Chapter 13; Natural Selection and Evolution

Natural selection

- The basic ideas of natural selection are that
  - Organisms can _____ over generations
  - Individuals with certain heritable traits leave more _____ than others
  - The result of natural selection is evolutionary _____

A Trinidad tree mantid that mimics dead leaves

A flower mantid in Malaysia

A leaf mantid in Costa Rica

What do all of these mantids show?_____

Lamarck and Adaptive Evolution

- In the mid-1700s, the study of _____ began to take form as a branch of science
- Naturalist Georges Buffon
  - Suggested that the Earth might be _____ than 6,000 years
  - Observed similarities between fossils and _____ species
- Jean Baptiste Lamarck
  - Suggested that organisms evolved by the process of _____
  - Also suggested some erroneous ideas, such as the inheritance of _____ characteristics
  - Lamarck's giraffes:_____

    _____

Darwin and The Voyage of the Beagle

- In December 1831, Darwin left Great Britain on the *HMS* _____ to explore the world
- On his journey on the *Beagle,* Darwin
- Collected thousands of _____
- Observed various _____ in organisms
- Darwin was intrigued by
  - The distribution of organisms on the _____ Islands
  - The fact that Galápagos organisms resembled those in _____ _____
  - Darwin reasoned that;
  - The Earth is very _____ and has been shaped by _____ processes
  - Subtle processes occurring over _____ periods of time can cause great _____

Descent with Modification

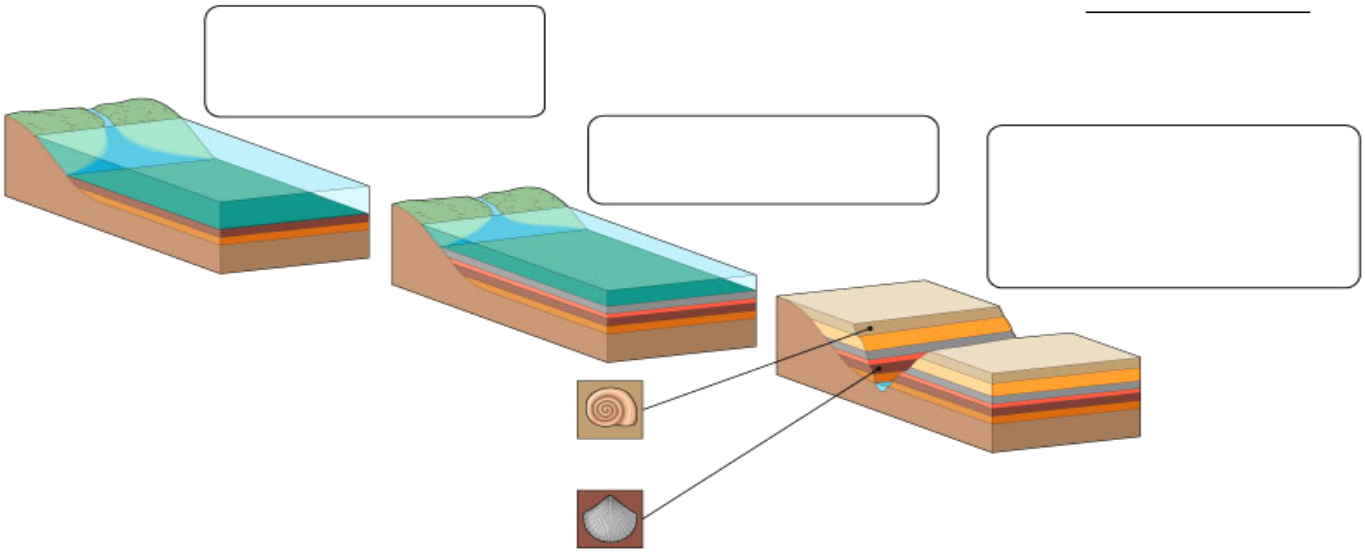
- Darwin made two main points in *The Origin of* _____
  - Organisms inhabiting Earth today descended from _____ species
  - Natural selection was the mechanism for _____ with _____

