

Department	Biology		· 	Date	January 27, 2015	
Check one: This is a d		_		nent) SEG	CTION of a variable content course	
Present Course Code	and Number	BIO 235	Course Title		Principles of Genetics	
BIO 235 Principles of Ge Prerequisite: BIO 121 or E to basic Concepts of classic	netics PMS 110; and BIO 1 cal, molecular and p	22 and CHM 116/. copulation and Me	117 or CHM 160/161 endelian genetics, gene	(recomment omics, biot	rough all deletions, and insert/bold new informanded) or higher; and MTH 135 or higher. An interest technology and epigenetics., and an inquiry interest tro manipulation of nucleic acids. Supplementa	roducti o the
	MS 110, and CHM renetics, genomics, b	iotechnology and			er; and MTH 135 or higher. Concepts of classical s is on the chemical characteristics and in vitro	l ,
What is changing? Chec	k all boxes that a	oply.				
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□Credit Hours/Contac	t Hours	□Per	iodicity	X Descr	ription	
genetics and recombinant I Prerequisite: New advance principles. Students who ha 160/161 (preferably) or CH How Did You Determine Title and Description: Our 235. The original title and tomore precise description with Prerequisite: Our experience	DNA technology. The sin genetics are over the not yet taken General M 116/117 will help the Need For This experience is that a terse description seed II better convey the see is that students will	e proposed descrip rwhelmingly mole neral Chemistry I so students better un is Change or Del- number of students in to reinforce stude comprehensive na no have already ha	etion better communicated and chemistry-betruggle with a number aderstand the BIO 235 etion? Is are caught off guard ent expectations for an ture of the course. In the decimal of the course of the course. In the decimal of the course of the course. In the decimal of the course of the course of the course.	ates these n ased, therefore of genetic material are by the bream a "only 200 to do well i	is the laboratory section heavily focuses on molecular mew aspects of genetics. If ore, require an understanding of basic chemical of concepts in both lecture and lab. Requiring CH and benefit more from the course. In the material and hence the difficulty level of the material and hence the difficulty level introductory course. The proposed new to the material and are enthusiastic about the material following the other hand, often find genetics	M I of BI
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Graduate Council	Math	(Considers all 60	00-900 level course ch		23-15	
	Department Head			·- <u></u>		

(Routing on Reverse Side)

FS Program Change - 10/8/2013



Department Biolog	gv			Date	1/28/2015	
Check one: This is a c		an existing COURSE on existing REGULAR (i	.e. permanent) S	SECTION (of a variable con	tent course
Present Course Code	and Number <u>Bl</u>	0485	Course Title_	Marine	Conservation	
Revised Catalog Desci	ription (Copy/paste	present description from o	nline catalog, strike	through ail	deletions, and insert	/bold new information.
BIO 485 Marine Conserv	ration					
marine organisms, with e	emphasis on marine	11, or BIO 122. An overve e species and habitats exp BIO 485 and 685. Public	oloited or endange	red by hun	nan actions. May b	n and management of e taught concurrently
Credit hours:1-3 Lecture Typically offered: Upon d	e contact hours: 1-3 lemand Fall, Sumn	3 Lab contact hours: 0 ner				
Complete New Catalog I	nformation					
BIO 485 Marine Conserva	ation					
Recommended Prerequis marine organisms, with e with BIO 685. Cannot rec	mphasis on marine	species and habitats exp	oloited or endange	red by hurr	nan actions. May b	and management of e taught concurrently
Credit hours:1-3 Lecture Typically offered: Fall, Su	e contact hours: 1-3 immer	B Lab contact hours: 0				
What is changing? Check	all boxes that app	ply.				
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Reason for Proposed Cha	ange or Deletion					
To bring catalog description	in line with the curr	ent course periodicity and a	dd missing informat	ion on cont	act hours.	
How Did You Determine	the Need For This	Change or Deletion?				
Course has been taught with	h this periodicity for	past several years.				
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Graduate Council		(Considers all 600-900 leve	l course changes.)	•		
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Signature	Department	Cal vive	Date	10	7-10	······
	Department Head					

(Routing on Reverse Side)

FS Program Change - 10/8/2013



Department_	Biology		Date_	1/28/2015
Check one: Th	his is a change to <u>x</u>		ermanent) SECTION	of a variable content course
Present Cours	e Code and Number <u>B</u>	iO 685 C	ourse Title Marine	e Conservation
Revised Catalo	og Description (Copy/past	te present description from online	catalog, strikethrough al	I deletions, and insert/bold new information.)
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Credit hours:1-3 Typically offered	Lecture contact hours: 1 : Upon demand Fall, Sum	-3 Lab contact hours: 0		
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BIO 685 Marine	Conservation			
An overview of c habitats exploited 685 and 485.	turrent issues related to the d or endangered by human	e conservation and managemen n actions. BIO 485 may be taug	t of marine organisms, ht concurrently with BIO	with emphasis on marine species and O 685. Cannot receive credit for both BIO
Credit hours:1-3 Typically offered	Lecture contact hours: 1- : Fall, Summer	-3 Lab contact hours: 0		
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Signature	(Mila	Mathis	Date	29-15
•	Department Head	(Routing on Reverse Side)		FS Program Change - 10/8/2013



