

Unit 2 Intro to Biodiversity

Diversity measured in _____ different levels

1. **Ecosystem Diversity**-the number of different habitats available in a given area

_____ **biodiversity** = _____ **ecosystem/population health**

Look for variation within a species as well as the number of species present in that area.

An area with a many individuals representing a bunch of different _____.

2. **Species diversity**: the _____ of different species in an ecosystem and the balance or evenness of the population sizes of all species in the ecosystem.

Populations with high diversity are better able to respond to environmental stressors.

3. **Genetic diversity**: how different the _____ are of individuals within a population (group of the same species)

Richness (r) is just the

_____ number of different species found in an ecosystem

High (r) is generally a good sign of

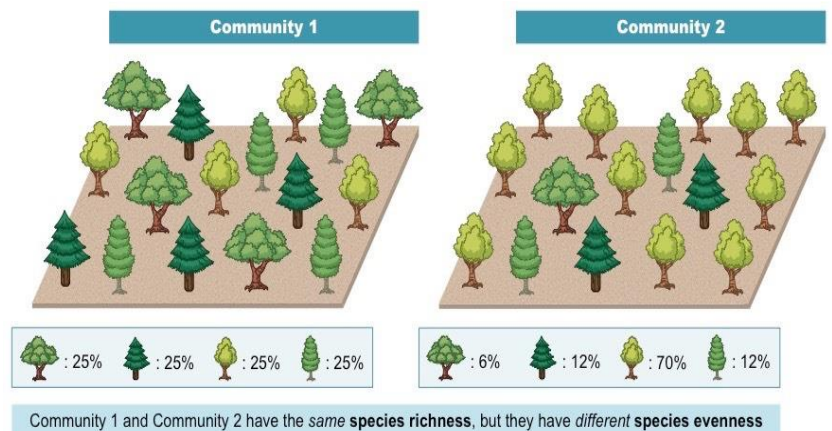
ecosystem _____ (more

species means more quality resources like

H₂O & soil)

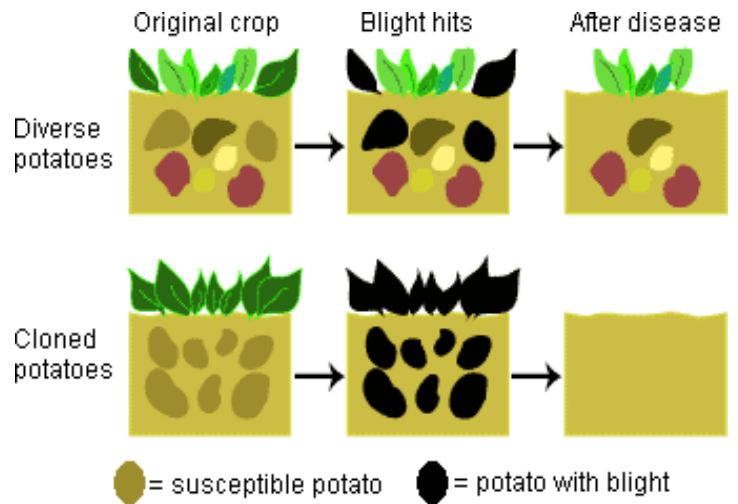
Evenness is a measure of how all of the individual organisms in an ecosystem are _____ between the different species

Evenness indicates if there are one or two _____ species, or if population sizes are well balanced



Genetic Diversity is Beneficial

Genetic diversity = measure of how different the _____ (set of genes) are of the individuals within a population of a given species



Lack of Genetic Diversity

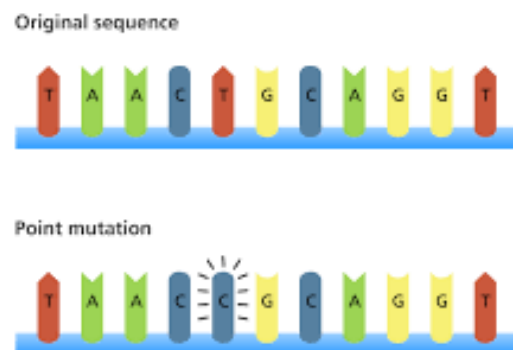
What is a result of lack of genetic diversity in a crop such as corn or soybeans?

Increased susceptibility to _____



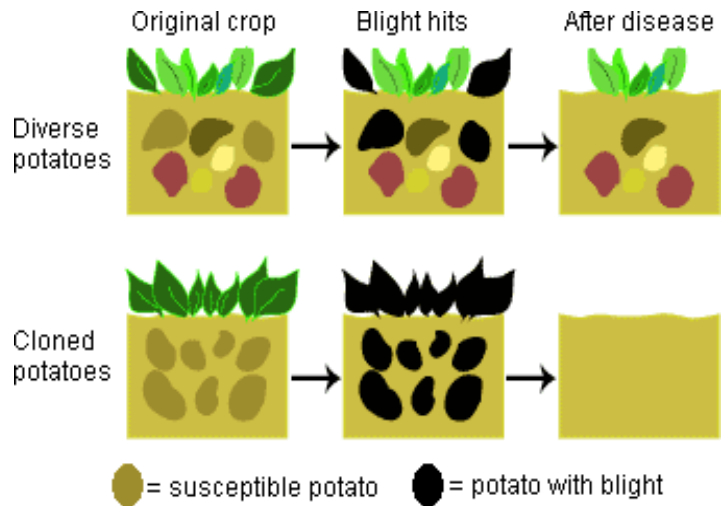
Mutations

There is genetic diversity in all populations because _____ mutations in copying of DNA & recombination of chromosomes in sex cells of parents leads to new gene combinations & new _____ in offspring



Genetic Diversity is Beneficial

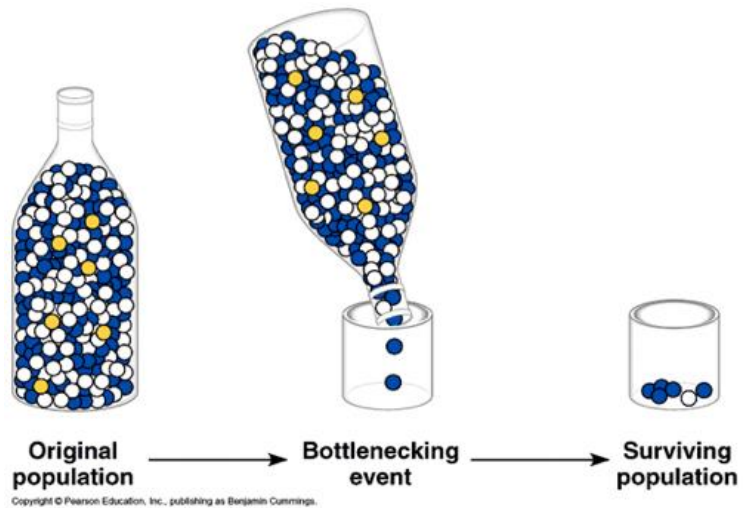
The more genetic diversity in a population the _____ they are likely to recover after a _____ in the ecosystem.