The Fossil Record

- Fossils are preserved remnants or _____ left by organisms that lived in the _____
  - Are often found in _____ rocks

How fossils form (fill in)

_____



- The fossil record
  - Is the chronology of _____ appearances in _____ layers
  - Testifies that organisms have appeared in a _____ sequence
  - Fits with other evidence of _____
- Paleontologists
  - Are scientists that study _____
  - Have discovered many transitional forms that link _____ and _____

What does this slide show?_____

_____

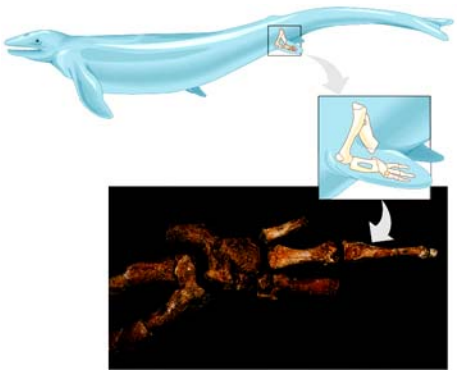
_____

_____

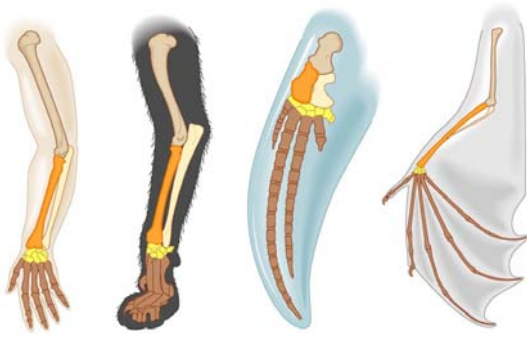
_____

_____-

_____



Comparative anatomy



- Is the comparison of _____ structures between different _____
- Confirms that _____ is a remodeling process
  What does that mean?_____
  _____
- Homology (fill in figure)
  - Is the similarity in structures due to common _____
- Comparative Embryology is the comparison of structures that appear during the _____ of different organisms (fill in)
  - Comparative embryology of vertebrates supports _____ theory
  - Ontogeny Recapitulates Phylogeny
    _____
    _____

NATURAL SELECTION AND ADAPTIVE EVOLUTION

- Darwin's finches are an excellent example of natural _____ and adaptive _____
  - Take written notes of this here;_____
    _____
    _____
  - Adaptive Radiation:_____
    _____
    _____

Darwin's Theory of Natural Selection

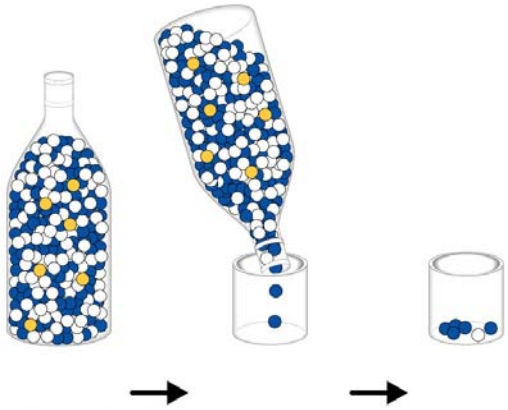
- Darwin based his theory of _____ _____ on two key observations
- Observation 1: Overproduction
  - All species tend to produce excessive _____
  - This leads to a struggle for _____
- Observation 2: Individual variation
  - Variation exists among _____ in a population
  - Much of this variation is heritable (_____)

- Inference (_____): Differential reproductive success (_____ selection)
    - Those individuals with _____ best suited for the local environment leave more _____ _____
    - Those _____ inherit the useful traits of their _____ and pass them on their _____
- Four causes of microevolution are
    - Genetic _____, Gene _____, _____ and Natural _____
- Genetic _____
    - Is a change in the _____ pool of a small population due to _____
- The bottle_____ effect
    - Is an example of _____ drift
    - Results from a drastic reduction in _____ size
- Bottlenecking in a population reduces _____ variation
- How does the population of cheetahs show bottlenecking?

