AIM: _____

THEORY OF EVOLUTION

all species have descended from earlier ancestral species

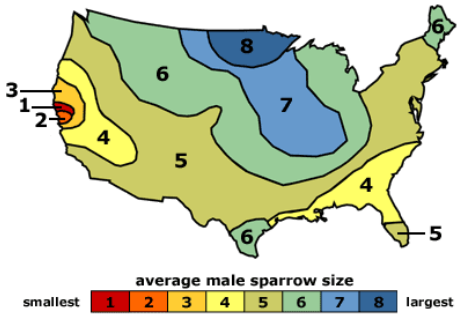
a. microevolution

ex. insect camouflage

micro

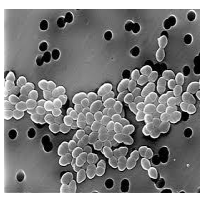
house sparrows

because of the colder climate northern sparrows developed to be larger in size and darker than those in southern regions



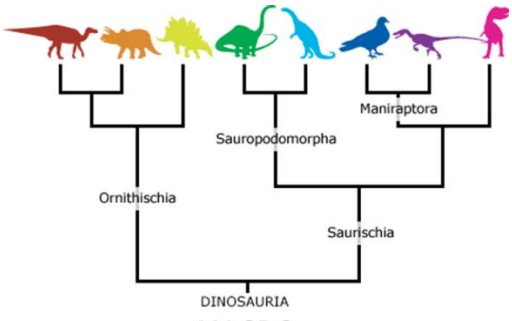
bacteria develop a resistance to antibiotics

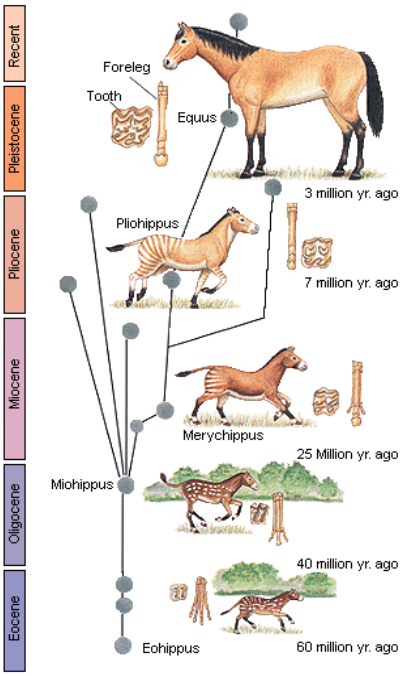
similarly: plants develop resistance to herbicides and different animals/insects develop a resistance to pesticides



b. macroevolution

ex. macroevolution is illustrated in phylogenetic trees





How does microevolution work?

Allele: different forms of a specific gene

Changes in allele frequencies occur because of:

1. MUTATIONS
   a. exposure to external factors: _____
   b. _____

2. NATURAL SELECTION *(Charles Darwin: On the Origin of Species 1859)*
   a. there must be a natural variability for a trait in a population
   b. the trait must be heritable (have a genetic basis that is passed on)
   c. **differential reproduction -** more offspring are produced with the traits that better enable survival in their environment

Adaptations / Adaptive Traits: any genetically controlled trait that helps an organism survive in their niche (can be physical or behavioral)

Examples:
- chimp and opposable thumb for grasping,
- large ears of the fennec fox for hearing and to regulate body temperature
- snowshoe hare fur changes color with seasons
- prehensile (grasping) tail of the opossum is used for climbing or as a tool for grabbing

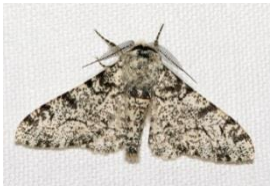
Kettlewell's Experiment – England (1953-1956)

meets all 3 criteria for evolution by natural selection

Pre-Industrial Revolution

5% dark-gray

95% speckled light-gray



speckled light-gray moths blended in better with lichen covered trees and avoided predation

Industrial Revolution

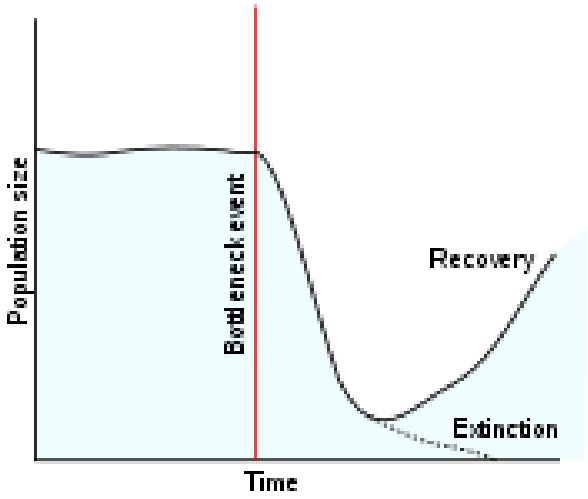
95% dark-gray

5% speckled light-gray

dark-gray moths blended in better with trees covered in from coal burning and avoided predation

The Bottleneck Effect and Genetic Drift

The **bottleneck effect** occurs when there is an environmental event that drastically reduces a population's size for at least one generation. Natural disasters, disease, and human encroachment are some of the leading causes of a population bottleneck. Undergoing a bottleneck can greatly reduce the genetic variation in a population which, in turn, leaves it more susceptible to extinction if it is unable to adapt to climactic changes or changes in resource availability. (Remember: more genetically diverse populations respond better to environmental stressors.)



