

Time is a Social Construct



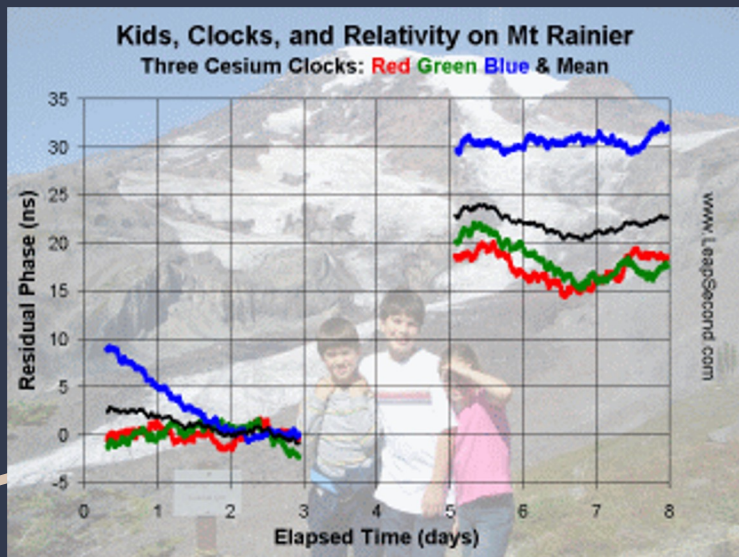
Time

- Only the present truly exists
 - Well, it existed 80 milliseconds ago...
- Einstein: “People like us who believe in physics know that the distinction between past, present, and future is only a stubbornly persistent illusion.”
- National Institute of Standards and Technology (NIST)
 - Responsible for 21 atomic clocks in Boulder, CO
 - “These... clocks tick using hydrogen atoms. The atoms are excited using radiofrequency energy and then sent into a chamber. Once inside, they decay, emitting a specific frequency of light.”
 - “Striking an atomic tuning fork”
 - Broadcasts the current time in the US
 - R&D for an atomic clock that can be placed on a microchip

Time Zones

- International Atomic Time (TAI)
 - Measured by ~450 atomic clocks
- Universal Time (UT1)
 - UT created in 1884
 - [International Telecommunication Union](#)
 - Measured by the Earth's rotation
 - Impacted by the Earth's irregular rotation and tidal acceleration
- Coordinated Universal Time (UTC)
 - [Bureau of Weights and Measures](#)
 - Adjusts TAI by leap seconds to align with the rotation of the Earth (UT1)
 - [A proposal to end leap seconds for 100 years](#)
- [Lunar time zones](#)
 - Currently using UTC, but ESA and NASA are proposing setting a lunar standard time
 - However, each day the moon is about 56 microseconds slower than Earth
- [Coordinated Mars Time](#) (MTC)
 - Proposal for Mars similar to Universal Time (UT1)

Time is (relatively) fragile



- Gravitational time dilation
 - Gravity stretches time
 - "...an observer in the strong gravity experiences time as running normally. It is only in relation to a reference frame with weaker gravity that time runs slowly."
 - NASA did the Twins Study
 - Scott Kelly spent a total 520 days in orbit
 - Mark Kelly spent a total 54 days in orbit
 - Scott is estimated to be about 5 milliseconds younger as a result
 - People on the moon will age 56 microseconds faster each day compared to people on the Earth
- Black holes
 - Crossing the point of no return, time and space flip
 - "Space now has an arrow, and it's one direction...and time doesn't have an arrow"
- Project GREAT
 - Tested Einstein's theory of general relativity, that "high-elevation clocks run fast"