a place of mind

FACULTY OF EDUCATION

Department of
Curriculum and Pedagogy

Biology Evolution: Natural Selection II

Science and Mathematics Education Research Group

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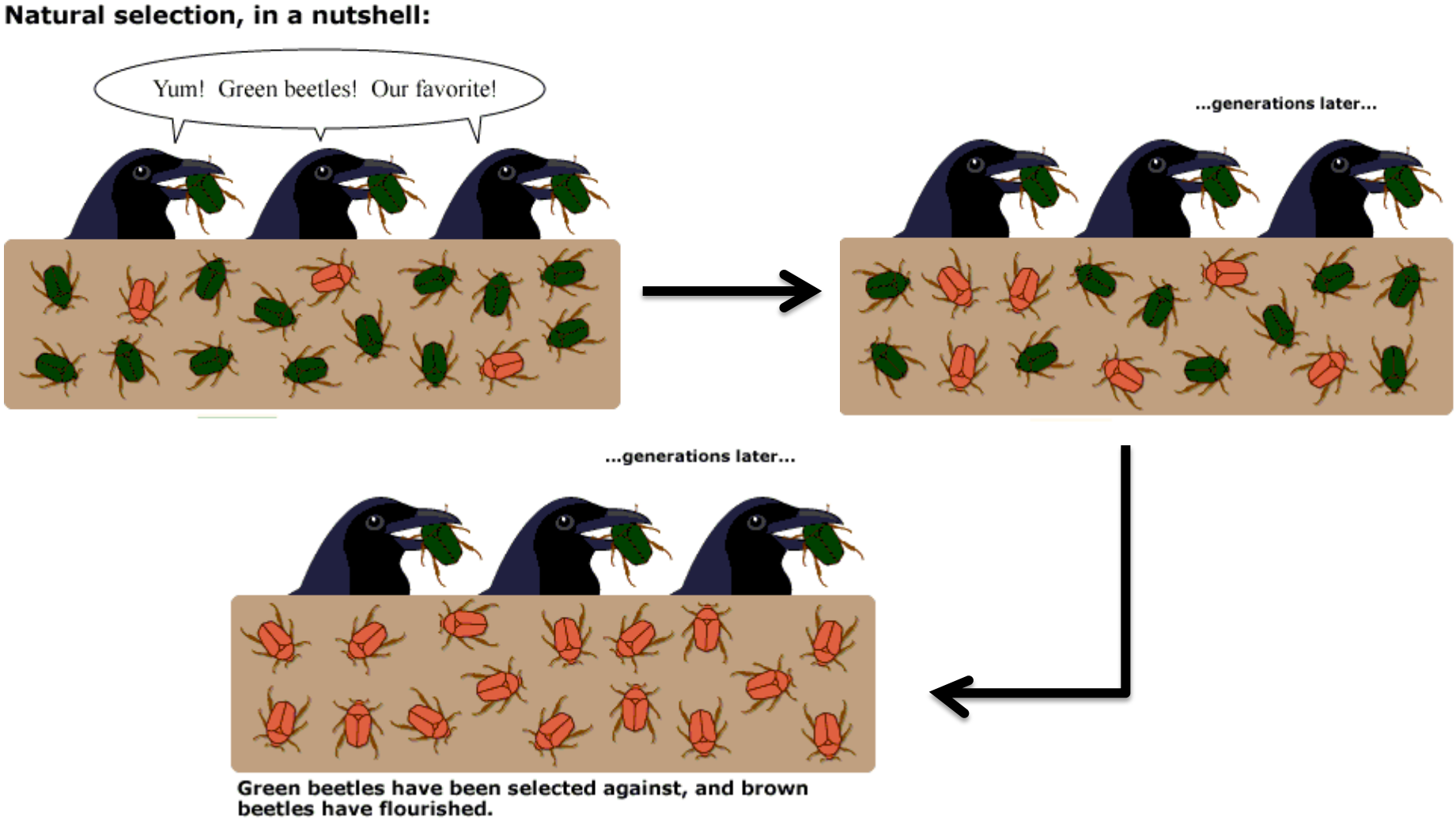
Natural Selection II



Retrieved from http://evolution.berkeley.edu/evolibrary/article/bergstrom_02

Question I

Two large populations of white and black butterflies were introduced to an island covered with white rocks. After a while, the number of black butterflies decreased significantly. The most likely agent of selection that affected the population of black butterflies is

A. Birds that eat butterflies.

B. Lichens growing on white stone.

C. Birds that eat only white butterflies.

D. Children that live on the white-stone island.

E. A scientist who collects black butterflies.

Image retrieved from www.backyardnature.net

Solution I

Answer: A

Justification:

Natural selection has to act with the trait (body colour) that butterflies clearly need to survive and to reproduce as males or females. In a white-rock island, black butterflies are more easily identified by birds due to their body colour on white-coloured rocks. Therefore they will tend to become consumed by birds more often and survive to reproduce less frequently than the white butterflies. Thus, the most advantageous trait, white coloration, which allows the white butterflies to have more offspring, becomes more common in the population. The black butterflies, which have a disadvantageous trait, become less common in the population.

Therefore, the correct answer is A.

Question II

MRSA (methicillin-resistant S. aureus) is drug resistant pathogen that threatens human health. However, MRSA is resistant not only to the antibiotic methicillin, but also to other types of antibiotics. How did S. aureus become resistant to antibiotics?