The bottleneck effect can also lead to **genetic drift**. Genetic drift is defined as the changing of the number of available alleles in a population by chance events. Theoretically, the most "fit" individuals in a population will survive longest and reproduce the most, however chance also plays a role in who survives, reproduces, and whose offspring survive to reproduce as well. A small population that has survived a population bottleneck may not necessarily consist of the individuals best adapted to survive and reproduce, but it will be the traits of those surviving individuals that will be passed on to the next generation nonetheless.

Date _____

AIM: _____

COEVOLUTION

- two species interact with each other to help one another evolve
- can be mutualistic, predator/prey or host/parasite relationships

Ex: leaf-cutting ants and fungus gardens – mutualistic coevolution – ants help fungus gardens grow by bringing leaf fragments that can be dissolved and used by fungus – fungus provides a large amount of nutrition for ant colony

In an ongoing coevolutionary relationship, the common **garter snake** continually evolves new levels of immunity to the toxins of one of its prey, the **newt**, while the newt continually evolves new toxins for defense from the attacks of its predator.

The predator-prey relationship between **crabs** and **marine snails** is a great example of coevolution. Indo-Pacific crabs have stronger claws than Caribbean crabs, and Indo-Pacific snails have thicker shells than Caribbean snails. It is presumed that the Indo-Pacific crabs and snails have evolved together. To avoid predation, the snails developed thicker shells. To become better predators, the crabs developed stronger claws.

Cabbage butterfly caterpillars have the ability to break down the chemical defense of **plants** that defend themselves with mustard oils that are toxic to other insects. The caterpillars can break down the mustard oils into simpler non-toxic compounds. So in this case, the plants evolved by developing a chemical defense against plant-eating insects, and in response, the caterpillar evolved a method to deal with that chemical defense.

Many **fruit-eating birds**, especially in tropical rain forests are coevolving with the **plants** whose fruits they eat. The birds get nourishment, and in the process the plants get their digestion-resistant seeds dispersed by regurgitation or along with the birds' droppings. Many characteristics of the plants have evolved to facilitate dispersal, and the behavior and diets of the birds have responded to those changes. In particular, the plants have evolved conspicuously colored, relatively odorless fleshy fruits to attract the avian dispersers of their seeds. They are coevolving in response to the finely honed visual systems of the birds; plant species coevolving with color-blind mammalian seed-dispersers have, in contrast, dull-colored but smelly fruits. The bird-dispersed plants often have evolved fruits with giant seeds covered by a thin, highly nutritious layer of flesh. This forces the bird to swallow the fruit whole, since it is difficult or impossible just to nip off the flesh. In response, some birds have evolved both bills with wide gapes (so they can swallow the fruit whole) and digestive tracts that can rapidly dissolve the flesh from the large impervious seed, which then can be regurgitated.

DIVERGENT EVOLUTION

the accumulation of differences between groups which can lead to the formation of new species, usually a result of separation of the same species to different and isolated environments

speciation – two species arise from one

2 phases:
1. geographic isolation (mountain barriers, separated on different islands, valleys carved by rivers, human construction)
2. reproductive isolation

When Charles Darwin stepped ashore on the Galapagos Islands in September 1835, it was the start of five weeks that would change the world of science, although he did not know it at the time. Among other finds, he observed and collected the variety of **finches** that inhabited the islands, but he did not realize their significance, and failed to keep good records of his specimens and where they were collected. It was not until he was back in London, puzzling over the birds, that the realization that they were all different, but closely related, species of finch led him toward formulating the principle of natural selection.