Department Geo	ography, Geology &	Planning		ate <u>Noven</u>	nber 12, 2014	
Check one: This is a ch		_	•	nanent) SECTION	I of a variable cor	ntent course
Present Course Code a	and Number Pl	LN 576	Course Title _	Site Plani	ning Studio	
Revised Catalog Descri	iption (Copy/paste pre		from online catal	og, strikethrough all	deletions, and insert/	bold new information.)
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Complete New Catalog Ir	nformation					
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What is changing? Check	all boxes that apply.	•				
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Reason for Proposed Cha	inge or Deletion					
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	Department Head	(Routing on R	everse Side)	•	/ FS Progra	m Chanae - 10/8/2013

Department	PAMS		January 16, 20		•• •
Title of Program					
Type of Program Certification Revised Catalo	Academic Rules	mprehensive Major s Other	Minc	or_X_ Certificate	
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(Routing on Reverse Side)

Department Head

S Program Change - 10/8/2013

Missouri State University CURRICULAR PROPOSAL



NEW COURSE (or new REGULAR SECTION of an existing variable content course)

Department Physics, Astronomy, and	Materials Science	Date <u>January 22, 2015</u>	
		nt) SECTION of an existing variable content course. If a new regular rse is it to be attached?	
Course Code AST Course Number 1:	L2 Course Title Life in the L	<u>Universe</u>	
neans to humanity. Topics include the	on the planet Earth, prospects origin of elements in the Un	d –Life Sciences). 3(3-0). Is for detecting it on other worlds and what that detection, or non-detection inverse and how they form the building blocks of life, how conditions recent discoveries of exoplanets, and possible effects on society.	n,
•	w me evolves, blodiversity, i		
etections or non-detections, is someth nswered within our students' lifetime,	ing this generation will have and most likely within the no the amazing discoveries ahea	ial of detecting alien life (intelligent or not), and the consequences of those to address. The big question, "Are we alone in the Universe?" will be ext few decades. This course will inform and educate our students about ad. This course allows students to partially fulfill the Breadth of Knowled so see the attached pages.	thi
ourse is similar, but more in depth and tudents are now required to take a cou	an intersession course titled a leans more towards the astroness of the under the Life Sciences of the will be an additional offer.	Astrobiology (BMS455) which has not been offered in many years. This conomical impacts on evolution, aliens, and the human experience. division of the Breadth of Knowledge-Natural World component of Genering in this component with material that is interdisciplinary, exciting, by human beings.	ra
EPARTMENT: Route according to AR	T VI, SEC 3B(1-4) of Bylaws	of the Faculty. Attach New Course Resource Information form (FS	
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Professional Education Committee	(Considers all new courses affect	cting BS and MS in Education and Educational Specialist degrees)	
X Committee on General Education and Intercollegiate Programs	(Considers all general education	n and multi-collège new course proposals)	
Graduate Council	(Considers all 600-, 700-, and 80	00-level new courses)	
f the course needs to gothrough more than	one council/committee, forward	d one additional form for each additional council/committee marked.	
ignature Department Head		Date	

(Routing on Reverse Side)

FS New Course - 4/10/2014

NEW COURSE RESOURCE INFORMATION



Department Physics, Astronomy, and Materials Science

Date January 20, 2015

Course Number and Title AST 112 Life in the Universe

Anticipated Average Enrollment 100

Maximum Enrollment Limit 130

Faculty Load Assignment 3 Equated Hours

- I Is another course being deleted? No If so, give course number and title.
- What will this course require in the way of:

Additional library holdings? None.

Additional computer resources? None. Access to current computer labs is sufficient.

Additional or remodeled facilities? None.

Additional equipment or supplies? None, this is not a lab course.

Additional travel funds? None.

Additional faculty-general vs specialized? None.

Other additional expenses? None.

If additional faculty are not required, how will faculty be made available to teach this course?

The Physics, Astronomy, and Materials Science Department is adjusting its astronomy course offerings in response to the revised General Education Program. Condensing the current offerings allows for the inclusion of this new course.

List names of current faculty qualified to teach this course:

Becky Baker, Bob Patterson (taught a shorter version as a special course), Peter Plavchan (taught a version at UCLA), and Mike Reed.

What is the anticipated source of students for this course? (If from within the department, will students be taking this course in addition to or in place of other courses? If from outside the department, which courses in other departments would most likely be affected?)

This is a General Education course. The source of students is the same as for current introductory astronomy courses, namely, the entire student body.

Other comments:

5

AST 112 Life in the Universe - Sample Syllabus

Purpose: This is a general education life science course covering the evolution of life in the Universe and prospects and impacts of extraterrestrial life. This course meets the Life Science General Goal: Students will understand basic concepts of living things, the nature of scientific knowledge, and relevance of biological knowledge to human affairs. The Specific Learning Outcomes are 1) Understand living systems by describing their nature, organization and evolution. 2) Understand and use the processes by which scientific knowledge of living things is generated. 3) Develop knowledge of living things through hypothesis testing and gain the ability to draw defensible conclusions regarding living things. 4) Make logical connections between key concepts in the life sciences and describe the interaction between human lives and other living things. 5) Understanding the human species as a biological organism. And 6) Understand the ways the environment impacts humanity and how human actions affect the environment. Other learning outcomes for this course are: 1) To understand how the Universe evolved to become hospitable for life; 2) To understand how Earth-based life developed, 3) evolved, and 4) was affected by astronomical events; 5) To understand the relationships between humans, other life, and their environments, including 6) terraforming; 7) To understand discoveries within our solar system and of exoplanets in relation to where life could exist; and 8) To examine the possible effects on society and humanity with acquired knowledge of whether or not alien life exists. The learning outcomes for this course will be evaluated using tests, focus group discussions, quizzes, homework, a questionnaire, and group projects.

