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A Cosmic Clock for the Classroom

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Abstract
Teachers who watched the first episode of Carl Sagan's *Cosmos* show on the Public Broadcasting System may have been impressed by his use of the "Cosmic Calendar" to dramatically introduce the evolutionary time scale of the universe. In this calendar, which Sagan first represented in *The Dragons of Eden,* the 15 billion year history of the universe is compressed into a single year. Each month represents 1.25 billion years, each day 40 billion years, and each second 500 years. At this scale the entire recorded history of mankind flashes by during the final 10 seconds of the cosmic year. [*excerpt*]

Keywords
cosmic year, Carl Sagan, Cosmos, Cosmic Calendar

Disciplines
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A cosmic clock for the classroom

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Teachers who watched the first episode of Carl Sagan's *Cosmos* show on the Public Broadcasting System may have been impressed by his use of the "Cosmic Calendar" to dramatically introduce the evolutionary time scale of the universe. In this calendar, which Sagan first presented in *The Dragons of Eden,*[1] the 15 billion year history of the universe is compressed into a single year. Each month represents 1.25 billion years, each day 40 million years, and each second 500 years. At this scale the entire recorded history of mankind flashes by during the final 10 seconds of the cosmic year.

A simple classroom demonstration graphically illustrates this time scale in a similar fashion. An electronic counter set to total up the pulses from an audio-frequency square-wave oscillator serves as a digital cosmic clock. By adjusting the frequency of the oscillator and by interpreting each count as a certain number of years, the entire cosmic history can be squeezed into a single classroom period.

In the setup we have used, for instance, an 8-digit Heath frequency counter (the more digits the better) is attached to a 5-KHz source. Each count is interpreted as 1 millenium = 1000 years. Thus our counter accumulates 10^6 counts, or 1 billion years, every 3 minutes, 20 seconds. The full 15 billion years is registered after 50 minutes, the duration of a class period.

For the purposes of the demonstration, the digits of the display can be labeled in millions and billions of years. While the least significant digits change too rapidly to be distinguished by the students (recorded history shoots by in a millisecond!), the overall scale of time for the formation of galaxies, the evolution of the solar system, and the development of life on earth can easily be appreciated. Alternatively, the instructor may choose to lower the oscillator pulse rate, compressing the universal time scale only into a week or a semester. The display may then be mounted in a public place and students can check on the progress of cosmic evolution over a longer period of time.

Reference

1. Carl Sagan, *The Dragons of Eden: Speculations on the Evolution of Human Intelligence* (Random House, New York 1977).