

AP ENVIRONMENTAL SCIENCE (APES) SUMMER ASSIGNMENT 2024

John C. Kimball High School

Mrs. Botelho

Hey new APES friends!

The **purpose** of this summer assignment is to help us skip through the first unit (Ecosystems) as fast as possible and prepare us for Unit 2 (Biodiversity). Since you have seen a lot of this in previous classes, this will hopefully be a lot of review.

- Feel free to work together if you would like. I encourage it! Science is collaborative and a lot of this class will be as well. **BUT**, when I say work together, I don't mean split up the sections and "share" information to speed it up. **Really**, you can work together, but each person is responsible for their own learning. A lot of the info in this assignment will NOT be covered in class in August but you will still be tested on it.
- Ask for help if you need it! Ask a friend in the class, ask me, ask ChatGPT for help. Using your resources is fine but remember if it doesn't get stuck into YOUR BRAIN you are wasting your time. Just getting the assignment done to get the points won't help for our class or the AP exam.
- I will be checking my email over summer, but my responses may not be instantaneous.
- The summer assignment is due on **Tuesday August 6, 2024**.

Checklist (see notes on each assignment on the backside of this page)

1. Flinn Lab Safety Contract (study to prep for test, fill out signatures and allergies)
2. Unit 1 Smedes Video Notes and Unit 2 Smedes Video Notes
3. Current Event #1 and Current Event #2

"Saving our planet, lifting people out of poverty, advancing economic growth... these are one and the same fight. We must connect the dots between climate change, water scarcity, energy shortages, global health, food security, and women's empowerment. Solutions to one problem must be solutions for all." -Ban Ki-moon

"You cannot get through a single day without having an impact on the world around you. What you do makes a difference, and you have to decide what kind of difference you want to make." -Jane Goodall

Onward,

Mrs. Botelho
jbotelho@tusd.net

1. Flinn Lab Safety

- Read the contract (attached), study it, sign it, prep for a quiz. You may have taken this one a few times so we will review and take the quiz in the first few days of class.

2. Video Notes for Unit 1 and Unit 2

- Jordan Dischinger-Smedes (Mr. Smedes) is an APES teacher who has a GREAT set of resources we will be using this year. You will be going through his videos on Units 1 and 2 and filling in cloze notes (attached) made by another educator, Carolyn Kelleher Mendonca.
- The links to the video playlists will be posted in Teams as part of the summer assignment and are listed on the links page of these instructions.
- We will use this as a way to speed through the first two units and save some time. So, make sure these get done or you will be at a disadvantage.

3. Current Events

In environmental science, it is important to know about current issues in the news. One of my goals is to familiarize you with environmental issues that are important to our community, country, and world. We will be reading and discussing a variety of current events throughout the school year as well. Over the course of the summer, find **2** recent articles related to environmental science.

All articles should be current (during the past year) and taken from a reliable source. The sources may be scientific publications, popular magazines, newspapers etc. Try the NY times (especially Tuesday), Washington Post, National Geographic, Discover Magazine, Natural History Magazine, etc. I do not care if you use a paper or online copy of your article as long as it is properly cited.

Each of the three articles should relate to a different topic chosen from the following list. As the year progresses you will be able to cover all of the topics!

Environmental Law	Ecosystems	Climate	Evolution	Preserving our biodiversity
Water pollution	Population growth	Cities and waste	Geology	Renewable Energy
Nonrenewable energy	Food/agriculture	Air pollution	Human Health	Forest or Rangeland

Article Analysis Directions: Include all of the following components and clearly identify each component with headings. Each analysis should be either typed or very neatly written in blue or black ink. Each article should be on its own paper.

- Title of the Article
- Summary: **brief** summary that tells me what the article is about.
- Analysis:
 - a. Points of view – does the article have more than one side/pov? If so, what are they?
 - b. Bias – Is this article biased in any way? In your opinion, does the author give a positive, negative, or neutral view of the environmental science topic?
 - c. Controversy: Is there any controversy surrounding this article? If so, briefly explain it.
 - d. Your perspective: State your perspective on this news article based on your personal knowledge of the topic and your reading of the article.
 - e. Effect on you: How does this topic relate to you or affect you?
- Attach the article – either a physical copy of the article or a working web address must be included.