Course design: The course will use the Drake Equation as a focus and will include the following sections:

- 1) History of the Universe with a focus on chemical production and energy which leads to a Universe where humans and other aliens could exist.
- 2) History of life on Earth as our only example of life within the Universe.
- 3) The biology and chemistry of life- conditions for life, including extremophiles.
- 4) Prospects for diversity of life.
- 5) Current exoplanet research in relation to where life could exist and how to find out whether there is alien life.
- 6) Impacts on society whether there is or isn't alien life.

Student Success: The mission of Missouri State University is to develop educated persons. In this class, we will use the following instructional methods which support student learning and success: 1) small (focus) group discussions; 2) peer instruction; 3) clickers; and 4) group projects.

Materials: The texts for this course are Life in the Universe by Bennett and Shostak and How Life Began: Evolution's Three Geneses by Meinesz. These are the only texts you will need for this course. However, this is a very dynamic and evolving area of science and so (some) lecture notes, useful links, and other material will be posted on the web.

AST 112 Life in the Universe - Sample Schedule

Week	Dates	Topics	Ch	apters
1-3	August (M,W,F)	•	Course overview, the scientific search for life in the universe. Ancient astronomy, basic astronomy. Formation of the solar system	1-3
4-5	September (M ,W, F)	•	Cosmology, the origins of the Universe Matter, Energy & Light The Habitability of Earth	4-5
6-8	September (M,W,F)	•	Appearance of life on Earth & Evolution Searching for Life in the Solar System & in particular Mars	6-8
9-11	October (M,W,F)		Midterm Exam (Chapters 1-8) Search for life in the solar system: Jupiter and beyond The Life Cycle, Classification of Stars, Nature of Habitability and the search for habitable worlds around other stars	9
12-14	November (M, W, F)	•	The Habitable Zone and Earth's Fate Climate Change and Global Warming Exoplanets	10-11
15-16	December (M,W,F)	•	Search for Intelligent Life (SETI) Interstellar travel and Fermi Paradox Final Exam (in class, cumulative)	12,13



AST 112 Life in the Universe - Sample Outline

Chapter 1

Extraterrestrial life: life beyond Earth

Extrasolar planets: planets orbiting starts other than our sun Habitable worlds: worlds that contain the basic necessities for life

Organic molecules for life. Must look for simple organisms)

SETI: search for extraterrestrial intelligence

Chapter 2

Greeks on Extraterrestrial life

Atomists: believed Earth and the heavens made from infinite number of indivisible atoms of each of the four elements

Belief in extraterrestrial life

Natural to assume that the same processes that created our world could also have created others Aristotelians: the four elements were confined to the realm of Earth, while heavens were made of distinct element ether World must be unique, so no other worlds exist

A scientific model must make testable predictions about natural phenomena that would force us to revise or abandon the model if the predictions do not agree with observations.

Paradigm

Scientific Theory

Chapter 3

Astronomical Definitions)

Star, planet, extrasolar planet, habitable planet, moon or satellite, asteroid, comet, solar system, star system, galaxy, universe or cosmos

Expanding Universe

Evidence comes from the overall chemical composition of the universe – calculations that run the expansion backwards led scientists to predict that the universe was about ¾ hydrogen and ¼ helium, which observations closely match.

Star Stuff

When we say that Earth and life are made from "star stuff", what we really mean is that the elements that make up the Earth and life were made from the fusion of helium and hydrogen inside stars larger than our sun.

Accretion and terrestrial planet formation

Jovian Planet Formation

Chapter 4

Geology: the study of earth, or any world with a solid surface

Rock analysis

Mineralogical analysis

Chemical analysis

Isotopic analysis

Radiometric dating

Most reliable way to determine the age of a rock, fossil, or other solid object

Radioactive decay always occurs at a specific and measurable rate that is different for every radioactive isotope.



Idea is to determine the age of a rock form the ratio of parent and daughter atoms within it, which depends only on the decay rate and the length of time over which the decay has been occurring. Geological time scale

4 Eons

Hadean - oldest!

Archean- 2.5 to 3.85 bya

Proterozoic- 540 mya to 2.5 bya Phanerozoic- Present to 540 mya

3 eras

Paleozoic (old life)

Mesozoic (middle life)

Cenozoic (recent life)

Eras divided into periods

Age of Earth

Oldest intact earth rocks date to about 4 bya

Radiometric dating shows that tiny mineral grains of zirconium silicate (zircons) date to 4.4 bya

Rocks on moon date to 4.4 bya

Maximum age set by dating formation of solar system as a whole via meteorites that are 4.57 bya

Key geological definitions

The Hadean Earth and the Dawn of Life

Atmosphere

Possible to inhabit earth after 100 myrs. Many modern day microbes survive in absence of oxygen.

