

**Homework, demos, and special content****COURSE OVERVIEW**

1. Which of the following is not currently an important component of astrobiology?
  - A) Studying conditions that might result in the development of life
  - B) Looking for the actual life on other planets
  - C) Genetic sequencing of lunar rock samples
  - D) Attempting to contact or receive transmissions from extraterrestrial life forms.
  - E) Identifying extraterrestrial places where life could develop
  
2. Which of the below is a place in our solar system where we think it is likely that life might occur?
  - A) The water-vapor cloud-tops of Mars
  - B) The icy oceans of Europa
  - C) The warm volcanoes of Io
  - D) The rocky surface of Jupiter
  - E) The iron-rich, rocky surface of Venus.
  
3. Where or when was the iron in your blood formed?
  - A) During the Big Bang
  - B) In the metallic core of the Earth
  - C) In the Sun
  - D) In another star that blew up, long, long ago
  - E) In the Precambrian
  
4. Atoms consist of...
  - A) A soup of protons, neutrons, and electrons, all mixed together
  - B) A nucleus of electrons, surrounded by a cloud of protons and neutrons
  - C) A nucleus of electrons and protons, that MAY be orbited by neutrons
  - D) A nucleus of neutrons and electrons, orbited by a cloud of photons
  - E) A nucleus of protons and neutrons, surrounded by a cloud of electrons
  
5. Which is not one of the three major domains of life?
  - A) Archaea
  - B) Bacteria
  - C) Eukarya
  - D) Prokarya

6. What was the classic 1950s experiment that tried to simulate the creation of organic compounds?
  - A) The Drake Experiment
  - B) The Manhattan Project
  - C) The Miller-Urey Experiment
  - D) The Alan-Parsons Project
  - E) The Viking Mars Probe
  
7. Which of the following is not evidence supporting the theory that massive asteroidal-cometary impacts occurred in the Earth's history?
  - A) Mass extinctions
  - B) Major impact craters and basins such as in the Yucatán Peninsula
  - C) Iridium deposits in K-Pg sediment layers
  - D) Shocked quartz and molten rock droplets in ancient sediments
  - E) Cave petroglyphs from northern Australia
  
8. Of the following places, which has been observed to be producing methane in its soils, that is potentially due to extraterrestrial life?
  - A) Mars
  - B) Venus
  - C) Io
  - D) Uranus
  - E) Mercury
  
9. Which planet or moon has the most extreme global greenhouse effect?
  - A) The Earth (only after 1983)
  - B) The Earth during the last 200 years
  - C) Venus
  - D) The Moon
  - E) Europa
  
10. The age of the galaxy in years...
  - A) ... is far shorter than the age of the Earth
  - B) ... is much larger than how long it would take to explore it
  - C) ... is very short, compared to how long it would take to explore it
  - D) ... is something that astronomers have no way to estimate
  - E)... is about 6000
  
11. A possible resolution to the Fermi Paradox is that...
  - A) The galaxy is populated by deadly von Neumann probes
  - B) Antimatter was not formed as common as matter, in the early Universe
  - C) Faster than light travel IS possible!
  - D) DNA developed after RNA, in an RNA world
  - E) Black holes evaporate over time

12. If we encountered an alien species, evolutionary diversity on Earth, and galactic timescales, suggest
- A) Life should be very much like it is on Earth
  - B) Life should be just about as advanced as it is on Earth
  - C) Life will almost certainly be based on DNA and RNA
  - D) The aliens will probably look like a short grey-skinned human
  - E) The alien life is likely to be completely different from terrestrial life

HW#01

13. A solar system model with the Earth at the center
- A) is called geocentric
  - B) is called heliocentric
  - C) is an accurate model of our solar system
  - D) obeys the Copernican Principle
  - E) has long been proven correct
14. A solar system model with the Sun at the center
- A) is called geocentric
  - B) is called heliocentric
  - C) was proven correct by Einstein
  - D) violates Newton's laws
  - E) has long been proven incorrect
15. What is our modern model of the solar system?
- A) geocentric
  - B) heliocentric
  - C) lunerocentric
  - D) polycentric
  - E) diablocentric
16. A habitable world is one
- A) where aliens have landed and colonized
  - B) that can naturally have liquid water on its surface
  - C) that is very close to its sun
  - D) with an extremely thick atmosphere
  - E) has organic molecules
17. A habitable world
- A) has life on it
  - B) could support life
  - C) must have a thick atmosphere of methane
  - D) must have advanced life
  - E) cannot exist

18. This scientist gave us three laws about planetary motion, but without an explanation as to how they worked
- A) Ptolemy
  - B) Kepler
  - C) Galileo
  - D) Newton
  - E) Einstein
19. This scientist gave us three laws about physics, which explained how objects in our solar system orbit each other
- A) Ptolemy
  - B) Kepler
  - C) Galileo
  - D) Newton
  - E) Einstein
20. The light reaching the Earth from the star  $\alpha$  Centauri (4.3 light years away)
- A) took 8.6 years to travel here
  - B) was Doppler shifted by a factor of 4.3
  - C) was Doppler shifted by a factor of 8.6
  - D) took 4.3 years to travel here
  - E) did not reach the Earth yet
21. A “light year” is a measure of
- A) time
  - B) speed
  - C) rotation rate
  - D) age
  - E) distance

HW#02

22. Which of the following is not one of the three basic types of rock?
- A) sedimentary
  - B) stromatolitic
  - C) igneous
  - D) metamorphic
23. A characteristic of sedimentary rock is that it is associated with
- A) the conversion of eroded material into rock
  - B) cooling lava or magma
  - C) meteors
  - D) rock that has been transformed by high temperatures or pressures
  - E) volcanoes