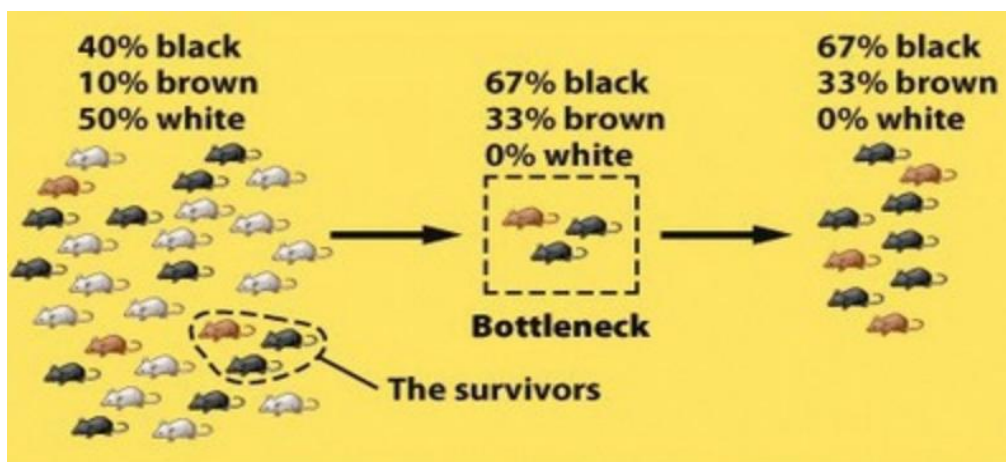
Bottleneck Effect

An environmental disturbance (natural disaster/human habitat destruction/over predation) that drastically reduces pop. size & kills organisms regardless of their genome

Surviving population is _____ and because individuals died randomly, it doesn't represent the genetic diversity of the original population



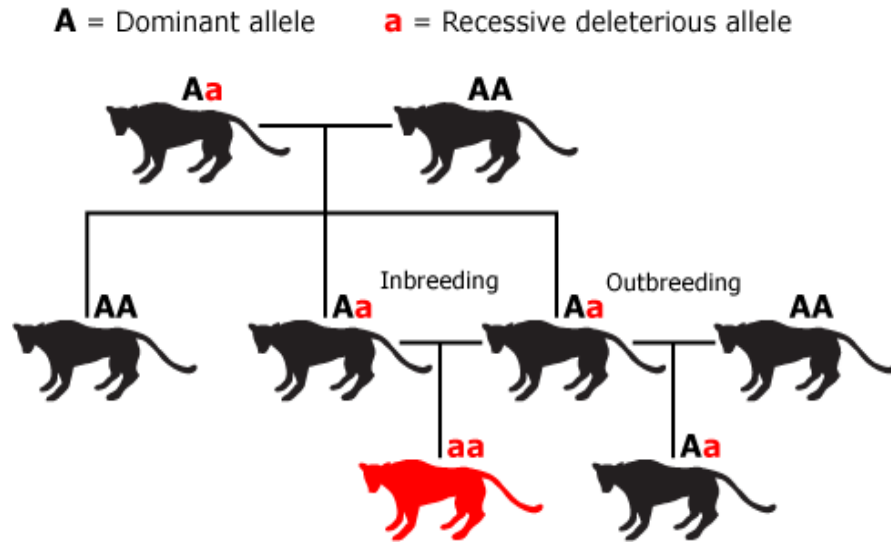
Because the population is smaller & less genetically diverse, it's even more vulnerable to future environmental disturbances



Inbreeding Depression

Inbreeding is when organisms mate with closely related “_____” members

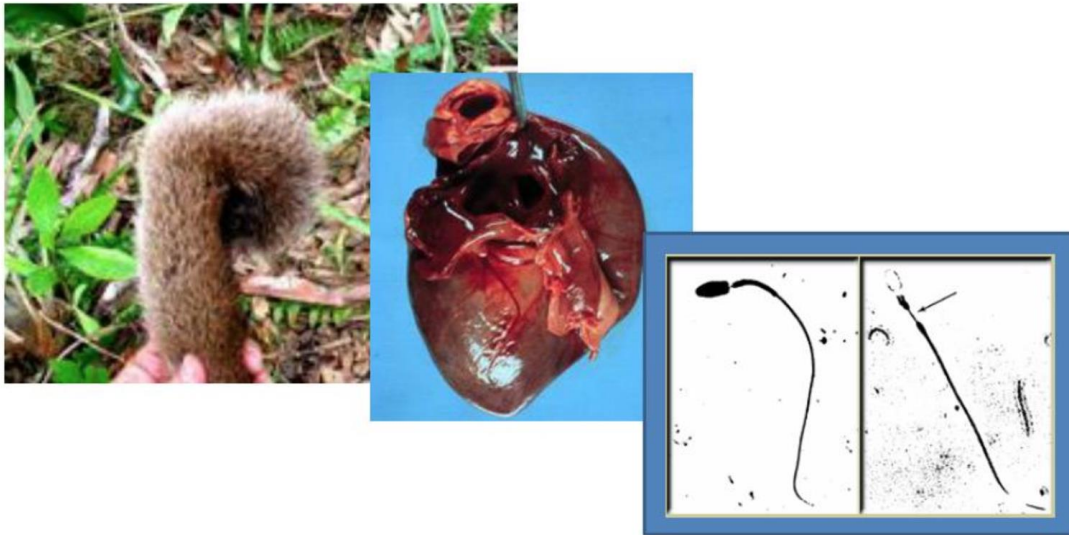
Leads to higher chance of offspring having harmful genetic mutations because they're getting similar genotypes from both parents



Smaller populations are more likely to experience inbreeding (difficult to find non-related mate)

Ex: Florida panther population decreased down to 30 in 1900s due to hunting & habitat loss. Inbreeding depression = kinked tails, heart defects, low sperm count, undescended testicles (saved in 95' by pumas from Texas)





Ecosystem Resilience

Resilience = the ability of an ecosystem to return to its _____ conditions after a major disturbance (windstorm, fire, flood, clear-cutting, etc.)