_____

_____

_____



Genetic Drift and Hereditary Disorders in Human Populations

- The _____ effect
    - Is _____ drift in a new colony
    - Explains the relatively high frequency of certain _____ disorders among some _____
    - How do these settlers show the founder effect (retinitis pigmentosa)?_____

_____

- Gene flow
    - Is genetic exchange with another _____
    - Tends to reduce _____ differences between populations
    - How does this cover show gene flow?_____

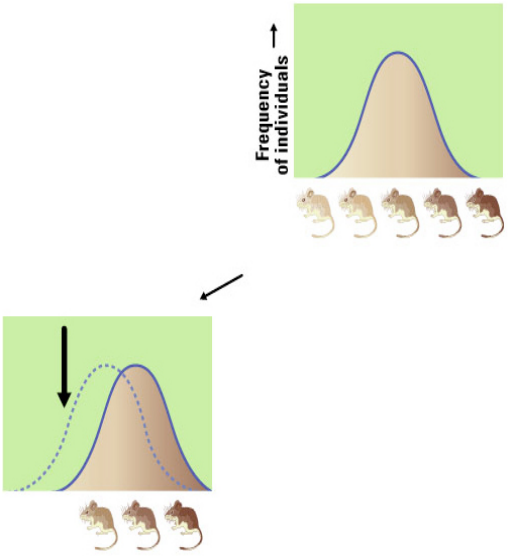
- Mutations
  - Are changes in an organism's _____
  - Alone do not have much effect on a large _____
  - Can have significant _____ effects on a population
  - Are most mutations good?_____
  - Is this baby a common mutation?_____

Natural Selection: A Closer Look

- Of all causes of microevolution, only natural _____ is generally _____
- _____ means a tendency towards increased _____ of offspring.
- Darwinian fitness
  - Is the contribution an individual makes to the _____ pool of the next generation relative to the contributions of other _____
  - How have both of these organisms adapted to take advantage of the presence of the other?

    _____

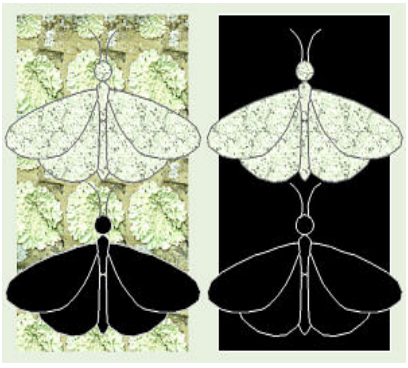
Three General Outcomes of Natural Selection



- Directional _____
- One extreme is _____ against.
- Shifts the phenotypic "_____" of a population
- Selects in favor of some _____ phenotype
- Can lead to _____ (forming new species) if population is _____

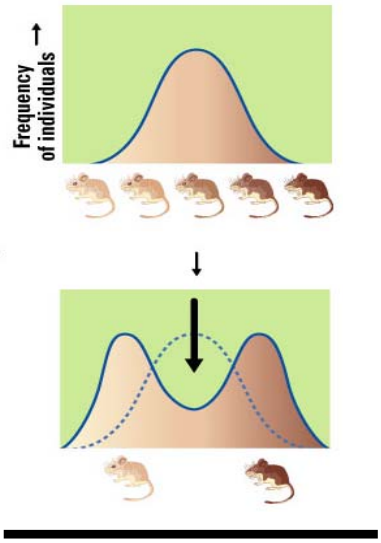
Evolution in our time; Pepper Moths of England