24. A characteristic of igneous rock is that it is associated with
- A) the conversion of eroded material into rock
  - B) cooling lava or magma
  - C) meteors
  - D) rock that has been transformed by high temperatures or pressures
  - E) limestone caves
25. A characteristic of metamorphic rock is that it is associated with
- A) the conversion of eroded material into rock
  - B) cooling lava or magma
  - C) meteors
  - D) rock that has been transformed by high temperatures or pressures
  - E) the atmosphere
26. What process could result in the conversion of sedimentary rock, bearing stromatolitic fossils, into igneous rock?
- A) the release of oxygen into the atmosphere
  - B) the transformation of the rock at high pressures
  - C) the rock being weathered by water, and deposited at the bottom of a lake
  - D) the complete melting of the rock into lava, and then its cooling into new rock
  - E) the impact of a giant comet
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- A) the release of oxygen into the atmosphere
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  - D) the complete melting of the rock into lava, and then its cooling into new rock
  - E) the impact of a giant comet
29. According to what we have learned in class, how old is the Earth?
- A) what we call the Earth is a fiction, it is an illusion, it is the Matrix
  - B) 6000 years old
  - C) about 4.6 billion years old
  - D) about 13.7 billion years old
  - E) we have no way of knowing

30. Several lines of evidence point towards the age of the Earth; which of the following is not such a line?
- A) It must be older than 4 billion years—the age of the oldest intact rocks
  - B) It must be older than 4.4 billion years—the oldest zircon crystals
  - C) It is probably older than 4.57 billion years—the ages of meteoric objects
  - D) It is probably around 5-6 billion years—the age of the moon
  - E) It must be older than 10 billion years—the age of the Sun
31. The heavy bombardment occurred
- A) five times in the last 570 million years
  - B) at the end of the Cretaceous, and the beginning of the Tertiary
  - C) several times, at more or less regular intervals throughout the Hadean and Archaean
  - D) during much of the Hadean
  - E) only during a short spike at the end of the Hadean
32. The late heavy bombardment occurred
- A) five times in the last 570 million years
  - B) at the end of the Cretaceous, and the beginning of the Tertiary
  - C) several times, at more or less regular intervals throughout the Hadean and Archaean
  - D) during much of the Hadean
  - E) only during a short spike at the end of the Hadean
33. An asteroidal impact that wipes out all life on a planet would be called
- A) a Martian meteorite
  - B) the Cambrian explosion
  - C) a sterilizing impact
  - D) the 2012 event
  - E) the heavy bombardment
34. Which is not one of the three key requirements for a planetary magnetic field to exist
- A) a liquid core of electrically conducting material
  - B) a relatively high rotation rate
  - C) convection in the liquid core
  - D) a thick layer of solid metal, such as the Earth's inner core
35. The Hadean eon was characterized by
- A) the time of planetary bombardment
  - B) the time during which life first developed, and was essentially single-celled
  - C) the appearance of oxygen in our atmosphere, eukaryotes, and multicelled life
  - D) the development of life visible to the naked eye
  - E) the formation of our Sun

36. The Archean eon was characterized by
- A) the time of planetary bombardment
  - B) the time during which life first developed, and was essentially single-celled
  - C) the appearance of oxygen in our atmosphere, eukaryotes, and multicelled life
  - D) the development of life visible to the naked eye
  - E) the formation of our Sun
37. The Proterozoic eon was characterized by
- A) the time of planetary bombardment
  - B) the time during which life first developed, and was essentially single-celled
  - C) the appearance of atmospheric oxygen, eukaryotes, and simple multicelled life
  - D) the development of life visible to the naked eye
  - E) the formation of our Sun
38. The Phanerozoic eon was characterized by
- A) the time of planetary bombardment
  - B) the time during which life first developed, and was essentially single-celled
  - C) the appearance of oxygen in our atmosphere, eukaryotes, and multicelled life
  - D) the development of life visible to the naked eye
  - E) the formation of our Sun

HW#03

39. The thin, cool, outer layer of the Earth is called the
- A) crust
  - B) inner core
  - C) mantle
  - D) outer core
  - E) atmosphere
40. The thick, plastic layer which convects heat from the Earth's interior is called the
- A) crust
  - B) inner core
  - C) mantle
  - D) outer core
  - E) atmosphere
41. The solid metallic layer of the Earth is called the
- A) crust
  - B) inner core
  - C) mantle
  - D) outer core
  - E) atmosphere

42. The liquid metallic layer of the Earth is called the
- A) crust
  - B) inner core
  - C) mantle
  - D) outer core
  - E) atmosphere
43. Which of the following is not a requirement for a planet, in order for it to have a magnetic field?
- A) conducting core
  - B) reasonably rapid rotation
  - C) convection currents
  - D) thick atmosphere
44. Which is true about greenhouse gases?
- A) they transmit infrared, but block visible light
  - B) they are opaque to visible light
  - C) they are transparent to infrared light
  - D) they are opaque to infrared, but transmit visible light
  - E) they are only produced by human pollution and farting cows
45. When the Earth froze over completely, this was called...
- A) the Little Ice Age
  - B) the Pleistocene
  - C) the great cooling
  - D) snowball Earth
  - E) iceberg planet

HW#04

46. In our class, we noted that lipids are
- A) a kind of protein that acts as a catalyst for reactions
  - B) sugars and starches that provide cells with both energy and structural components
  - C) a form of energy storage (fats) and also an important part in forming membranes
  - D) molecules used as structural elements, enzymes, and are built from amino acids
  - E) the enormous molecules used to store genetic information