A. S. aureus evolved through a single mutation in the whole population to survive exposure to the antibiotic.

B. S. aureus can produce methicillin-resistant hormone.

C. S. aureus evolved using an antibiotic called Vancomcine.

D. S. aureus evolved through the process of mutation selection to survive exposure to the antibiotic

E. E. All of above.

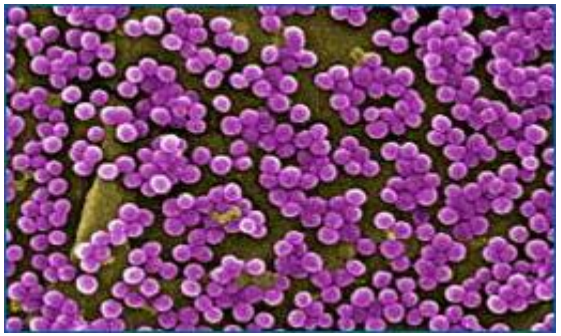


Image retrieved from http://evolution.berkeley.edu/

Solution II

Answer: D

Justification:

Antibiotic resistance in microorganisms is a well-known example of natural selection. When a population of bacteria (S. aureus) with considerable variation in their genetic material is exposed to antibiotics, most of the bacteria die quickly, but some may have mutations that allow them to survive the antibiotic treatment. These survivors will then reproduce, and the following generation of bacteria will inherit their antibiotic resistance gene. Thus, spontaneous mutation and natural selection will reduce the bacteria`s susceptibility to different types of antibiotic and these individuals will have a higher chance to survive and reproduce.

Therefore, the answer is A.

Question III

The water weevil is a major insect pest of irrigated rice in the USA. An agricultural field became infested with the water weevil. An insecticide is sprayed on the rice and 98 % of the pest died off. Some water weevils survived because they…

A. Evolved during the spraying to adapt to a new environment.
B. Inherited different genotypes, which allowed them to survive and reproduce.
C. Mutated during the spraying to adapt to a new environment.
D. Mutated using the chemical contents of the spray to survive.
E. Migrated to a neighboring agricultural field and then came back after the insecticide was gone.

Solution III

Answer: B

Justification:

This is another example of natural selection. The survivor water weevils' parents must have had a gene which increased their resistance to the insecticide. Thus, the resistant water weevils were likely to survive.

It is very difficult to evolve and mutate in a short time (during the spraying) and even though there is a small chance of the migration of water weevils from other neighbouring agricultural fields, they would have less chance to survive due to the residual insecticides in the field.

Therefore, the correct answer is B.

Question IV

During the Industrial Revolution in England, London was covered with soot (dark coloured impure carbon particles) from the new coal-burning factories. Peppered moth habitats (white trees and buildings) were affected by the pollution and went under major natural selection processes. Which of the following is a possible phenotype of the peppered moth during the Industrial Revolution?

A. The peppered moths had white colouration.

B. The peppered moths had dark colouration.

C. The peppered moths had fluorescent colouration.

D. The peppered moths had gray colouration.

E. None of the above.

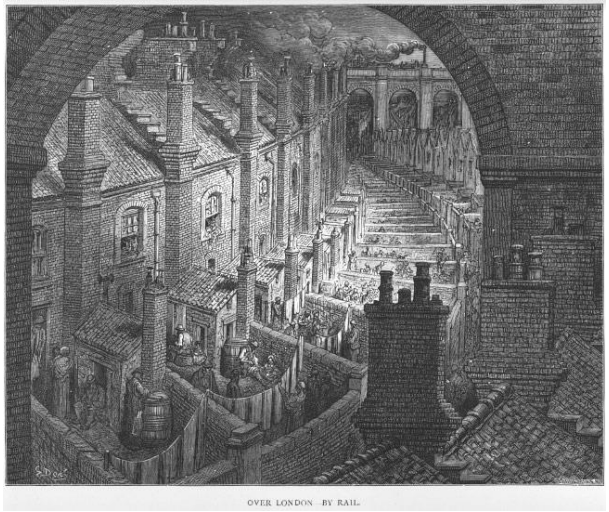


Image retrieved from http://en.wikipedia.org/wiki/Industrial_Revolution

Solution IV

Answer: B

Justification:

Before the Industrial Revolution, the majority of peppered moths were light-coloured to camouflage themselves from their predators. However, as the Industrial Revolution started, their habitats were covered with the soot, and their body colour was no longer a suitable trait to survive in a dark-coloured city.

Therefore, predators had a much easier time identifying the light-coloured moths and the population of light-coloured moths decreased. On the other hand, dark-coloured moths had higher survival rates and successfully passed their traits on to the next generation.

Over the months and years, the dark-coloured body became a more “fitted” trait for the environmental conditions.

Therefore, the correct answer is B.

Question V

Organisms are always undergoing the evolutionary process and some of their traits disappear and reappear over time. When natural selection works on humans, selection sometimes selects a “bad” gene as a fit variable that can be passed on to the next generation. Which of the following is an example of this selection?

A. Lactose gene
B. Sickle cell gene
C. Skin colour gene
D. Both A & B
E. Both B & C

Solution V

Answer: B

Justification:

The sickle cell gene causes a hereditary blood disorder called sickle-cell anaemia. This disorder affects red blood cells and reshapes the cells like a crescent (sickle). The sickle cell gene can cause serious health complications. The sickle cell gene is a “bad” gene. However, natural selection selected this gene as a fit variable where malaria was common. The reason is that the sickle cell gene provides some protection from malaria. The lactose gene is a “good” gene that helps people digest milk. The skin colour gene is the gene that controls a phenotype of humans.

Therefore, the correct answer is B.

FYI

For more real-life examples of Natural selection,

Please visit Discovery Channel Webpage

http://www.discovery.com/tv-shows/curiosity/topics/10-examples-natural-selection.htm

For more information on Natural selection, read books of Richard Dawkins