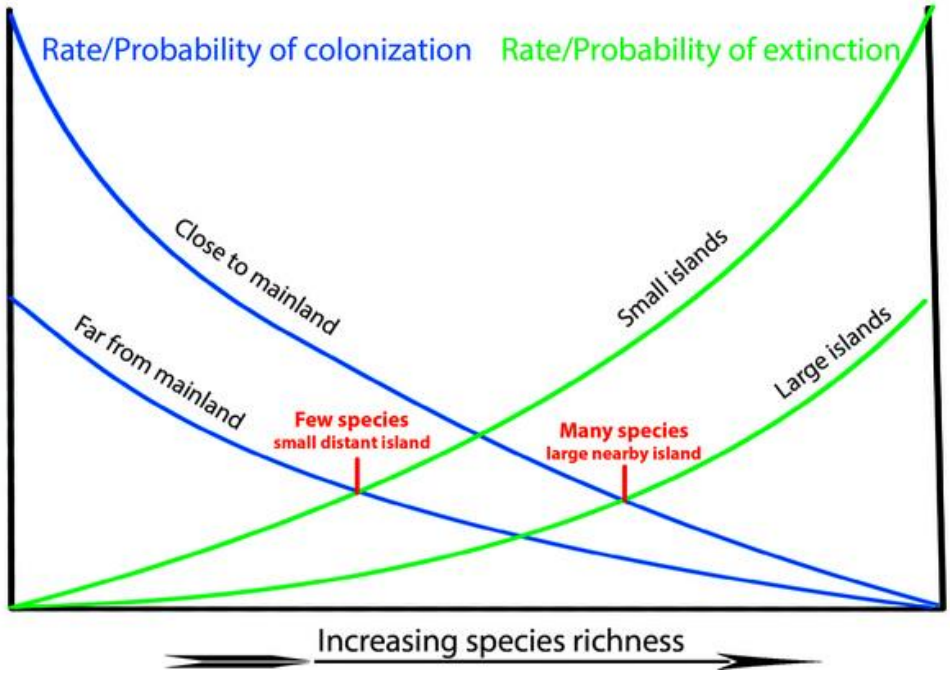
In his memoir, *The Voyage of the Beagle,* Darwin noted, almost as if in awe, "One might really fancy that, from an original paucity of birds in this archipelago, one species had been taken and modified for different ends." Indeed, the Galapagos have been called a living laboratory where speciation can be seen at work. A few million years ago, one species of finch migrated to the rocky Galapagos from the mainland of Central or South America. From this one migrant species would come many -- at least 13 species of finch evolving from the single ancestor. This process in which one species gives rise to multiple species that exploit different niches is called adaptive radiation. The ecological niches exert the selection pressures that push the populations in various directions. On various islands, finch species have become adapted for different diets: seeds, insects, flowers, the blood of seabirds, and leaves.

The ancestral finch was a ground-dwelling, seed-eating finch. After the burst of speciation in the Galapagos, a total of 14 species would exist: three species of ground-dwelling seed-eaters; three others living on cactuses and eating seeds; one living in trees and eating seeds; and 7 species of tree-dwelling insect-eaters. Scientists long after Darwin spent years trying to understand the process that had created so many types of finches that differed mainly in the size and shape of their beaks.

The divergent evolution of **wolves** and **domesticated dogs** from a common ancestor provides another example. Scientists once thought that dogs descended from gray wolves. Now, through genetic studies, researchers know that dogs and wolves share a common ancestor instead of a direct lineage.

Their common ancestor was a prehistoric wolf that lived in Europe or Asia anywhere between 9,000 to 34,000 years ago, according to various studies. (Several subgroups of prehistoric wolves went extinct about 10,000 years ago, at the same time as the mammoths, giant sloths and saber-toothed tigers.)

Island Biogeography and Species Diversity



A modified version of the classical island biogeography model proposed by MacArthur and Wilson (1963) is depicted above. The model considers the interaction of two main parameters, colonization and extinction, and then considers island size and distance from mainland as predictors of the species richness found on each island. Both colonization and extinction can be thought of in terms of rates or probabilities, and the size and isolation of islands impacts the probability of colonization and of extinction. Simply, islands close to the mainland will more readily receive colonists from that mainland and, similarly, probability of colonization of large islands will be higher than that of small islands. Thus, the larger the island and closer to the mainland, the more potential species will arrive. Species will also more readily go extinct on small islands than large, due to factors such as smaller population sizes and less available habitat and resources. **These parameters go hand in hand predicting that species richness will peak in large islands near a mainland and be lowest in small islands far away from a mainland.**

Also, many island species have evolved to be specialists based on the limited resources and space available on the island. The long-term survival of specialists may be jeopardized if invasive species (which are typically generalists), are introduced and outcompete the specialists. Generalists outcompete specialists because they can more easily adapt to the changes going on while trying to get resources. For example, generalist species can feed on a wide variety of things. If they exploit one food source of a specialist, the specialist will have a difficult time surviving with a lack of that food source. Once that source has been fully exploited, the generalists can find a different food source, while the specialist cannot.

 Date _____

ENDANGERED SPECIES

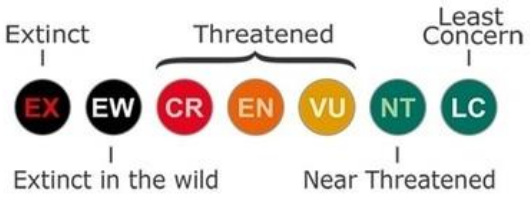
INTERNATIONAL UNION FOR CONSERVATION OF NATURE (IUCN)