However, lots of volcanic eruptions.

Possible Sterilizing impacts

Impact of object 10-20 km thought to have caused the extinction of dinosaurs 65 mya

Asteroid of 350-400 km would vaporize the oceans and raise global surface temperature to 2000 deg C

No way to know if anything this big happened during hadean period

Greenhouse effect makes earth habitable

Global average temperature: average temperature of the entire planet

Green house effect

Regulating Earth's temperature

The Carbon dioxide cycle

Chapter 5

Properties of Life

Order: exhibit some sort of order in the molecules or the arrangement of the atoms

Reproduction: reproduce or are products of reproduction

Growth and development

Energy utilization

Response to the environment

Evolutionary adaptation

Species: groups of organisms that are genetically distinct from other groups

Genus: the generic category to which an organism belongs, which will be specified by the species

Mechanisms for Evolution

Fact 1: overproduction and competition for survival

Fact 2: individual variation.

Fact 3: the inescapable conclusion: unequal reproductive success

"Natural selection"



Cells

Cells: microscopic units in which the living matter inside is separated from the outside world by a barrier called a membrane

All pass on their hereditary information with DNA

Earth life is carbon based

Life on earth made of 20 different elements

Oxygen, carbon, hydrogen, and nitrogen make up 96% of mass of typical living cells

Silicon based life – 3 strikes!

Bonds formed by silicon significantly weaker than carbon bonds. i.e. more fragile, making complex molecules too fragile to form the structural components of living cells

Silicon does not normally form double bonds, which carbon does. This limits the variety of molecular structures

Carbon can be mobile in the environment in the form of gaseous carbon dioxide, but silicon dioxide is a solid

Molecular components of cells

Carbohydrates: provide energy to cells, cellular structure

Lipids: store energy for cells. Can spontaneously form membranes in water, trapping other organic molecules inside the membrane – important for early earth

Proteins: key evidence of common ancestor of life!!

Some serve as structural elements, enzymes are crucial to all important biochemical reactions (including copying of DNA), catalyst facilitates a chemical reaction or accelerates it

Built with large chains of amino acids – this is important evidence that all life on earth shares a common ancestor

Nucleic acids: DNA, RNA (carries instructions to DNA)

3 Domains of Life on Earth

Bacteria

Archaea

Eukarya

4 Metabolic Classifications

Photoautotrophs: get energy from plants and carbon from carbon dioxide in the environment plants

Chemoautotrophs: get energy from chemical reactions and carbon from environmental carbon dioxide Need neither sun nor food to survive. Archaea in hot springs are an example.

Photoheterotrophs: get energy from sun and carbon from consuming other organisms or their remains Much rarer. Found in lakes, rivers, hot springs, and some aquatic environments with very high salt concentrations

Chemoheterotrophs: get energy from chemical reactions and carbon from consuming other organisms Water and the Metabolism

Metabolism requires that organic chemicals be readily available for reactions, and liquid water allows organic chemicals to float within the cell

Metabolism requires a means for transporting chemicals to and within cells

Water plays role in many of the metabolic reactions within cells, i.e. necessary for the reactions that store and release energy in ATP= adenosine triphosphate

ATP is used to store and release energy – every living cell uses it!

What kinds of conditions can life survive?

Extremophiles: organisms that survive in extreme environments

Endoliths (within rocks) special interest for Mars. Live within rocks, chemoautotrophs

Thermophiles: organisms that survive in extremely hot water



Many from Archaea domain.

A lot of hyperthermophiles are anaerobic (live without oxygen)

Psychrophiles: cold-loving organisms

Chapter 6

Stromatolites: rocks that are characterized by a distinctive, layered structure.

Photosynthesize and those below use the waste products of the photosynthesized microbes.

Evidence that they date back as far as 3.5 bya

Microfossils

Difficult to find because old rocks are often destroyed with time, altered by geological processes

3.5-3.2 bya: fossilized cells, up to debate.

2.7-3 bya: particular molecules that almost certainly indicate biological origin

Isotopic Evidence

The Miller-Urey Experiment

Other Sources of Organic Materials

RNA World

Possibility of Migration

Chapter 7

Water's role on Earth

Potential liquids for life

Ammonia, methane, and ethane remain liquid within reasonable temperatures

Advantages of water

Environmental requirements for habitability

Must have a source of molecules from which to build living cells

Must have a source of energy to fuel metabolism

Must have a liquid medium - most likely liquid water - for transporting the molecules of life

Chapter 8

Mars invading popular culture

Conditions on Mars

Temperature well below freezing, atmospheric pressure of 1% of Earth's, 40% of Earth's gravity, days are

40 minutes longer than on earth

Lack of surface liquid water

Geological History

Evidence of water on Mars

Channels almost certainly carved by running water 2-3 bya

Must have had much warmer and thicker atmosphere at one point

Martian water today

Climate

How Mars changed

Habitability

Has elements for life: energy for life (sunlight), chemical energy (underground volcanoes), just needs

liquid water

Life on Mars – 3 Viking experiments

However, no measurable level of organic molecules in the Martian soil at all.

