency * wavelength = speed of sound

If students insert a column in the spreadsheet and use this to multiply the frequency by the wavelength this will give the constant in the equation which is the speed of sound.

'Plot function' can then be used to test this out.



34432 is the speed of sound in cm/sec

Further ideas. Students could also investigate the graphs of note number against wavelength		See the Calculator page in the previous example for further information on this.
The Pythagoreans used $\frac{9}{8}$ as the ratio between successive tones (2 semi-tones or notes) . This is a good approximation to $\sqrt[6]{2}$	Various calculations could be done to show this on a calculator page.	

Further information from:-

http://www.phy.mtu.edu/~suits/notefreqs.html
http://en.wikipedia.org/wiki/Equal_temperament
http://en.wikipedia.org/wiki/MIDI
http://www.phy.mtu.edu/~suits/NoteFreqCalcs.html