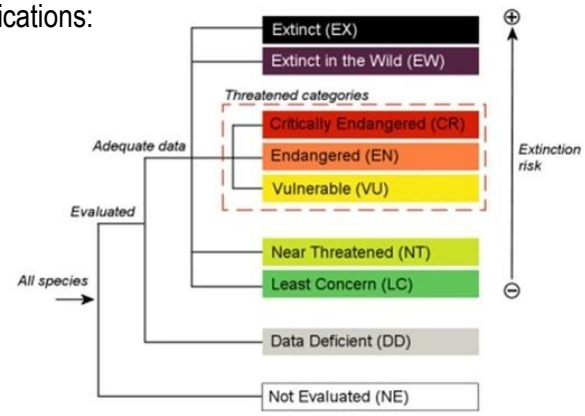
The **International Union for Conservation of Nature** (**IUCN**) is an organization working in the field of nature conservation and sustainable use of natural resources. The IUCN was established in 1948, and has gone through several incarnations, name changes, and has expanded its mission statement to reflect issues in the changing environment. It is involved in data gathering and analysis, research, field projects, advocacy, and education. IUCN's mission is to "influence, encourage and assist societies throughout the world to conserve nature and to ensure that any use of natural resources is equitable and ecologically sustainable".

Over the past decades, IUCN has widened its focus beyond conservation ecology and now incorporates issues related to sustainable development in its projects. Unlike many other international environmental organizations, IUCN does not itself aim to mobilize the public in support of nature conservation. It tries to influence the actions of governments, business and other stakeholders by providing information and advice, and through building partnerships. The organization is best known to the wider public for compiling and publishing the IUCN Red List of Threatened Species, which assesses the conservation status of species worldwide.

While different governments and local organizations often have their own way of deciding for species that are close to home, the IUCN maintains the most-comprehensive list of endangered species around the world. The Red List of Threatened Species, as it's called, judges each species on five different standards for an in-depth scientific approach**. According to the IUCN, an endangered species is one that meets any one of the following criteria: a 50–70% population decrease over 10 years, a total geographic area less than 5,000 km^2 (or local population area less than 500 km^2), a population size less than 2,500 adults, a restricted population of 250 adults, or a statistical prediction that it will go extinct within the next 20 years.**

The International Union for Conservation of Nature's Red List of Threatened Species consists of the following classifications, each of which has its own specific qualifications:





Currently, there are more than 134,400 species on The IUCN Red List, with more than 37,400 species threatened with extinction. This includes both endangered animals and endangered plants.

The species endangered include one in four mammals, one in eight birds, one third of all amphibians and 70% of the world's assessed plants on the 2007 IUCN Red List are in jeopardy of extinction. The total number of extinct species has reached 785 and a further 65 are only found in captivity or in cultivation. In the last 500 years, human activity has forced over 800 species into extinction.

CITES

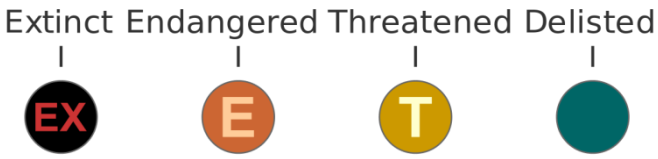
The **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)** is an international treaty to prevent species from becoming endangered or extinct because of international trade. Under this treaty, countries work together to regulate the international trade of animal and plant species and ensure that this trade is not detrimental to the survival of wild populations. Any trade in protected plant and animal species should be sustainable, based on sound biological understanding and principles.

In the early 1960s, international discussion began focusing on the rate at which the world's wild animals and plants were being threatened by unregulated international trade. The Convention was drafted as the result of a resolution adopted in 1963 at a meeting of the International Union for the Conservation of Nature (IUCN). Today, 182 countries and the European Union implement CITES, which accords varying degrees of protection to over 35,000 species of animals and plants.

THE UNITED STATES ENDANGERED SPECIES ACT

Overview

In the United States, the **Endangered Species Act (ESA, 1973)** requires that the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) maintain a federal list of endangered or threatened species. "Endangered" means a species is in danger of extinction throughout all or a significant portion of its range. "Threatened" means a species is likely to become endangered within the foreseeable future. The ESA categorizes species using four different categories:



All species of plants and animals, except pest insects, are eligible for listing as endangered or threatened. Listing an animal species provides that species' population with federal protection. The U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) may designate a species as endangered or threatened based on the following five factors:

(A) the present or threatened destruction, modification, or curtailment of its habitat or range

(B) overutilization for commercial, recreational, scientific, or educational purposes

(C) disease or predation

(D) the inadequacy of existing regulatory mechanisms

(E) other natural or manmade factors affecting its continued existence.

THE UNITED STATES ENDANGERED SPECIES ACT
"Taking" of Species

The federal government maintains a list of federally protected animal and plant species. The law prohibits the *taking* of a listed species. *Taking* includes harming, pursuing, hunting, killing, capturing, or collecting a member of a federally listed species. Federal regulations further define harm to a species as "an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering." Harassment of a listed animal species is "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." Listed animal species are protected primarily through the enforcement of the take prohibition as it is applied to a species and its habitat.