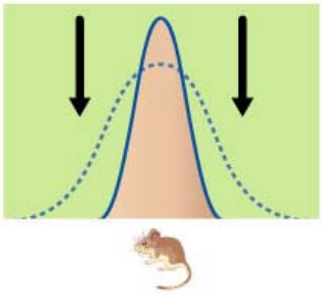
- Prior to the industrial revolution, the trees in England were _____ colored.
- The pepper moths that lived on them came in two varieties; dark and light morphs (_____)
- The dark morph (alleles) were _____ abundant, because the dark moths were seen by birds and eaten (_____ against)
- During the industrial _____, the soot from the factories turned the _____ dark brownish-black



- What effect do you think that had on the population of moths_____
- Now that England has cleaned up the pollution, the trees have become _____ again.
- What effect has this had on the moths?_____

- Diversifying or _____ selection
  - The most common (_____) form is selected against.
  - Can disrupt a single population into _____ or more contrasting phenotypes in a population
- Can lead to _____ if disruption lasts long enough
- Describe how the two mice would react to each other after enough time._____
- Stabilizing selection
  - Selects against the _____ in a population
  - Reduces _____ for a particular trait; phenotypes stay within a narrow range
  - Usually does not lead to _____





POPULATION GENETICS OF THE SICKLE-CELL ALLELE

- Sickle-_____ disease
  - Affects about one out of every 500 _____ Americans
  - Causes _____ blood cells to become misshaped, can cause severe pain and even _____
  - Is more common among African Americans; but why? (see next slide)
- The sickle-cell _____
  - Confers resistance to the disease _____, if the person is _____ for the condition.
  - If the person is homozygous _____ they show sickle-cell
  - If the person is homozygous _____ (normal) there is no malaria protection.
  - Is adaptive in the African tropics where _____ is common

Review Questions;

Review the figures from the notes above **(especially those that show a PROCESS)**

You will be asked to identify and answer questions about the mouse graphs above.

1. Which of the following is not a cause of microevolution
   A. Genetic drift
   B. Gene flow
   C. Mutations
   D. Natural selection
   E. None of these is correct

2. What form of microevolution is illustrated by the nearly extinct cheetahs?
   A. Genetic drift/bottleneck effect
   B. Gene flow
   C. Mutations
   D. Natural selection
   E. None of the above are correct

3. What is genetic drift called in a small, isolated colony?
   A. Flounder effect
   B. Gene flow
   C. Inbreeding
   D. Founder effect
   E. None of the above are correct

4. What effect does the Founder Effect have on rare, recessive alleles?
   A. Decreases their frequency
   B. Increases their frequency
   C. Has no effect on their frequency
   D. Impossible to tell, not enough data
   E. None of the above are correct

5. What is genetic exchange with another population called?
A. Genetic drift
B. Gene flow
C. Mutations
D. Natural selection
E. None of the above are correct

6. What is a change in an individual's DNA?
A. Genetic drift
B. Gene flow
C. Mutation
D. Natural selection
E. None of the above are correct

7. Which form of microevolution is generally the only one that is adaptive?
A. Genetic drift
B. Gene flow
C. Mutations
D. Natural selection
E. None of the above are correct

8. What does "adaptive" mean?
A. Something that is a result of a mutation
B. Something that helps you plug a cord into a wall socket
C. Something that helps an organism or species survive and reproduce better
D. Something that makes an organism physically stronger and faster
E. None of the above are correct

9. When one extreme phenotype is selected against, what is this called
A. Disruptive selection
B. Stabilizing selection
C. Directional selection
D. All of the above
E. None of the above are correct

10. What can directional selection cause
A. Extinction
B. Speciation
C. Nothing
D. The end of the world
E. None of the above are correct

11. When intermediate forms are selected against, what is this called
A. Disruptive selection
B. Stabilizing selection
C. Directional selection
D. All of the above
E. None of the above are correct

12. How does disruptive selection cause speciation
A. After a certain amount of time, nothing will happen
B. After a certain amount of time, if two groups of a species are separated they will each change and then if forced to mate, they will still have no offspring
C. After a certain amount of time, if two groups of a species are separated they will each change and then recombined, they will not choose to mate with each other again
D. It doesn't
E. None of the above are correct