Higher species diversity = higher ecosystem resilience

High species diversity means more plant species to _____ disturbed ground, anchor soil, and provide food & habitat for animal species

Practice FRQ 2.1

Describe one of the three levels of biodiversity.

Explain how high biodiversity at the level you described is beneficial to ecosystems.

Ecosystem Services

Goods that come from _____ resources or services/functions that ecosystems carry out that have measurable economic/financial value to _____

Provisioning-Goods taken _____ from ecosystems or made from natural resources
(wood, paper, food)

Regulating-Natural ecosystems regulate climate/air quality, reducing storm damage & healthcare costs

Supporting-Natural ecosystems support processes we do _____, making them cheaper & easier (bees pollinate crops and bats eating mosquitos)

Cultural-_____ generate by recreation (parks, camping, tours) or scientific knowledge

Human Disruption

Human activities disrupt the ability of ecosystems to function, which _____ the value of ecosystem services they provide

This has ecological (_____) and economic (_____) consequences

- Clearing land for _____/_____ removes trees that store _____ (more CO₂ in atmosphere alters climate = more storm damage & crop failure)
- More increases CO₂ =global temperature rise because of the _____.
- Overfishing leads to fish population _____ (lost fishing jobs and lower fish sales in the future)

Provisioning Services

Goods/products directly provided to humans for _____/use by ecosystems

Ex: Fish, _____ animals, lumber (wood for furniture/buildings) naturally grown foods like berries, seeds, wild grains, honey

Goods/products that are _____ from natural resources that ecosystems provide

Ex: paper, medicine, rubber

Disrupted by overharvesting, water pollution, clearing land for agriculture/urbanization

Regulating Services

Benefit provided by ecosystem processes that _____ natural conditions like climate and air quality

- Trees in a forest _____ (store) CO₂ through photosynthesis which reduces rate of climate change & lessens damage caused by rising sea level & reduces crop failure from drought
- Trees _____ air by absorbing air pollutants which reduces health care costs for treating diseases like asthma and bronchitis

Disrupted by _____

Supporting Services

Natural ecosystems support processes we do ourselves, making them less costly and easier for us

- Wetland plant roots filter pollutants, leading to _____ groundwater that we don't have to pay as much to purify with expensive water treatment plants
- Bees & other insects _____ our agriculture crops, leading to more crop production & higher profits

Disrupted by pollinator habitat _____ & filling in _____ for development

Cultural Services

_____ from recreational activities (hunting/fishing licenses, park fees, tourism-related spending) & profits from scientific discoveries made in ecosystems (health/agriculture/educational knowledge)

- Beautiful landscapes draw tourists who _____ to enter parks, spend money at local stores/restaurants, or camping fees
- Fishermen pay for fishing _____ to catch fish in clean rivers
- Scientists learn about plant compounds that can lead to creation of _____ medicines which are _____ for profit

Disrupted by _____, _____ **and** _____

Practice FRQ 2.2

Describe an ecosystem service that intact forest ecosystems provide for humans.

Identify one human activity that could degrade this ecosystem service and **explain** how the activity decreases the value of the ecosystem service.

Specialist

Lives in a _____ niche
Only eats _____ plants/animals
_____ adaptable to environmental change
Susceptible to an _____ species
Susceptible to _____
Examples: _____ and _____

Generalist

Lives in a _____ niche
Eats _____ types of plants/animals
Very _____ to environmental change
_____ as susceptible to an invasive species
Examples: _____ and _____

Island Biogeography

Study of ecological relationships & community structure on islands

- Islands can be _____ islands in a body of water or figurative habitat islands such as central park in New York City or _____ (natural habitats surrounded by human developed land)



2 Basic Rules

1. Islands _____ to the “mainland” support more species

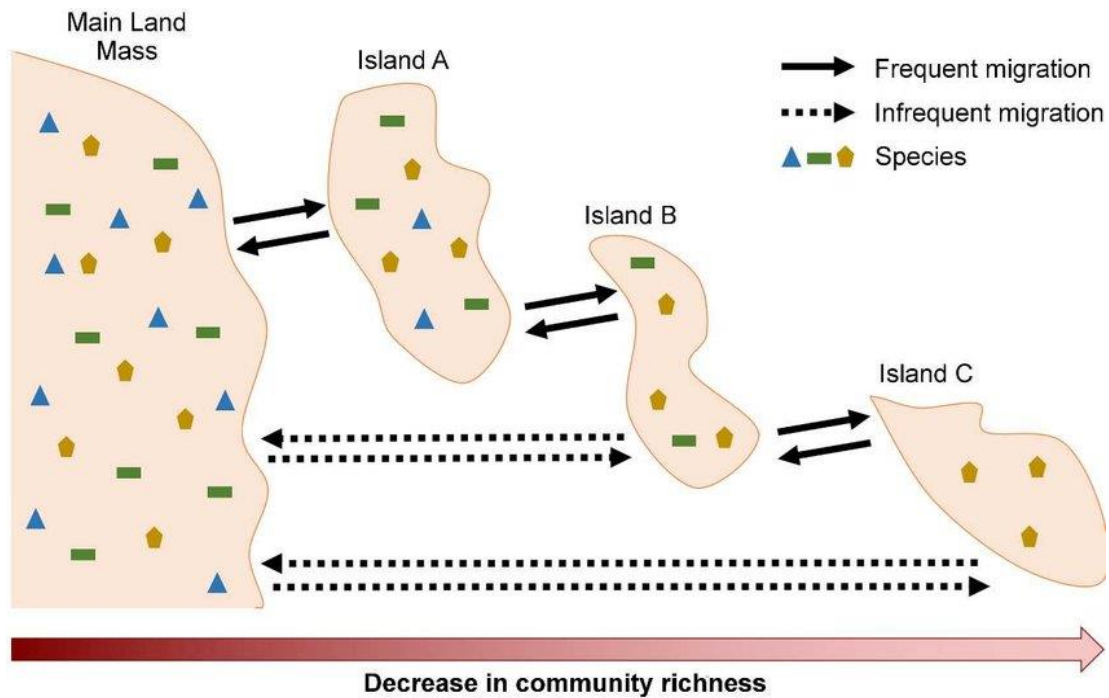
- Easier for colonizing organisms to get to island from mainland (5km is easier than 15km)
- More colonizing organisms = more genetic _____ in new population

Closer to the island = more species _____

- Easier for more species to _____ to island from mainland (swim/fly)
- More continual migration of individuals to the island habitat
 - Frequent migration brings more genetic diversity & _____ population size
- Inverse relationship between island distance from mainland & species richness
 - The _____ away from mainland, the _____ species

Smaller islands that are close to the mainland have a different problem

- If a small population gets established, they have to worry about possible _____ species, because it is easy for those species to get there, and the low numbers of the new population may not be able to _____ the new invasive species.