The legislation is meant to prevent the extinction of vulnerable species throughout the United States, but also requires the federal government to establish recovery plans for listed species. Recovery plans "describe the steps needed to restore a species to ecological health" in order to delist the species, an action that removes federal protection from a species after threats to its recovery have been eliminated or reduced.

THE UNITED STATES ENDANGERED SPECIES ACT
Private Land Modifications

Approximately half of the species listed as endangered or threatened have around 80 percent of their habitat on privately owned land. In addition, the U.S. Fish and Wildlife Service is required to designate land and habitat for a listed species' conservation. Because federal law prohibits harmful interactions, including an activity that adversely modifies a species' habitat, private property use can be regulated unless a landowner receives federal approval.

Private landowners who plan to modify their land can apply for an incidental take permit, which authorizes the incidental taking of a listed species even if a member of the species is potentially harmed. Before a permit is granted, property owners must submit a habitat conservation plan, which must contain information on the relevant and predicted effects of the individual's taking of a listed species, how the effects will be minimized and/or mitigated, and how the plan will be financed. Individuals must document that they have considered all possible protective actions for the listed species before finalizing a habitat conservation plan.

The Endangered Species Act does allow the taking of a listed species if individuals are protecting themselves from bodily harm. However, the protection an individual's property from a listed species is not considered a permissible defense against potential federal penalties. For example, an individual cannot kill a listed animal to prevent damage to a house, a building, or other piece of property unless individual was also protecting himself or herself from bodily harm.

In some circumstances, landowners are permitted to kill listed animals for the damage done to some forms of property. For example, private landowners in North Carolina were permitted to kill or injure red wolves attacking livestock. Federal officials have been permitted to harm gray wolves attacking livestock and crops in Minnesota. These instances were permitted under specific federal regulations.

ENDANGERED SPECIES INDIVIDUAL ASSIGNMENT

Do an internet search (make sure to cross-reference sources) to find information related to the species listed below.

Create 2 slides according to the instructions below and include in the shared Google Slides presentation.

Slide 1:
1. Species Name and Your Name
2. Clear Picture of Organism
3. IUCN Red List Classification **or** classification under the United States Endangered Species Act
4. Habitat Type(s) (forest, desert etc.) and Specific Geographic Region(s)

Slide 2:
5. Specific Reason(s) Populations Have Declined
6. Environmental Significance of Species (indicator, keystone, other?)
7. Conservation Efforts / Recovery Plans / Species Prognosis

Organism Assignments:

1. **Bengal tiger**
2. **gopher tortoise**
3. **orangutan**
4. **sea turtle**
5. **manatee**
6. **spider monkey**
7. **wood stork**
8. **Asian elephant**
9. **sea otter**
10. **sperm whale**
11. **Amazon pink river dolphin**
12. **black rhinoceros**
13. **Florida panther**
14. **California condor**
15. **red wolf**
16. **scalloped hammerhead shark**
17. **platypus**
18. **blue-throated macaw**
19. **black-footed ferret**
20. **cheetah**
21. **king cobra**
22. **snowy owl**
23. **bluefin tuna**
24. **vaquita**

KEEP YOUR SLIDES SIMPLE!
DON'T JUST CUT AND PASTE PARAGRAPHS FROM ONLINE SOURCES!
YOUR SLIDES SHOULD LOOK *MY AWESOME SLIDES* AND SHOULD BE FRIENDLY TO YOUR AUDIENCE OF NOTETAKERS!

Date _____

AIM: _____

1. Types of Biodiversity

Biodiversity (biological diversity): the number and variety of different species in a given area

a. Genetic Diversity	b. Species Diversity	c. Ecosystem Diversity
all the differences in the DNA contained within a population of a given species	the number of species and the abundance of each species that live in a particular area.	the number and variety of ecosystems within a given region

2. Measuring Biodiversity

a. Species Richness - the number of different species in a given ecological community

b. Species Evenness - the measure of relative proportions of different species in an ecological community
- similar abundances of different species = high degree of evenness

c. Species Dominance - the degree to which a species is more numerous than its competitors in an ecological community
- if dominance exists, there is a lower degree of evenness

Community A
Species and number of individuals
A 59
B 12
C 11
D 10
E 05
F 03
Total 100

Community B
Species and number of individuals
A 21
B 20
C 19
D 14
E 13
F 13
Total 100

3. Benefits of Biodiversity

a. Ecosystem Functioning	b. Agriculture and Food Stability	c. Medicinal Value	d. Ecotourism