School Name _____

Teacher _____

PURPOSE

Science is a hands-on laboratory class. You will be doing many laboratory activities which require the use of hazardous chemicals. Safety in the science classroom is the #1 priority for students, teachers, and parents. To ensure a safe science classroom, a list of rules has been developed and provided to you in this student safety contract. These rules must be followed at all times. Two copies of the contract are provided. One copy must be signed by both you and a parent or guardian before you can participate in the laboratory. The second copy is to be kept in your science notebook as a constant reminder of the safety rules.

GENERAL RULES

1. Conduct yourself in a responsible manner at all times in the laboratory.
2. Follow all written and verbal instructions carefully. If you do not understand a direction or part of a procedure, ask the instructor before proceeding.
3. Never work alone. No student may work in the laboratory without an instructor present.
4. When first entering a science room, do not touch any equipment, chemicals, or other materials in the laboratory area until you are instructed to do so.
5. Do not eat food, drink beverages, or chew gum in the laboratory. Do not use laboratory glassware as containers for food or beverages.
6. Perform only those experiments authorized by the instructor. Never do anything in the laboratory that is not called for in the laboratory procedures or by your instructor. Carefully follow all instructions, both written and oral. Unauthorized experiments are prohibited.
7. Be prepared for your work in the laboratory. Read all procedures thoroughly before entering the laboratory.
8. Never fool around in the laboratory. Horseplay, practical jokes, and pranks are dangerous and prohibited.
9. Observe good housekeeping practices. Work areas should be kept clean and tidy at all times. Bring only your laboratory instructions, worksheets, and/or reports to the work area. Other materials (books, purses, backpacks, etc.) should be stored in the classroom area.
10. Keep aisles clear. Push your chair under the desk when not in use.
11. Know the locations and operating procedures, where appropriate, for all safety equipment including first aid kit, eyewash station, safety shower, fire extinguisher, and fire blanket. Know where the fire alarm and exits are located.
12. Always work in a well-ventilated area. Use the fume hood when working with volatile substances or poisonous vapors. Never place your head into the fume hood.
13. Be alert and proceed with caution at all times in the laboratory. Notify the instructor immediately of any unsafe conditions you observe.
14. Dispose of all chemical waste properly. Never mix chemicals in sink drains. Sinks are to be used only for water and those solutions designated by the instructor. Solid chemicals, metals, matches, filter paper, and all other insoluble materials are to be disposed of in the proper waste containers, not in the sink. Check the label of all waste containers twice before adding your chemical waste to the container.
15. Labels and equipment instructions must be read carefully before use. Set up and use the prescribed apparatus as directed in the laboratory instructions or by your instructor.
16. Keep hands away from face, eyes, mouth and body while using chemicals or preserved specimens. Wash your hands with soap and water after performing all experiments. Clean all work surfaces and apparatus at the end of the experiment. Return all equipment clean and in working order to the proper storage area.
17. Experiments must be personally monitored at all times. You will be assigned a laboratory station at which to work. Do not wander around the room, distract other students, or interfere with the laboratory experiments of others.
18. Students are never permitted in the science storage rooms or preparation areas unless given specific permission by their instructor.
19. Know what to do if there is a fire drill during a laboratory period; containers must be closed, gas valves turned off, fume hoods turned off, and any electrical equipment turned off.
20. Handle all living organisms used in a laboratory activity in a humane manner. Preserved biological materials are to be treated with respect and disposed of properly.

21. When using knives and other sharp instruments, always carry with tips and points pointing down and away. Always cut away from your body. Never try to catch falling sharp instruments. Grasp sharp instruments only by the handles.
22. If you have a medical condition (e.g., allergies, pregnancy, etc.), check with your physician prior to working in lab.

CLOTHING

23. Any time chemicals, heat, or glassware are used, students will wear laboratory goggles. There will be no exceptions to this rule!
24. Contact lenses may be worn provided adequate face and eye protection is provided by specially marked, non-vented safety goggles. The instructor should know which students are wearing contact lenses in the event of eye exposure to hazardous chemicals.
25. Dress properly for lab activities. Long hair, dangling jewelry, and loose or baggy clothing are hazardous. Long hair must be tied back and dangling jewelry and loose or baggy clothing must be secured. Shoes must completely cover the foot. No sandals allowed.
26. Lab aprons have been provided for your use and should be worn during laboratory activities.

