

Exercise walk-through

7.12

Origins of Life on Earth

AP Biology

Artificial selection, and the evolution we can watch

artificial selection

humans, not nature, choose which individuals breed – crops, livestock, dogs

the mechanism

identical to natural selection; only the *selecting agent* differs

the evidence it gives

large phenotypic change in a few hundred generations, from existing variation

evolution is ongoing

antibiotic-resistant bacteria, pesticide-resistant insects, and rapid change in fast-breeding species

why those examples

a short generation time makes the change **observable within a human lifetime**

Artificial selection was Darwin's own opening argument, because it shows selection producing change in a timescale anyone can check.

Hardy-Weinberg

$$p + q = 1$$

$$p^2 + 2pq + q^2 = 1$$

p frequency of allele A
 q frequency of allele a
 p^2 frequency of genotype AA
 $2pq$ frequency of genotype Aa
 q^2 frequency of genotype aa

H-W equilibrium: no selection, mutation, migration, drift, or non-random mating

Hardy-Weinberg: allele frequencies p and q give genotype frequencies p^2 , $2pq$, q^2

What all life shares

the claim

all life descends from a **common ancestor**

the same machinery

DNA and RNA, transcribed and translated the same way in every domain

the same genetic code

the same codons specify the same amino acids, nearly universally

ribosomes

present in every cell, and structurally conserved

shared metabolism

core pathways such as glycolysis appear everywhere

the inference

features this arbitrary and this universal are far better explained by **inheritance** than by repeated invention

The argument is not that the features are useful – it is that the **particular arbitrary choices** are shared. A different code would work just as well.

Exercises 2.1·2.3

2.1 What did the Miller-Urey experiment produce? [1]

2.2 Why is RNA proposed as the first self-replicating molecule? [1]

2.3 What is a protocell? [1]

Exercises 2.1-2.3

2.1 What did the Miller-Urey experiment produce? [1]

2.1

- Amino acids (organic molecules) from simple gases and energy
-

2.2 Why is RNA proposed as the first self-replicating molecule? [1]

2.2

- RNA can both store information and act as a catalyst (enzyme)
-

2.3 What is a protocell? [1]

2.3

- A membrane-enclosed droplet containing molecules – a precursor to a cell

Exercises 3.1-3.2

3.1 The Miller-Urey experiment supported the idea that

[1]

☐

A cells arose fully formed

B organic molecules can form from inorganic ones

C DNA came before RNA

D life came from space only

3.2 Put these steps of life's origin in order: polymers, protocells, simple organic monomers, self-replicating molecules.

[2]

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3.1 B

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[2]

3.2

- Simple organic monomers
- polymers
- protocells
- self-replicating molecules

Exercise 3.3

3.3 Explain why the ability to self-replicate was a key step for evolution to begin. [2]

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- Self-replication allowed information to be copied and passed on (heredity); variation in the copies could then be selected, so evolution could begin