Answers to Concept Check Questions

1. How would you define physiology?

Answer

It is the study of the functioning of biological structures and systems, or how organisms work.

2. What is a model organism in the context of physiological research?

Answer

The August Krogh Principle suggests that "for any biological question, there is an organism on which it can be most conveniently studied." A model organism is a convenient animal on which to study a biological question. Squid, for example, was an early model to study neuronal function because of the size of its giant axon.

3. Why do the rates of biochemical reactions increase as temperature increases? Do they do so infinitely?

Answer

Temperature increases the thermal energy of molecules and increases the number of collisions between molecules. Because most reactions require molecular collisions, increasing the rate of collisions will increase the rate of reactions. This increase does not continue to infinity as temperature increases because at high temperatures many of the intermolecular bonds that stabilize protein structure start to break, causing proteins to unfold and denature. When proteins are unfolded they are unable to perform their functions. Because most biochemical reactions only occur at high rates because of the actions of protein catalysts, reaction rates decline when the catalysts begin to denature.

4. What is allometric scaling?

Answer

Some processes or structures change in direct proportion to body mass, which is called isometric scaling. If the process or structure changes disproportionately with body mass, it is considered to scale allometrically.

5. What is an adaptation?

Answer

An adaptation is a trait that arose via a process such as natural selection and that causes an increase in reproductive success.

6. Distinguish between homology and analogy.

Answer

Homology describes a pattern where a trait that is present in two taxa is inherited from a common ancestor. These traits may or may not be similar in appearance and function in the two taxa. For example, bird wings and human arms appear to be quite different, but they are actually homologous because they both evolved from the forelimbs of a four-legged ancestor.

Analogy describes a pattern where a trait is used for a similar function in two taxa, but is not inherited from a common ancestor. For example, the camera-type eyes of vertebrates and cephalopods were derived from the non-camera eyes of the closest relatives of each of these groups. This independent derivation suggests that these eyes are not homologous, but instead are analogous.

7. What is homeostasis?

Answer

Homeostasis is the regulation or maintenance of internal conditions within a narrow range, despite changes in the external environment.

8. Distinguish between acclimation, acclimatization, polyphenism, and phenotypic plasticity.

Answer

Acclimatization is a reversible phenotypic change produced from variations in natural environmental conditions, usually working in combination (for example, low temperature and short day length in the winter).

Acclimation is similar but describes the process of reversible phenotypic adjustment in response to a single environmental variable, usually in an artificial (e.g. laboratory) environment.

Polyphenism occurs when different environments lead to discrete alternative phenotypes. For example, developmental plasticity can lead to polyphenism that is often irreversible.

Phenotypic plasticity is a general term that reflects the ability of a single genotype to result in multiple phenotypes as a result of the environment; thus acclimation, acclimatization, and polyphenism are all types of phenotypic plasticity.