tpo_36_passage_3

The idea of natural selection is that organisms in a species that have characteristics favoring survival are most likely to survive and produce offspring with the same characteristics. Because the survival of organisms with particular characteristics is favored over the survival of other organisms in the same species that lack these characteristics, future generations of the species are likely to include more organisms with the favorable characteristics. One of the most thoroughly analyzed examples of natural selection in operation is the change in color that has occurred in certain populations of the peppered moth, Biston betularia, in industrial regions of Europe during the past 100 years. Originally moths were uniformly pale gray or whitish in color; dark-colored (melanic)individuals were rare and made up less than 2 percent of the population. Over a period of decades, dark-colored forms became an increasingly large fraction of some populations and eventually came to dominate peppered moth populations in certain areas-especially those of extreme industrialization such as the Ruhr Valley of Germany and the Midlands of England. Coal from industry released large amounts of black soot into the environment, but the increase of the dark-colored forms was not due to genetic mutations caused by industrial pollution. For example, caterpillars that feed on soot-covered leaves did not give rise to dark-colored adults. Rather, pollution promoted the survival of dark forms on soot-covered trees. Melanics were normally quickly eliminated in nonindustrial areas by adverse selection; birds spotted them easily. This phenomenon, an increase in the frequency of dark-colored mutants in polluted areas, is known as industrial melanism. The North American equivalent of this story is another moth, the swettaria form of Biston cognataria, first noticed in industrialized areas such as Chicago and New York City in the early 1900s. By 1961 it constituted over 90 percent of the population in parts of Michigan. The idea that natural selection was responsible for the changing ratio of dark- to light-colored peppered moths was developed in the 1950s by H.B.D.Kettlewell of Oxford University. If natural selection was the explanation, then there should be different survival rates for dark- and light-colored moths. To determine whether this was true, Kettlewell released thousands of light and dark moths (each marked with a paint spot) into rural and industrialized areas. In the nonindustrial area of Dorset, he recaptured 14.6 percent of the pale forms but only 4.7 percent of the dark forms. In the industrial area of Birmingham, the situation was reversed: 13 percent of pale forms but 27.5 percent of dark forms were recaptured. Clearly some environmental factor was responsible for the greater survival rates of dark moths. Birds were predators of peppered moths. Kettlewell hypothesized that the normal pale forms are difficult to see when resting on lichen-covered trees, whereas dark forms are conspicuous. In industrialized areas, lichens are destroyed by pollution, tree barks become darker, and dark moths are the ones birds have difficulty detecting. As a test, Kettlewell set up hidden observation positions and watched birds voraciously eat moths placed on tree trunks of a contrasting color. The action of natural selection in producing a small but highly significant step of evolution was seemingly demonstrated, with birds as the selecting force. Not every researcher has been convinced that natural selection by birds is the only explanation of the observed frequencies of dark and light peppered moths. More recent data, however, provide additional support for Kettlewell's ideas about natural selection. The light-colored form of the peppered moth is making a strong comeback. In Britain, a Clean Air Act was passed in 1965. Sir Cyril Clarke

has been trapping moths at his home in Liverpool, Merseyside, since 1959. Before about 1975, 90 percent of the moths were dark, but since then there has been a steep decline in melanic forms, and in 1989 only 29.6 percent of the moths caught were melanic. The mean concentration of sulphur dioxide pollution fell from about 300 micrograms per cubic meter in 1970 to less than 50 micrograms per cubic meter in 1975 and has remained fairly constant since then. If the spread of the light-colored form of the moth continues at the same speed as the melanic form spread in the last century, soon the melanic form will again be only an occasional resident of the Liverpool area.

question 1

Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.

A Peppered moth populations gradually increased in size, with dark-colored moths increasing their numbers fastest in the industrialized areas of Germany and England.

B Over a period of decades, dark-colored peppered moths came to certain areas of the Ruhr Valley and the Midlands and became the dominant forms there.

C In Germany and England, dark-colored peppered moths forced most light-colored moths out of their territories.

D While they also increased elsewhere, dark-colored peppered moths gradually became the dominant form in areas of extreme industrialization.

question 2

In the passage, why does the author mention that "the increase of the dark-colored forms was not due to genetic mutations caused by industrial pollution"?

A To suggest that the rate of genetic change in peppered moths actually decreased

B To emphasize that pollution in industrial areas had no role in the increase of dark peppered moths

C To introduce the information about the soot-covered trees that caterpillars fed on as the correct explanation for the increase in dark peppered moths

D To reject a view of the role of pollution in the increase of dark peppered moths that would not involve natural selection

question 3

The passage suggests which of the following about "the swettaria form of Biston cognataria" ?

A It was a dark-colored moth form.

B It is now extinct in industrialized areas.

C It did not exist before the early 1900s.

D It came to North America from Europe.

question 4

Paragraph 3 answers all of the following questions about Kettlewell's experiment EXCEPT:

A How was it determined whether a recaptured moth was one of those that Kettlewell released?

B Were equal numbers of dark- and light-colored moths released?

C What hypothesis was Kettlewell trying to test with the experiment?

D What were the results of the experiment?

question 5

Paragraph 4 suggests which of the following about the survival of peppered moths?

A Light forms of the moth are more likely to survive in polluted rather than unpolluted areas.

B Birds are more likely to determine the survival rates of moths in rural rather than industrial areas.

C Environment determines whether dark or light forms of the moth survive.