Date _____

AIM: _____

1. Extinction: the complete disappearance of a species from the Earth

It is estimated that 99.9% of all species that ever existed have become extinct

2. Long-Term Patterns Influenced by:

a. continental drift
led to geographic and then reproductive isolation

b. gradual climate change
human influences on global warming

c. rapid climate change
resulting from catastrophic events

3. Rate of Extinction

a. Background Extinction –

standard low rate of extinction BEFORE humans became a contributor

prior to human influences:
1-5 species per year
(scientists think the rate has increased 1000x or more)

b. Mass Extinction –

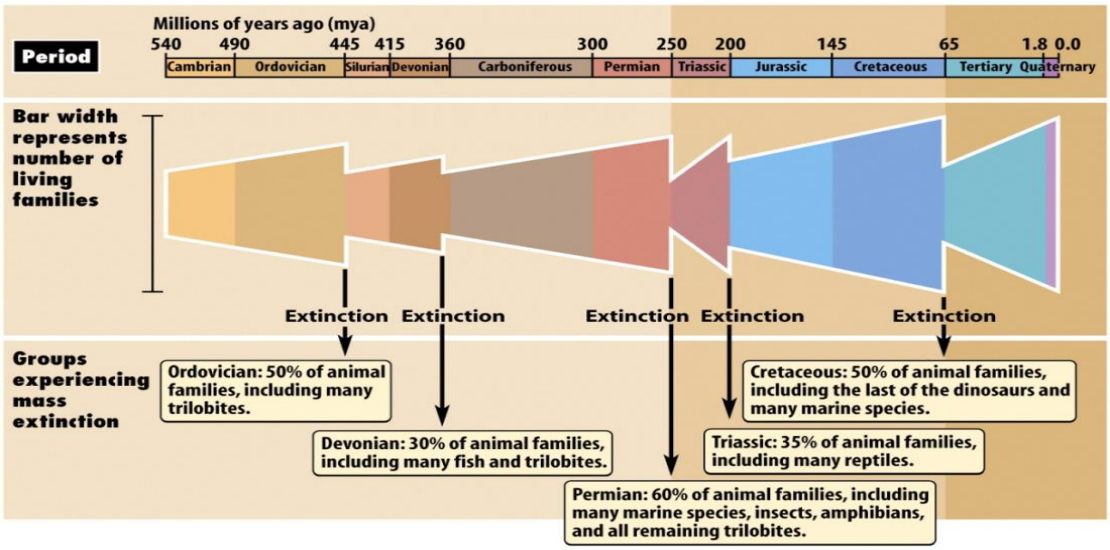
- widespread (often global)
- 25-70% of all species die off as a result of the event
- 5 mass extinction events
  (last one: 65 mya at end of Cretaceous Period [dinosaurs])

4. Adaptive Radiation:

a process by which new species evolve to fill new niches or ones left vacant.

(Ex: mammals replace niches left behind after dinosaur extinction)

The 5 Major Mass Extinctions and Adaptive Radiations



5. Scale of Extinction:

a.	b.	c.

6. Causes of Extinction / Loss of Biodiversity

a. _____

b. _____

c. _____

d. _____

e. _____

Just a Few Evolution and Biodiversity Review Questions

1. The most aggressive male deer with the biggest antlers mates more frequently than smaller less aggressive males. This is an example of
   (A) mutation
   (B) coevolution
   (C) differential reproduction
   (D) adaptive radiation
   (E) resource partitioning

2. Which of the following identifies the two factors thought to be the most harmful to biodiversity?
   (A) acid rain and increased use of fertilizers for agriculture
   (B) depletion of the ozone layer and oil drilling
   (C) destruction of habitat and invasion by nonnative species
   (D) changes in climate and pollution
   (E) global warming and decline in fisheries

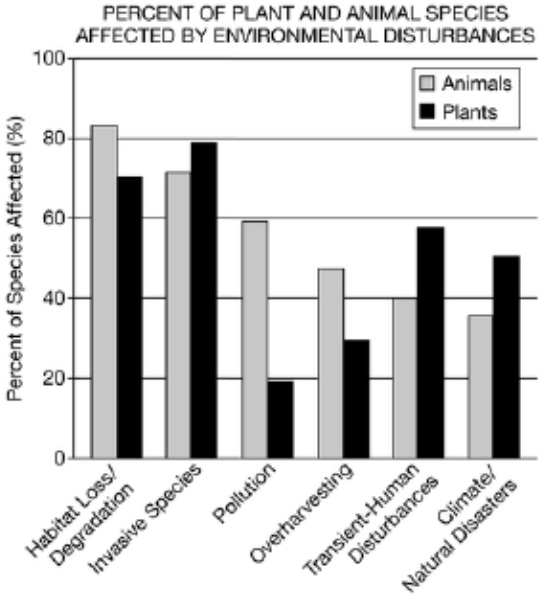
3. The dodo bird inhabited the island of Mauritius in the Indian Ocean, where it lived undisturbed for years. It lost its ability to fly and it lived and nested on the ground where it ate fruits that had fallen from trees. There were no mammals living on the island. In 1505, the first humans set foot on Mauritius. The island quickly became a stopover for ships engaged in the spice trade. The dodo was a welcome source of fresh meat for the sailors and large numbers of dodos were killed for food. In time, pigs, monkeys, and rats brought to the island ate the dodo eggs in the ground nests.