ACCIDENTS AND INJURIES

27. Report any accident (spill, breakage, etc.) or injury (cut, burn, etc.) to the instructor immediately, no matter how trivial it may appear.
28. If you or your lab partner are hurt, immediately yell out "Code one, Code one" to get the instructor's attention.
29. If a chemical splashes in your eye(s) or on your skin, immediately flush with running water from the eyewash station or safety shower for at least 20 minutes. Notify the instructor immediately.
30. When mercury thermometers are broken, mercury must not be touched. Notify the instructor immediately.

HANDLING CHEMICALS

31. All chemicals in the laboratory are to be considered dangerous. Do not touch, taste, or smell any chemicals unless specifically instructed to do so. The proper technique for wafting chemical vapors will be demonstrated to you.
32. Check the label on chemical bottles twice before removing any of the contents. Take only as much chemical as you need.

33. Never return unused chemicals to their original containers.
34. Never use mouth suction to fill a pipet. Use a rubber bulb or pipet pump.
35. When transferring reagents from one container to another, hold the containers away from your body.
36. Acids must be handled with extreme care. You will be shown the proper method for diluting strong acids. Always add acid to water, swirl or stir the solution and be careful of the heat produced, particularly with sulfuric acid.
37. Handle flammable hazardous liquids over a pan to contain spills. Never dispense flammable liquids anywhere near an open flame or source of heat.
38. Never remove chemicals or other materials from the laboratory area.
39. Take great care when transporting acids and other chemicals from one part of the laboratory to another. Hold them securely and walk carefully.

HANDLING GLASSWARE AND EQUIPMENT

40. Carry glass tubing, especially long pieces, in a vertical position to minimize the likelihood of breakage and injury.
41. Never handle broken glass with your bare hands. Use a brush and dustpan to clean up broken glass. Place broken or waste glassware in the designated glass disposal container.
42. Inserting and removing glass tubing from rubber stoppers can be dangerous. Always lubricate glassware (tubing, thistle tubes, thermometers, etc.) before attempting to insert it in a stopper. Always protect your hands with towels or cotton gloves when inserting glass tubing into, or removing it from, a rubber stopper. If a piece of glassware becomes "frozen" in a stopper, take it to your instructor for removal.
43. Fill wash bottles only with distilled water and use only as intended, e.g., rinsing glassware and equipment, or adding water to a container.
44. When removing an electrical plug from its socket, grasp the plug, not the electrical cord. Hands must be completely dry before touching an electrical switch, plug, or outlet.
45. Examine glassware before each use. Never use chipped or cracked glassware. Never use dirty glassware.
46. Report damaged electrical equipment immediately. Look for things such as frayed cords, exposed wires, and loose connections. Do not use damaged electrical equipment.
47. If you do not understand how to use a piece of equipment, ask the instructor for help.
48. Do not immerse hot glassware in cold water; it may shatter.

HEATING SUBSTANCES

49. Exercise extreme caution when using a gas burner. Take care that hair, clothing and hands are a safe distance from the flame at all times. Do not put any substance into the flame unless specifically instructed to do so. Never reach over an exposed flame. Light gas (or alcohol) burners only as instructed by the teacher.
50. Never leave a lit burner unattended. Never leave anything that is being heated or is visibly reacting unattended. Always turn the burner or hot plate off when not in use.
51. You will be instructed in the proper method of heating and boiling liquids in test tubes. Do not point the open end of a test tube being heated at yourself or anyone else.
52. Heated metals and glass remain very hot for a long time. They should be set aside to cool and picked up with caution. Use tongs or heat-protective gloves if necessary.
53. Never look into a container that is being heated.
54. Do not place hot apparatus directly on the laboratory desk. Always use an insulating pad. Allow plenty of time for hot apparatus to cool before touching it.
55. When bending glass, allow time for the glass to cool before further handling. Hot and cold glass have the same visual appearance. Determine if an object is hot by bringing the back of your hand close to it prior to grasping it.

QUESTIONS

56. Do you wear contact lenses?
☐ YES ☐ NO
 57. Are you color blind?
☐ YES ☐ NO
 58. Do you have allergies?
☐ YES ☐ NO
- If so, list specific allergies _____

AGREEMENT

I, _____ (student's name) have read and agree to follow all of the safety rules set forth in this contract. I realize that I must obey these rules to ensure my own safety, and that of my fellow students and instructors. I will cooperate to the fullest extent with my instructor and fellow students to maintain a safe lab environment. I will also closely follow the oral and written instructions provided by the instructor. I am aware that any violation of this safety contract that results in unsafe conduct in the laboratory or misbehavior on my part, may result in being removed from the laboratory, detention, receiving a failing grade, and/or dismissal from the course.

