

Test One Preview

AST I05 Life in the Universe

General study advice:

- 1) Use the course outline as your guide.
- 2) Then, study your notes.
- 3) Then, go over your written assignments, including the new terms.
- 4) Finally, as much as time permits, go over your reading assignments.

For the early history, Unit II (blue Course Outline), know the following:

- reasons why astronomy is the oldest science, that is, what were its impetuses?
- in what ways the Greeks took science beyond what anyone else ever did
- what Eratosthenes and Hipparchus did.
- Aristotle's reasons for the geocentric model
- Aristotle's approach to doing science and how it relates to current-day pseudoscience

This test covers one of the very most important revolutions in history—the Scientific Revolution. It is covered in Unit III of your blue Course Outline. The central sciences of the Scientific Revolution were the closely related astronomy and physics. The Scientific Revolution was covered in a straightforward way, with the key players and their work presented. So just make sure you know what each of them did that was noteworthy. And of course, with Galileo, you should also know about his clash with the Roman Catholic Church and the lessons we learned from that clash and advances to science he contributed.

There are some possibilities for math problems on this test. Specifically, they will deal with Kepler's 3rd Law of planetary motion and Newton's Law of Gravity. The numbers used regarding the gravity formula will be simple enough that you should not need a calculator. You just need to know what to do with the numbers. Complete understanding of the three motion laws was not given, but I do expect you are comfortable with the concepts of inertia (First Law) and force (Second Law). That means, some basic question or two may be asked about them.

See that Section "B" in Unit IV of the Course Outline? Past experience has shown me that students space out, as it were, the observational/experimental proofs of earth's motions in space that we learned following the scientific revolution. Earlier, I wanted you to understand Aristotle's reasons for favoring the geocentric model, but it would not do if graduates of my courses do not understand why scientists have progressed beyond the geocentric model. Kepler and Galileo's work was impressive, but not conclusive, for the reason that they did not prove that earth, itself, is a moving planet. What are the two proofs given in class?

Science is covered by the Introductory Note Set you purchased. The units referred to in the text box (next page) refer to the units in the Introductory Note Set, not the blue Course Outline.

Review of Introductory Course Note Set

The gist: Study your Foundational Assignment answers for all the Introductory Course Notes Units, except for Units IV and VI, which were covered in class. Details follow...

In your review of the Introductory Note Set, read over the goals/benefits to attain in this course in Unit I.

You may skip Unit II (on the teaching) and skim Unit III (U.S. scientific illiteracy). By “skim,” I mean just note the interesting survey results.

Focus especially on Unit IV (science) You must understand the aspects of science as presented in its definition in Section A of Unit IV, and in later sections, the “Heart of Science” and the “Scientific Attitude.” In Unit IV , note especially, well, everything.

In Unit V memorize the 8 aspects of critical thinking; they will be on the test. (You may be helped by the article “Thinking Creatively and Critically.” See side cabinet in the classroom for a copy.)

In Unit VI, note especially the characteristics of pseudoscientific thinking and the differences between science and pseudoscience. At the end, recognize those pseudosciences related to astronomy.

I don’t expect for you to pick up a lot of the detailed information in unit VIII, just be able to briefly describe the three dangers of pseudoscience.

In Units IX and X, covering non-psychological and psychological factors that influence us into accepting pseudoscientific claims, make sure you are familiar with the first factor in each unit. I don’t expect you to be well familiar with all the factors I cover, though most are fairly straightforward and you should be able to mention several on the test.

Unit XI? Casinos.

Regarding the brightness aspect of light, you should be familiar with the use of magnitude numbers.

Know the relation between light energy and wavelength. Also know the regions of the electromagnetic spectrum. Know what multiple of a meter is a(n) Ångstrom, nanometer, micrometer.

You should know the scale factor and zero point for each of the three temperature scales. Be sure you memorize the surface temperature of our sun, as it offers a handy reference value when discussing stars.

Understand what the Wien and Stefan-Boltzmann laws tell us. Same for the Luminosity relation, which tells you how to calculate a star’s luminosity from its size and temperature.

Be able to describe or draw the two basic types of spectra covered: continuous and absorption line.

Quantum Mechanics was introduced lightly, presenting only what we need here to have some understanding of atomic structure. With this knowledge, you should understand how we get emission

and absorption lines from shining objects as well as how lines from a collection of atoms of the same element are “just so” and why they are seen in absorption (or emission).

What star properties affect the spectral line appearance?