47. In our class, we noted that carbohydrates are
- A) a kind of protein that acts as a catalyst for reactions
  - B) sugars and starches that provide cells with both energy and structural components
  - C) a form of energy storage (fats) and also an important part in forming membranes
  - D) molecules used as structural elements, enzymes, and are built from amino acids
  - E) the enormous molecules used to store genetic information
48. In our class, we noted that nucleic acids are
- A) a kind of protein that acts as a catalyst for reactions
  - B) sugars and starches that provide cells with both energy and structural components
  - C) a form of energy storage (fats) and also an important part in forming membranes
  - D) molecules used as structural elements, enzymes, and are built from amino acids
  - E) the enormous molecules used to store genetic information
49. In our class, we noted that proteins are
- A) important as acting as a solvent for all chemical reactions in life
  - B) sugars and starches that provide cells with both energy and structural components
  - C) a form of energy storage (fats) and also an important part in forming membranes
  - D) molecules used as structural elements, enzymes, and are built from amino acids
  - E) the enormous molecules used to store genetic information
50. In our class, we noted that enzymes are
- A) a kind of protein that acts as a catalyst for reactions
  - B) sugars and starches that provide cells with both energy and structural components
  - C) a form of energy storage (fats) and also an important part in forming membranes
  - D) molecules such as water, which allow for the diffusion of nutrients and wastes
  - E) the enormous molecules used to store genetic information
51. Which of the three major domains of life are you?
- A) archaea
  - B) bacteria
  - C) prokarya
  - D) virus
  - E) eukarya
52. Which of the following is a common, long-known source of disease, but which is not actually alive?
- A) archaea
  - B) bacteria
  - C) prion
  - D) virus
  - E) eukarya

53. Which of the following is a relatively rare protein, only recently believed to be the source of syndromes such as mad cow disease?
- A) archaea
  - B) bacteria
  - C) prion
  - D) virus
  - E) eukarya

HW#05

54. Which of the following is not true about RNA?
- A) RNA is a nucleic acid similar to DNA
  - B) RNA is constructed out of four amino acids
  - C) RNA stores genetic information
  - D) RNA is more complex than DNA
  - E) RNA is found in the human body
55. What is the RNA world?
- A) a world where the crust is made nearly (or completely) out of RNA crystals
  - B) a period that follows the current DNA world
  - C) a recently discovered exoplanet
  - D) a world where the magnetic field shields us from RNA
  - E) an earlier period of evolution, where the chief nucleic acid used by life was RNA
56. Which statement about the RNA world is incorrect?
- A) it preceded the DNA world
  - B) it was characterized by “chemical evolution”, where the RNA molecules competed against each other
  - C) it is an extrasolar planet orbiting the star 61 Cygni
  - D) it is currently thought to be the era in which chemical evolution transformed into biological evolution
  - E) it possibly arose from RNA developing on clay substrates
57. Which was the Cambrian Explosion?
- A) it was a giant asteroidal impact that caused a major extinction
  - B) it was a huge sterilizing event during the late heavy bombardment
  - C) it was a time of huge evolutionary diversification of lifeforms
  - D) it was the tectonic collision of India into Asian, creating the Himalaya.
  - E) it was the first time that the Earth’s magnetic field alternated polarities
58. When was the Cambrian Explosion?
- A) 6000 YA
  - B) 65 MYA
  - C) 540 MYA
  - D) 2.3 BYA
  - E) 4.6 BYA

59. Which is not a factor likely to have contributed to the Cambrian explosion?
- A) the oxygen levels in the atmosphere changed
  - B) organisms may have developed sufficiently complex genetics
  - C) a set of rapid climate change, such as snowball Earth phases
  - D) sophisticated predators had not yet evolved
  - E) an asteroidal impact wiped out the dinosaurs

HW#06

60. Which description fits the Martian Tharsis Bulge
- A) it is a continent-sized region bulging upwards, associated with volcanoes
  - B) it is a volcano about three times taller than Mount Everest
  - C) it is a giant system of valleys, probably originating from tectonic stresses
  - D) it is a heavily cratered area, with signs of (water or wind) erosion, dating from about 3.8 BYA
  - E) it is terrain with less cratering, suggesting obliteration from lava flows
61. Which description fits the Martian Olympus Mons
- A) it is a continent-sized region bulging upwards, associated with volcanoes
  - B) it is a volcano about three times taller than Mount Everest
  - C) it is a giant system of valleys, probably originating from tectonic stresses
  - D) it is a heavily cratered area, with signs of (water or wind) erosion, dating from about 3.8 BYA
  - E) it is terrain with less cratering, suggesting obliteration from lava flows
62. Which description fits the Martian Valles Marineris
- A) it is a continent-sized region bulging upwards, associated with volcanoes
  - B) it is a volcano about three times taller than Mount Everest
  - C) it is a giant system of valleys, probably originating from tectonic stresses
  - D) it is a heavily cratered area, with signs of (water or wind) erosion, dating from about 3.8 BYA
  - E) it is terrain with less cratering, suggesting obliteration from lava flows
63. Which description fits the Martian southern highlands
- A) it is a continent-sized region bulging upwards, associated with volcanoes
  - B) it is a volcano about three times taller than Mount Everest
  - C) it is a giant system of valleys, probably originating from tectonic stresses
  - D) it is a heavily cratered area, with signs of (water or wind) erosion, dating from about 3.8 BYA
  - E) it is terrain with less cratering, suggesting obliteration from lava flows

