AP® Biology
2003 Sample Student Responses
Form B

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4A1

4. Biologists are interested in preserving the diversity of living organisms on the planet.

(a) **Explain** THREE of the following processes or phenomena, using an appropriate example for each.

- mutation
- adaptive radiation
- polyploidy
- population bottlenecks
- growth of the human population

(b) For each process or phenomenon you selected in (a), **discuss** its impact on the diversity of life on Earth.

One of the reasons there is a great diversity of life is ~~[illegible]~~ mutation. This is a mistake in the DNA sequence that leads to new characteristics in the offspring. A mutation can be a change in one base in the DNA base sequence, or it can be a deletion or an addition ~~[illegible]~~ of bases, or ~~[illegible]~~ codons. This mutation, though sometimes deadly, may ~~[illegible]~~ give that individual a new trait which, if it proves favorable and gives it a natural advantage to procreate, it will give to its offspring. Eventally this trait may ~~[illegible]~~ spread until it is present in many members, at which case a new species may have evolved.

Adaptive radiation ~~[illegible]~~ also gives rise to new species. It occurs when members of ~~[illegible]~~ the same species, due to geographical or environmental differences in their particular habitat, ~~adapt differently to~~ evolve differently because of their different needs of adaptation. This had had a great influence on the diversity of life on Earth as many species have evolved in that matter. As a ~~[illegible]~~ millions of years go by the

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initial differences increase as they continue to adapt to their different environments.

The growth of the human population is increasing steadily, and for the first time a generation has seen how the world population has doubled in their lifetime. This is due to the fact that humans have technology, and can thus eliminate many of the limiting factors that before kept the human population in balance with the world around it. This increadible growth is having devastating effects of the diversity of life on Earth. As the human needs increase along with the ~~pop~~ population, a lot of species become extinct due to deforestation, pollution, or excess hunting or fishing.

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4B,

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Mutations are the only source of new genes and therefore have a great impact on the diversity of life on Earth. Mutations in genetic information can occur during DNA replication or protein biosynthesis and are a result of changes in the sequence of nucleotides and resulting genetic code. They can come in many forms as there are many ways in which a sequence can be altered. When a base is omitted it is a deletion, when a sequence is flipped it is an inversion, when bases jump locations it is a translocation, when bases are abnormally repeated is a duplication. Mutations can be beneficial or harmful. The mutation resulting in sickled red blood cells, for example, can be beneficial as the malaria virus cannot act on them. Such a beneficial mutation would accumulate as generations progressed. It is this kind of accumulation of favorable traits that result in new species and diversity. This can easily be seen in the case of the various types of finches the occupy different islands in the Galapagos.

Similarly, population bottlenecks also contribute to diversity of life. as they are a factor of evolution. Population bottlenecks are when a large population is cut off or reduced to

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a small group; possibly as a result of a natural disaster such as a fire or a flood. This reduced, smaller group now has a smaller gene pool in which to produce offspring. The genes they have may be favorable and cause diversification, or they may need to adapt to their altered environment, which could also result in diversification.

The growth of the human population has affected the diversity of life on Earth in a negative way. By consuming unreplenishable resources, expanding into and destroying forests and polluting the environment, humans are killing off organisms, populations and species; reducing diversity of life. As the human population grows it expands and pushes other species out of existence by destroying their habitats. By cutting down the rain forest humans have wiped hundreds of species off the face of the Earth, including many insects. Human expansion makes it difficult for other organisms to survive and create a diverse biome.

4C,

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(1)(a) Adaptive Radiation is a phenomena best explained by Darwin's finches. Finches are birds that populate the coast of south america along the pacific. Darwin observed that on the galapagos islands, off the coast of Argentina, § Finches had migrated from the mainland to the islands. Over the years, dif Finches settled in different parts of the island and in different islands. They gradually adapted to the locale in which they settled and by adaptive radiation became quite different from each other. So different such that mating within two individuals from different parts of the island became impossible. Some finches adapted for hunting fish in the sea, others adapted to ~~eat~~ feed on insects and worms. Therefore by 'Adaption', Darwin's finches 'radiated' from a common ancestor into several sub-species of finches.

(b) This adaptive radiation has diversified many species (2) due to geographical locations, physical barriers and population migrations. This causes many different organisms to adapt to their environment and as such evolve to be genetically different from the common ancestor. Therefore adaptive radiation has increased the diversity of life on earth and developed organisms well suited to their environment.

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②@Growth of the human population has been a relatively stable growth up till the industrial revolution. With the various improvements in the standard of living after the industrial revolution there has been an exponential increase in the population of the world. The birth rate has remained a constant over the centuries, but with a dramatic fall in the death rate & infant mortality rate there has been an exponential jump in the growth of the human population. The invention of vaccines and antibiotics were largely responsible for this increase. Improving health facilities also ensure that most adolescents reach reproductive age without any loss of health.

ⓑ The impact on the diversity of life on earth has been devastating. Increased population requires an increased amount of food, timber, chemicals, land and other materials which have badly affected other forms of life. Many creatures have become extinct since this increase in population and still more face the threat of extinction.

③@ Mutations are any spontaneous changes in the genetic make-up of an organism. Such changes can affect the survival rate of a population. If the mutation causes and an individual to reach reproductive maturity more quickly than it to produce offspring that are able to survive and reproduce better and more efficiently, then the Mutation can cause the population to take up its change as an average genetic make-up of the organisms.

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① Mutations have increased the diversity of life on this planet. Many organisms contain features brought about by mutations which enable it to survive and reproduce better. This distinguishes it from its parent and forms a new line of species or replaces the parent species. Mutations have also allowed gradual evolution from sea-dwelling animals to terrestrial and arboreal animals and from sea weed to higher terrestrial plants.

② Polyploidy is the presence of many sets of chromosomes in one organism. This can cause expression of multiple genes causing mental retardation in human children. ~~Polyploidy is also~~.