2. Larger Islands support more total species

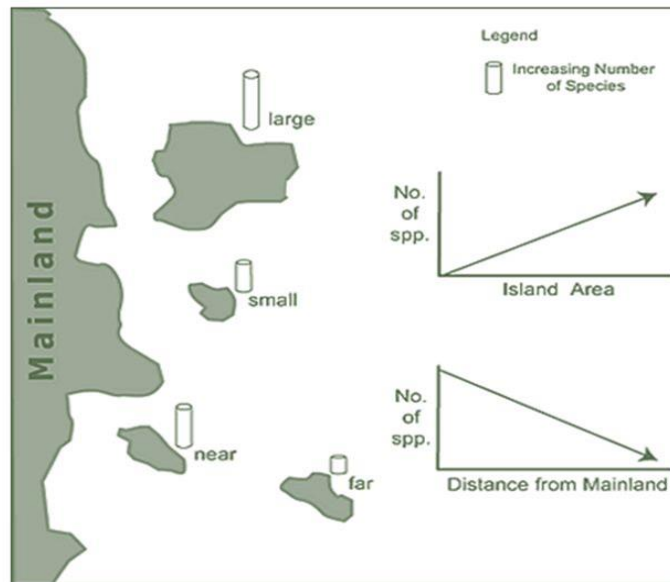
- The _____ the island, the greater the ecosystem diversity
- Greater ecosystem diversity = more food & habitat resources
- More niches, or “roles” organisms can play in the ecosystem

Smaller islands are more prone to _____

- The _____ the island = _____ resources available
- More vulnerable to _____ events
- Less _____, or “roles” organisms can play in the ecosystem

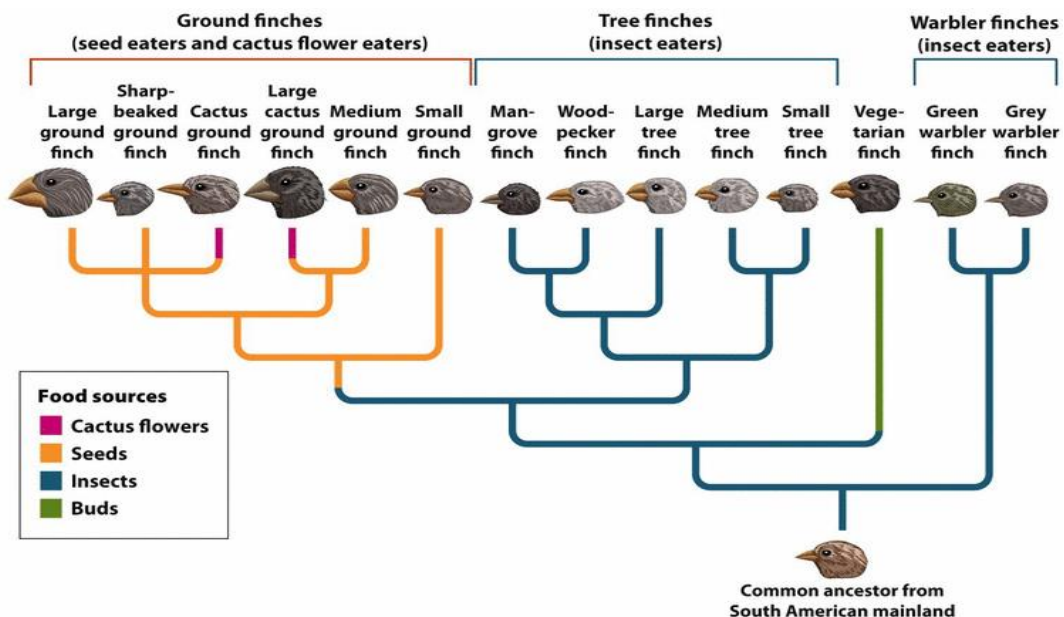
Larger islands support more _____

- higher ecosystem _____
- More available “niches” or roles
 - Ex: all the different food sources available to birds on Galapagos
- Larger population sizes (more genetically diverse and more resistant to env. disturbance)
- _____ extinction rate (species less likely to die off)
- Positive correlation between island size & species richness



Evolution on Islands

- Islands have limited space & resources, creating unique conditions for evolution
 - More pressure for species to adapt to narrower niches (more specific food/habitat)
- **Adaptive radiation** = single species rapidly evolving into several _____ species to use diff. resources & reduce competition
 - Ex: Galapagos Finches
- Different _____ quickly evolve to fit variety of different food sources on island
- Single colonizing species from mainland quickly _____ to many slightly different species to adapt to new island conditions.



Practice FRQ 2.3

Describe the processes of colonizing an island habitat. **Describe** how the island's distance from the mainland influences the number of species that will colonize the island habitat.

Ecological Range of Tolerance

Range of conditions such as _____, _____, _____, or _____ that an organism can endure before injury or _____ results.

Species and individual organisms both have a range of tolerance for all the different environmental conditions of their habitat

Salmon

Salmon have a basic range of tolerance for temperature from _____° to _____° C. But some individual salmon have adaptations that give them a range of tolerance that is outside the basic range for the species.

Due to genetic _____

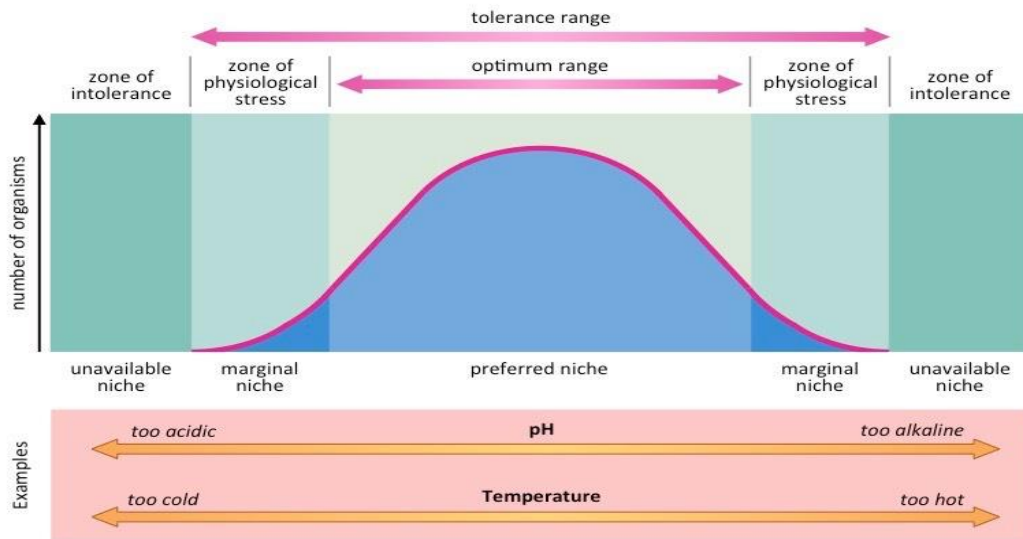
Makes populations of salmon more _____ to disturbances, like global _____

Tolerance Zones

Optimal range: range where organisms _____, _____, and _____

Zone of physiological stress: range where organisms survive, but experience some _____ such as infertility, lack of growth, decreased activity, etc.