64. Which description fits the Martian northern lowlands
- A) it is a continent-sized region bulging upwards, associated with volcanoes
  - B) it is a volcano about three times taller than Mount Everest
  - C) it is a giant system of valleys, probably originating from tectonic stresses
  - D) it is a heavily cratered area, with signs of (water or wind) erosion, dating from about 3.8 BYA
  - E) it is terrain with less cratering, suggesting obliteration from lava flows
65. Why is Olympus Mons so huge?
- A) it is a giant crack in Mars' thick crust
  - B) it was formed by a giant impact on the Martian surface
  - C) it was created by a huge, ancient ocean on Mars
  - D) it is a volcano sitting stationary over a hot spot on Mars
  - E) it developed because of a runaway greenhouse effect
66. The largest known volcano in the solar system is
- A) Olympus Mons on Mars
  - B) the Tharsis Bulge
  - C) Mauna Kea on Earth
  - D) Valles Marineris
  - E) Mount Everest

HW#07

67. What is tidal heating?
- A) underwater volcanism
  - B) the heat stored in oceans
  - C) gravitational stresses deforming, flexing, and heating a world's structure
  - D) chemical energy heating a world's structure
  - E) energy associated with varying magnetic fields
68. Changing gravitational forces, which squeeze and relax a planet's core
- A) keep the Earth's core molten
  - B) are important in keeping Venus so hot
  - C) are called tidal heating
  - D) are important in keeping Mercury so hot
  - E) keep Jupiter hot
69. What causes tidal heating?
- A) strengthening and weakening gravitational forces as an object orbits in an elliptical orbit
  - B) the oceans causing erosion on shorelines
  - C) the formation of jarosite blueberries on the Martian terrain, suggestive of ancient oceans and stable water
  - D) asteroids melting subsurface ice, resulting in temporary river channels
  - E) retrograde motion

70. In tidal heating effects, what keeps the heated object's orbit elliptical?
- A) the intense gravitational pull of the central jovian planet
  - B) the intense magnetic field of the central jovian planet
  - C) orbit-orbit resonances with other satellites in the system
  - D) giant volcanoes
  - E) retrograde motion
71. The result of tidal heating on Io causes
- A) giant impact craters
  - B) a tremendous world-wide magnetic field
  - C) a thick nitrogen atmosphere
  - D) intense volcanism
  - E) liquid water oceans just beneath the surface of ice
72. The result of tidal heating on Europa causes
- A) giant impact craters
  - B) a tremendous world-wide magnetic field
  - C) a thick nitrogen atmosphere
  - D) intense volcanism
  - E) liquid water oceans just beneath the surface of ice
73. Sunlight is unlikely to be a source of energy for European life because
- A) the sunlight is too strong
  - B) sunlight is faint at Jupiter's distance from the sun, and further it is unlikely to penetrate through the European ice
  - C) sunlight is far too faint at Jupiter's distance from the sun, and could never penetrate Europa's thick nitrogen atmosphere
  - D) Europa is always in Jupiter's shadow
  - E) Europa is a world of volcanoes, and cannot have life on it
74. Which is not a potential source of energy for European life?
- A) sunlight reaching near-surface life, or penetrating through cracks in the ice
  - B) energy associated with deep-sea oceanic vents, and redox reactions
  - C) high-energy particles accelerated by Jupiter's magnetic fields
  - D) radioactivity, such as potassium isotopes
  - E) nuclear fusion
75. In addition to tidal heating, radioactive decay of core material and potassium, and tiny amounts of radiation from the sun, what other source of energy might help fuel life on Europa?
- A) density waves from Saturn's cloud belt
  - B) Saturn's coriolis effect
  - C) high energy particles accelerated by Jupiter's magnetic field
  - D) asteroidal objects drawn in by Jupiter's gravity
  - E) collisions between Jupiter's satellites

76. What do we suspect European life might be like?
- A) it has been detected, and we think it originated on the Earth
  - B) large, buoyant gas-bag life that floats in the atmospheres of Jupiter's moons
  - C) large, whale-like, predatory creatures that swim in the oceans
  - D) primitive life, probably in low abundance since there is so little available energy
  - E) the dread god Cthulhu, who impatiently waits for the day to rise again and destroy Earth
77. Earth is habitable, and Mars might have been in the past. Where is another place astrobiologists feel is most likely for life to exist in our solar system?
- A) the water surrounding the ice patches at the poles of our Moon
  - B) the warm clouds in the atmospheres of Phobos and Deimos
  - C) the briny oceans that may exist under the icy shells of jovian moons
  - D) the asteroids that pass close to the Earth
  - E) in the surface rocks of Venus

HW#08

78. Why would we expect that Venus has outgassed similar amounts of CO<sub>2</sub> and H<sub>2</sub>O as the Earth has?
- A) Venus has a thick atmosphere of nitrogen
  - B) Venus collided with the Earth, sharing large amounts of material, so we have many similarities
  - C) the rotation characteristics of Venus and the Earth are almost identical
  - D) both planets have large amounts of active plate tectonics
  - E) the two planets have similar sizes and compositions
79. The CO<sub>2</sub> of Venus has mostly found its way into
- A) space, because it escaped the planet's gravity
  - B) the atmosphere, where it is today
  - C) the rocks in the planet's crust, where it is today
  - D) carbohydrates, which are stored in the tissues of life forms
  - E) the planet's magnetic field where it is held in the magnetosphere
80. The CO<sub>2</sub> of Earth has mostly found its way into
- A) space, because it escaped the planet's gravity
  - B) the atmosphere, where it is today
  - C) the rocks in the planet's crust, where it is today
  - D) carbohydrates, which are stored in the tissues of life forms
  - E) the planet's magnetic field where it is held in the magnetosphere

