Natural Selection
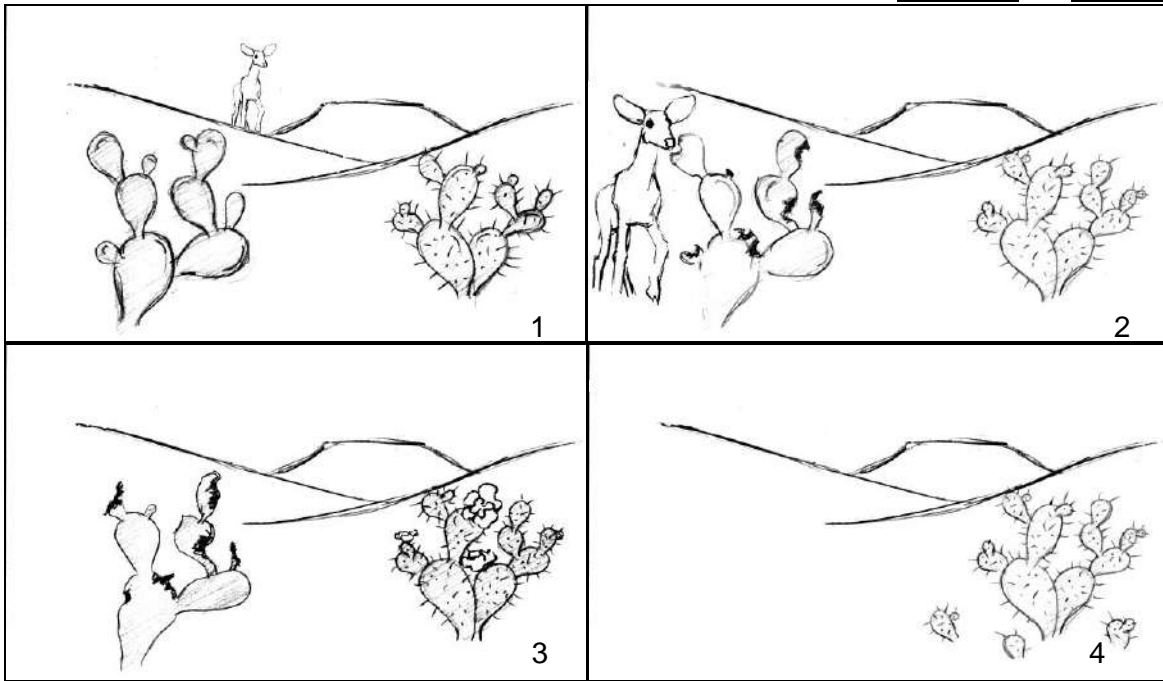
Recall that there are six parts of natural selection to take place.

A) Above is a series of pictures representing changes in a population of cacti. Pictures 1 and 2 show what happened when a deer came to eat, picture 3 shows the cacti a few weeks later (notice the flowers on the right-hand cactus), and picture 4 shows the situation a few months later.

1) **Genetic Variation** within the population: In picture 1, what is the main difference between the cactus on the left and the cactus on the right?

2) **Struggle to survive**: Why would a deer be more likely to eat the cactus on the left than the cactus on the right in picture 1?

3) **Differential Successful Reproduction (fitness)**: What effect does the deer's behavior have on the survival and reproduction of these two types of cactus?

4) Do you think that evolution by natural selection is occurring in this cactus population? (Assume there is actually a large population of cacti, some look like each type of cacti shown above)Explain why or why not.

B) **Peppered Moth Background:**

Natural selection is the reproductive success of organisms that are best suited for an environment. It is the driving force of evolution. Natural selection occurs within populations, which are interbreeding groups of individuals of the same species. Genetic variation is one factor that influences natural selection. Genetic variation occurs when a population has multiple versions of a trait. For example, some organisms in a population of moths are dark colored, while some are light colored. Natural selection over time results in adaptations, where certain traits are favored due to their influence on survival. Adaptations over many generations can lead to evolution. Peppered moths have lived in the forests around Manchester, England for hundreds of years. There are two genetic variations for color in peppered moths- the moths can be dark with light spots OR light with dark spots.