Methane detected

Comes from either comet impacts, volcanic activity, or life

Meteorites



Chapter 9

Jovian Moons

Jupiter: Io, Ganymede, Callisto

Europa

Evidence for an ocean

Life on Europa?

Source of elements to build living organisms: rock/water combo probably has all elements needed Source of energy for growth and metabolism: unknown

If volcanism in deep water vents, then possible. However, on earth, most of energy still filters down from life above.

Total energy available is less than available on earth

Liquid medium for transporting molecules of life?

Saturn

Titan

Atmosphere

Possibility of life

Strong evidence of liquid hydrocarbons, but since methane and ethane are colder than liquid water, chemical reaction rates would be slower, so outlook for biology is bleak.

Synchronous rotation of the moons

Tidal Heating

Chemical energy

Need disequilibrium to initiate a chemical reaction

Reduction: process of accepting electrons

Oxidation: process of losing electrons

Electron transport chains: chains of redox reactions used for photosynthesis and other life processes

Amino Acids

Building blocks from proteins

Molecules containing an amine group, a carboxylic acid group and a side chain that varies between different amino acids.

These molecules contain the key elements of carbon, hydrogen, oxygen, and nitrogen.

Handedness

In nature, you see both right and left handed amino acids, but most amino acids in life are left handed

Chapter 10

Habitable zone

Range of distances from a star at which a planet could potentially have surface temperatures that would allow for abundant liquid water

3 factors.

Life outside habitable zone?

Venus

Runaway Greenhouse effect

Global warming

Increasing CO2

Evidence from tree rings and ice cores

Consequences of global warming



Chapter 11

Star's "Life Cycle"

Types of Stars

Multi-star systems

Binary star systems

Detecting planets

Directly

Indirectly

Precise measurements of stellar properties (position, brightness, or spectra) may indirectly reveal the effects of orbiting planets

Gravitational Tugs

Astrometric Technique

Doppler Technique

Transits

Gravitational Lensing

Hot Jupiters

Most of the discovered planets are around size of Jupiter or Saturn (can't detect smaller planets as well yet) and most either have close orbits to the star or highly elliptical orbits

Formation

Planets likely formed in outer regions of their solar systems (Jovian traits), but migrated when waves in the nebula caused these young planets to spiral slowly toward their star.

Habitability

Unlikely these would be habitable, but maybe moons would be

Theoretical work suggests that the migration of hot Jupiters could affect inner solar system seriously, i.e. swallow terrestrial worlds or fling less massive planets inward toward its star or outward to interstellar space

Impact rates and Jupiter

Many trillions of comets orbit the sun (Oort Cloud) at distances beyond Pluto

If Jupiter did not exist, the comets might have remained in the part of the solar system where they could pose a danger to Earth.

Climate stability

Plate tectonics important for climate stability due to its role in CO2 cycle

Earth's tilt is fairly static due to the gravitational tugs from Moon. If there were no moon, Earth's rotation would be greater affected by other planets, causing large swings in tilt.

Chapter 12

Drake Equation

Equation that lays out the factors that are important in determining the number of transmitting civilizations

Does not give us an actually number because we don't know that values of all variables

 $N_{civilizations} = N_{HP} x f_{life} x f_{civ} x f_{now}$

 $N_{HP} = habitable \ planets, \ f_{life} = fraction \ of \ HP \ that \ have \ life, f_{civ}$

= fraction of life with civilization capable of interstellar communication, f_{now}

= fraction of these that have civ now capable of this

Measuring Intelligence

Encephalization Quotient (EQ)

Plot of brain mass vs. body mass, where EQ=1 means typical allotment of mental ability for creatures of their size

(5)

Dolphins = 5, chimps = 2.5, humans = 7

EQs for dolphins and whales improved drastically around 35 mya when developed eco-location An elevated social position for dolphins and primates often allows you to have 1st choice in mates, so clever, high-ranking individuals will tend to produce clever, high-ranking offspring.

SETI

Send frequency of 1420 MHz b/c it is the frequency at which neutral hydrogen gas produces natural radio static

Categories of signals

Signals used for local communication on the world where intelligent beings live

Signals used for communication b/w a civilization's home world and some other site, such as a colony or spacecraft on another world

International signal beacons, purposely designed to get the attention of other societies

Chapter 13

Messages abroad

Because spacecraft themselves should survive unscathed for millions of years in the near-vacuum of interstellar space, we have included messages in case any extraterrestrial beings someday find them Escape velocity

11 km/s to overcome Earth's gravity

Limitations of chemical rockets

Requires a mass ratio (mass of fully fueled rocket to empty rocket) of 39 to reach escape velocity Spacecraft for interstellar flight

Nuclear fission, Ion engine, Solar sails, Ramjets and Relativity

Fermi Paradox

The idea that neither we nor our planet is in any way special suggests that someone should have colonized the galaxy by now.

The idea of a galactic civilization implies that we should be surrounded by evidence of this civilization — but aside from unconvincing claims of extraterrestrial UFOs, no such evidence exists.

It should have been possible or Earth-like planets to be born at least 5 billion years before our own planet.

Possible solutions

We are alone

Civilizations are common, but no one has colonized the galaxy

Von Neumann machines

General idea of self-replicating machines would allow us to explore much farther and wider than we could by going to other worlds ourselves.

