Physics Integration Lesson 11 – What's in a Number?

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When experimenting with a wave on a string under constant tension, it becomes clear that musical notes are related to the number of segments into which the string is divided. Although a guitarist can achieve higher notes by pressing a finger against a fret, thus shortening the length of the vibrating string, there is something special about harmonics. Harmonics are achieved by adjusting the frequency until the string naturally subdivides itself into segments. The harmonic number corresponds to the number of segments, antinodes, existing between the ends of the vibrating string.

Combinations of different harmonics provide the basis for western music. An octave is a comparison between the second and first harmonic, which has a frequency twice that of the later. When comparing the third and second harmonic, one gets a frequency ratio of 1.5, which is called a perfect fifth. Pythagorean tuning provides a twelve-tone division of an octave by using combinations of products and quotients of octaves and perfect fifths. Although modern musical instruments are tuned using equal-tempered intervals, the connection to the method attributed to Pythagoras cannot be denied.

Pythagoras' influence on modern science is profound. Noticing the connection between numbers and music, Pythagoras believed mathematical equations could describe the motion of the planets and that they played a symphony of notes. Attributing special value to certain numbers and symbols, a Pythagorean cult was founded during the sixth century BC. By the fourth century Pythagorean philosophers were incorporated into the academy of Plato. Pythagorean influence is attributed to such noted scientists as Copernicus (heliocentric solar system), Kepler (laws for planetary motion) and Newton (universal law of gravity). The whole field of physics rests on the notion that physical phenomena can be described as mathematical relationships, though not necessarily as musical notes.

1. Gnosticism, a term meaning "having knowledge," is assigned to a heresy that arose in the first century church. Gnostics were strongly influenced by Greek thinking hailing back to Plato and Pythagoras. Sin was not considered to be an offence against a perfect creator, but merely as ignorance. Therefore, salvation is achieved by gaining knowledge from any source available: Scripture, nature and mystical practices. Do people think this way today and if so, how does it affect our society? Explain your answer.
2. Modeling the physical world through mathematics allows one to design useful tools, evaluate the past and predict the future. Is this knowledge forbidden by Scripture as gnostic heresy or is it a valuable means of worshipping the Creator, who is revealed in the Scriptures? Explain.