Honors 392, Cosmology, Self and Society: *Prof B. McGrane*
Adventures in Cosmologies ***Fall 2019*** *Roosevelt 216*

COSMOLOGY, SELF AND SOCIETY: ADVENTURES IN COSMOLOGIES (with deference to Whitehead's *Adventures of Ideas, 1933*)

OVERALL COURSE STRUCTURE: The Ancient Greeks, The Renaissance, The Enlightenment, The 20/21st Centuries

First, some important philosophical, orienting general statements:

"*Had we never seen the stars, and the sun, and the heaven*, *none of the words which we have spoken about the universe would ever have been uttered.* But now the sight of day and night, and the months and the revolutions of the years, have created number, and have given us a conception of time, and the power of inquiring about the nature of the universe; and from this source we have derived philosophy, than which no greater good ever was or will be given by the gods to mortal man." (Plato, *Timaeus*, 360 B.C., my emphasis, in Ferris p19)

"Even before the start of history, the sky must have been commonly used as a compass, a clock, and a calendar...We know that the stars were used for similar purposes very early in history." (Weinberg, *To Explain the World,* 2015, p55)

"Why do we need to know whether the sun revolves around the earth or vice versa? What business of ours is it, anyway? Can this knowledge be of any use to us?...The ultimate questions as to the meaning of our actions and as to the meaning of life in general always tend to involve astronomical problems...The statement that the earth does not occupy the center of the world means more than an astronomical fact...And who among us can declare in all seriousness that he is able to imagine the tremendous size of the sun or to comprehend the cosmic distances defying all earthly ways of measurement?" (Hans Reichenbach, *From Copernicus to Einstein*, 1942, p11-13)

"What could be more *outer* than cosmos? What could be more *inner* than psyche*...Our understanding of the universe affects every aspect of our interior life* from our highest spiritual convictions to the most miniscule details of our daily experience....To a crucial extent, the nature of the universe depends on us." (Tarnas, *Cosmos and Psyche*, 2006, p491)

"at the most basic ontological level, the physical universe is a concept." (Frank Tipler*, The Physics of Immortality*, 1997 p 209

"Our model of the universe is based on our model of ourselves." (Levine, *Who Dies*, p53)

"Like everything mental, the so-called law of causation contradicts itself. No thing in existence has a particular cause--the entire universe contributes to the existence of even the smallest thing; nothing could be as it is without

the universe being what it is. When the source and ground of everything is the only cause of everything, to speak of causality as a universal law is wrong." (Sri Nisargadatta Maharaj, *I Am That*, 1973 p9)

Overall Bibliographical/Historical Outline (a detailed, more specific, organized *required readings guide* given on pg 9 under "Optimistic Calendar and Road Map"):

Ancient Greeks

I. Plato (427-348 B.C.) **Timaeus**; Aristotle (384-322 B.C.), **On the Heavens** 350 B.C. (selections in Munitz or Bb)

II. Ptolemy (100 A.D.-170 A.D.), **Almagest** circa 150 A.D. (short selections in Munitz or Bb "the **Almagest** had become the standard textbook on astronomy which it was to remain for more than a thousand years... down to the sixteenth century. It was dominant to an extent and for a length of time which is unsurpassed by any scientific work except Euclid's **Elements**." Toomer 1984: 2)

III. Secondary Interpretive Sources:

a. Thomas Kuhn, **The Copernican Revolution** (1957) Harvard U. Press (complete)
b. Timothy Ferris, **Coming of Age in the Milky Way** (1988) Harper Collins (selections)
c. Steven Weinberg, **To Explain the World, The Discovery of Modern Science** (2016) Harper Perennial (selections on our Bb)
d. Arthur Koestler, **The Sleepwalkers, A History of Man's Changing Vision of the Universe** (1959) The Macmillan Co. (selections)
e. John Holt, **Why Does the World Exist, An Existential Detective Story** (2012) Ch 2, Ch 14 & 15 (on our Bb)
f. Isaac Asimov's Sci-Fi classic, "Nightfall" and E. M. Forster's "The Machine Stops" together with Plato's philosophical classic "Allegory of the Cave"

Renaissance

I. Ficino (1433-1499), **The Book of the Sun** (De Sole 1494) (complete on our Bb)

II. Copernicus (1473-1543), **On the Revolutions of the Heavenly Spheres**, (Short Selections in Munitz or Bb) (1543) ("The Book that Nobody Read", Arthur Koestler)

III. Secondary Interpretive Sources:
   a. Thomas Kuhn, **The Copernican Revolution** (1957) (complete)
   b. Michel Foucault, **The Order of Things, An Archaeology of the Human Sciences,** (1970). Random House (selections on our Bb)
   c. Ernst Cassirer, **The Individual and the Cosmos in Renaissance Philosophy,** (1963 [1926]), Barnes and Noble (selections on our Bb)