Be able to describe the three fundamental observational techniques of astronomy.

Regarding the textbook, my hint is the same for all tests. Any question and problem I chose for homework is fair game to ask on the test.

Revised October, 2009 (reduced history a bit)

Test Two Preview

AST I05 Life in the Universe

Refer to the start of the Preview Sheet for Test 1 for general study advice.

This test material starts with (blue Course Outline) Unit VII, “The Cosmic Perspective.” This Unit comprises Sections A-C. (The Solar System, Cosmic Perspective—Space, Cosmic Perspective—Time) The test goes on to cover all Units up to Unit XII, “The Lives and Importance of Stars.”

The “description” material in Unit VII, Section A, is entirely descriptive. You are only working at the memorization level here. You may be queried on any of the material in this section, tho note particularly the size and distance values of the planets given in basic data. These are the numbers that most quantify your general visualization of the Solar System.

Section B, cosmic perspective, deals with space and distances here, and may introduce a few terms relating to the hierarchical structure of the universe, so know them. Remember Powers of Ten from the Web? Watch it again, if you wish, by clicking [here](#).

Section C, more cosmic perspective, deals with time here. Here you’re given some historic background (Who was Bishop Ussher; what did he do?).

Understand the examples given for determining relevant and absolute age dating. Be prepared to determine the age of a rock on the test using radiometric age dating. What were those two astrophysical determinations of the age of the solar system that conform with the results of radiometric age determinations?

Unit VIII: Galaxies

Be familiar with the size and shape of our Milky Way Galaxy.

Know the names of the galaxy types; be able to describe them. Be able to say which is/are most conducive to life.

Unit IX: The Universe—nature and origin

This unit is presented in detail in your blue course outline. There are two very important understandings involved regarding the Big Bang theory.

- The Big Bang is one of the greatest theoretical insights of science. When understanding theories, it is imperative to be familiar with their evidential basis. So note well the lines of evidence that point toward this theory.
- The theory was presented as a process, so know the various stages in the process from the start to the widespread development of galaxies.

Unit X: Star Basics

Memorize the spectral classification sequence from O to T.

Know the H-R DIAGRAM's axes and where in the diagram the following are positioned: main sequence, red giants, white dwarfs, sun

Double stars - know the following terms

- physical vs. optical
- visual binaries
- spectroscopic binaries
- the Doppler effect---Be ready to calculate the radial velocity of a star, given the equation for doing it.
- astrometric binaries

And what benefits to astronomical understanding do double stars offer?

Do you understand how star mass determines the star luminosity?

Regarding Stellar Populations, just know the relation between chemical composition and age.

Unit XI: Star & Planet Formation

Focus on the terms: yin and yang, nuclear fusion, nucleosynthesis.

In the Pre-main sequence phase, know the sequence of steps of the origin of stars and planets we covered in class. What is the condensation sequence? See how today's solar system is directly connected to its origin.

Unit XII: Stellar Evolution: The lives and importance of stars

What do all stars do while in the main sequence phase? How does Einstein's $E = mc^2$ apply?

What do stars do following the main sequence stage? (Break up into low and middle -mass stars and high mass stars.) What can massive stars (greater than several solar masses) do that less massive stars can't? What makes it difficult for the high mass stars to support life?

What are white dwarfs, neutron stars, black holes? What probability for life do we expect for life on planets around them?

Of course, know the three astrobiological impacts of stars.

Regarding the textbook, my hint is the same for all tests. Any homework question and problem is fair game to ask on the test.

Test Three Preview

AST 105 Life in the Universe

As before, your overall guide is the blue Course Outline. Refer to the start of the Preview Sheet for Test 1 for general study advice.

As you study for the test, you may find some of the subjects mentioned below only in the textbook. There will be a few questions taken explicitly from the homework assignments.

Unit XIII, “Life on Planets around other Stars”

Habitability Zones - know the relevant factors to this concept. This is a central, basic concept relevant to the consideration of the probability of life in the universe.

–extremophiles

Extra-solar Planets

- difficulties in detecting
- three ways of detecting
- first planets not detected til about when?
- what is the major selection effect?
- what are we learning about planetary systems?
- how to explain “hot Jupiters”? Why such low density for them?
- how many currently known?

