Origins of Life (Summer 2020)

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Question 1

Rather than observations alone, how could theories and experiments help us constrain the likelihood of life emerging on a planet?

- A. They would allow us to build models that predict the probability of life emerging under certain circumstances
- B. They could help us uncover "universal laws of life"
- C. They would directly detect alien life and determine its abundance
- D. A and B
- E. A, B, and C

Question 2

Which of the following properties of an exoplanet do we NOT measure using the Transit technique?

- A. Radius
- B. Mass
- C. The amount of radiation the planet receives from its star
- D. Period (time it takes for the planet to complete its orbit around the star)
- E. All of the above

Question 3

In what way is the habitable zone useful for finding alien life?

- A. It guarantees that we will find life on an Earth-like planet in the habitable zone
- B. It helps us select which exoplanets should be observed with new telescopes
- C. It is easy to calculate for any exoplanet because each star has the same habitable zone
- D. It allows us to rule out the possibility that water could exist on a planet outside the habitable zone
- E. If a planet is in the habitable zone, we know what its atmospheric composition is like

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Question 4

Which of the following techniques allows us to characterize the atmospheres and surfaces of an exoplanet?

- A. Transmission spectroscopy
- B. Phase curves
- C. Direct Imaging
- D. Radial Velocity
- E. A, B, and C

Question 5

Autocatalytic sets are an example of which hypothesis for the origin of life?

- A. Genetics-First
- B. Metabolism-First
- C. Chicken-First
- D. Proteins-First
- E. Lipids-First

Question 6

In the same way that we have an atomic theory for water that explains its emergent properties, we need an underlying theory that ex emergent properties of life. Which of the following is a proposed theory that attempts to do this?

- A. Life as an information processing system; all organisms are organized by flows of information
- B. Life is made of cells; all organisms are organized in a cellular structure
- C. Life is a system that can evolve; a population of organisms are organized by evolution
- D. Life is spontaneous generation; LUCA appeared spontaneously in nature
- E. Life is DNA; all organisms have unique sets of genes, without sharing any in common with other species

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Question 7

All adaptive processes lead to an agent maximizing the amount of information it possesses about the world in which it lives. How wc functionalist use this to support their argument?

- A. The only reason agents maximize their information is because there was a specific set of prebiotic chemicals available
- B. The particular mechanical implementation matters; there is only one chemical composition that leads to this maximizing of information
- C. The particular mechanical implementation doesn't matter; all agents end up maximizing their information about the world
- D. A and B
- E. A, B, and C

Question 8

There is a spectrum of adaptive agency. What is likely to happen to organisms that live in very uncertain environments?

- A. They will become simple
- B. They will become complex
- C. They will immediately go extinct
- D. They will not evolve
- E. They will be consumed by organisms that live in certain environments

Question 9

From a functionalist perspective, which of the following is true about the origin of life?

- A. There was only one origin of life
- B. There were multiple origins of life
- C. Life can only emerge on the molecular scale
- D. Life can only emerge on the Earth
- E. Life only began once the Constitution of the United States was written

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Question 10

Using a genetic algorithm that incorporates the components of Darwinian evolution, what is usually the first thing that occurs in a typ performance curve?

- A. The maximum fitness rises
- B. The mean fitness goes down
- C. The mean fitness doesn't change
- D. The maximum fitness goes down
- E. The maximum fitness doesn't change

Question 11

If given the amount of resources per unit area and the resource requirements of each individual, what can researchers determine, u laws?

- A. The mean fitness of the individuals in the area
- B. The evolutionary relationships between individuals in the area
- C. The maximum number of individuals that can be found in the area
- D. The age of each individual in the area
- E. None of the above

Question 12

According to Population Energy Use (PEU) scaling laws, which of the following is true?

- A. An elephant's heart beats faster than a mouse's heart
- B. An elephant has a slower metabolic rate than a mouse
- C. At the population level, mice use more energy than elephants in a given area
- D. At the population level, mice use less energy than elephants in a given area
- E. At the population level, mice use the same amount of energy as elephants in a given area

Question 13

Why do we see scaling relationships between different organisms in nature, such as the three-quarter law for metabolic rate and bo

- A. Biological systems inhabit similar environments, leading them to develop similar traits
- B. Biological systems consume the same resources, causing a scaling relationship
- C. Biological systems have evolved under natural selection to optimize performance
- D. A and B
- E. A, B, and C

Question 14

There are many ways that organisms use energy. Which of the following energy uses are necessary for an organism to evolve?

- A. Development and growth
- B. Maintenance
- C. Reproduction
- D. A and B
- E. A, B, and C

Question 15

There are many different theories and definitions of life. Which of the following concepts do we know to be true?

- A. The adaptive arrow of time is the same as the thermodynamic arrow of time
- B. All modern life on Earth (e.g. humans, mice, bacteria) follows the Population Energy Use scaling law
- C. Early life did not involve information processing
- D. There are no other planets with an Earth-like radius in the habitable zone of their star
- E. None of the above

Question 16

Phase transitions are a way for natural systems to spontaneously become ordered and are controlled by order parameters. What mig order parameter of life?

- A. The direction and strength of a cellular membrane
- B. The independence of life's structures and processes
- C. Life can only exist on Earth-sized planets in the habitable zone of a star
- D. The chemical and energetic processes that are interdependent in biogeochemical cycles
- E. Population size as determined by resource limits