Zone of intolerance: range where the organism will _____



Natural Disturbances to the Ecosystem

A _____ event that disrupts the structure and or function of an ecosystem

Examples include:

Events can be even greater than human disturbances

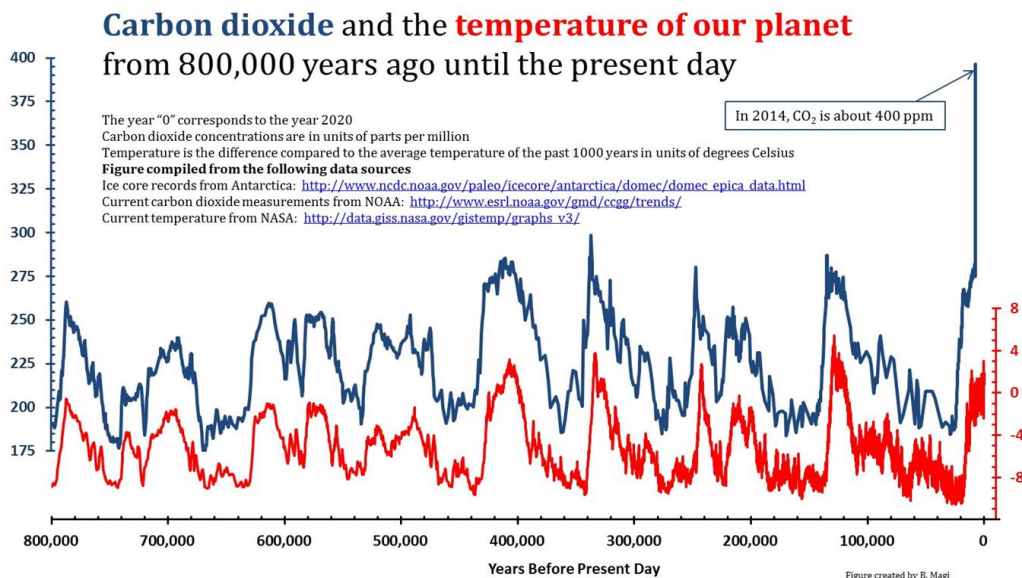
Periodic: occurs with _____ frequency (ex: dry-wet seasons)

Episodic: occasional events with _____ frequency (ex: hurricanes, droughts, fires)

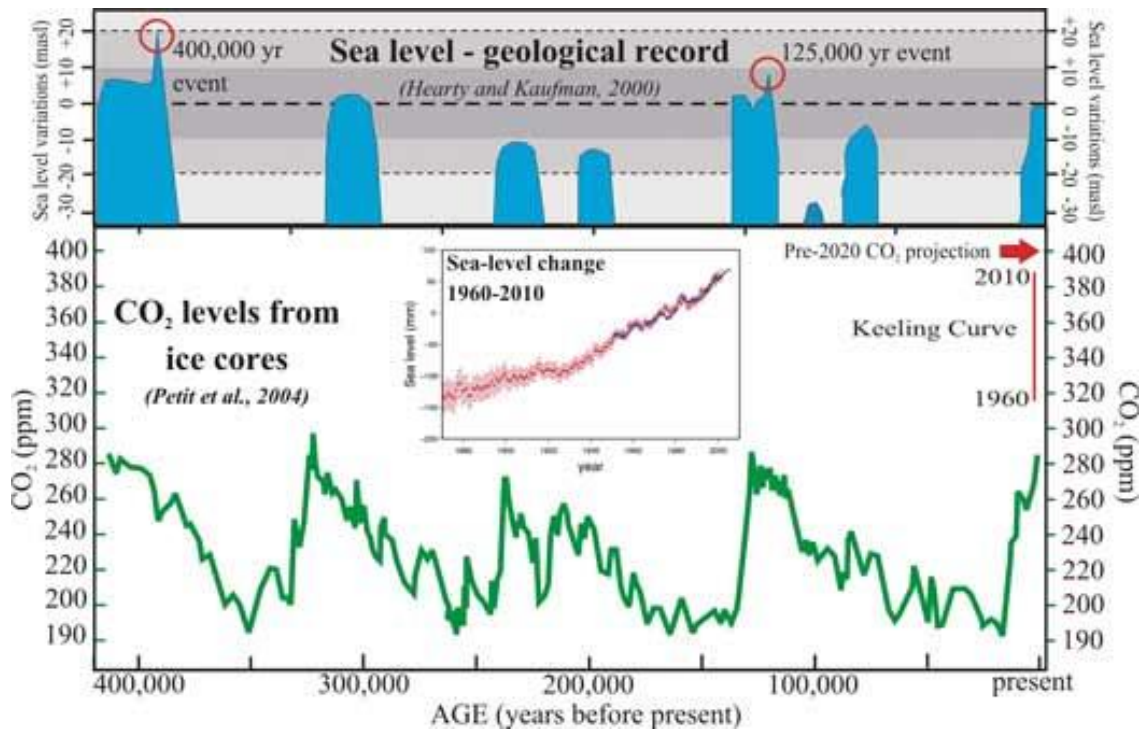
Random: _____ regular frequency (volcanoes, earthquakes, and asteroids)

Earth's climate has varied over geologic time for numerous reasons

Slight changes in earth's _____ & _____ cause mini ice ages & warmer periods as earth shifts slightly closer to & further from sun