Student Signature _____

Date _____

Dear Parent or Guardian:

We feel that you should be informed regarding the school's effort to create and maintain a safe science classroom/laboratory environment.

With the cooperation of the instructors, parents, and students, a safety instruction program can eliminate, prevent, and correct possible hazards.

You should be aware of the safety instructions your son/daughter will receive before engaging in any laboratory work. Please read the list of safety rules above. No student will be permitted to perform laboratory activities unless this contract is signed by both the student and parent/guardian and is on file with the teacher.

Your signature on this contract indicates that you have read this Student Safety Contract, are aware of the measures taken to ensure the safety of your son/daughter in the science laboratory, and will instruct your son/daughter to uphold his/her agreement to follow these rules and procedures in the laboratory.

Parent/Guardian Signature _____

Date _____

Video Links Unit 1:

Unit 1.1 - Ecosystems: <https://youtu.be/-lMCElvN0lk?si=iqe4UjEaggZt9nww>

Unit 1.2 – Terrestrial Biomes: <https://youtu.be/DliF5uQmtn0?si=DL8n0aHMT054h9aQ>

Unit 1.3 – Aquatic Biomes: https://youtu.be/wpYZW_pV1u4?si=XekfW_Hw8KlqYwcG

Unit 1.4 – Carbon Cycle: <https://youtu.be/pFrFOnw8TFs?si=f9sWGlki59WjTwpZ>

Unit 1.5 – Nitrogen Cycle: <https://youtu.be/hGJkzTPcX2A?si=5VHZVaAq4x0YsxUz>

Unit 1.6 – Phosphorous Cycle: https://youtu.be/AmnVAp0aGdc?si=QfFQVGMJg_aKz9D3

Unit 1.7 – Hydrologic (Water) Cycle: <https://youtu.be/lsKLNzKK2T8?si=qJLAZ8zqtSYQJrD7>

Unit 1.8 – Primary Productivity: <https://youtu.be/tRXp-WPnjxE?si=BhBPwHaMVR-zZMrY>

Unit 1.9 and 1.10 – Trophic Levels and the 10% Rule: https://youtu.be/tFvphrq_xsc?si=hOZicnSzvoK7sGpe

Unit 1.11 – Food Webs and Chains: <https://youtu.be/SCKJJSsKqQY?si=HAXvG-g3SQG9Twsf>

Video Links Unit 2:

Unit 2.1 Intro to Biodiversity: <https://youtu.be/gMavNnExCQI?si=2reCtflYuy8qzgXD>

Unit 2.2 Ecosystem Services: <https://youtu.be/0gadVwWOHo0?si=GXBU34aXdeBO4HDG>

Unit 2.3 Island Biogeography: https://youtu.be/3QMSojbUHKk?si=RDT0TvThF_Fi0hzx

Unit 2.4 Ecological Tolerance: <https://youtu.be/433goMWxrPk?si=hZOTgqxsN67znDH7>


Unit 2.5 Natural Disruptions to Ecosystems: <https://youtu.be/ydnrbgFiEQQ?si=pVyVC7urgt-qlnQ3>

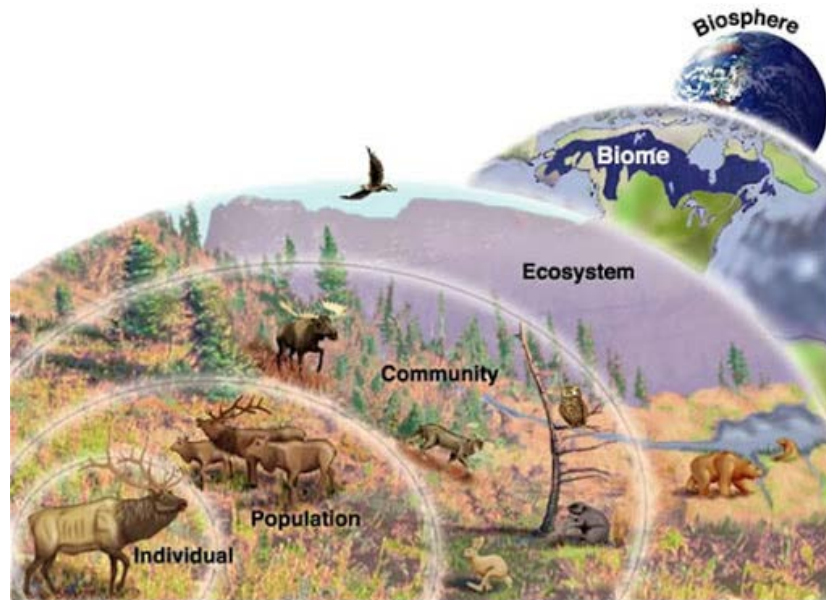
Unit 2.6 Adaptations: https://youtu.be/gLaT0_hyVQk?si=RtIJP2NwWlaVoieJ

