Review Worksheet Answers: DNA Evidence ERVs and mtDNA

1: Where do scientists gain information from when comparing DNA?
(2 marks)

Information is gained from DNA sequencing (1). Once the sequence of bases is known, it can be compared (1).

2: Define 'genome'. Describe how sequencing the genome can be used to provide evidence for evolution.
(4 marks)

The complete set of DNA (1) in each cell of an organism is called the genome. Comparing base sequences from the DNA of one species that of another shows regions of similarity and difference (1). This provides evidence for evolution because more closely related organisms (1) have greater similarity in their genome. (1)

3: Define 'endogenous retrovirus'.
(1 mark)

Endogenous retroviruses are viral sequences that have become part of an organism's genome and are heritable (1).

4: Describe how endogenous retroviruses are used as evidence for evolution.
(3 marks)

Endogenous retroviruses appear in the non-coding sections of DNA (1). As they are inherited, they will appear in the same location of DNA in different species that share a common ancestor (1). The more ERV's two organisms have in common, the more closely related they are (1).

5: What do the genes on mtDNA code for?
(3 marks)

Mitochondrial DNA contains 37 genes. 24 genes contain the code for making transfer RNA (1) molecules and 13 genes have instructions for making some enzymes (1) needed for the reactions of cellular respiration. (1)

6: Why do we only inherit mitochondrial DNA from our mothers?
(3 marks)

The mitochondria in sperm are located in the midpiece, between nucleus and tail (1). When the sperm fertilizes the egg, only the sperm nucleus enters the ovum (1). The sperm mitochondria are therefore not part of the new organism. (1)

7: The DNA of dogs is 85% similar to that of humans, while the DNA of chimpanzees is 98% similar to that of humans. Explain how this information supports the idea that we have a more recent common ancestor with chimpanzees than with dogs.
(5 marks)

When speciation occurs, the new species will have very similar DNA to the original species (1). As further speciation occurs and many new species gradually evolve through mutations, natural selection and genetic drift, they accumulate more differences in their DNA (1). Species that are more closely related share a greater portion of their DNA. (1) Sharing 98% of our DNA with chimpanzees compared to 85% of DNA with dogs indicates we had a more recent (1) common ancestor (1) with chimpanzees.

8: Explain why not all retroviruses are endogenous retroviruses, and why only endogenous retroviruses are useful in providing evidence for evolution.

Retroviruses copy their DNA or RNA into the host cell (1). The retroviruses will only become endogenous when this occurs in the gametes (1), so the sequence can be passed on during reproduction (1). When retroviruses become endogenous, the viral sequence will be passed on to the offspring from the common ancestor (1), so when comparing different species that share a common ancestor, the ERV would be found at the same location (1) in the chromosome of both species (1).

9: Explain why comparison of structures such as endogenous retroviruses and mitochondrial DNA was not available prior to the development of techniques such as electrophoresis and DNA sequencing.
(2 marks)

ERVs and mtDNA are both composed of base sequences (1). In order to locate and determine these so they can be compared, sequencing techniques, including electrophoresis must be used. (1)

10: Below is a table showing different animals and the type of ERVs their DNA contains. Analyse the data and answer the questions below about the relatedness of the organisms listed.
(9 marks)

Animal	**ERVs**
Fish	ervZ, ervB, ervN
Lizard	ervZ, ervB, ervF, ervQ, ervL
Bird	ervZ, ervB, ervF, ervR
Shark	ervZ, ervM
Human	ervZ, ervB, ervF, ervE, ervQ

a) Which of the listed animals shares the most recent common ancestor with humans?
(1 mark)

The Lizard

b) Which of the listed animals is shares the most recent common ancestor with birds?
(1 mark)

The Lizard

c) Which of the listed animals is most distantly related to humans?
(1 mark)

The Shark

d) Is the Fish more closely related to the Shark, or the Bird? Explain your answer.
(6 marks)

The fish is more closely related to the bird (1). The fish and the shark share only ervZ (1), whereas the fish and bird share ervZ and ervB (1). This indicates that the common ancestor of the fish and shark existed before the ervB was incorporated into the genome (1), whereas the common ancestor of the fish and bird existed after ervB was incorporated into the genome (1). It can therefore be inferred that the common ancestor of bird and fish existed more recently than that of the fish and the shark. (1)

11. Body temperature regulation within a narrow range of values is important for survival. The body can gain and lose heat from the external environment.

a) List the two ways in which the body can gain heat from the external environment and give an example of each.
(4 marks)

Via conduction (1) and radiation (1). For example, warm air or water in contact with skin conducts heat into the body (1). Solar radiation causes the body to heat up when standing in the sun. (1)

b) List the two ways in which the body can lose heat to the external environment and give an example of each.
(4 marks)

Via convection (1) and evaporation (1). Cold air or water in contact with skin moves heat away from the body (1). This includes sweat evaporates, drawing heat energy away from the skin.(1)