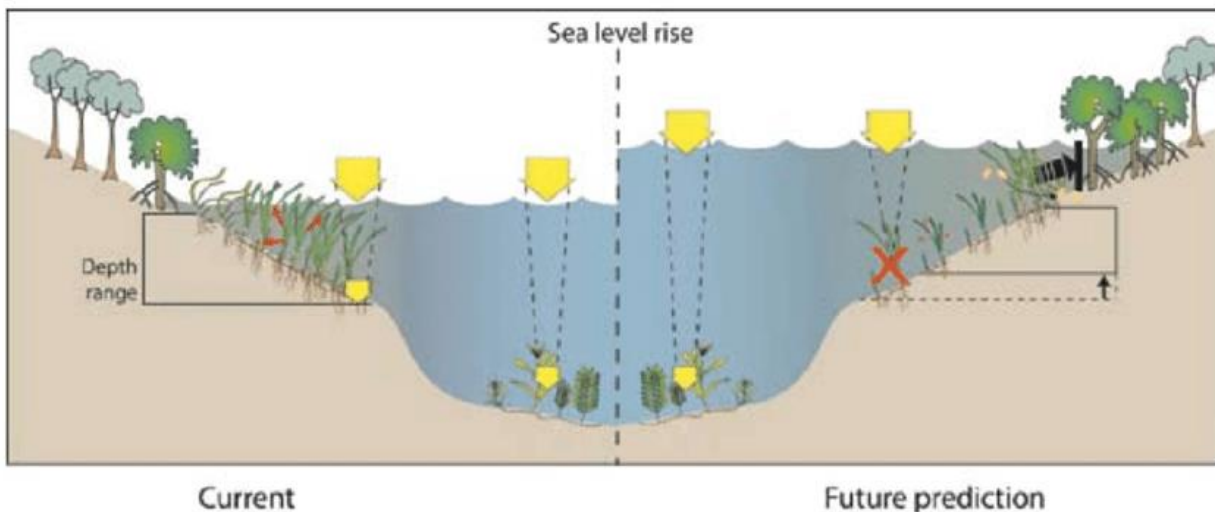
Sea level has varied over geological time as glacial ice on Earth _____ & _____



Environmental Change=Habitat Destruction

Major environmental disturbances result in _____ habitat changes and or loss

Examples include:

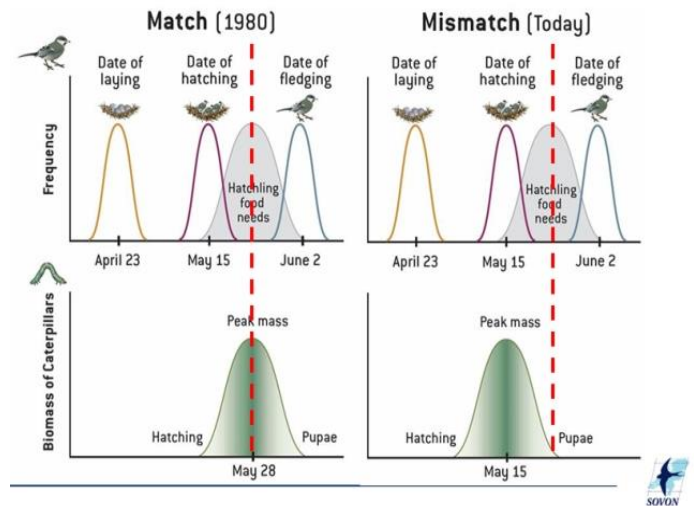
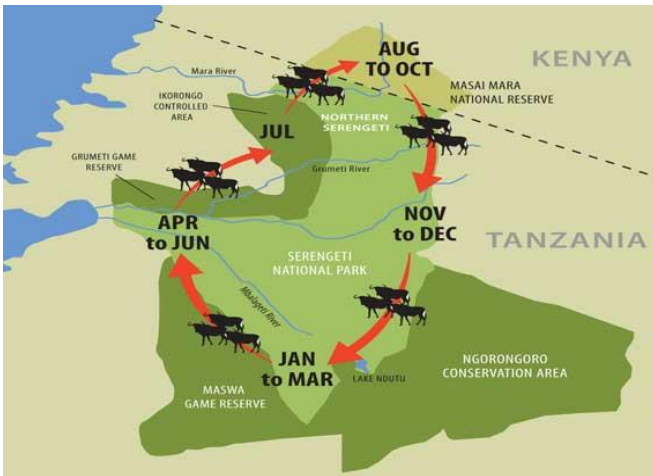


Migration

Wildlife may migrate to a _____ habitat as the result of natural disruptions

Ex: wildebeests migrating to follow _____ patterns of _____ savanna

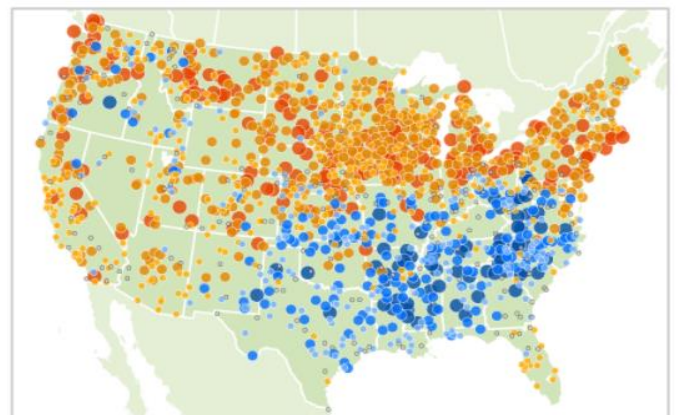
- Ocean species moving further north as water temperature warms
- Bird migration & breeding shifting earlier as insect hatching shifts earlier with warming climate



Practice FRQ 2.5

Describe the relationship between latitude and change in first leaf date depicted in the graph.
Explain why you think this relationship exists.