81. The runaway greenhouse effect happens when
- A) industrial CO<sub>2</sub> is emitted into the atmosphere
  - B) industrial CO<sub>2</sub> causes global warming
  - C) the greenhouse effect raises the global temperature, which in turn reduces any further greenhouse effect in a negative feedback effect
  - D) the greenhouse effect raises the global temperature, which in turn increases the greenhouse effect, producing a positive feedback effect
  - E) water vapor rises above the ozone, and is disassociated by ultraviolet photons
82. In a runaway greenhouse effect, the massive amount of atmospheric CO<sub>2</sub> causes heat to be retained, which then
- A) results in the atmosphere being stripped
  - B) evaporates the oceans, stopping the process by which CO<sub>2</sub> is returned to the rock
  - C) results in a sterilizing impact
  - D) induces a snowball-Earth type of phase
  - E) produces the impetus for the development of life
83. Why did the runaway greenhouse effect happen to Venus, but not the Earth
- A) since Venus lost its oceans, it could not store CO<sub>2</sub> in its surface rocks
  - B) since they are different types of planets, we can expect Venus and Earth to have different amounts of CO<sub>2</sub>
  - C) CO<sub>2</sub> is not stable on the surface of Earth
  - D) the Earth lost its CO<sub>2</sub> to space
  - E) ultraviolet light is blocked by the ozone

HW#09

84. What determines the interior boundary of the habitable zone?
- A) the runaway greenhouse effect and possibly the moist greenhouse effect
  - B) the failure of an insulating greenhouse effect, and possibly the freeze-out of CO<sub>2</sub> at large distances from the sun
  - C) the loss of the magnetic field as the planet cools
  - D) the presence of a jovian-sized planet
  - E) tidal heating
85. What determines the exterior boundary of the habitable zone?
- A) the runaway greenhouse effect and possibly the moist greenhouse effect
  - B) the failure of an insulating greenhouse effect, and possibly the freeze-out of CO<sub>2</sub> at large distances from the sun
  - C) the loss of the magnetic field as the planet cools
  - D) the presence of a jovian-sized planet
  - E) tidal heating

86. What is the moist greenhouse effect?
- A) the trapping of heat by CO<sub>2</sub> and other greenhouse gases
  - B) the change of the greenhouse effect by human-caused CO<sub>2</sub> emissions
  - C) the loss of the magnetic field as the planet cools
  - D) the movement of water vapor into the upper atmosphere, where it is lost to space
  - E) the re-emission of CO<sub>2</sub> by volcanic activity
87. What is the continuously habitable zone?
- A) the range of distances from the sun where water is currently stable in liquid form on a planetary surface
  - B) the range of distances from the sun where water has been stable in liquid form, from about 4 BYA to the current time
  - C) the range of distances from the sun at which spacecraft could travel without being destroyed
  - D) the region in which the tidal forces can warm the interior of a planet
  - E) the area between Mars and Jupiter that contains most of the asteroids
88. Although presented in the USA as controversial by politicians and the media, global climate change
- A) is primarily a mass of bogus science assembled by scientists who want grants so they can spend time studying fictional effects
  - B) is, overall, a good thing because it will increase crop yields in some countries
  - C) is generally considered well supported science, by climate scientists, ecologists, major corporations, and most industrialized nations
  - D) is another example of false alarms, like the so called diminishing ozone
  - E) is only going to have impacts in a hundred years or so

#### HW#10

89. The Kepler satellite looked for exoplanets by
- A) photographing the exoplanets directly
  - B) looking for spectral indications of planetary atmospheres
  - C) looking for Doppler effects on the star being orbited
  - D) looking for magnetic field changes in stars as they are eclipsed
  - E) looking for brightness changes in stars as they are transited by the planets
90. The direct detection of exoplanets is so difficult because
- A) the planets are faint compared to the stars
  - B) we don't know where to look
  - C) planets tend to dwarf the stars the orbit
  - D) planets are exceedingly rare
  - E) telescopes usually cannot peer through our atmosphere



91. A jovian planet that is found orbiting even closer to the central star than Mercury orbits the sun
- A) has not yet been detected, but we have reason to believe they exist
  - B) is called a hot Jupiter
  - C) is called a cold mercury
  - D) was detected in our own solar system in the late 1900s
  - E) could not possibly exist
92. Hot Jupiters are surprising because
- A) they are not as common as we would expect
  - B) they should be visible even without a telescope
  - C) they are primarily a mass of bogus science assembled by scientists who want grants so they can spend time studying fictional effects
  - D) they do not fit in our conventional theory of solar system formation
  - E) they should only appear in tidally locked pairs
93. As a jovian planet spirals towards its sun, in becoming a hot Jupiter,
- A) other jovian planets in the system will merge into an eccentric jupiter
  - B) the central star will become a red giant
  - C) terrestrial planets might be destroyed or ejected from the solar system
  - D) terrestrial planets will probably be entirely unaffected
  - E) an outer cometary belt (like the Kuiper belt) would be ejected
94. In a planetary system with jovian and terrestrial planets, the migration of a hot Jupiter towards the central star
- A) would cause resonances in the orbits of the terrestrial planets, stabilizing their orbits
  - B) would create giant impacts, where each terrestrial planet would receive a large moon like our own
  - C) would stimulate a deadly runaway greenhouse effect
  - D) would likely scatter the terrestrial planets out of their orbits, perhaps even sending them into interstellar space
  - E) will disrupt the central star