   Which statement describes what most likely happened to the dodo bird within 100 years of the arrival of humans on Mauritius?
   (A) Dodo birds developed the ability to fly in order to escape predation and their population increased.
   (B) The dodo bird population increased after the birds learned to build their nests in trees.
   (C) Human exploitation and introduced species significantly reduced dodo bird populations
   (D) The dodo bird population became smaller because they preyed upon the introduced species.
   (E) Speciation led to the extinction of the dodo bird.

4. Gradual successive changes in two or more ecologically interdependent species that have a relationship in an ecosystem is known as
   (A) speciation
   (B) convergent evolution
   (C) divergent evolution
   (D) coevolution
   (E) macroevolution

5. The Chatham Island robin is a small endangered bird found in scrub forests off the coast of New Zealand. The robin is preyed upon by introduced species such as cats and rats. In 1980, the population decreased to only 5 individuals and every individual today is a descendant of a single female. Which of the following is best illustrated in the decline of the Chatham Island robins?
   (A) carrying capacity
   (B) population bottleneck
   (C) population overshoot
   (D) type 1 survivorship

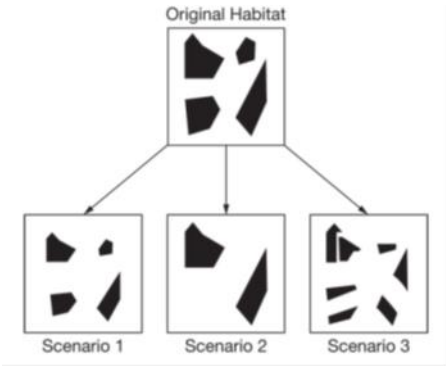
Questions 6-7:
The data in the graph reflect threats identified in species recovery plans.



6. Based on the data in the graph, altering human activity in which of the following areas will most benefit plant species?
   (A) habitat loss and degradation
   (B) introduction of invasive species
   (C) pollution
   (D) climate and natural disasters

7. Local legislation was passed to protect animal species prone to extinction. The legislation included criminalizing poaching, setting limits on number of fish people can catch, and protecting habitats. Which of the following threats shown in the graph will most likely decrease the most as a result of the legislation?
   (A) habitat loss and degradation
   (B) overharvesting
   (C) pollution
   (D) climate and natural disasters

The diagram shows how a patch of habitat could possibly be altered.



8. Which of the following would be the most likely explanation for the changes shown in Scenario 3?
   (A) Native species were replanted in the areas, which led to fewer niches.
   (B) Roads and electric power lines subdivided the landscape into smaller pieces and decreased the amount of available habitat.
   (C) The increased edge-to-interior ratio resulted in habitat fragmentation and the formation of smaller, more manageable parcels of land.
   (D) Habitat corridors were built to allow individuals between populations to mate, which helped to prevent inbreeding and reduce the genetic diversity often found in isolated populations.

The many finch species of the Galápagos Islands evolved from a single species that immigrated to the islands from the coast of South America. These species differ primarily in beak shape, which is closely related to the type of food each species specializes in eating.

9. Which of the following best explains why each of the finch species on the Galápagos Islands evolved to be specialists?
   (A) Islands have limited food resources, forcing species to feed on a small range of food items.
   (B) Climate on islands tends to be less variable than on the mainland, minimizing seasonal absences of food.
   (C) Reduced competition from other bird species allows finch species to focus on specific food resources.
   (D) Food resources on islands are more plentiful and nutrient rich than on the mainland, leading to specialist behaviors in feeding.

10. Which of the following can be used to assess the biological diversity of an area?
    (A) Population size of each species and area occupied by each population
    (B) Minimum population area and minimum viable population size
    (C) Ratio of *r*-strategists to *K*-strategists and life expectancy of *K*-strategists
    (D) Number of individuals under fifteen years old and number of individuals over sixty-five years old
    (E) Genetic variation within each species and number of species present

In England approximately 250 years ago, the peppered moth had light-colored wing patterns that camouflaged them against the light-colored trees. Over time in urban areas, the number of peppered moths with dark-colored wings increased as pollution from the Industrial Revolution darkened the trees the moths rested on.

11. Which of the following statements best describes how the moths adapted to the new environment over time?
    (A) The moths adapted to the new environment through isolation.
    (B) The moths adapted to the new environment through primary succession.
    (C) The moths adapted to the new environment by changes in the genetics of the population.
    (D) The moths adapted to the new environment by becoming a generalist species.

12. Which of the following best explains how environmental stressors, such as wildfires, can affect biodiversity in an ecosystem?
    (A) After an environmental stress, a genetic bottleneck may occur, which will increase genetic diversity.
    (B) Habitat diversity will increase the available niches if the landscape becomes more uniform after a disturbance.
    (C) Ecosystems with more species diversity are more likely to recover after a disturbance than ecosystems with low species diversity.
    (D) Smaller populations are less likely to go extinct than larger populations, so the species diversity will remain constant.