Figure 2. Change in First Leaf Date Between 1951–1960 and 2006–2015

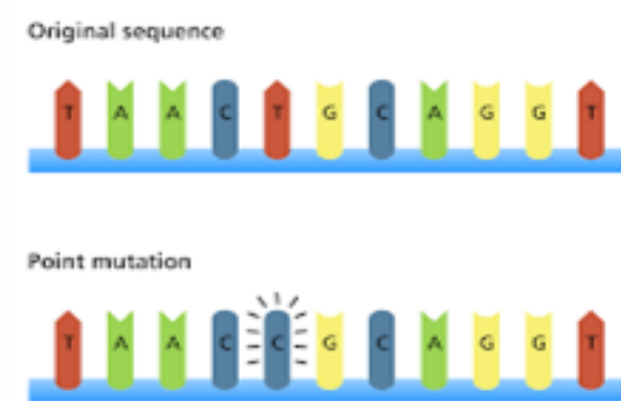


Fitness and Adaptations

All populations have some genetic diversity, or variability in genomes of _____;

Genetic diversity exists because:

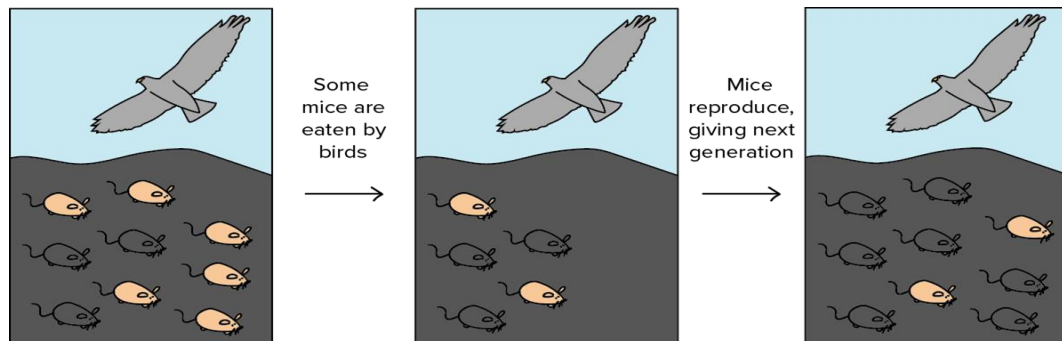
- ❖ _____ mutations while DNA is being copied create new traits
- ❖ Crossing over in parent chromosomes creates _____ combinations of genes (and therefore traits)
- ❖ **Adaptation:** a new trait that increases an organism's **fitness** (ability to survive and reproduce)



Adaptations and Natural Selection

Natural selection: organisms that are better adapted to their environment survive and reproduce more _____

- ❖ Individuals with adaptations pass them on to _____ & individuals without adaptations die off, which leads to the entire population having the adaptation over time (evolution)
- ❖ **Selective pressure/force:** the environmental condition that _____ individuals without the adaptation

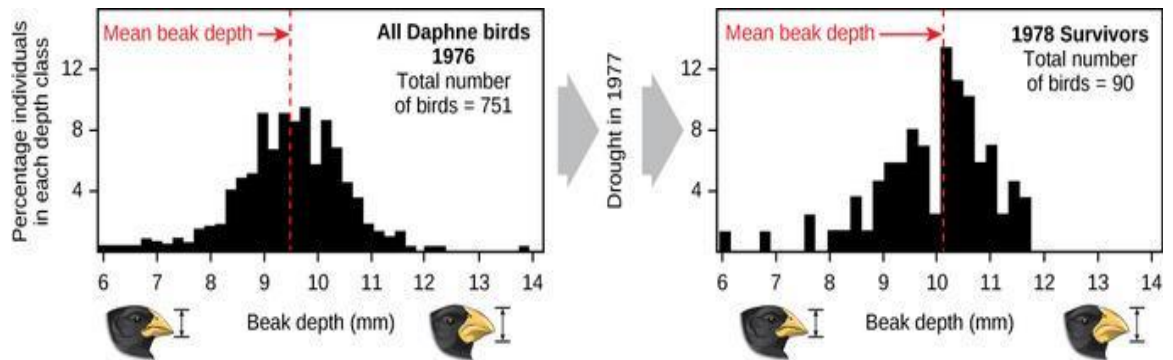


The hawk (predator) is the selective pressure

Environmental Change and Evolution

The environment an organism lives in determines which traits are _____

- ❖ As environments change, different traits may become adaptations & old traits may become _____
- ❖ **Ex:** a drought can kill off finches with smaller beaks, making larger beaks for cracking harder seeds an adaptation



The Pace of Evolution

The more rapidly an env. changes, the less likely a species in the env. will be to adapt to those changes

- ❖ If the pace of evolutionary change is too rapid, many species may migrate out of the env. or die-off completely
- ❖ **Ex:** if the ocean warms too quickly, many species of fish may not be able to migrate before they run out of oxygen and suffocate

The more genetic diversity in a population, the better they're able to adapt to environmental change (higher chance that some individuals have good mutations)

The longer the lifespan of the organism, the slower the rate of evolution

- ❖ **Ex:** bacteria & viruses can adapt and evolve in days
- ❖ Insects can evolve in years
- ❖ Humans evolution = thousands to millions of years

Practice FRQ 2.6

This data table shows the beak size of 20 finches from two different islands in the Galapagos.

Describe the difference in beak size between the two islands. **Make a claim** about the reason for this difference in beak size.

Daphne Island Beak Size (mm)	Santa Cruz Island Beak Size (mm)
9.55	10.05
8.70	9.74
9.62	10.27
9.22	9.81
8.79	10.46
9.61	10.24
9.02	10.02
7.85	10.30
9.01	10.43
8.26	10.52

Ecological Succession

A series of _____ stages of growth that a forest goes through

Primary Succession: starts from _____ in an area with no previous soil formation

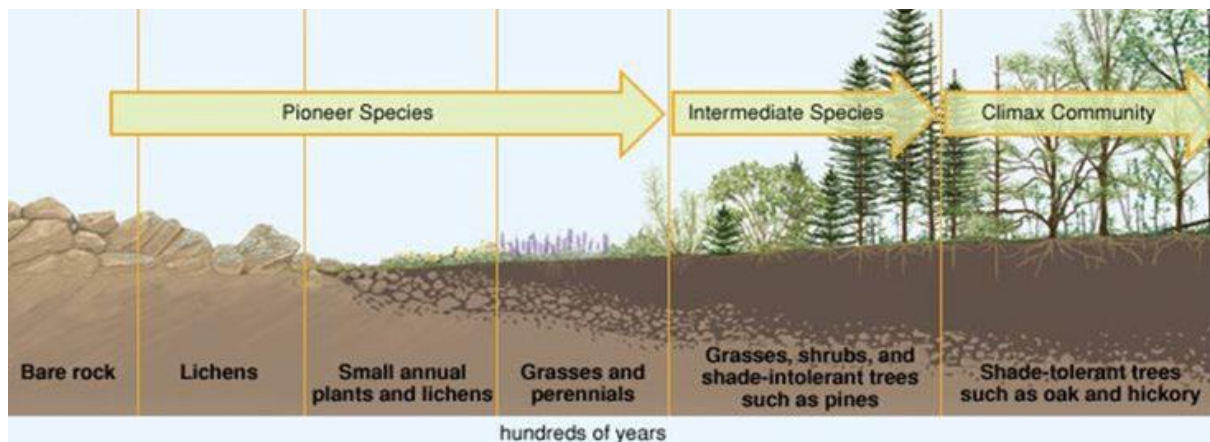
Moss & lichen spores carried by the wind grow directly on rocks, breaking them down to form soil