Enlightenment

I. Galileo (1564-1642), **Letters on Sunspots** (1613) (complete on our Bb) & **The Starry Messenger** (1610) (selections in Munitz and on our Bb)

II. Kepler (1571-1630), **A New Astronomy** (1609) (selections in Munitz and on our Bb) [Original full title: *A New Astronomy based on causation or A Physics of the Sky, derived from Investigations of Motions of the Star Mars, Founded on Observations of the noble Tycho Brahe*) Kepler defined his program in a letter to a colleague:" My Aim is to show that the heavenly machine in not a kind of divine, live being, but a kind of clockwork (and he who believes that a clock has a soul, attributes the maker's glory to the work), insofar as nearly all the manifold motions are caused by a most simple, magnetic, and material force, just as all the motions of the clock are caused by a simple weight. And I also show how these physical causes are to be given numerical and geometrical expression." (Koestler, *Sleepwalkers*, p 345)

III. Newton (1642-1726), **Mathematical Principles of Natural Philosophy** (1687) (selections in Munitz and on our Bb). Newton...in a famous letter to Bentley wrote: "It is inconceivable , that inanimate brute matter should, without the mediation of something else, which is not material, operate upon, and affect other matter *without mutual contact;* as it must do, if gravitation, in the sense of Epicurus, be essential and inherent in it. And this is one reason, why I desired you would not ascribe innate gravity to me. *That gravity should be innate*, inherent, and essential to matter, so that one body may act upon another, *at a distance through a vacuum*, without the mediation of anything else, by and through which their action and force may be conveyed from one to another, *is to me so great an absurdity*, that I believe no man who has in philosophical matters a competent faculty of thinking, can ever fall into." (Koestler *Sleepwalkers*, p 344. italics added)

IV. Immanuel Kant (1724-1804**), Universal Natural History and Theory of the Heavens** (1755) (selections in Munitz and on our Bb)

V. Secondary Interpretive Sources:
   a. Thomas Kuhn, **The Copernican Revolution** (1957) (complete) Harvard U. Press
   b. Thomas Kuhn, **The Structure of Scientific Revolutions** (1962) University of Chicago Press 2nd ed. (selections)
   c. Alexander Koyre**, From the Closed World to the Infinite Universe** (1957) (selections on our Bb) John Hopkins Press
   d. E. A. Burtt, **The Metaphysical Foundations of Modern Science** (1924) (selections on our Bb) Doubleday
   e. Lawrence Lipking, **What Galileo Saw, Imagining the Scientific Revolution**, (2014) (selections on our Bb) Cornell University Press

20th/21st Century

I. Einstein (1879-1955), **Special Theory of Relativity** (1905**), General Theory of Relativity (**1915) (selections in Munitz and on our Bb)

II. Edwin Hubble (1889-1955), **The Realm of the Nebulae** (1936) Yale U. Press and **The Observations Approach to Cosmology** 1937. Oxford U Press. (selections in Munitz and on our Bb)

III. Stephen Hawkings (b 1942), **A Brief History of Time** (1988). Bantam (selections on our Bb)

IV. Secondary Interpretive Sources:
   a. Thomas Kuhn, **The Structure of Scientific Revolutions** (1962) (selections)
   b. Timothy Ferris, **Coming of Age in the Milky Way** (1988) Harper Collins (selections), **The Whole Shebang, A State of the Universe (s) Report** (1997) Simon and Schuster (selections on our Bb)
   c. R. G. Collingwood, **The Idea of Nature** (1945) Oxford U. Press (selections on our Bb)
   d. Peter Coles, **Cosmology, A Very Short Introduction** (2001) Oxford U. Press (selections on our Bb)

e. **Daedalus, Journal of the American Academy of Arts and Sciences**, Fall 2014, *From Atoms to the Stars.* Editors: J. Meinwald and J. Ostriker. (selections on our Bb)

Structures and Themes

We humans are a little like water. We take the shape of whatever universe we happen to find ourselves poured into at birth and currently inhabiting. This course will be an adventure into and exploration of those various universes.

"We see the world the way we do not because that is the way it is, but because we have these ways of seeing." (Ludwig Wittgenstein). This course is an inquiry into those *ways of seeing*. It isn't *about the universe* but rather *our changing ideas* about the universe. We treat the universe somewhat as a cosmic inkblot--inkblot tests are not about inkblots but rather about their interpretations and interpreters. Further our method of approach toward these cosmologies is not strictly historical, in the conventional sense, nor is it strictly philosophical or epistemological. The approach will be what the contemporary French philosopher/historian Michel Foucault at one time called 'archaeological.' (In the context of Chapman University, we might also call it 'interdisciplinary'.)