Before the 1800s (figure 14.11a), the trees were light colored and the light colored moths were well camouflaged. After the 1800s, when England went through the Industrial Revolution, the pollution from factories made the trees darken (figure 14.11b). Now, the trees were dark colored and the dark colored moths were well camouflaged. Various birds eat both kinds of moths IF they are able to be seen.

Data: The table below displays the Number of peppered moths of each color found over a ten year period. Graph the data below to show how the peppered moth populations changed in the 1800s. You should make a line graph with two lines. Years should be on the x axis and number of moths on the y axis. Assume year one was the start of the industrial revolution. Don't forget a legend.
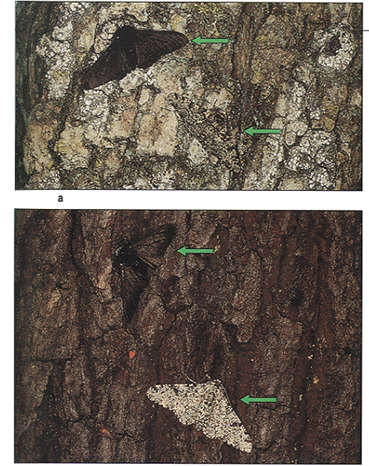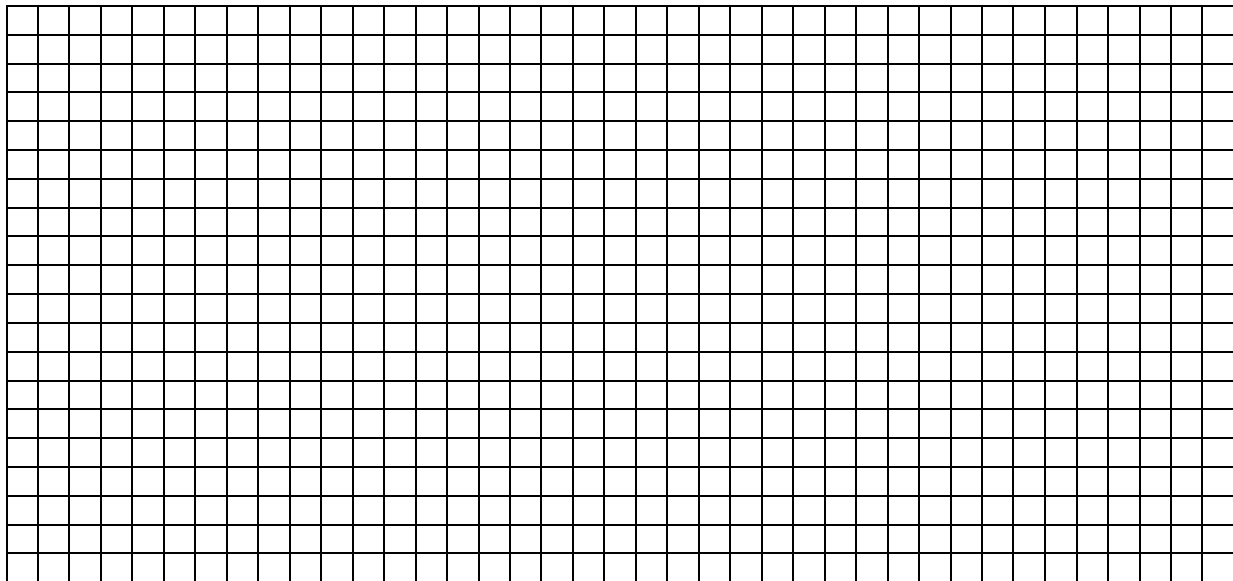

a

b

Figure 14.11 Individuals of a moth population that has undergone directional selection in response to changes in the environment. Light-winged and dark-winged peppered moths (*Biston betularia*) are resting on a lichen-covered tree trunk in (**a**) and on a soot-darkened tree trunk in (**b**).