13. What is gene flow?
A. The random changing of DNA in a population
B. The mixing of genes from different populations
C. The loss of genes from a population
D. All of the above
E. None of the above are correct

14. Why is gene flow happening the U.S. so much today?
A. Because so many people are leaving the U.S.
B. Because so many people are dying in the U.S.
C. Because so many people are coming to the U.S. and intermarrying
D. Because that is the natural way of things
E. None of the above are correct

15. When both extremes in a population are selected against, what is this called
A. Disruptive selection
B. Stabilizing selection
C. Directional selection
D. All of the above
E. None of the above are correct

16. Which of the following is **NOT** true for the sickle-cell allele in African-Americans?
A. It is a valuable allele to possess when living in America.
B. Being homozygous recessive causes you to have the sickle-cell disease
C. It greatly helped some of their heterozygous ancestors resist malaria in Africa
D. Having no sickle-cell allele gives a person no resistance to malaria.
E. None of these is correct

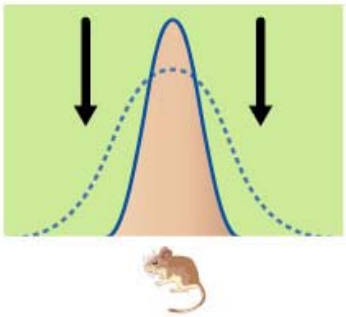
17. The pepper moths of England show what type of microevolution
A. Genetic drift
B. Gene flow
C. Mutations
D. Natural selection
E. None of the above are correct

18. Why did the frequency of the alleles in the moths change?
A. One of the alleles was bad
B. The environment remained the same
C. The environment changed
D. The trees became bushes
E. None of the above are correct

19. How does adaptive radiation lead to speciation?
A. Only the strongest survive
B. Natural variation within a species eventually leads to a wide array of different species in their descendants
C. Individuals in a species have to be totally different when

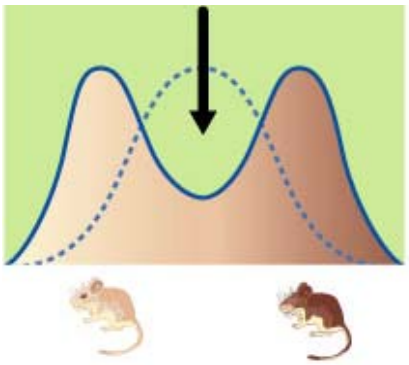
they arrive in a new place, like at the Galapagos Islands.
D. Each individual changes their own phenotype to suit its environment better and then passes on those changes to their offspring.
E. None of these is correct

20. Use the figure below to answer the following questions;



21. This figure shows;
A. Stabilizing selection
B. Directional selection
C. Disruptive selection
D. Adaptive radiation
E. None of these is correct

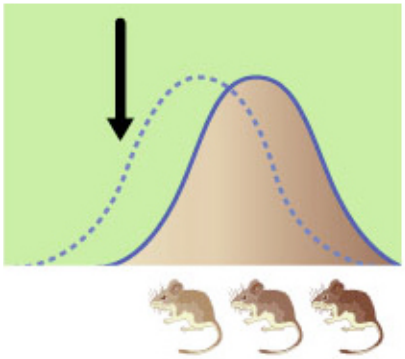
22. In what situation is the above effect beneficial (good for a species)?
A. Reducing variation in a species is usually good
B. When an intermediate form is the only form that can survive (like birth weight in human babies).
C. When trying to form two different species
D. It is never beneficial
E. None of these is correct



23. This figure shows;
A. Stabilizing selection
B. Directional selection
C. Disruptive selection
D. Adaptive radiation
E. None of these is correct

24. If these two groups of mice are isolated from each other for long enough, it can lead to;
A. Isolation
B. Extinction
C. Speciation
D. The formation of a third phenotype
E. None of these is correct