Regarding our readings, classroom discussions and viewings, we will attempt to generate an educational environment of immersion (immersion sort of like what the participant-observer field anthropologist attempts when studying an alien/primitive/different culture). We will engage in this existential/epistemological immersion such that we get inside the lived/experienced cosmologies we encounter (inside the Aristotelian/Ptolemaic world, the Renaissance world, the Enlightenment world, the Contemporary world) and at the same time analytically inquire into how they were possible—in the sense of '**how were they think-able'**. What fundamental unconscious taken for granted assumptions allowed them to arise as they did, what 'way of seeing' made them possible? In this approach we will do our best not to unconsciously assume, nor consciously judge, 'they were wrong/incorrect/mistaken'—again, like the participant-observer anthropologist's attitude toward the alien culture she studies.

(Human beings look much the same, but we often perceive things utterly differently and, in a deep sense, we each live in our own unique, separate, individual world. As the late Tibetan Master, Kalu Rinpoche said: "If a hundred people sleep and dream, each of them will experience a different world in his dream. Everyone's dream might be said to be true, but it would be meaningless to ascertain that only

one person's dream was the true world and all others were fallacies. There is truth for each perceiver according to the ... patterns conditioning his/her perceptions.")

("A human being is a part of the whole called by us universe, a part limited in time and space. He experiences himself, his thoughts and feeling as something separated from the rest, a kind of optical delusion of his consciousness. This delusion is a kind of prison for us, restricting us to our personal desires and to affection for a few persons nearest to us. Our task must be to free ourselves from this prison by widening our circle of compassion to embrace all living creatures and the whole of nature in its beauty." Albert Einstein)

THE MAJOR HISTOICAL EPOCHES WE WILL ADDRESS:

The Ancient Cosmos (Aristotle/Ptolemy/Christian). ***The Cocoon Universe***

"The skies of our ancestors hung low overhead. When the ancient Sumerian, Chinese, Korean astronomers trudged up the steps of their squat stone ziggurats to study the stars, they had reason to assume that they obtained a better view that way...because they had got themselves appreciably closer to the stars" (Ferris, *Coming of Age in the Milky Way*, p 19). We live on a stable, secure, solid, immovable earth (an 'earth island', more accurately—"Orbis Terrarum"--surrounded by the impenetrable 'Ocean'—"Oceanus"). Like the familiar "Russian dolls" *nesting* arrangement, this earth is enveloped inside a series of crystalline revolving layers, the "heavens." The Earth itself is immobile and at the center of the universe. It is a sphere (only a small minority have ever truly believed it to be actually flat). Above, quite visibly, are thousands of moving "stars": the Sun-star, the Moon-star, the five wandering, vagabond planet stars ('planet' derives from the Greek for "wanderer") and the roughly three-thousand "fixed' stars.

<u>*Cosmology, Self and Society Statement*</u>: The cosmos we live in is a warm cocoon, which reflects us and in which we are enfolded. We live, as it were, inside a planetarium with a large domed roof. *Unlike Our Transitory often times chaotic Earth Below*, *The Heavens Above are Divinely Perfect and Unchanging displaying Uniform Motion in Perfect Circles.*

The Modern Universe (Copernicus). ***The Crack in the Cosmic Egg Universe***

We live on a rotating, earth sphere which is simultaneously travelling around the now fixed, stable, unmoving Sun. [The Earth *rotates* around its own axis and *revolves* around the Sun.] The spherical earth is traveling in its own perfectly circular orbit--as are the other five planets. We are inside this "Solar System" with the outer most sphere of the fixed stars very, very, very far away.

Cosmology, Self and Society Statement: The universe we live in is amazing and divine and to properly understand it *is* to understand God, the Christian God. *We are moving! And the Heavens are All Around*.

The Modern Universe (version 2.0,Galileo, Kepler, Newton). ***The Stable Clockwork Universe***

We live on a rotating, elliptically revolving planet which, along with 5 other planets, elliptically revolve around the Sun. The Sun is now revealed as actually being a "star." There will be ever more and more stars discovered in this new very much larger space-volume, this container, our Milky Way Galaxy. In fact space itself has become infinite and contains possibly an infinite number of stars and, further, this infinite space has been existing for an infinite amount of time—though the earth itself is roughly 7000 years old, according to established Biblical chronology.