Unit 2.7 Ecological Succession: https://youtu.be/2g4ygzsJXNg?si=DXE7oMiQI_YKtJts

1.1 Ecosystems

Ecosystem Basics

- Individual = _____
 - Pop. = _____ of individuals of same _____ (elk herd)
 - Community = _____ in an area
 - Ecosystem = _____ (plants, animals, rocks, soil, water, air)
-  Biome = large area with similar _____ conditions that determine _____ there
- Ex: (tropical rainforest)



Organism Interactions

- _____: organisms fighting over a resource like food or shelter; limits pop. size
- _____: one organism using another for energy source (hunters, parasites, even herbivores)
- _____: relationship that benefits both organisms (coral reef)
- _____: relationship that benefits one organism & doesn't impact the other (birds nest in trees)

Type of interaction	Species 1	Species 2
Competition	-	-
Predation	+	-
Mutualism	+	+
Commensalism	+	0

Predation (+/-)

- _____: (plant eaters) eat plants for energy (giraffe & tree)

- _____: (carnivores) kill and eat prey for energy (leopard & giraffe)
- _____: use a host organism for energy, often without killing the host & often living inside host
 - Ex: mosquitoes, tapeworms, sea lamprey
- _____: lay eggs inside a host organism; eggs hatch & larvae eat host for energy
 - Ex: parasitic wasps, bot fly

Symbiosis sym = together |
bio = living | osis =
condition

What is coral?

Corals are made up from colonies of tiny organisms called polyps

Polyps are related to sea anemones and jellyfish

Tentacles to capture microscopic organisms in the water

Coral polyps are translucent, they receive colour from algae such as **dinoflagellates** that live on them in a **symbiotic relationship**

Algae use nitrogen, phosphorus and other **metabolic waste from the coral** to generate energy from the sun via **photosynthesis**

► Ocean acidification affects hard coral's ability to absorb **calcium carbonate** and build carbon skeletons

Polyps connect to one another through their **calcium skeletons**, creating colonies and reefs

Oxygen and other **organic products of photosynthesis** help the coral to grow

- Under environmental stress, such as a change in temperature, corals will expel algae
- Loss of algae causes coral bleaching, making them vulnerable to disease
- Bleached coral will eventually die if they don't regain algae

Source : NOAA/NationalGeographic/Oceana.org/teachoceanscience.net

AFP

Any _____
between two organisms of _____

- Mutualism (+/+), commensalism (+/0), and parasitism (+/-) are all symbiotic relationships
- _____: Organisms of diff. species living close together in a way that benefits both
 - _____ (animals) provide reef structure & CO₂ for **algae**; algae provide sugars for coral to use as energy
 - _____ = composite organism of fungi living with algae; algae provide sugars (energy) & fungi provides nutrients

Competition

_____ since there are fewer resources available & fewer organisms can survive

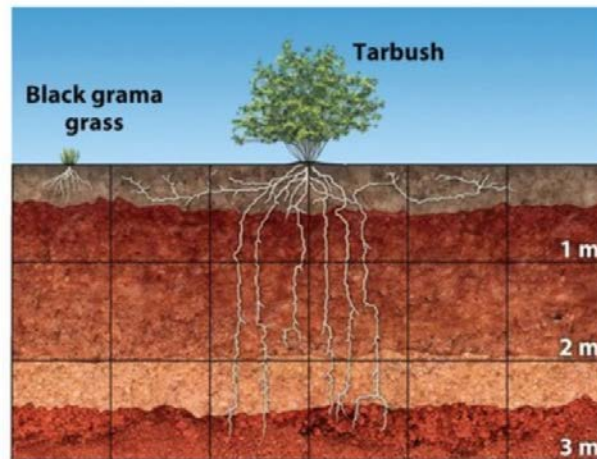
- _____: different species using the same resource in diff. ways to **reduce competition**
 - _____: using resource

