The Evolution of Peppered Moths: A Case Study in Natural Selection

A case study in natural selection
In the early 1950's, H.B.D. Kettlewell, an English physician with an interest in butterfly and moth collecting, decided to study the unexplained color variations of the peppered moth.

Kettlewell wanted to understand a trend that had been noted by scientists since the early nineteenth century (the 1800s). This trend, observed in the industrialized areas of England (the cities), revealed a peppered moth population -- once mostly made up of light-gray colored moths -- that suddenly consisted mostly of dark-gray individuals. Kettlewell was curious: Why had this shift in the moth population taken place? Why had the dark gray moths become more common only in industrial, urban areas, while the light gray moths were still the more common variety in rural areas? What do these observations mean?

Why had this color variation taken place?
To figure out why the change in the population had taken place, Kettlewell set about the task of designing several experiments. He hypothesized that something in industrial regions had caused the dark gray moths to be more successful than the light gray individuals. Through his investigations, Kettlewell established that dark gray moths had greater fitness in the industrial areas than the light gray moths. He believed that this increased fitness was due to the dark gray moths' ability to better blend into their habitat and avoid predation by birds.

****Somehow, the dark gray moths had an advantage over the light-gray moths in the cities – Why do you think this is the case? ____________________________________________________
_______________________________________________________________________________________
_______________________________________________________________________________________

Once Kettlewell had completed his experiments, the question remained: what had changed the moth's habitat in industrial regions enabling darker colored individuals to blend in to their surroundings better? To answer this question, we can look back into Britain's history. In the early 1700's, the city of London became the birthplace of the Industrial Revolution. Advancements in iron production, steam engine manufacturing, and cloth production sped up many social and economic changes that altered the future of what had been, until then, a mostly agricultural workforce. Great Britain's large coal supplies provided the energy resources needed to fuel the fast-growing metalworking, glass, ceramics, and brewing industries. Because coal is not a clean energy source, its burning released vast quantities of soot (a kind of pollution) into London's air. The soot then settled as a black film over the city.

In the midst of London's newly industrialized environment, the peppered moth found itself in a difficult struggle to survive. Soot coated and blackened the trunks of trees throughout the city, killing lichen that grew on the trees and turning the bark from a light gray-peppered pattern to a dull, black film. The light gray, pepper-patterned moths, that once blended into the lichen-covered bark, instead stood out as easy targets for birds and other hungry predators.

Why were dark gray moths more common in industrial areas while light gray moths were still predominant in rural areas?
The theory of natural selection states that individuals that are best adapted to their environment will _______________, ________________ more successfully, and pass on their _________ to future generations.

In this case, changed environmental conditions meant that one variation of the moth suddenly had a large advantage over the other one. Therefore, the one with the advantage was able to avoid being eaten, could reproduce successfully, and pass its genes on to further generations. All of a sudden, the "fittest" moth became the dark-gray moth. The variety of moth with the disadvantage was often eaten before it could reproduce, so its genetic traits became less common among the population.
USE COMPLETE SENTENCES to answer the questions below.

1. What was Kettlewell trying to figure out about the moth population?

2. What change in the peppered moth population was observed in the mid-1800s?

3. When the trees are covered in light-gray lichens, then which color moth is easier to spot? _________
   What about if the trees are covered in soot and, therefore, dark gray? ____________________________
   ****So which variation of moth would you expect to be more common if the trees are light-gray?

4. What event happened in England that changed the trees from being mostly light to mostly dark?

5. What effect did the change in trees have on the moth population? WHY did it have this effect?

6. What is genetic variation within a species? EXPLAIN how this moth species shows an example of
   genetic variation.

7. What would have happened to the moth population if it had NOT been genetically diverse?

8. What is natural selection?

9. Explain natural selection in your OWN WORDS!!

10. How can natural selection explain the major change in London’s moth population?