Cosmology, Self and Society Statement: The Universe we live in is a stable clock-work of enormous size. It reflects the Divine and we are a brief admirer. *The Heavens are* ***Infinite,*** ***Eternal*** *and Exquisite.* ***Time and Space*** *are* ***primordial*** *and the material Universe arises* ***within them****. The material universe is not primordial but arises within primordial, preexisting Space and Time.*

The Contemporary Universe (Einstein/Hubble). ***The Hydrogen Bomb Universe.***

We live on a rotating planet, spinning at about 1000 mph, revolving in its one year long elliptical path around a medium size star--the Sun--at roughly 19 miles per second (67,000 miles per hour). We are moving fast! Our Sun and Solar system as a whole--located about 2/3's from the center of our spiral, Milky Way Galaxy--is traveling on *its* elliptical path around the Milky Way Galaxy at about 143 miles per second (514,000 miles per hour). One journey of our solar system around the center of the Milky Way galaxy--sometimes called a 'cosmic year'--takes roughly 250,000,000 years (250 million years). Our Milky Way Galaxy itself is travelling through space at 1 ½ million miles per hour.

Our huge galaxy is not the universe! Our Spiral Milky Way Galaxy is one of about 30-40 Galaxies in our "Local Group" of Galaxies. There is an estimated 100 to 200 billion galaxies in the Universe, and a roughly guesstimated 100,000,000,000,000,000,000,000,000,000 stars, or a "1" with 29 zeros (*not* an "infinite" number). Stars themselves come in all shapes and sizes: Red Giant Stars, White Dwarf Stars, Neutrino Stars, Pulsars, Quasi-Stellar things called Quasars, Collapsed Stars called Black Holes, and many more. Stars are the *factories producing all the heavy elements of the periodic table* (the chart/tabular arrangement of all the 118 chemical elements—familiar and posted in every school classroom-- ordered by their atomic number--see brief footnote 1 end of syllabus). Before the 'star-factories' started their construction machineries the universe was *only* hydrogen and helium. Indeed, we ourselves are actually composed of star-dust (puts a rather different spin on the old Biblical phrase, 'from dust man comes and to dust he returns'). Viewed from the "largest perception," all these galaxy clusters are *rushing away from each other* at incalculably high velocities and the ones furthest away are *rushing faster and faster the further and further away they hurtle.* "The Hubble Law basically means that galaxies twice as far away from the observer are moving away twice as quickly. Those three times away move three times as fast, and so on. Hubble published the discovery of his famous law in 1929, which resulted from a study of the spectra of a sample of galaxies." (Coles, p39) "Not only the distance of any nebula from us is increasing, but *all* mutual distances between any two of them are increasing at the same rate. Our own galactic system is only one of a great many, and observations made from any of the others would show exactly the same thing. All systems are receding, not from any particular center, but *from each other*: the whole system of galactic systems is *expanding*." (William deSitter. 1932 in Munitz p 308)

Space is *not infinite* and time is *not eternal*. Space and time are inextricably inter-woven and inter-dependent into Space-Time. *If you take away matter space disappears*; "the space-time that we inhabit is a construction. It is not fundamental to nature, but emerges from a deeper level of reality." (Musser) The universe is finite. It began with an "explosion" about 13.8 billion years ago. As the noble laureate Steven Weinberg concludes in his *The First Three Minutes: A Modern View of the Origin of the Universe,* (1977) "...whichever cosmological model proves correct, there is not much comfort in any of this. It is almost irresistible for humans to believe that we have some special relation to the universe, that human life is not just a more-or-less farcical outcome of a chain of accidents reaching back to the first three minutes...It is very hard to realize that this all is just a tiny part of an overwhelmingly hostile universe. It is even harder to realize that the present universe has evolved from an unspeakably unfamiliar early condition, and faces a future extinction of endless cold or intolerable heat. The more the universe seems comprehensible, the more it also seems pointless." (p 154)

The ultimate questions as to the meaning of our actions and as to the meaning of life in general always tend to involve astronomical problems. Hans Reichenbach

Cosmology, Self and Society Statement: The universe we live in is essentially an inconceivably expanding, multi-dimensional material-energy—matters and energies known and unknown. Think of it as living inside an already ignited, violently, exploding hydrogen bomb. We are a momentary particle. *The Heavens are Violent*. *Time and Space are not primordial but the daughters of the Material Universe.*

Optimistic Calendar and Detailed Road Map:

(You are absolutely responsible for *everything that occurs in class whether you are present or not.* Many assignments *only given orally* (I suggest you get 2 classmates contact information in case you miss class). This syllabus is a guide for an educational journey, not a legal document. Please relate to it accordingly. *All electronic devices* must be *turned off* during class.)

Week 1 - (Aug 27) –*1ST READING*: THIS SYLLABUS (please read it closely); then Inge Bell – *This Book Is Not Required*, (on our Bb) Chapters: Grades, Support Your Local Teacher, An Academic Question, Questions of Academic Integrity.