@ different times, such as wolves & coyotes hunting @ different times (night vs. day)

- _____: using diff. areas of a shared habitat (diff. length roots)
- _____: using diff. resources based on diff. evolved body features



(a) Temporal resource partitioning

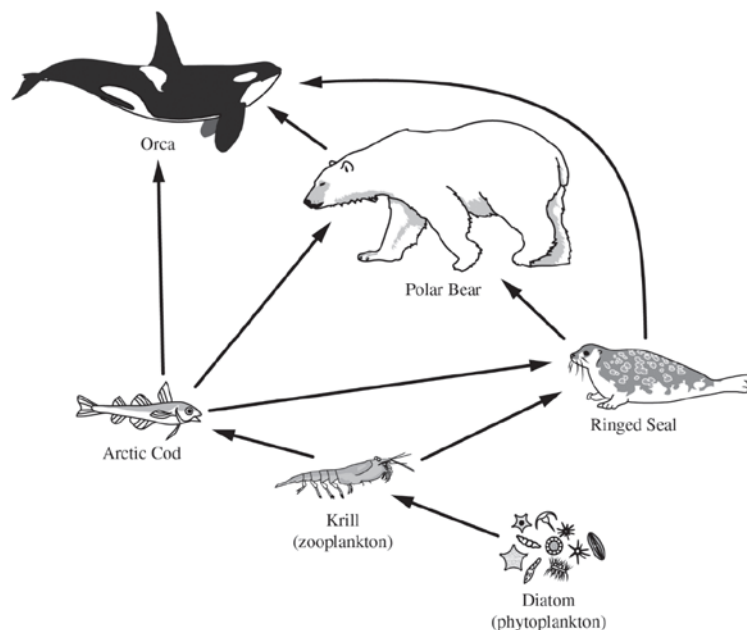


(b) Spatial resource partitioning





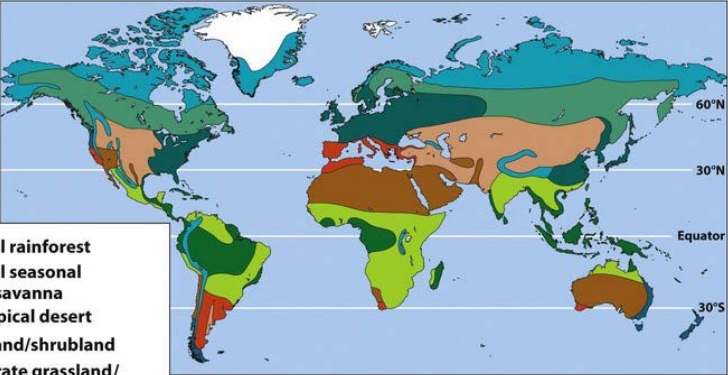

(c) Morphological resource partitioning

Practice FRQ 1.1

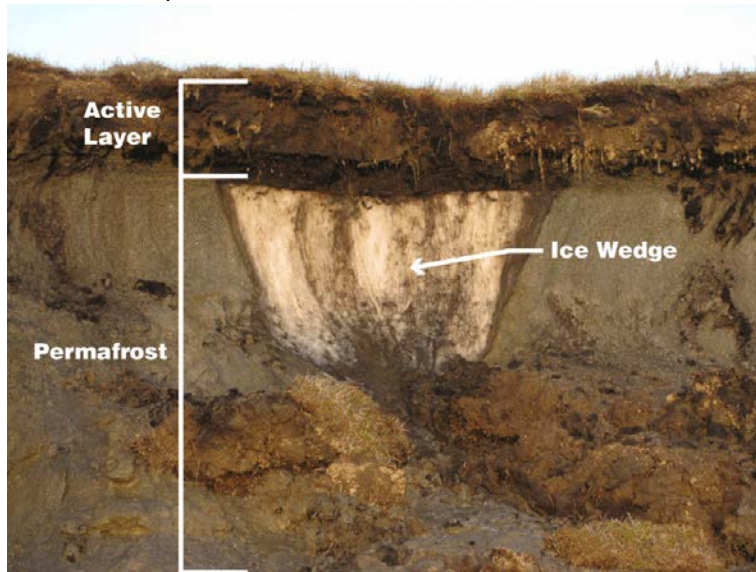


	<p>Identify two organisms that compete for a shared food resource.</p> <p>Describe how resource partitioning could reduce the competition between the two organisms you identified.</p>
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1.2 Terrestrial (Land) Biomes