| Peppered Moth Populations		
Year	Light Colored Population	Dark Colored Population
1	537	112
2	484	198
3	392	210
4	246	281
5	225	357
6	193	412
7	147	503
8	84	594
9	53	638
10	38	673

Line Graph

Analysis Questions for B:

6. What changes occurred in both forms of the moth over these ten years?

7. Why do you think these changes occurred? (your explanation needs to include the FOUR parts natural selection from your notes, using these moths as an example for each part)

8. England has recently cleaned up their factories and now produces much less pollution. As a result, the trees are slowly becoming lighter. What might happen to the populations of each form of the moth in the next 10 years? Why?

9. Describe what is happening in figures 1-3 to the right. Is the population of mice different in figure 3 than in figure 1? Explain why.
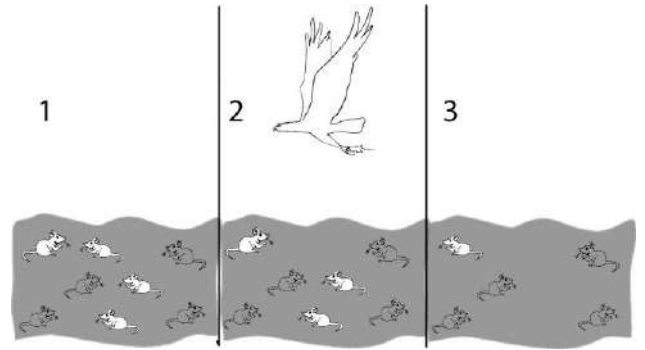
10. Living things that are well adapted to their environment survive and reproduce. Those that are not well adapted don't survive and reproduce. An adaptation is any characteristic that increases fitness, which is defined as the ability to survive and reproduce. What characteristic of the mice is an adaptation that increased their fitness in #3?

11. The table below gives descriptions of four female mice that live in a beach area which is mostly tan sand with scattered plants. According to the definition given for fitness, which mouse would biologists consider the fittest? Explain why this mouse would be the fittest.

Color of fur→	Black	Tan	Tan and Black	Cream
Age at death	2 months	8 months	4 months	2 months
# pups produced by each female	0	11	3	0
Running speed	8 cm/sec.	6 cm/sec.	7 cm/sec.	5 cm/sec.

12. A more complete definition of fitness is the ability to survive and produce offspring who can also survive and reproduce. Below are descriptions of four male lions. According to this definition of fitness, which lion would biologists consider the "fittest"? Explain why.

Name→	George	Dwayne	Spot	A bear
Age at death	13 years	16 years	12 years	10 years
# cubs fathered	19	25	20	20
# cubs surviving to adulthood	15	14	14	19
Size	10 feet	8.5 feet	9 feet	9 feet