THE SEQUENCE OF OUR READING SCHEDULE (which will be ongoingly discussed and monitored)

* Isaac Asimov's *Nightfall (1941)* –science fiction short story and E. M. Forster's *The Machine Stops(1909)*--also a science fiction short story. These two are to be read in contrast/comparison with Plato's *Parable of the Cave*—taken from *The Republic (381 B.C.)* (both on our Bb)

*Begin reading Thomas Kuhn's *The Structure of Scientific Revolutions (1962)* (we will be reading the entire book)

*Introduction to McGrane's project, *Man Made Sun- A History of our Changing Ideas of the Sun: Prologue and Invention verses Discovery (*both on Bb)

*Introduction to a variety of "skill sets": to "*Exploriments*" as a way of inquiry and learning; to "*Writing Practice*" as a technique of relating to writing; and, finally, to "*Analysis*" as a specific way of achieving foundational thinking.

Resources:

Getting a personal and existential "feel" for the Universe we live in. What is the architectural structure of our home? Of our universe? Introduction to phenomenological observation; to field astronomy; to how the starry heavens appear to the human eye. Getting a further personal and existential "feel" for the star gazers of ancient times. The structure of the heavens: the Sun, the Moon, the roughly 3000 visible stars moving from eastern horizon to western horizon across the heavenly dome, the 'staked down' immobile North Star (Polaris), the vagabond planets (planet is Greek for "wanderers"). We will focus on: The primacy and the perfection (or "obsession") of the CIRCLE and the SPHERE. The CENTER of the revolving heavens. The STABILITY and AT-RESTNESS of the center.

1. The Personal Experiment: A Day in the Life and Death of a Day (McGrane's **The Un-TV and 10 MPH Car**)

2. Visuals/DVD's- The Planetarium Experience as the Ptolemaic Experience

3. Field Trip to Griffith Observatory and Planetarium (2800 East Observatory Road, L.A. 90027) Day and Time TBA

Week 2, (Sept 3)

Continue reading the materials laid out in week 1.

Week 3, (Sept 10)

Continue reading the materials laid out in week 1.

Week 4, (Sept 17) CLASSICAL GREEK WORLD

Arthur Koestler – *Sleepwalkers* pgs. 9-87

Thomas Kuhn – *The Copernican Revolution* pgs. Xiii-134

Milton K. Munitz – *Theories of the Universe* pgs. 1-7; 61-138

Timothy Ferris – *Coming of Age in the Milky Way* pgs. 19-45

Week 5, (Sept 24)

Continue readings laid out in week 4.

Week 6, (Oct 1)

Continue readings laid out in week 4. **ESSAY # 1 DUE Oct 1st**

Week 7, (Oct 8) RENAISSANCE-ENLIGHTENMENT-19TH CENTURY

Arthur Koestler – *Sleepwalkers.* In general it would be good to read continuously pgs. 121-553 but specifically *required* are: pgs. 148-157; 194-225; 244-248; 249-270; 276-281; 286-294; 317-349; 357-384; 393-404; 431-435; 431-435; 458-468; 471-487; 504-553

Thomas Kuhn – *The Copernican Revolution* pgs. 134-265

Milton K. Munitz – *Theories of the Universe* pgs. 141-271

Timothy Ferris – *Coming of Age in the Milky Way* pgs. 47-175

Resources:

DVD's: Galileo ; Newton (Nova, History/Discovery). Neil Tyson De-Grasse's *Cosmos* Series. (selections), Carl Sagan's Original *Cosmos* Series (short selections); The Mystery of Mathematics (Nova)

Week 8, (Oct 15)

Continue readings laid out in week 7

Week 9, (Oct 22)

Continue readings laid out in week 7

Week 10, (Oct 29)

Continue readings laid out in week 7 **ESSAY #2 DUE Oct 29th**

Week 11,(Nov 5) $20^{TH}/21^{ST}$ CENTURY

Milton K. Munitz – *Theories of the Universe* pgs. 271-433 (Partial Selections TBA)

Timothy Ferris – *Coming of Age in the Milky Way* pgs. 177-392 (Partial Selections TBA)

Stephen Hawkings (b 1942), **A Brief History of Time** (1988). Bantam (Selections on Bb).

Timothy Ferris, **The Whole Shebang, A State of the Universe (s) Report** (1997) Simon and Schuster (Bb Selections TBA)

R. G. Collingwood, **The Idea of Nature** (1945) Oxford U. Press (Selections on Bb)

Peter Coles, **Cosmology, A Very Short Introduction** (2001) Oxford U. Press (Bb Selections TBA).

Daedalus, Journal of the American Academy of Arts and Sciences, Fall 2014, *From Atoms to the Stars.* Editors: J. Meinwald and J. Ostriker. (Selections on Bb)

Resources:

DVD's : Nova's Inside Einstein's Mind, The Mystery of Mathematics, The Origins of the Universe, Exploring Hubble, The Dinosaurs and the Killer Comet, The Origin and Evolution of Earth, The Beginning and End of the Universe

Week 12, (Nov 12)

Continue readings laid out in week 11

Week 13, (Nov 19)

Continue readings laid out in week 11

**********THANKSGIVING BREAK **********

Week 14, (Dec 3)

Continue readings laid out in week 11 **ESSAY #3 DUE ON DATE OF FINAL**

INSTRUCTIONAL STRATEGIES:

1. Selections from primary texts in cosmology will be read. Students will be assigned to present and lead the discussions of each selection.

