1. *Group Discussion:* "What is time?" is too ambitious.
Instead, write down 3 things that you would say *about* time.

- Time related to motion or change?
- Time and its subdivision process as a cultural construction.
- Is time the same for everyone? For everywhere? For everywhen?
- How we perceive time can vary.
- Is time linear?
- "Time as a necklace of pearls." Is time discrete or continuous?
- Does time flow, from past to present to future?

2. Hal talked about his own work in gravity and black holes, and how much considerations of time come up in this work.

Hal also quoted a Hindu way of organizing time, the 4 Yugas (ages of the world), both to show the cultural element of time division and the vast scale of some time systems.

3. Time is challenging for anyone to tackle:

- Psychologists – How we perceive time
- Philosophers – Finding the language and questions for describing time.
- Physicists – Fitting ideas of time into how our models describe the universe.
- Engineers – How we can measure time more accurately.

We will address all of these in this course, concentrating on the last two.

4. We need basic quantities to measure things in terms of. Physicists have narrowed that down to 7 fundamental quantities, and have standard units for each:

Length	meter (m)
Mass	kilogram (kg)
Time	second (s)
Electric Current	Ampere (A)
Temperature	Kelvin (K)
Amount	mole (mol)
Luminosity	candela (can)

We also have modifiers to scale these units up or down by factors of 1000.

m, milli- (10^{-3})	k, kilo- (10^{3})
μ, micro- (10^{-6})	M, Mega- (10^{6})
n, nano- (10^{-9})	G, Giga- (10^{9})
p, pico- (10^{-12})	T, Tera- (10^{12})

5. For example, taking the velocity of a wave (v: distance/time), we can relate it to how often the wave oscillates (frequency, f: cycles/time) and the physical length of the wave (wavelength, λ: distance/cycle). So,

$v = f \cdot \lambda$ Sound: $v = 344$ m/s Light: $v = 3.00 \times 10^8$ m/s

So, for instance, a sound wave with $\lambda = 0.50$ m has

$$f = \frac{v}{\lambda} = \frac{344\,\text{m/s}}{0.50\,\text{m/cycle}} = 688\,\text{cycles/s}.$$

6. How would we compare two items by one of these quantities?

For instance, to compare the lengths of two tubes, we could put them next to each other and see which is longer. But if we cannot move them, we could use a measuring instrument (a *meter stick*) to look at each one (one is 60 cm, the other is 61 cm) and compare the numbers measured by the measuring instrument.

We will use similar processes for measuring time, using *clocks* as our measuring instruments. But we will have the added wrinkle of not being able to, even theoretically, pick up time intervals and move them next to each other for comparison. Focusing on the details of our measuring processes will be instructive as we try to unravel the mysteries of time and what it means.