C. *Background*:

Suppose that a bear had genes that he passed on to his cubs that helped his cubs to resist infections, so they were more likely to survive to adulthood. These genes would be more common in the next generation, since more of the cubs with these genes would survive to reproduce.
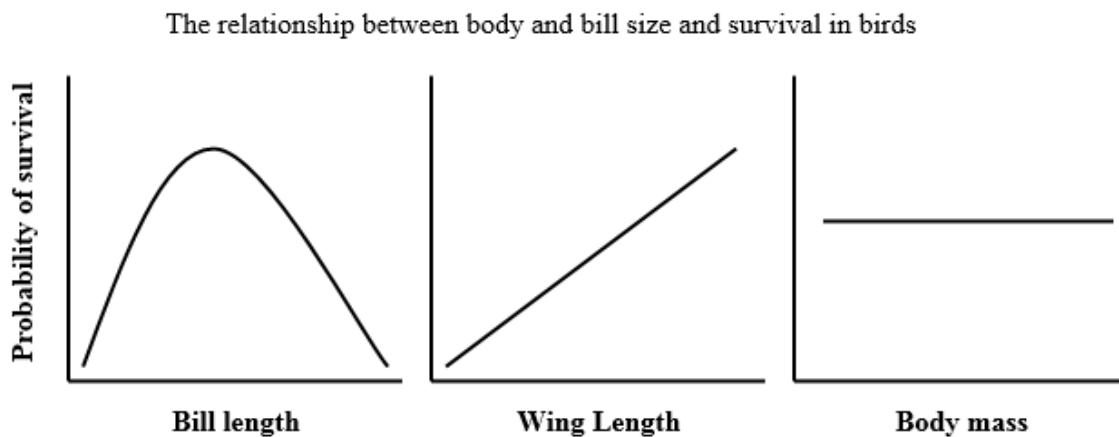
A characteristic which is influenced by genes and passed from parents to offspring is called **heritable**. Over many generations heritable adaptive characteristics become more common in a population. This process is called evolution by **natural selection**. Evolution by natural selection takes place over many, many generations.

Evolution by natural selection leads to adaptation within a population. The term evolution by natural selection does not refer to individuals changing, only to changes in the frequency of adaptive characteristics in the population as a whole. For example, for the mice that lived in the beach area with tan sand, none of the mice had a change in the color of their fur; however, due to natural selection, tan fur was more common for the pups than for the mother mice.

In summary, a heritable characteristic that helps an organism to have more offspring which survive to reproduce will tend to become more common in a population as a result of evolution by natural selection.

13. Explain why a characteristic which helps an animal to live longer will generally tend to become more common in the population as a result of evolution by natural selection.

14. Some times characteristics are not heritable but are environmentally influenced. Describe three characteristics that are not inherited but affect survival.

The relationship between body and bill size and survival in birds

Bill length   Wing Length   Body mass

These data on morphology and survival comes from a long-term study on African finches
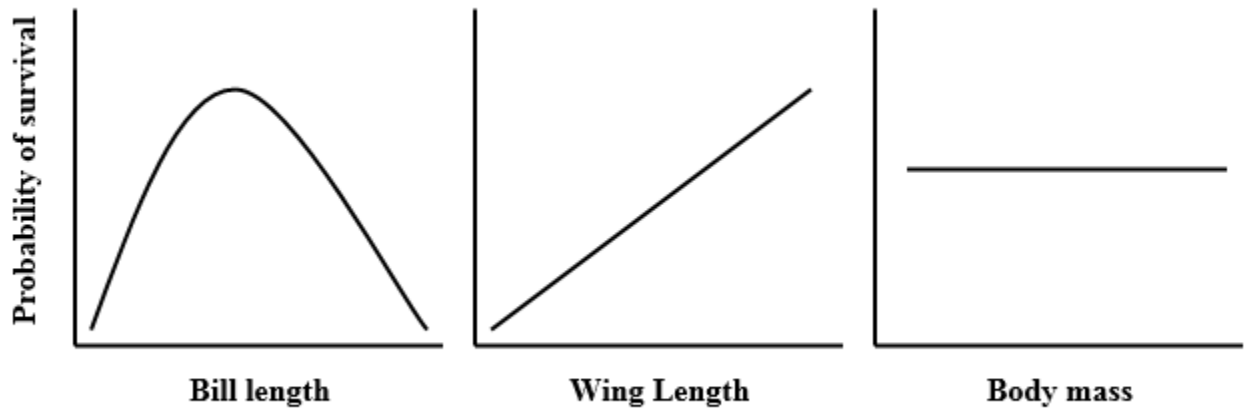
15. Write down three things you know about African finches:

a.

b.

c.

16. Describe an African finch that you think would have the best chance of survival.

Look at the three graphs below:

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Answer the following