#### HW#11

95. The Rare Earth Hypothesis
- A) was proven by the Miller-Urey experiment
  - B) was disproven by the Miller-Urey experiment
  - C) proposes that planets like the Earth, for whatever reason, might be very uncommon
  - D) proposes that planets like the Earth, for whatever reason, might be very common
  - E) proposes that while planets like the Earth are common, they are rarely contacted by aliens—hence, the Great Silence

96. We think that the galactic habitable zone's inner boundary might be set by
- A) high levels of elements other than hydrogen and helium
  - B) low levels of elements other than hydrogen and helium
  - C) low numbers of sterilizing supernova explosions
  - D) high numbers of sterilizing supernova explosions
  - E) the presence or absence of hot jupiters
97. We think that the galactic habitable zone's outer boundary might be set by
- A) high levels of elements other than hydrogen and helium
  - B) low levels of elements other than hydrogen and helium
  - C) low numbers of sterilizing supernova explosions
  - D) high numbers of sterilizing supernova explosions
  - E) the presence or absence of hot jupiters
98. If a solar system did not have a Jupiter-sized planet, it is possible that
- A) terrestrial planets will not form
  - B) the asteroid belt will never form
  - C) comets will be ejected to the outer solar system, making the terrestrial worlds uninhabitable
  - D) comets will not be ejected to the outer solar system, and the terrestrial worlds might be subject to never-ending impacts
  - E) the terrestrial planets will be ejected into space

HW#12

99. The Drake Equation
- A) calculates the number of male ducks needed to maintain a healthy flock
  - B) can be used to accurately calculate the number of alien civilizations in the galaxy
  - C) is useful for framing the discussion of how many alien civilizations are in the galaxy
  - D) determines the rate at which atmospheric stripping removes gas from a planet
  - E) measures the rate at which hot jupiters vaporize
100. In the Drake Equation,  $R^*$
- A) is the rate at which stars are formed
  - B) is the number of habitable planets are formed around a star
  - C) is the fraction of habitable planets that develop life
  - D) is the fraction of life-bearing planets that develop technological civilizations
  - E) is the fraction of technological civilizations that still exist
101. In the Drake Equation,  $N_{HP}$
- A) is the rate at which stars are formed
  - B) is the number of habitable planets are formed around a star
  - C) is the fraction of habitable planets that develop life
  - D) is the fraction of life-bearing planets that develop technological civilizations
  - E) is the fraction of technological civilizations that still exist

102. In the Drake Equation,  $f_{life}$
- A) is the rate at which stars are formed
  - B) is the number of habitable planets are formed around a star
  - C) is the fraction of habitable planets that develop life
  - D) is the fraction of life-bearing planets that develop technological civilizations
  - E) is the fraction of technological civilizations that still exist
103. In the Drake Equation,  $f_{civ}$
- A) is the rate at which stars are formed
  - B) is the number of habitable planets are formed around a star
  - C) is the fraction of habitable planets that develop life
  - D) is the fraction of life-bearing planets that develop technological civilizations
  - E) is the fraction of technological civilizations that still exist
104. In the Drake Equation,  $f_{now}$
- A) is the rate at which stars are formed
  - B) is the number of habitable planets are formed around a star
  - C) is the fraction of habitable planets that develop life
  - D) is the fraction of life-bearing planets that develop technological civilizations
  - E) is the fraction of technological civilizations that still exist
105. Of the three general categories of broadcast signals that might be used by civilizations, which is the most likely to be detected by another civilization
- A) signals used for local communication (i.e., the equivalent of tv and radio signals)
  - B) signals used for communication between a civilization and a satellite colony or spacecraft
  - C) intentional signal beacons
  - D) secret military transmissions
  - E) personal devices, such as cell phones
106. In general, science does not consider UFO sightings to be well supported, partly because
- A) the evidence simply does not survive well when closely and objectively examined
  - B) people with southern accents are uneducated
  - C) the government forces scientists to keep quiet
  - D) "Men in Black" intimidate people to be quiet about their experiences
  - E) scientists have all decided, in the Big Secret Union of Sneaky Scientists (BSUSS), that society is not ready to hear the truth
107. CETI is controversial in scientific circles because
- A) it costs too much
  - B) it uses valuable telescope time
  - C) it is scientifically impossible
  - D) it is potentially unwise to notify alien civilizations of our existence
  - E) scientists have concluded it to be a dead end for research

HW#13

108. What do UFO-theorists think happened at Roswell in 1947?
- A) a nuclear bomb was detonated
  - B) a classified program (Mogul) was being developed to spy on the Soviet Union
  - C) an alien spacecraft crashed in the desert
  - D) a spacecraft abducted a couple as they drove home at night
  - E) the first-ever crop circle was detected
109. What was the original, official explanation for what crashed at Roswell in 1947?
- A) a nuclear bomb
  - B) a weather balloon
  - C) an alien spacecraft
  - D) the being Kolac from planet Twylo
  - E) Keanu Reeves
110. What is the actual, declassified explanation for the event that happened at Roswell in 1947?
- A) a nuclear bomb was detonated
  - B) a classified program (Mogul) was being developed to spy on the Soviet Union
  - C) an alien spacecraft crashed in the desert
  - D) a spacecraft abducted a couple as they drove home at night
  - E) the first-ever crop circle was detected
111. What are the alien “greys”, that were portrayed in ancient Egyptian hieroglyphs?
- A) exactly that—visitors to the Earth, presumably from zeta Reticulum
  - B) more recent hieroglyphs, that were written over older hieroglyphs
  - C) an alien spacecraft carved out of gold
  - D) potted plants
  - E) interdimensional, space-travelling bigfoots that live in Loch Ness