2. Secondary interpretive texts will be assigned and all will be responsible for discussions.

3. A wide variety of educational DVD's will be assigned both for outside of class viewing as well as in class viewing.

4. An array of astronomical and cosmological 'exploriments" (field experiences/experiments) will be assigned. These are designed for students to have a 'personal experience' of the abstract ideas we will be learning about. We will also try to visit a planetarium.

METHODS OF EVALUATION:

1. PAPER AND ELECRONIC: ALL TAKE HOME ESSAYS MUST BE *SUBMITTED AS PAPER IN CLASS* AND ALSO *SUBMITTED ELECTRONICALLY TO OUR BLACKBOARD, ASSIGNMENTS, TURNITIN.COM.*--NO CREDIT GIVEN IF THESE PROCEDURES ARE NOT FOLLOWED. FOR THE IN-CLASS PAPER COPY DO *NOT PUT YOUR NAME ON FRONT* AS USUSAL BUT *ON BACK* OF LAST PAGE.

2. In class presentations on the readings will be evaluated as well as overall class participation. Written responses to our "experiments" and to our theoretical "analysis" will be evaluated.

3. Formal take home comprehensive "integration" essays of 3-5 pages will be assigned after each segment of a historical epoch. (For example, after the Ancient Greek section, the Renaissance section, etc.). *These essays will bring together all of the readings and films of that segment around a core integrating theme*. There will be 3 of these essays.

Field Experiments/"Analysis" exercises/Oral Reports:	25%
Essay #1	25%
Essay #2	25%
Essay #3	25%

"Science is built with facts as a house is with stones, but a collection of facts is no more a science than a heap of stones is a house." -Jules Henri Poincaré, mathematician, physicist, and philosopher (29 Apr 1854-1912)

"The most important scientific revolutions all include, as their only common feature, the dethronement of human arrogance from one pedestal after another of previous convictions about our centrality in the cosmos." -Stephen Jay Gould, paleontologist, biologist, author (1941-2002)

GENERIC PORTION (UNIVERSITY WIDE) OF SYLLABUS:

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Our Program Learning Outcomes are the following:

1. Students will learn to explain and discuss the intellectual and cultural history, theory, and terminology regarding cosmologies.

2. Students will learn to explain and discuss how astronomical and cosmological research and analysis has been carried out in Western history.

3. Students will learn to explain and discuss the broad range of social institutions, cultural beliefs and processes historically affected by cosmologies, astronomies and philosophies. Students will become critically aware of how large cosmological issues can and do impact us in startling, intimate and unexpected ways.

4. Students will demonstrate an ability to write effectively using appropriate historical, cosmological and philosophical styles and terminologies.

Our Course learning outcomes are the following:

Students who complete this course should be able to:

1. Describe the key paradigms of cosmological and astronomical thinking in the Western world from the Ancient Greeks to the 20th/21st centuries.

2. Design, conduct, and evaluate research employing a variety of different historical, philosophical and astronomical methodologies.

3. Evaluate competing "knowledge claims" regarding the foundations and interpretations of our Western cosmologies.

The Chapman University Academic Integrity Policy, Chapman University's students with Disabilities Policy, and Equity and Diversity policy has been modified. The following is the revised text:

Chapman University's Academic Integrity Policy:

Chapman University is a community of scholars which emphasizes the mutual responsibility of all members to seek knowledge honestly and in good faith. Students are responsible for doing their own work, and academic dishonesty of any kind will not be tolerated anywhere in the university.

Chapman University's Students with Disabilities Policy:

In compliance with ADA guidelines, students who have any condition, either permanent or temporary, that might affect their ability to perform in this class are encouraged to inform the instructor at the beginning of the term. The University, through the Disability Services Office, will work with the appropriate faculty member who is asked to provide the accommodations for a student in determining what accommodations are suitable based on the documentation and the individual student needs. The granting of any accommodation will not be retroactive and cannot jeopardize the academic standards or integrity of the course.

Equity and Diversity

Chapman University is committed to ensuring equality and valuing diversity. Students and professors are reminded to show respect at all times as outlines in Chapman's Harassment and Discrimination Policy: http://tinyurl.com/CUHarassment-Discrimination. Any violations of this policy should be discussed with the professor, the Dean of Students and/or otherwise reported in accordance with this policy.