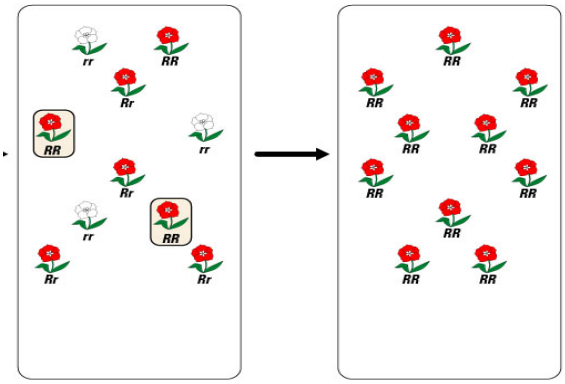
25. You would know that the two mouse populations have become separate species because when individuals met;
A. They would never mate with each other, even when isolated and forced
B. They would mate if forced and would have healthy babies that could reproduce
C. They would mate if forced, but would could not produce offspring, or the offspring would be sterile (unable to reproduce)
D. They would not know the other animal was a mouse.
E. None of these is correct



26. This figure shows;
A. Stabilizing selection
B. Directional selection
C. Disruptive selection
D. Adaptive radiation
E. None of these is correct

27. What other organism that we talked about in lecture showed the above pattern?
A. Cheetahs
B. Pepper moths
C. Mantids
D. Finches
E. None of these is correct

Use the figure below to answer the following questions



28. The above figure shows;
A. Genetic drift
B. Gene flow
C. Mutations
D. Natural selection
E. None of these is correct

29. The flowers (from above) that survived and reproduced were the ones that were best suited for the environment True (A) or

False (B)

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30. What were Darwin's two **observations** about natural selection?
A. Evolution has occurred and it caused the finches to have different beaks
B. That both iguanas and finches have evolved on the Galapagos
C. Overproduction and Evolution
D. Overproduction and Individual variation
E. None of these is correct

31. This illustration above is intended to show;
A. The fossil record
B. Homologous structures
C. How different animals use their forelimbs
D. Coevolution
E. None of these is correct

32. The above forelimbs have no connection to each other. These animals each evolved forelimbs independently. The closest ancestor of these mammals probably did not have any arms or legs; True (A) or False (B)

33. Which of the following is **not** one of the three basic ideas of natural selection?
A. Organisms can change over generations
B. Individuals with certain heritable traits leave more offspring than others
C. The result of natural selection is evolutionary adaptation
D. All organisms evolved from bacteria
E. None of these is correct

34. Lamarck believed that;
A. Organisms contained DNA and could evolve through mutation and adaptation
B. Individuals could change their physical structures through use and then pass those changes on to their offspring
C. Darwin was correct in his book
D. The Earth was only 250 years old
E. None of these is correct

35. What is the comparison of body structures (like forelimbs) between different species
A. Phylogeny
B. Comparative anatomy
C. Mammalogy
D. Embryology
E. None of the above are correct

36. What process(es) do Darwin's finches show?
A. Adaptive radiation
B. Natural selection
C. Evolution
D. All of the above are correct
E. None of the above are correct

37. According to evolutionary theory, what do humans, cats, whales, and bats have in common?
A. Nothing
B. A mammal ancestor with no arms or legs
C. A mammal ancestor with arms and legs similar to all current mammals
D. Different front legs
E. None of the above are correct

38. What is the difference between artificial and natural selection?
A. Natural is made by man, artificial is made by nature
B. Natural is using the environment and artificial favors features selected by humans
C. One is organic, the other is not
D. They both involve humans, but artificial has more of it
E. None of the above are correct

Essays;

Figures from notes (be able to fill them in and describe)

How do fossils form?

How are whales different now than they were in the past?

How does sickle-cell anemia gene both help and hurt people?

Describe what happened to the Pepper Moths of England.

Extra Credit

What does "ontogeny recapitulates phylogeny" mean?