Also, these machines could function after journeys through space that take centuries to millennia.



This course is about Life in the Universe wrapped in the context of the Drake Equation. This equation includes factors for 1) how the Universe produced the conditions (chemistry and energy) amenable to life; 2) the conditions which we know are favorable to life (chemicals which are important for life, the developments of proteins to DNA to higher organisms), the prospects for life in other conditions (extremophiles on Earth, silicon-based life, buoyant life on non-Terrestrial planets), the generation and spread of biological materials, and recent results concerning the abundance of planets; 3) evolution of life and astronomical impacts upon evolution; 4) the propensity of life to develop civilizations which emit signals outside of their ecosystem; 5) and the survivability of such civilizations. Beyond the Drake Equation, the class will also consider the impact on current societies whether there is or isn't alien life.

Life Science Goals of understanding basic concepts of living things addressed in #2 &3; nature of scientific learning in #1; and relevance of biological knowledge to human affairs in #4 & 5.

This course is multidisciplinary in that it draws extensively from astronomy, physics, chemistry, biology and geology. It is timely because only recently could astronomers begin to estimate the numbers and conditions of extrasolar planets, and space exploration has revealed other likely places for life within our own solar system. Most likely, during the lifetimes of our current student population, we will (at least statistically) know whether alien life exists or not!



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	Present Course Code and Number_AST 114_ Course Title_Survey of Astronomy_
	Revised Catalog Description (Copy/paste present description from online catalog, strikethrough all deletions, an insert/bold new information.)
	AST 114 Survey of Astronomy General Education Course (Focus on Physical Sciences). Historical and descriptive aspects of astronomy; topics of current interest related to space science. Cannot receive credit for both AST 114 and 115. May only receive credit for one of AST 113, AST 114, or AST 115. Credit hours: 4 Lecture contact hours: 4 Lab contact hours: 0 Typically offered: Fall, Spring
	Complete New Catalog Information AST 114 Survey of Astronomy General Education Course (Focus on Physical Sciences). Historical and descriptive aspects of astronomy; topics of current interest related to space science. May only receive credit for one of AST 113, AST 114, or AST 115. Credit hours: 4 Lecture contact hours: 4 Lab contact hours: 0 Typically offered: Fall, Spring
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- -	How Did You Determine the Need For This Change or Deletion? Currently, students could obtain credit for two similar courses. This change avoids that. Check if this is a non-substantive change. Distribution for non-substantive changes of 100- through 500-level courses: two priginally-signed copies to Faculty Senate; 600- through 900-level courses: three originally-signed copies to Graduate Council. Graduate Council will give two copies to Faculty Senate after approval.
5	Substantive Change: Department routes according to ART VI, SEC 3B(1-4) of Bylaws of the Faculty. Forwardthree originally signed forms to be supported by the following (please check all that apply and send to first council/committee marked). If proposal needs to go through more than or council/committee, forward one additional form for each additional council/committee marked. See Senate Action 11-93/94 for definitions or substantive/non-substantive changes.
2	College Council (All substantive course changes numbered 100-599 must go through College Council first. After approval, College Council will forward appropriate number of copies to the next committee/council or directly to the Faculty Senate if no further committee approval is needed. The last level of committee/council will forward two originally signed copies to the Faculty Senate.) Professional Education Committee (Considers all substantive course changes for Professional Education courses and Teaching Methods courses.) Committee on General Education (Considers all substantive course changes for Constant Education)
n	and Intercollegiate Programs proposals.)
·	Graduate Council (Considers all 600-900 level course changes.)
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A modern inquiry of the interplanetary exploration AST 513, or AST 613.	planets, comets, asteroids, ar ns and Earth-based observati	nd other members of our solar ions. Cannot receive credit for	system and the plane both AST 313 and AST	ts of other stellar systems, -513. May only receive cre	based on recent dit for one of AST 313,
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AST 315 The Lives and Deat Prerequisite: AST 113 or AS		4 138 or above.		
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AST 315 The Lives and Death Prerequisite: AST 113 or AST		138 or above		
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S Program Change - 10/8/2013



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AST 513 Solar and Extra-S	Solar Systems AST 114 or 115; and MTH 3	03.			
Doth ASI 313 and ASI 51.	stems, planetary dynamics, 3. May be taught concurrent ve credit for one of AST :	ly with AST 313 and/c	r 613. Cann	ct required. Cannot r oot receive credit for b	eceive credit fo oth AST 613 ar
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AST 513 Solar and Extra-S	olar Systems				·
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AST 613 Solar and Extra-S	olar Systems		
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S Program Change - 10/8/2013



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AST 515 Stellar Structure Prerequisite: AST 113 or	and Evolution AST 114 or 115; and MTH 3	03.			
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AST 515 Stellar Structure a Prerequisite: AST 113 or AS	and Evolution 5T 114 or 115; and MTH 303	3.			
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low Did You Determir urrently, students taking A	e the Need For This C ST 113 would not meet the	hange or Deletion? astronomy prerequisite	e for AST 515, t	hough they should.	•
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ubstantive Change: Department of the following (please chemonically committee, forward one obstantive/non-substantive ch	ment routes according to ART \ eck all that apply and send to fe additional form for each addit anges.	/I, SEC 3B(1-4) of Bylaws o first council/committee mai tional council/committee m	f the Faculty. For rked). If proposa narked. See Sena	ward <u>three</u> originally sign needs to go through mo te Action 11-93/94 for d	ned forms to ore than one efinitions of
College Council			•	4	
Professional Educatio	n Committee				
/ }	l Education and Intercol	legiate Programs	·		
_Graduate Council gnature	mle	Date /	-23-11	_	
Program Change - 10/8/20	ortment Head	(Routing on Reve	erse Side)		