HW#14

112. The Fermi Paradox explores, in part, the observation that
- A) spacetime is curved
  - B) causality would be violated if you traveled back in time and killed your parents before you were born
  - C) we do not see that the galaxy is filled with alien communication signals
  - D) the night sky is black
  - E) aliens do not seem to be common

113. The Fermi Paradox explores, in part, the observation that
- A) spacetime is curved
  - B) causality would be violated if you traveled back in time and killed your parents before you were born
  - C) we do not see that the galaxy is filled with alien communication signals
  - D) the night sky is black
  - E) a species could explore the galaxy in a relatively short time
114. Conservative estimates for the time it would take for us to explore the galaxy are
- A) up to 450 years
  - B) short compared to the age of our modern civilization
  - C) longer than the age of life on our planet
  - D) short compared to the age of the galaxy
  - E) long compared to the age of the universe
115. Other civilizations, if they exist, are likely to be significantly older than ours because
- A) star formation in our galaxy did not start until 2 billion years ago
  - B) the Earth is only 6000 years old
  - C) the galaxy is 10 billion years old, but our sun is only 5 billion years old
  - D) they'd have to be, because if they weren't, we'd have detected them
  - E) UFOs have a lot of technology
116. The Rare Earth Hypothesis says we haven't detected aliens because
- A) civilizations such as the one on Earth are extremely rare
  - B) civilizations destroy themselves before they can try to contact us
  - C) other civilizations consider our Earth to be unattractive, or difficult to visit
  - D) there is a global conspiracy by our leaders to keep us uninformed
  - E) aliens will only contact us once we have enough technology
117. The Self Destruction Hypothesis says we haven't detected aliens because
- A) civilizations such as the one on Earth are extremely rare
  - B) civilizations destroy themselves before they can try to contact us
  - C) other civilizations consider our Earth to be unattractive, or difficult to visit
  - D) there is a global conspiracy by our leaders to keep us uninformed
  - E) aliens will only contact us once we have enough technology
118. The Unattractive Earth Hypothesis says we haven't detected aliens because
- A) civilizations such as the one on Earth are extremely rare
  - B) civilizations destroy themselves before they can try to contact us
  - C) other civilizations consider our Earth to be unattractive, or difficult to visit
  - D) there is a global conspiracy by our leaders to keep us uninformed
  - E) aliens will only contact us once we have enough technology

119. The Government Conspiracy Hypothesis says we haven't detected aliens because
- A) civilizations such as the one on Earth are extremely rare
  - B) civilizations destroy themselves before they can try to contact us
  - C) other civilizations consider our Earth to be unattractive, or difficult to visit
  - D) there is a global agreement by the leaders of the world to keep us uninformed
  - E) aliens will only contact us once we have enough technology
120. The Immaturity Hypothesis says we haven't detected aliens because
- A) civilizations such as the one on Earth are extremely rare
  - B) civilizations destroy themselves before they can try to contact us
  - C) other civilizations consider our Earth to be unattractive, or difficult to visit
  - D) there is a global conspiracy by our leaders to keep us uninformed
  - E) aliens will only contact us once we have enough technology
121. The Zoo Hypothesis says we haven't detected aliens because
- A) we are secretly being observed by aliens as a kind of oddity
  - B) civilizations destroy themselves before they can try to contact us
  - C) other civilizations consider our Earth to be unattractive, or difficult to visit
  - D) there is a global conspiracy by our leaders to keep us uninformed
  - E) aliens will only contact us once we have enough technology
122. The Quarantine Hypothesis says we haven't detected aliens because
- A) we are secretly being observed by aliens as a kind of oddity
  - B) civilizations destroy themselves before they can try to contact us
  - C) other civilizations consider our Earth to be sick, unhealthy, or dangerous
  - D) there is a global conspiracy by our leaders to keep us uninformed
  - E) aliens will only contact us once we have enough technology
123. The Deadly Probes Hypothesis says we haven't detected aliens because
- A) we are secretly being observed by aliens as a kind of oddity
  - B) civilizations destroy themselves before they can try to contact us
  - C) other civilizations consider our Earth to be sick, unhealthy, or dangerous
  - D) there is a global conspiracy by our leaders to keep us uninformed
  - E) the galaxy is filled with self-replicating robot killing machines
124. The Great Silence explores the observation that
- A) spacetime is curved
  - B) causality would be violated if you traveled back in time and killed your parents before you were born
  - C) we do not see that the galaxy is filled with alien communication signals
  - D) the night sky is black
  - E) aliens do not seem to be common