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(1)The Russian chemist Dmitri Mendeleev published the first widely recognized periodic table in 1869. He developed his table to illustrate periodic trends in the properties of the then-known elements. Mendeleev also predicted some properties of then-unknown elements that would be expected to fill gaps in this table. Most of his predictions were proved correct when the elements in question were subsequently discovered. Mendeleev's periodic table has since been expanded and refined with the discovery or synthesis of further new elements and the development of new theoretical models to explain chemical behaviour.

All elements from atomic numbers 1 (hydrogen) to 118 (oganesson) have been discovered or synthesized, with the most recent additions (nihonium, moscovium, tennessine, and oganesson) being confirmed by the International Union of Pure and Applied Chemistry (IUPAC) in 2015 and officially named in 2016: they complete the first seven rows of the periodic table.[1][2] The first 94 elements exist naturally, although some are found only in trace amounts and were synthesized in laboratories before being found in nature.[n 1] Elements with atomic numbers from 95 to 118 have only been synthesized in laboratories or nuclear reactors.[3] Synthesis of elements having higher atomic numbers is being pursued. Numerous synthetic radionuclides of naturally occurring elements have also been produced in laboratories. (From Wikipedia 8/2017)

Today's selection -- from *Spooky Action at a Distance* by George Musser. Jenann Ismael on the idea that physical locality may not be the deepest level of reality. "One of the strangest aspects of quantum physics is entanglement: If you observe a particle in one place, another particle -- even one light-years away -- will instantly change its properties, as if the two are connected by a mysterious communication channel." The idea of quantum entanglement -- the ability of separated objects to share a condition or state -- was once dismissed by Albert Einstein as "spooky action at a distance." Over the past few decades, however, physicists have demonstrated the reality of this kind of "spooky action" over ever greater distances:

"Maybe particles in an entanglement experiment or galaxies on the farthest reaches of known space act strangely because they're really projections -- or, in some other way, secondary creations -- of objects existing in a very different realm. 'In the kaleidoscope case, we know what we have to do: we have to see the whole system; we have to see how the image space is created,' Ismael says. 'How do we construct an analogue of that for quantum effects? That means seeing space as we know it -- everyday space in which we view measurement events located at different parts of space -- as an emergent structure. Maybe when we're looking at two parts, we're seeing the *same* event. We're interacting with the same bit of reality from different parts of space.'

"She and others question the assumption, made by nearly every physicist and philosopher from Democritus onward, that space is the deepest level of physical reality. Just as the script of a play describes what actors do on stage, but presupposes the stage, the laws of physics have traditionally taken the existence of space as a given. Today we know that the universe has more to it than things situated within space. Nonlocal phenomena leap out of space; they have no place in its confines. They hint at a level of reality deeper than space, where the concept of distance ceases to apply, where things that appear to lie far apart are actually nearby or perhaps are the same thing manifested in more than one place, like multiple images of a single shard of kaleidoscopic glass. When we think in terms of such a level, the connections between subatomic particles across a lab bench, between the inside and the outside of a black hole, and between opposite sides of the universe don't seem so spooky

anymore. Michael Heller, a physicist, philosopher, and priest at the Pontifical Academy of Theology in Krakow, Poland, says: 'If you agree that the fundamental level of physics is not local, everything is natural, because these two particles which are far apart from each other explore the same fundamental nonlocal level. For them, time and space don't matter.' Only when you try to visualize these phenomena in terms of space -- which is forgivable, because it's hard for us to think in any other way -- do they defy comprehension.

"The idea of a deeper level seems natural because, after all, it is what physicists have always sought. Whenever they can't fathom some aspect of our world, they assume they must not yet have gotten to the bottom of it all. They zoom in and look for the building blocks. How mysterious it is, for example, that liquid water can boil to steam or freeze to ice. Yet these transformations make perfect sense if liquid, vapor, and solid are not elemental substances, but distinct forms of a single fundamental substance. Aristotle took the states of water to be diverse incarnations of so-called prime matter, and the atomists -- presciently -- thought they were rearrangements of atoms into tighter or looser structures. En masse, the building blocks of matter acquire properties that, individually, they lack. A molecule of water is not wet, and an atom of carbon is not alive, but lots of them, coming together in the right way, can be. Likewise, space might be built of pieces that are not themselves spatial. Those pieces might also be disassembled and reassembled into nonspatial structures such as the ones that black holes and the big bang are hinting at. 'Spacetime can't be fundamental,' says the theorist Nima Arkani-Hamed. 'It has to come out of something more basic.'