Rare Earth

- An estimate for the probability of simple life forms
- An estimate for the probability of complex life forms
- An estimate for the probability of intelligence
- know examples given in notes and text and related aspects
- know responses or questions raised to this hypothesis

Unit XIV, Earth, Moon, and Cosmic Perspectives

The Moon

Basic Data. Be able to describe the maria and highlands. Be familiar with its internal structure and why maria appear only on the Moon’s near side. Know the four hypotheses (names with descriptions) that have been proposed to explain the Moon’s origin and which is the favored one. What was the scientific value of the moon as enabled by the Apollo missions? Brief history of the moon.

The Earth

Basic Data.

The age of the Earth

The 4 sources of energy that made the early Earth hot

The internal structure of the Earth. Know, related to this, the terms plate tectonics, seismology, gravitational differentiation.

The 3 fundamental rock types of the crust

The composition of the atmosphere at first and now

Regarding the origin and subsequent evolution of life on Earth know the following terms: Snowball Earth, Cambrian Explosion

Cosmic Perspectives

The interplaying roles of atmosphere and life in regard to oxygen

A possible “kick start” for the development of complex life.

Cosmic Perspective aspects

Be able to mention several examples of cosmic influences on earth.

Unit XV, Life on Earth.

The test covers the material in the first two sections The Nature of Life and The Origin of life.

The Nature of Life

There are five sections in this unit, the 5th covering the cell. It is the longest of the sections. There is a lot of minutiae in this unit that you needn't worry over memorizing. However, the minutiae are there to flesh out the main points regarding the nature of life. What are the main points? Well, here we take advantage of the outline format. The format tells you major points and not-so-major points and their interrelationships. The first three sections present the major ideas we need to ponder the nature of life.

- **Section A (of class notes), physical entity engaged in chemical processes. Key points and terms:
 - the carbon advantage**
 - metabolic processes**
 - entropy**
 - information****
- **Section B, Defining life—what and where to look for it occurs.**
- **Section C, Information aspect of life**
 - **DNA and its structure, including the names and locations of the four bases.**
 - **gene**
 - **chromosome**
 - **genome**
 - **RNA. Here, RNA is mentioned only in terms of function, so know that. Learn more about RNA at the end of Section D.**
- **Section D. Cells—the basic chemical factory unit) is about the cell. Straightforward and to the point.**
- **Section E. Simply know the four chemical compounds of life.**

The Origin of Life on Earth

- **In Section B (Numerous Creation Myths) peruse thru the “top10 intelligent designs” site and select one other than the Judeo-Christian tradition that you have probably been acculturated into, that interests you. Be able to describe it reasonably well on the test. In addition, be able to simply name several of these creation myths.**
- **Sections C (First scientific hypothesis—Spontaneous Generation) and D (First 20th century hypothesis—the reducing atmosphere with primordial rich organic soup oceans) offer several scientific hypotheses proposed to explain the origin of life. You don’t need to be able to regurgitate all the details, but you should be able to describe them. Key terms: “spontaneous generation” and “rich organic soup oceans”**
- **Sections E (During the 1960's scientists’ growing understanding...began to lead scientists to reject the cool, reducing atmosphere model) and F (Growing evidence and insights) So what was this growth in understanding? What was some of the new evidence?**
- **Section G (Life forms exposed on the surface of early Earth) Why the change in thinking about the importance of tidal pools?**
- **Sections H (Understanding the origin of life necessitates knowing where, and under what conditions, it formed) and I (And so, latest thinking has it that first life arose in the dark under anaerobic (no O₂) conditions) Well, what to know here is mentioned in the title of Section H.**
- **In Section J (Chemical Evolution) What is the natural principle that applies to both biological AND chemical evolution? How did the chicken-egg argument over RNA and DNA settle out in favor of being first?**
- **In Section K (A literally far-out, origin-of-life group of hypotheses...Panspermia) and assessments of various versions of Panspermia. Be able to distinguish among the various panspermia hypotheses.**

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Test Four Preview

AST I05 Life in the Universe

Refer to the start of the Preview Sheet for Test 1 for general study advice, as always.

Unit XV in the blue Course Outline sheets is “Life on Earth.” We covered its Units I and II on the nature and origin of life in Test 3.

We start the material for Test 4 at Unit III in the “Life on Earth” class notes. Unit III is “Evolution of Life on Earth,” Key points in its sections follow:

Sections A (Evolution definition embodies two aspects) and B (Basic question people have regarding evolution) each tell us the basics of how to approach in understanding evolution. Know the essence of the two approaches presented here.

Unit IV. The Fact of Evolution is incontrovertible and rests upon...evidence. There’s an obvious list-type question here for the test...