Primary succession **Occurs in an area that hasn't previously been colonized by plants (bare rock)**

Examples include:

Moss and lichen (spores dispersed by wind) are able to grow directly on rock by secreting acids that break down rock & release minerals containing nutrients they need (N/P/K)

Chemical weathering of rocks by moss & lichen combined with organic matter from moss & lichen dying form initial shallow soil

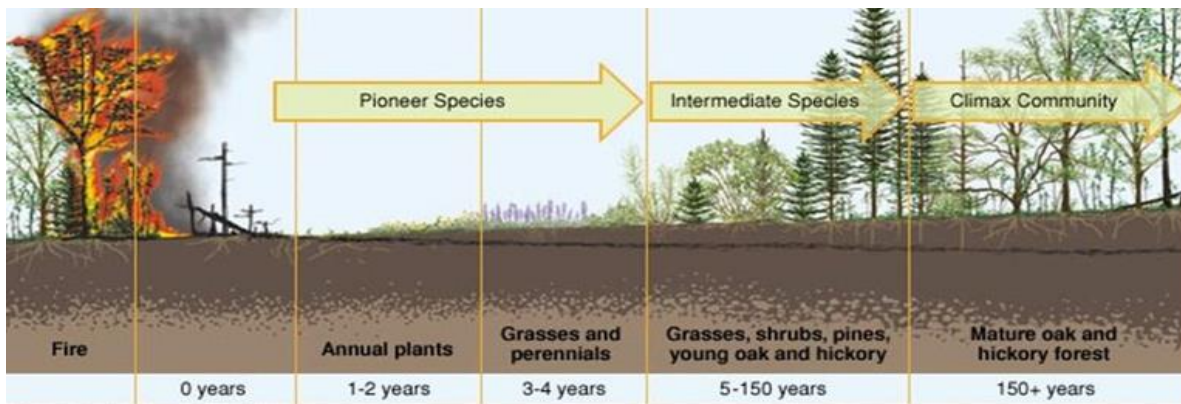


Secondary Succession: starts from _____ established soil, in an area where a disturbance (fire/tornado/human land clearing) cleared out the majority of plant life

Grasses, sedges, wildflowers, and berry bushes have seeds dispersed by wind or animal droppings

Pioneer species are still wind-dispersed seeds of plants that are fast-growing and sun tolerant, but grasses/_____/weeds instead of _____/_____

Soil is already established & sometimes even enriched by nutrient-rich _____ from fire; overall more _____ process than primary succession



Stages of Succession

Stages are characterized by which types of _____ species _____ the ecosystem; different species are adapted to the conditions of the different stages

Pioneer or early succession species appear first, when the ground is simply _____ rock, or bare _____ after a disturbance

Characteristics: seeds spread by _____ or _____, fast growing, tolerant of _____ soil and full sunlight

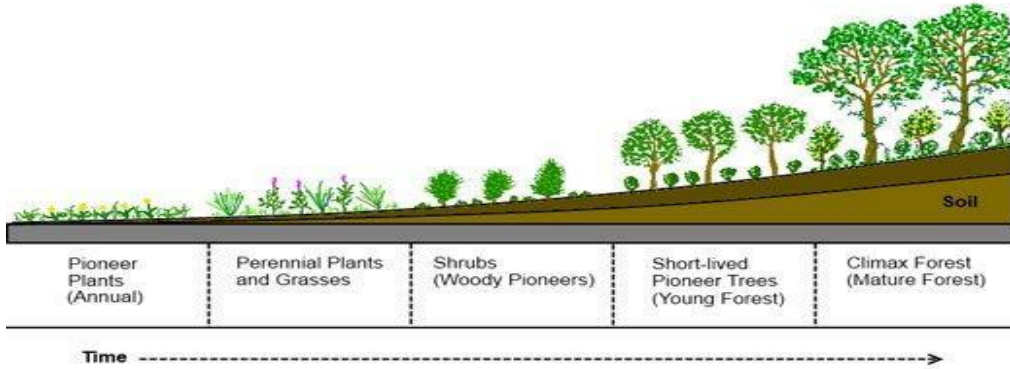
Ex: moss, lichen (bare rock) | wildflowers, raspberries, grasses/sedges

Mid-successional species appear _____ pioneer species have helped develop _____ soil with more nutrients by their cycles of growth/death

Characteristics: relatively _____ growing, _____ plants that need _____ soils with more nutrients than pioneers, sun tolerant

Ex: shrubs, bushes, fast-growing trees like aspen, cherry, and pine

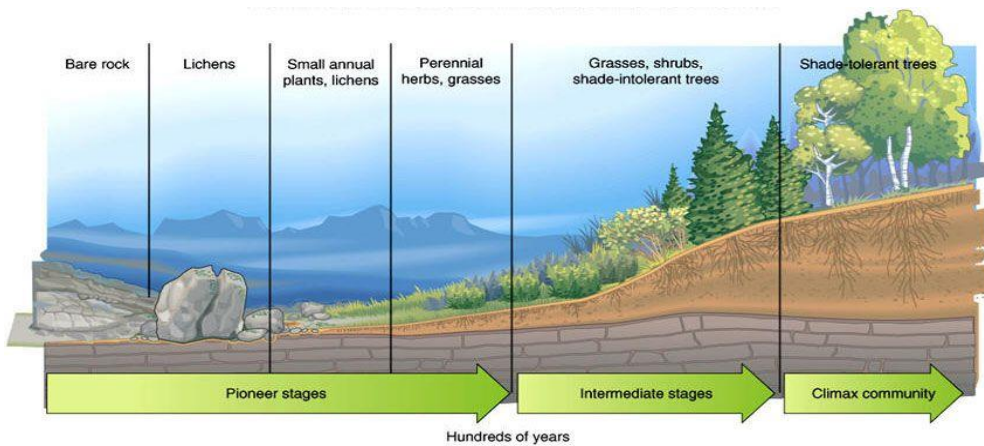
Stages of Forest Succession



Late successional or climax community species appear _____, after soil is _____ and _____ with nutrients by cycles of growth and death by early & mid successional species

Characteristics: large, _____-growing trees that are tolerant of shade and require deep soils for _____ root networks

Ex: maples, oaks, other large trees



Practice FRQ 2.7

Based on the graph below, **explain** whether spruce trees are an early, middle, or late successional species.