"This thinking completely inverts physics. Nonlocality is no longer the mystery; it's the way things really are, and *locality* becomes the puzzle. When we can no longer take space for granted, we have to explain what it is and how it arises, either on its own or in union with time. Clearly, constructing space isn't going to be as straightforward as melding molecules into a fluid. What could its building blocks possibly be? Normally we assume that building blocks must be smaller than the things you build out of them. A friend of mine and his daughter once erected a detailed model of the Eiffel Tower out of popsicle sticks; they hardly needed to explain that the sticks were smaller than the tower. When it comes to space, though, there can be no 'smaller,' because size itself is a spatial concept. The building blocks cannot presume space if they are to explain it. They must have neither size nor location; they are everywhere, spanning the entire universe, and nowhere, impossible to point to. What would it mean for things not to have positions? Where would they be? 'When we talk about emergent spacetime, it must come out of some framework that is very far from what we're familiar with,' Arkani-Hamed says."

author: George Musser

title: *Spooky Action at a Distance*

publisher: Scientific American/Farrar, Straus and Giroux

date: Copyright 2015 by George Musser

page(s): 168-170

https://www.scientificamerican.com/article/a-movie-of-the-evolving-universe-is-potentially-scary/?utm_source=newsletter&utm_medium=email&utm_campaign=today-in-science&utm_content=link&utm_term=2020-08-03_featured-this-week&spMailingID=68158223&spUserID=NDA5MTc0NDc0OTA4S0&spJobID=1940333059&spReportId=MTk0MDMzMzA1OQS2

Planetarium Online: Tour of the Evening Sky (April 9, 2020)

https://www.youtube.com/watch?v=60MAYR8-z6I

https://www.thenewatlantis.com/publications/inventing-the-universe

A review of 2 books on quantum theory

From Zachery Stein's EDUCATION IN A TIME BETWEEN WORLDS (2019)(pg 37)

The fact that an individual's freedom is usually in some way overridden through education is a very important issue...[we need to] confront the fact that individuals need to be educated *into* autonomy.

Lack of education or exposure to the wrong kinds of education can imprison the mind, while access to the right kinds of education can liberate the mind. The question here is how to characterize the difference between educational relationships that are oppressive and those that are emancipatory....Simply put, there is a difference between doing something *to* someone, doing something *for* someone, and doing something *with* someone. Ideally, education is undertaken *with* someone.

AND, "We just looked at the example of moral development in which one's felt experience of love and care moves from **egocentric, to ethnocentric, to world-centric, to cosmo-centric**"

Kanopy lecture How Ancient Astronomy Ended (30 Min. good on Copernicus, Tycho, Galileo & Kepler)

https://chapman.kanopy.com/video/how-ancient-astronomy-ended

Kanopy Lecture on Hubble Ultra-Deep field. (30 Min. Good to use with Youtube Hubble, Greatest picture)

https://chapman.kanopy.com/video/hubble-ultra-deep-field

Film on David bohm

https://www.youtube.com/watch?v=XDpurdHKpb8

https://www.youtube.com/watch?v=FM5HkpyXxsQ

Scott Galloway on Universities today (see also 7 minutes with Anderson Cooper)

Joe Rogo has his mind blown by Lawrence Krauss, 7 min (Universe/expansion, multiverse)
https://www.youtube.com/watch?v=RKapUWxTvWI

Lawrence Krauss explains the Universe in under 2 minutes:
https://www.youtube.com/watch?v=QsLCs8vR2VE

Lawrence Krauss interview on A UNIVERSE FROM Nothing (26 Min)
https://www.youtube.com/watch?v=46sKeycH3bE

L. Krauss on Seeing the Early Universe:
https://bigthink.com/stephen-johnson/lawrence-krauss-on-looking-back-in-time-on-the-early-universe

I know you enjoy videos, so I thought I'd share some of my findings with you for a theoretical physics and mathematics class I'm in (HON 382 Fabric of the Cosmos: Space, Time, and The Texture of Reality with Adrian Vajiac). I've linked below two short videos and one longer video that I think you will find fruitful, fun, and educational in terms of explaining some curious aspects of our physical universe such as time and light.

Let me know what you think when you get a chance to watch them. The first two are shorter and the second is longer. I recommend watching them in the order they are linked below.

1. https://www.youtube.com/watch?annotation_id=annotation_15129767&feature=iv&src_vid=8ORLN_KwAgs&v=p-MNSLsjjdo

2. https://www.youtube.com/watch?v=8ORLN_KwAgs

3. https://www.youtube.com/watch?v=H1WfFkp4puw

Happy Tuesday.

Bowing,

A THOUGHT FOR TODAY:

Read, every day, something no one else is reading. Think, every day, something no one else is thinking. Do, every day, something no one else would be silly enough to do. It is bad for the mind to continually be part of unanimity. -Christopher Morley, writer (5 May 1890-1957)

A THOUGHT FOR TODAY:

It took less than an hour to make the atoms, a few hundred million years to make the stars and planets, but five billion years to make man! -George Gamow, physicist and cosmologist (4 Mar 1904-1968)

A THOUGHT FOR TODAY:

A book must be an axe for the frozen sea inside of us. -Franz Kafka, novelist (3 Jul 1883-1924)