D The presence of lichen on tree trunks encourages birds to prey on both dark and light forms of the moth with the same frequency.

question 6

What is the purpose of paragraph 5 in the passage?

A To explain why Kettlewell’ s view has been widely misunderstood

B To present a view that various researchers have criticized

C To suggest why new developments seem to confirm Kettlewell’ s view

D To state one of the proposed alternatives to Kettlewell’ s view

question 7

According to paragraph 5, which of the following is true of melanic forms in Liverpool?

A Increased sulphur dioxide pollution decreased their numbers after 1975.

B Their population slowly increased from 1975 to 1989.

C From 1950 on, they have seldom been seen in the Liverpool area.

D Before 1975 their population was higher than that of light-colored moths.

question 8

In paragraph 5 the change in the frequency of melanic forms is attributed to which of the following?

A New kinds of pollution in Liverpool

B The passage of the Clean Air Act in 1965

C Changes in rates of genetic mutation

D Changes in populations of moth predators

question 9

Look at the four squares [ ] that indicate where the following sentence could be added to the passage.

The idea of natural selection is that organisms in a species that have characteristics favoring survival are most likely to survive and produce offspring with the same characteristics. Because the survival of organisms with particular characteristics is favored over the survival of other organisms in the same species that lack these characteristics, future generations of the species are likely to include more organisms with the favorable characteristics. One of the most thoroughly analyzed examples of natural selection in operation is the change in color that has occurred in certain populations of the peppered moth, Biston betularia, in industrial regions of Europe during the past 100 years. Originally moths were uniformly pale gray or whitish in color; dark-colored (melanic)individuals were rare and made up less than 2 percent of the population. Over a period of decades, dark-colored forms became an increasingly large fraction of some populations and eventually came to dominate peppered moth populations in certain areas-especially those of extreme industrialization such as the Ruhr Valley of Germany and the Midlands of England. Coal from industry released large amounts of black soot into the environment, but the increase of the dark-colored forms was not due to genetic mutations caused by industrial pollution. For example, caterpillars that feed on soot-covered leaves did not give rise to dark-colored adults. Rather, pollution promoted the survival of dark forms on soot-covered trees. Melanics were normally quickly eliminated in nonindustrial areas by adverse selection; birds spotted them easily. This phenomenon, an increase in the frequency of dark-colored mutants in polluted areas, is known as industrial melanism. The North American equivalent of this story is another moth, the swettaria form of Biston cognataria, first noticed in industrialized areas such as Chicago and New York City in the early 1900s. By 1961 it constituted over 90 percent of the population in parts of Michigan. The idea that natural selection was responsible for the changing ratio of dark- to light-colored peppered moths was developed in the 1950s by H.B.D.Kettlewell of Oxford University. If natural selection was the explanation, then there should be different survival rates for dark- and light-colored moths. [] To determine whether this was true, Kettlewell released thousands of light and dark moths (each marked with a paint spot) into rural and industrialized areas. [] In the nonindustrial area of Dorset, he recaptured 14.6 percent of the pale forms but only 4.7 percent of the dark forms. [] In the industrial area of Birmingham, the situation was reversed: 13 percent of pale forms but 27.5 percent of dark forms were recaptured. [] Clearly some environmental factor was responsible for the greater survival rates of dark moths. Birds were predators of peppered moths. Kettlewell hypothesized that the normal pale forms are difficult to see when resting on lichen-covered trees, whereas dark forms are conspicuous. In industrialized areas, lichens are destroyed by pollution, tree barks become darker, and dark moths are the ones birds have difficulty detecting. As a test, Kettlewell set up hidden observation positions and watched birds voraciously eat moths placed on tree trunks of a contrasting color. The action of natural selection in producing a small but highly significant step of evolution was seemingly demonstrated, with birds as the selecting force. Not every researcher has been convinced that natural selection by birds is the only explanation of the observed frequencies of dark and light peppered moths. More recent data, however, provide additional support for

Kettlewell's ideas about natural selection. The light-colored form of the peppered moth is making a strong comeback. In Britain, a Clean Air Act was passed in 1965. Sir Cyril Clarke has been trapping moths at his home in Liverpool, Merseyside, since 1959. Before about 1975, 90 percent of the moths were dark, but since then there has been a steep decline in melanic forms, and in 1989 only 29.6 percent of the moths caught were melanic. The mean concentration of sulphur dioxide pollution fell from about 300 micrograms per cubic meter in 1970 to less than 50 micrograms per cubic meter in 1975 and has remained fairly constant since then. If the spread of the light-colored form of the moth continues at the same speed as the melanic form spread in the last century, soon the melanic form will again be only an occasional resident of the Liverpool area.

question 10

Directions: An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. This question is worth 2 points.

A. Over time, peppered moth populations in Germany and England migrated from nonindustrialized areas to those that were industrialized.

B. Originally most peppered moths were pale in color, but especially in areas of extreme industrialization, dark-colored moths began to dominate.

C. Kettlewell’ s experiments showed that birds were acting as a selecting force by eating light-colored moths on dark trees in polluted areas.

D. The recent increase of pale forms as pollution decreases supports the importance of natural

selection by birds as a factor affecting peppered moth populations.

E. According to Kettlewell’ s theory, natural selection produced birds that were better able to detect moths even when areas were polluted.

F. Recent research indicates that when adult moths fail to choose appropriate backgrounds, they are usually eaten by birds.