Program: An Overview of the Latest Nobel Prizes in Physics, Chemistry, and Medicine
Speakers: Dick Carter, Alan Schmidt, and Tom Lauer (all Scientech Club members)
Introduced by: Joe Abella
Guests: Cliff Biggs, Carol Biggs, Alan Brown, Lisa Kennedy, Jonah Kennedy, Bill Allen, Paul Kellogg, Edward Koolish, Damier Dixon, Will Turner, Liz Hourigan, Larry and Carolyn Woodling, Rick Wiethoff, Ben Kinnex
Attendance: 120
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Circadian Rhythm Explained: orHow to Get a Nobel Prize: 2017 Physiology/Medicine presented by Dr. Tom Lauer.

Circadian Rhythms: physical, mental, and behavioral changes that follow a daily cycle. In the 18th century Jean Jacques d'Ortous de Mairan found that the mimosa plant will respond to "innate behaviors, not "environmental" cues, meaning Circadian Rhythms were genetically controlled. DNA in your cell nucleus contains information on what makes each species unique – and necessary to develop, survive and reproduce. Each cell of your body contains a chromosome which when unwound contains the double helix structure of amino acids – DNA. Sections of the DNA are called genes that tell the body how to make specific proteins. Proteins do most of the work in cells and are required for the structure, function and regulation of the body's tissues and organs. This would include Circadian Rhythms. In the1970's Konopka and Benzer identified the circadian gene in fruit flies but did not understand how it worked. In the 1980's Jeffery Hall, Michael Rosbash, and Michael Young determined how the gene works. They received the Nobel Prize in 2017 in Physiology and Medicine. The gene creates mRNA that then builds protein PER at night. The PER degrades during the day. Daily oscillations of the PER level occur in association with the day and night cycle. Young discovered another gene (doubletime) that control accumulation of PER on a 24 hours cycle.

2017 Nobel Prize in Physics "for decisive contribution to the LIGO detector and observation of gravitational waves" presented by Dick Carter.

The Royal Swedish Academy of Sciences decided to award the 2017 Nobel Prize in Physics "for decisive contributions to the LIGO detector and the observation of gravitational waves". **LIGO** is an acronym derived from: **L**aser **I**nterferometer **G**ravitational-Wave **O**bservatory. It is currently an earthbound detector with two stations; one in Livingston LA and the other in Hanford WA.

LIGO detects the influence of gravitational wave quivers, transiently radiating across the universe, as they finally arrive and gravitationally impact the physical dimensions of LIGO itself! Gravity is a fundamental force which tries to pull two objects with mass toward each other. The more massive an object is, the stronger its gravitational pull is. Gravity is the weakest of the Four Fundamental Forces of the Universe (1. Strong, 2. Weak, 3. Electromagnetic and 4. Gravity). Over 100 years ago, Einstein revealed that gravity warps spacetime and that gravitational waves exist. Gravitational waves are warping ripples of gravitational changes spreading in spacetime. They carry radiating gravitational energy in spacetime. The much stronger gravitational wave signals are caused by: the rapid acceleration or rapid deceleration of cosmic sized masses, or by the rapid appearance or disappearance of gigantic mass in the cosmos. Two orbiting black holes lose mass by radiating gravitational energy waves, and that mass loss produces quicker orbiting cycle times. The first gravitational waves detected by LIGO, in September 2015, were due to the ultra-powerful energy emitted from the accelerating, nearly half the velocity of light binary orbital rotation, and then the subsequent phenomenally destructive collision of two massive black holes! The collision of those two medium size black holes (around 30 solar masses each) resulted in the loss of three solar masses in a

very short time. The resulting gravitational energy radiation flashes for less than a second of time and were cosmically powerful. It took 1.3 billion years for that gravitational wave flash to finally radiate to us. It subsequently was also found that the velocity of gravity is the velocity of light as determined from a later detected collision of two neutron stars that emitted both light and gravitational waves. LIGO is not an ordinary telescope, as generally used for detecting light and other frequencies of electromagnetic radiation emitted from space objects. LIGO is a highly sensitive instrument for detecting the radiating spacetime gravitational waves' impacts upon LIGO itself. LIGO is basically an extremely sensitive Laser Interferometer. It is a **"Light Wave Phase Change Detector" that measures the impact of gravitational waves** upon the length of the two different right-angled legsof the laser light wave interferometer. Detection of the detector leg length changes on the order of 1/4,000th of the diameter of a proton are required to show the impact of the received gravitational waves. This incredible accuracy is equivalent to measuring the distance to a star that is 10 light years away to an accuracy of the width of a human hair! The detected frequency of the gravitational waves is near that of the audio spectrum of our human hearing, ranging from one to ten thousand Hz (cycles per second). LIGO has only detected 5 cosmic sized gravitational wave events during the past 2 years of scanning.

The following Nobel laureates have ensured that the more than four decades of effort led to gravitational waves finally being observed. Kip Thorne was the advanced theory and sophisticated analysis expert. Rainer Weiss pioneered and built ingenious instruments with the highest levels of creative engineering and craftsmanship. Barry Barish became the leader for LIGO, transforming the earlier 40-person group into a large-scale international collaboration with more than a thousand participants. Barry searched for the necessary expertise, the timely involvement of individual people and groups from many countries and obtained over $1 Billion funding for facilities.

Nobel Prize in Chemistry 2017 presented by Alan Schmidt. Jacques Dubochet, Joachim Frank and Richard Henderson are awarded the Nobel Prize in Chemistry for their development of an effective method for generating three-dimensional images of molecules of life.

Using cryo-electron microscopy, researchers can now freeze biomolecules mid-movement and portray them at atomic resolution. This technology has taken biochemistry into a new era. In the first half of the century, biomolecules were terra incognita on the map of biochemistry since they had no idea what they looked like. X-Ray crystallography and NMR spectroscopy only reveals their structure and how they move and interact with other molecules. In the following years electron microscopy gradually improved but would not provide the same view as crystallography and NMR. Electron microscopy got better and cytotechnology developed in which samples were cooled with liquid nitrogen during the measurements to protect them from the electron beam. They still were not able to generate highresolution 3D images of proteins that were randomly scattered and oriented in different directions. It was believed that this problem might never be solved! Later Joachim Frank developed a new image processing method that was fundamental to the development of cryo-EM. Henderson used glucose to protect his membrane from dehydrating, but this did not work in water soluble biochemicals. Jacques Dubochet had a potential solution in cooling water so rapidly that it was solidified in its liquid form to form glass instead of crystals. This process was called the Dubochet's vitrification method. Vitrified water is now believed to be the most usual form of water in the universe. In 1982 the new method using vitrified water was applied in cryo-EM. The first images of biological material could be relatively easily prepared for electron microscopy. Yet the images still had poor resolution. In 1991 Frank prepared ribosomes using Dubochet vitrification method and analyzed the images in his own software. This allowed him to have a resolution of 40 A. The original cryo-EM images looked like blob's but with the new revolution, atomic resolution was now available to EM. Dubochet's vitrification method produces films that reveal how proteins move and interact with other molecules. The joint work of these gentlemen earned them the Nobel Prize.

Tom Lauer, Dick Carter, Alan Schmidt