13. For which of the following reasons do small isolated islands have a greater rate of species extinction than larger, less isolated islands?
    (A) Small isolated islands are more likely to receive more migrating species.
    (B) Small isolated islands provide opportunities for a greater diversity of species.
    (C) Because of their size, small isolated islands accumulate more species by chance.
    (D) Small isolated islands have a lower availability of resources.
    (E) Because they have fewer available niches, small isolated islands are targeted and colonized by species.

14. Some individuals in a population have genetic traits that are favored by environmental conditions because the trait enhance their ability to survive and produce offspring. This is a process called
    (A) natural selection
    (B) artificial selection
    (C) genetic drift
    (D) mutation
    (E) bottleneck effect

15. Geographic isolation, followed by reproductive isolation are the two steps that can lead to
    (A) convergent evolution
    (B) speciation
    (C) selective breeding
    (D) coevolution
    (E) species degradation

16. Five islands, *A*, *B*, *C*, *D*, and *E*, differ only in distance from the mainland, area, and species diversity. Which island would be predicted to have the highest species diversity?

(A)

Island	Distance from Mainland (kilometers)	Area (hectares)
A	50	1×10^2

(B)

Island	Distance from Mainland (kilometers)	Area (hectares)
B	50	1×10^6

(C)

Island	Distance from Mainland (kilometers)	Area (hectares)
C	500	1×10^2

(D)

Island	Distance from Mainland (kilometers)	Area (hectares)
D	1,000	1×10^2

(E)

Island	Distance from Mainland (kilometers)	Area (hectares)
E	1,000	1×10^6

17. The common garter snake continually evolves new levels of immunity to the toxins of one of its prey, the newt, while the newt continually evolves new toxins for defense from the attacks of its predator. This is a clear example of
    (A) speciation
    (B) convergent evolution
    (C) divergent evolution
    (D) coevolution
    (E) macroevolution

18. According to the United States Endangered Species Act,
    (A) a species is not allowed to be "taken" under any circumstances
    (B) private property use can be regulated unless a landowner receives federal approval to make modifications
    (C) insect pests can be classified as endangered
    (D) endangered organisms have 7 different severity classifications
    (E) CITES is no longer adhered to by the United States

19. Present day examples of organisms changing by natural selection may be seen in
    (A) insect populations becoming increasingly resistant to chemical pesticides
    (B) bacteria becoming increasingly resistant to antibiotics
    (C) weeds becoming increasingly resistant to herbicides
    (D) all of the above
    (E) none of the above

Concerns About Endangered Birds Won't Stop July 4 Fireworks Show in Old Orchard Beach

The Fourth of July fireworks show will go on as planned in Old Orchard Beach on Thursday despite concerns about an endangered bird that was about to give birth to a brood of chicks nearby.

The piping plover's nest was only feet from where the fireworks are staged, . . . sparking concerns that the explosions and the thousands of people expected to attend the traditional waterfront display could disrupt the bird and their nest.

. . . Town Manager Larry Mead said the holiday fireworks display will go on as planned Thursday because the chicks have hatched and the birds are expected to move away from the noise and crowds. . . .

There are currently a record nesting plover pairs in Maine, according to Laura Zitske, director of Maine Audubon's Piping Plover and Least Term Project. . . . Piping plovers require wide, open sand and dune grass to nest. The birds are endangered largely because of habitat loss.

Uncertainty about the Independence Day display surfaced in Old Orchard last week when the town canceled its Thursday night fireworks display, a summer tradition in this beachfront resort that draws thousands of visitors each week.

OOB365, a group of Old Orchard Beach businesses and private citizens, hinted at a brewing conflict with the nesting plover site on its Facebook page.

"Tonight's fireworks (June 27th) have been cancelled due to the nesting piping plovers along the beach. Fingers crossed for next week and the 4th of July," OOB365 said in the post.

Mead met with officials from Maine Audubon . . . Friday and they agreed to set up a protective corridor around the plover nesting site on the night of July Fourth. Signs, twine, and netting will make it clear that the area will be off-limits to the public, Mead said. . . .

Independence Day fireworks are one of the annual sources of concern for the plovers. Zitske said fireworks can scare parents away from newly hatched chicks that need to be kept warm, and Audubon employees have come across nests in the past only to find dead chicks.

Typically, the biggest concern about piping plovers and the Fourth of July is the crowds of people walking on the beach in the dark after the fireworks are over, Zitske said. In some areas, volunteers will stand guard to keep people from trampling over nesting areas in the dark. . . .

Zitske . . . attributes the nesting success in large part to increased educational outreach to beachgoers, who must share the beaches with the bird.

20. Which of the following identifies a claim made by the author in the article?
    (A) Piping plovers are endangered in Maine because of the loss of wide, open sand and dune grass habitats That the birds use for nesting.
    (B) The light emitted from the holiday fireworks has led to an increase in plover nests because the plovers need light to lay eggs.
    (C) An increase in protective nets to protect piping plovers' eggs has led to an increase in the birds being caught in the netting and becoming injured.
    (D) Maine officials should close Old Orchard Beach during the summer months because large crowds of beachgoers are consistently destroying plover nests.