S Program Change - 10/8/2013



Department	PAMS	Date	January 16, 2015
Check one: 1 permanent) §	his is a change toX_a SECTION of a variable con	an evictina COUDS	E an existing REGULAR (i.e.
Present Cour	se Code and Number_AST	615_ Course Tit	le_Stellar Structure and Evolution
	og Description		
AST 615 Stellar Str	ucture and Evolution		
4.4	113 or AST 114 or AST 115; and M	1TH 303.	
Basic concepts of s AST 615. May be to	tellar structure, atmospheres, and	evolution. Project require	ed. Cannot receive credit for both AST 315 and credit for both AST 515 and AST 615. May
Credit hours: 3 Leci	ture contact hours: 3 Lab contact r Spring (odd-numbered years)		
Complete New	Catalog Information		
AST 615 Stellar Stru	acture and Evolution		
	13 or AST 114 or AST 115; and MTF	1 303.	
Basic concepts of st		evolution Project require	d. May be taught concurrently with AST 315
Credit hours: 3 Lect	ure contact hours: 3 Lab contact he Spring (odd-numbered years)		
_Course Deletio _Credit Hours/C leason for Prop	g? Check all boxes that app n □Course Code ontact Hours osed Change or Deletion ieneral Education Course AST 113.	□Course Number □Periodicity	□Title X Prerequisite X Description
low Did You Det urrently, students t	ermine the Need For This Caking AST 113 would not meet the	hange or Deletion? astronomy prerequisite t	for AST 615, though they should.
Check if this is iginally-signed copies	a non-substantive change Dist	The contract of the contract o	changes of 100- through 500-level courses: two y-signed copies to Graduate Council. Graduate
ubstantive Change: ne of the following (pleouncil/committee, forwaldstantive/non-substantive/n	ard one additional form for each additional	/I, SEC 3B(1-4) of Bylaws of irst council/committee mark ional council/committee ma	the Faculty. Forward <u>three</u> originally signed forms to ed). If proposal needs to go through more than one rked. See Senate Action 11-93/94 for definitions of
College Counci			
_Professional Ed	ucation Committee		
Committee on G	ieneral Education and Intercol	legiate Programs	
gnature	Department Head	Date/_	-23-15
Program Change -	• • • • • •	(Routing on Rever	se Side)



Department	PAMS	Dat	:e	_January 16, 2015
Check one: This is permanent) SECTIO	a change toX_ N of a variable co	_an existing COUI ntent course	RSE	an existing REGULAR (i.e.
Present Course Cod	e and Number_AS	T 517_ Course 7	آitle_	_Galaxies and Cosmology_
Revised Catalog De				
AST 517 Galaxies and Cosn	nology			
Prerequisite: AST 113 or A	ST 114 or 115; and MTH	303.		
galaxies, are big barid tile)	AST 517. May be taught	nd the eventual fate of a concurrently with AST 3	our Ur	ur Galaxy and other galaxies, clusters of iniverse. Project required. Cannot receive and/or 617. Cannot receive credit for both AST 617.
Credit hours: 3 Lecture cont Typically offered: Spring (act hours: 3 Lab contact			
Complete New Catalog	Information			
AST 517 Galaxies and Cosm	ology			
Prerequisite: AST 113 or AST	114 or 115; and MTH 30	03.	<i>:</i>	
Study of galaxies and the Ungalaxies, the Big Bang theor concurrently with AST 317 and	y (including inflation), ar	id the eventual fate of o	ur Hn	ur Galaxy and other galaxies, clusters of niverse. Project required. May be taught 7, AST 517, or AST 617.
Credit hours: 3 Lecture conta Typically offered: Spring (e	ct hours: 3 Lab contact !			·
What is changing? Che □Course Deletion □Co □Credit Hours/Contact Reason for Proposed Cl Updating to reflect General E	eurse Code Hours Jange or Deletion	□Course Number □Periodicity		Title X Prerequisite Description
How Did You Determine Currently, students taking AS	the Need For This	Change or Deletion e astronomy prerequisit	i? te for	AST 517, though they should.
Check if this is a non-s	ubstantive change. Dist	cribution for non-substantiv		anges of 100- through 500-level courses: two igned copies to Graduate Council. Graduate
Substantive Change: Departments one of the following (please checouncil/committee, forward one a substantive/non-substantive charges)	dditional form for each add	VI, SEC 3B(1-4) of Bylaws first council/committee m litional council/committee	of the arked) marke	e Faculty. Forward <u>three</u> originally signed forms to). If proposal needs to go through more than one ed. See Senate Action 11-93/94 for definitions of
College Council				
Professional Education	Committee			
Committee on General	Education and Interco	ollegiate Programs		
Signature //a//	ment Head	Date	1-	23-15
S Program Change - 10/8/201		(Routing on Rev	verse S	Side)