- What was the first great discovery of geology?
- Phylogeny—Try to memorize the Taxonomic Classification System.
- Homologous structure
- Regarding biogeography’s contributions to the understanding of evolutionary sequences, from where did Darwin’s Galapagos Island finches come?
- ecological niche
- Molecular biology notes the correlation of what over the passage of time? What molecules are studied in order to determine evolutionary relatedness?
- What is one reason for the absence of intermediate life forms? Hint: the fruit fly wings experiment. There is a second reason given elsewhere. Might be opportunity for extra credit here if you can answer with it, too.
- Be able to distinguish relative age dating from absolute age-dating.
- What was an early “outside the field” prediction made on the basis of evolution by Darwin that was later shown to be true?

Unit V. “The Theory of Evolution.” Be prepared to see the following on the test:

- principle of natural selection
- descent with modification
- survival of the fittest
- genotype
- phenotype
- The power of the theory of evolution—Thoughts from this section may be utilized in the test.
- Final points about The Theory of Evolution
- What is the role of quantum mechanics in the random aspect of evolution?
- Know how the two predictable influences on life’s evolution (chemistry and the environment) make the evolution of life not totally random.

Unit VI, “Scientific” Creationism (SC) and its Ver. 2.0 “Intelligent Design” (ID)”

Section A, “Philosophical aspects of “Scientific” Creationism”

- **Natural Theology by Rev. William Paley and the design argument for the existence of God**
- **Special Creation**
- **What is missing in both Genesis creation accounts**
- **The 5 fundamentals—which is the one that leads to anti-evolutionism**
- **What is missed by accepting as literal and final the Genesis creation accounts**

Section B, “Problems with “Scientific” Creationist Arguments and the claimed evidence against Evolution”

- **The three basic scientific and philosophical objections to SC—These are most important to know.**

Section C, “Intelligent Design (“Scientific” Creationism ver. 2.0)”

- **The two improvements over SC**
- **irreducible complexity and what its proponents miss**
- **How ID has encouraged creationists to legally push public school systems to teach it in science classrooms**

Unit VII, “The Geologic Time Scale and The History of the Evolution of Life on Earth”

Sections A—F,

- **eon**
- **names and order of first three eons**
- **one distinctive feature of each**
- **important inference**
- **mesophilic, thermophilic**
- **prokaryotic, eukaryotic, archaeoytic**
- **photosynthesis**
- **two advantages of sex over mitosis/meiosis**
- **description of the first complex organisms and their approximate time of origin**
- **ediacara**

Section G, “by the end of the third of the four eons of Earth”

- **fraction of Earth’s history covering the time before the advent of complex life**
- **the three domains of life**

Section H, “Phanerozoic Eon”

- **Cambrian Explosion and its starting time**
- **phylum—what this classification deals with**

Section I, “Era”

- **era**
- **period**
- **epoch**
- **ages**

Section J, “the fundamental developments of life on Earth”

- familiarize yourself with the list of developments by the end of the Cambrian Period

Section K, “The Paleozoic Era”

- the names of each period and one or two distinctive features (development/event) for each (don’t worry about their order, tho I might ask for extra credit)

Section L, “The Mesozoic era”

- the names of each period and one or two distinctive features (development/event) for each
- know the start/end dates for this era

Section M, “The Cenozoic era”

- what were the attributes of the animals that survived the extinction of the dinosaurs event?
- the names of each period and one or two distinctive features (development/event) for each
- the names and dates of the two epochs of the Quaternary period
- what developments we humans trace back to fish
- human taxonomic classification
- what most distinguishes homo sapiens from other animals
- the nearest relative (died away 30,000 years ago)

Assignments 9 and 10 cover evolution of life on Earth and the possibilities of life in the solar system. Be able to answer any question or problem of those assignments. They cover the material very well.

We cover Unit XVI, “Life in the Solar System,” in the last class meetings. This entails looking at Mars, Europa, Titan, and now Enceladus. Pick up on the factors that favor and disfavor the odds of life appearing on or in these worlds.

Units XVII, “Life in the Universe” is covered as much as time permits. If we go over it in class, be familiar with the Drake Equation for the test. You will be helped by information in Chapter 12.1, part of Assignment 11. We will either watch a video on this topic or try out the Drake Equation for ourselves in our last lecture class, or both. You will be responsible for any other topics covered in class; there won’t be many.

Because of time constraints, you are not responsible on Test 4 for material introduced in Assignments 11–13, with the exception of the Drake Equation (found in Ch. 12.1).