125. Which of the following is a theoretical method of propulsion in space, but which has NOT yet been used by human-created space probes?
- A) nuclear fusion
  - B) solar sail
  - C) ion drive
  - D) liquid chemical rockets
  - E) solid rocket boosters
126. Which of the following is a theoretical method of propulsion in space, but which has NOT yet been used by human-created space probes?
- A) nuclear fission
  - B) solar sail
  - C) ion drive
  - D) liquid chemical rockets
  - E) solid rocket boosters
127. Which of the following is a theoretical method of propulsion in space, but which has NOT yet been used by human-created space probes?
- A) Alcubierre spatial modification
  - B) solar sail
  - C) ion drive
  - D) liquid chemical rockets
  - E) solid rocket boosters
128. Von Neumann machines
- A) were used to drill deep into the permanently frozen ice in the Austrian Alps, where ancient bacterial life forms were discovered. These life forms were subsequently identified as Archaean microbes that could survive conditions found in deep space, suggesting that life might have filtered down to the Earth from the stars.
  - B) were used to probe life in the deep, underwater hydrothermal vents off the Galapagos Islands. These probes found unprecedented levels of chemoautotrophic life forms underwater, which survive by redox reactions based upon the sulfide compounds emitted by the chimney vents.
  - C) were used in the Viking Probes to examine Martian soils for indications of life. The von Neumann machines on Viking 1 and 2 consisted of a carbon assimilation experiment, a gas exchange experiment, a labeled release experiment, and finally the chromatograph/mass spectrometer experiment.
  - D) are theoretical, self-replicating robot probes that could be used to explore the galaxy; one variant is the Bracewell Probe which would be used for communications, another variant is the Deadly Probe which would be used to destroy all life wherever it was found.

## SPECTROSCOPY DEMONSTRATION

129. From the peak of an object's continuum spectrum, we can learn an object's
- A) distance
  - B) mass
  - C) speed
  - D) temperature
  - E) composition
130. Spectroscopes can break light into its separate wavelengths, and from the wavelength of the spectral peak we can learn about an object's
- A) distance
  - B) mass
  - C) speed
  - D) temperature
  - E) composition
131. Spectroscopes can break light into its separate wavelengths, and from the wavelengths of the absorption or emission lines we can learn about an object's
- A) distance
  - B) mass
  - C) speed
  - D) temperature
  - E) composition
132. Spectroscopy allows us to learn an object's characteristics...
- A) although it cannot be used to determine an object's composition
  - B) although it cannot be used to determine an object's temperature
  - C) although it cannot be used to determine an object's line-of-sight velocity
  - D) even though you cannot even detect photons from the object
  - E) even without having a physical sample of the object in your lab

## CRYOGEN DEMONSTRATION

133. What dangerously cold compound did we work with in liquid form
- A) H<sub>2</sub>O
  - B) CO<sub>2</sub>
  - C) N<sub>2</sub>
  - D) He
  - E) H



134. When brought to the temperature of liquid Nitrogen, tissues of terrestrial life forms
- A) are unaffected
  - B) turn into gas
  - C) melt
  - D) experience deadly cell rupture and freeze to a (usually) brittle state
  - E) are suffocated by the unbreathable nitrogen
135. What compound is dry ice?
- A) H<sub>2</sub>O
  - B) CO<sub>2</sub>
  - C) N<sub>2</sub>
  - D) He
  - E) H
136. Which compound might exist as both a liquid and a solid on Europa (at different depths)?
- A) H<sub>2</sub>O
  - B) CO<sub>2</sub>
  - C) N<sub>2</sub>
  - D) He
  - E) H

#### PLANETARIUM DEMONSTRATION

137. A bright streaking light, moving across the sky in a few seconds, is probably
- A) a meteor
  - B) a human-made satellite
  - C) a planet such as Venus
  - D) a flying craft—airplane or otherwise
  - E) a comet
138. A steady, silent light slowly moving across the sky in about a minute, is probably
- A) a meteor
  - B) a human-made satellite
  - C) a planet such as Venus
  - D) a flying craft—airplane or otherwise
  - E) a comet
139. A bright light, stationary or appearing to oscillate slightly in position and/or brightness, especially in the morning or evening sky, is probably
- A) a meteor
  - B) a human-made satellite
  - C) a planet such as Venus
  - D) a flying craft—airplane or otherwise
  - E) a comet

140. A moving light, perhaps slowly changing direction, and with (often colored) extra lights, is probably
- A) a flying craft—airplane or otherwise
  - B) a human-made satellite
  - C) a planet such as Venus
  - D) a meteor
  - E) a comet

#### ROCK WALK DEMONSTRATION

141. The oldest rocks on the rock walk are
- A) hundreds of years old
  - B) thousands of years old
  - C) 13.7 million years old
  - D) billions of years old
  - E) 13.7 billion years old
142. Stromatolites are believed to be
- A) rock strata exhibiting S-trauma
  - B) shark teeth
  - C) fossilized bacterial colonies
  - D) rocks with colored layers indicating the development of atmospheric oxygen
  - E) a characteristic fracture pattern, indicating extremely energetic impacts
143. Specimens of banded iron are
- A) rock strata exhibiting S-trauma
  - B) shark teeth
  - C) fossilized bacterial colonies
  - D) rocks with colored layers indicating the development of atmospheric oxygen
  - E) a characteristic fracture pattern, indicating extremely energetic impacts
144. Shatter cones are believed to be
- A) rock strata exhibiting S-trauma
  - B) shark teeth
  - C) fossilized bacterial colonies
  - D) rocks with colored layers indicating the development of atmospheric oxygen
  - E) a characteristic fracture pattern, indicating extremely energetic impacts

## NATURE WALK DEMONSTRATION

145. All organisms in an ecosystem are
- A) working together to achieve a single objective
  - B) producing oxygen for us to breathe
  - C) trying to kill each other
  - D) struggling to outcompete each other for resources
  - E) either plants or animals
146. Seeds may have sticky surfaces, or structures enabling them to fly, so they can
- A) be annoying to people
  - B) be attractive to birds
  - C) repel deer
  - D) stop invasive microorganisms from killing them before they can germinate
  - E) explore their environment, and look for new places to live
147. Which is not a key resource being fought for by all eukaryotes
- A) water
  - B) nutrients
  - C) energy
  - D) soil and sunlight
  - E) a suitable habitat