Biome	<p>_____ : an area that shares a combination of avg, yearly temp. & precipitation (climate)</p> <p> The community of org. (plants & animals) in a biome are _____ to live in that biome</p> <p>Ex: camels & cacti have _____ for _____ ; shrubs & wildflowers _____ to recover quickly from _____ in _____</p>
Biome Characteristics	<p> _____ (distance from eq) determines _____ which is why biomes exist in predictable pattern on earth</p> <p>Biome chart can also predict where on earth biomes are found</p> <p>Biomes are defined by annual _____</p> <div data-bbox="446 1077 1271 1627"><p>Legend:</p><ul style="list-style-type: none">Tropical rainforestTropical seasonal forest/savannaSubtropical desertWoodland/shrublandTemperate grassland/cold desertTemperate seasonal forestTemperate rainforestBoreal forestTundraPolar ice cap</div>
Nutrient Availability	<p>Plants need _____ to grow, so _____ determines which plants can survive in a biome</p> <p> Ex: frozen soils of _____ don't allow _____ in _____ to be broken down by decomposers</p> <p>- Low soil _____</p>

- Low water _____
- Few plants survive here

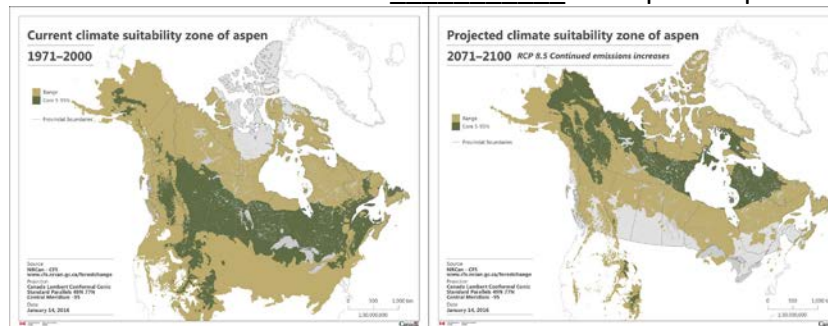


Shifting Biomes

 Biomes _____ in location on earth as climate changes



Ex: warming climate will shift boreal forests further _____ as tundra permafrost soil melts & lower latitudes become too _____ for aspen & spruce

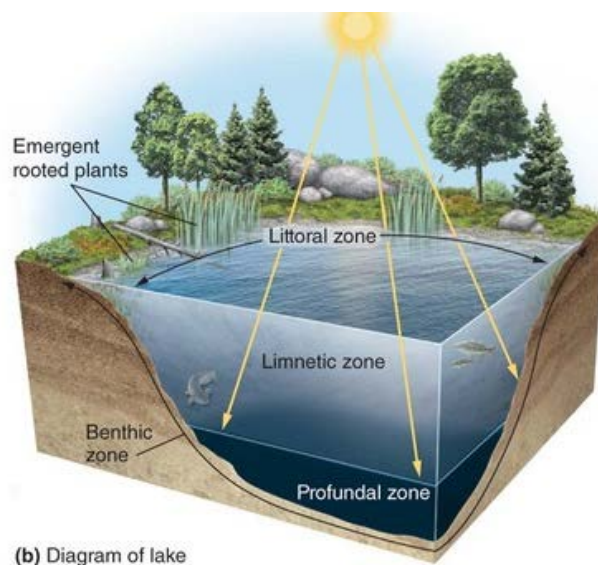


Practice FRQ 1.2

Identify one characteristic of a biome and **explain** how that characteristic determines the community of organisms found in the biome.