Department	PAMS	Date	January 16, 2015	
Check one: This is permanent) SECTI	s a change to XON of a variable co	an existing COUR	SE an existing RE	GULAR (i.e.
Present Course Co	de and Number_A	ST 617_ Course Ti	tle _Galaxies and Cosmo	loav
Revised Catalog D			-	-9)_
AST 617 Galaxies and Cos Prerequisite: AST 113 or	= -	d MTH 303.		
Study of galaxies and the galaxies, the Big Bang the	Universe. Topics include to cory (including Inflation), and AST 517. May be taugh	the structure and content of and the eventual fate of our concurrently with AST 31	of our Galaxy and other galax ur Universe. Project required. L7 and/or 517. Cannot receiv or AST 617.	~
Credit hours: 3 Lecture cor Typically offered: Spring	ntact hours: 3 Lab contac			
Complete New Catalo	g Information	-		
AST 617 Galaxies and Cos	nology			
Prerequisite: AST 113 or A	 -	1TH 303.		
Study of galaxies and the l galaxies, the Big Bang the concurrently with AST 317	ry (including inflation), a	ind the eventual fate of ou	of our Galaxy and other galaxion of Universe. Project required. N 1317, AST 517, or AST 617.	es, clusters of lay be taught
Credit hours: 3 Lecture con Typically offered: Spring	tact hours: 3 Lab contact			
What is changing? Ch ☐Course Deletion ☐Coredit Hours/Contact Reason for Proposed Coredit Hours/Contact ☐Coredit Hours/Contact ☐Coredit Hours/Contact ☐Coredit Hours/Contact ☐Coredit Hours/Contact ☐Coredit Hours/Contact	Course Code t Hours Change or Deletion	□Course Number □Periodicity	□Title X Prerequi X Description	isite
How Did You Determin Currently, students taking A	e the Need For This ST 113 would not meet t	Change or Deletion? the astronomy prerequisite	for AST 617, though they sho	ould
Check if this is a non-	substantive change. Di	stribution for non-substantive	changes of 100- through 500-lev lly-signed copies to Graduate Cou	
substantive Change: Department of the following (please che council/committee, forward one substantive/non-substantive ch	additional form for each ad	T VI, SEC 3B(1-4) of Bylaws o o first council/committee mai Iditional council/committee m	f the Faculty. Forward <u>three</u> origing rked). If proposal needs to go thro larked. See Senate Action 11-93/9	ally signed forms to ough more than one 34 for definitions of
X College Council				
Professional Educatio	n Committee			•
Committee on Genera	l Education and Interc	collegiate Programs		
X Graduate Council√	1 /	J		
ignature_	mll-	Date <i></i>	1-23-15	
Department S Program Change - 10/8/20	ortment Head 113	(Routing on Reve	erse Side)	



Department Physics, Astronomy, a	nd Materials Scien	ice	Date	January 16, 2015	
Check one: This is a change to					
en e	_ an existing REGU	ULAR (i.e. perm	anent) SECTION	of a variable content	course
Present Course Code and Number	PHY 233	Course Title_	Engineering Stat	ics	
Revised Catalog Description (Copy/p	aste present descriptio	on from online catal	og, strikethrough al	l deletions, and insert/bold	new information.
PHY 233 Engineering Statics Prerequiproblems; topics include principles and satisfy any requirement for a pharmally offered: Spring, Fall	of center of mass, r	resultant force. 1	friction, momen	tofinertia torque oto	Course d
Complete New Catalog Information					
PHY 233 Engineering Statics <i>Prerequ</i> problems; topics include principles on not satisfy any requirement for a ph Typically offered: Spring, Fall	of center of mass, r	resultant force, f	friction moment	of inertia torque ot-	C
What is changing? Check all boxes that □Course Deletion □Course Cou □Credit Hours/Contact Hours Reason for Proposed Change or Deletio	de ¤Cours XPerio	se Number dicity	□Title □Description	XPrerequisite	
How Did You Determine the Need For T	his Change or Deleti	:3			
Without the prerequisite change, the course necessary to keep the course viable. Periodic Check if this is a non-substantive change senate; 600-through 900-level courses: three orig	is unsuitable for a large city reflects current offer.	e fraction of the cur Fering,	100 through 500 leaves		
Substantive Change: Department routes according theck all that apply and send to first council/commadditional council/committee marked. See Senate	to ART VI, SEC 3B(1-4) of	Bylaws of the Faculty	Forward three origin	ally signed forms to one of the f	
X College Council Professional Education Committee	directly to the Fact committee/council	Louncil will forward ulty Senate if no fur il will forward two o	appropriate numbe ther committee app priginally signed copi	go through College Council (er of copies to the next common proval is needed. The last level es to the Faculty Senate.) I Education courses and Teac	mittee/council or el of
Committee on General Education and Intercollegiate Programs		tantive course chan	ges for General Edu	cation and Intercollegiate P _I	ogram
Graduate Council	(Considers all 600-9	900 level course cha	/ 3)_/ <u>{</u> -	
Department Hea	id (Daniel			, 3	

(Routing on Reverse Side)

FS Program Change - 10/8/2013