1.3 Aquatic Biomes

Characteristics of Aquatic Biomes	<p>_____</p> <p>How much salt there is in a body of water, determines _____ can survive & usability for _____</p> <p>(Fresh water vs. estuary vs. ocean)</p> <p>_____</p> <p>Influences how much _____ can penetrate and reach plants below the surface for _____</p> <p>_____</p> <p>Determines which _____, how much _____ into water</p> <p>_____.</p> <p>_____ water holds _____ so it can support _____ aq. organisms</p>
Freshwater: Rivers & Lakes	<p>_____ have _____ due to flow mixing water & air, also carry nutrient-rich _____ (deltas & flood plains = fertile soil)</p> <p>_____ = standing bodies of fresh H₂O (key drinking H₂O source)</p> <p>_____ : shallow water w/emergent plants</p> <p>_____ : where light can reach (photosynth)</p> <p>No rooted plants, only phytoplankton</p> <p>_____ : too deep for sunlight (no photos.)</p> <p>_____ : murky bottom where inverts (bugs) live, nutrient-rich sediments</p>



Freshwater: Wetlands

_____ : area with soil _____
 _____ in water for at least part of the year,
 but shallow enough for _____ plants

🌿 Plants living here have to be _____ to
 living with roots _____ in standing water
 (cattails, lily pads, reeds)

Benefit\$ of Wetland\$

_____ during storms, lessening
 floods

_____ by absorbing rainfall into
 soil

Roots of wetland plants _____ from
 water draining through

High productivity (plant growth) due to lots of
 _____ (dead organic matter) in sediments







(a)

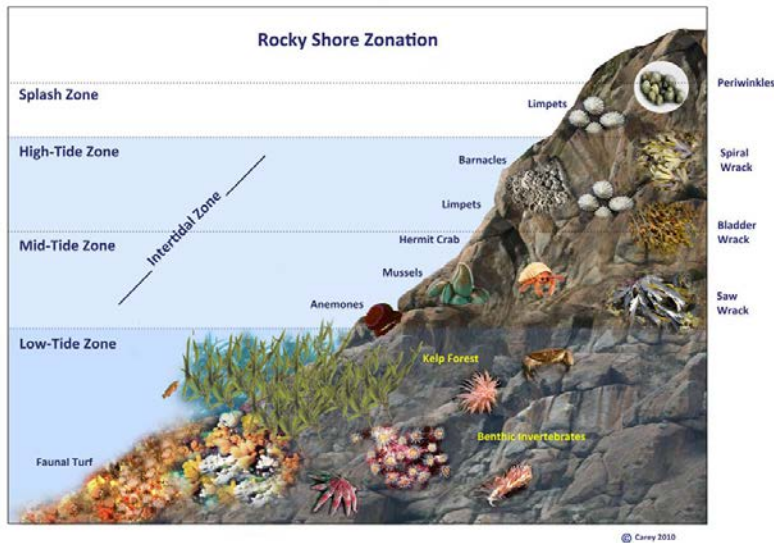


(b)



(c)

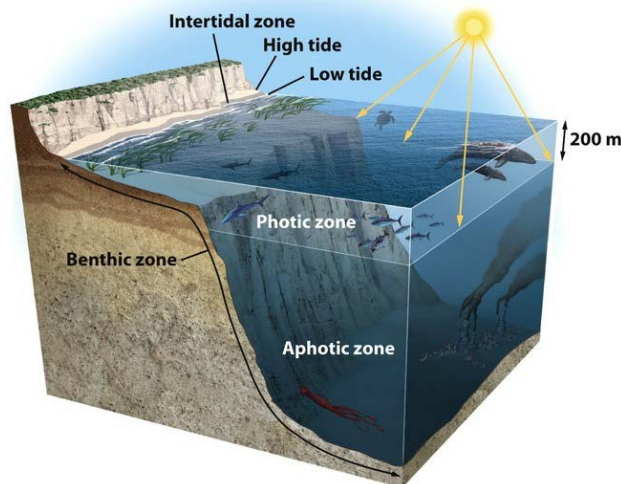
Estuaries	<p>areas where _____ into the ocean</p> <p> Mix of _____ water (species adapt to this ex: _____ trees)</p> <p> High _____ (plant growth) due to nutrients in sediments deposited in estuaries by river</p> <p>_____:</p> <ul style="list-style-type: none"> ● Estuary hab. along coast in _____ ● _____ for many fish & shellfish species <p>_____:</p> <ul style="list-style-type: none"> ● Estuary hab. along coast of _____ ● Mangrove trees with long, stilt roots _____ & _____ for many species of fish & shellfish
Coral Reef	<ul style="list-style-type: none"> ● _____ shallow waters beyond the shoreline; most _____ marine (ocean) biome on earth ● _____ relationship between _____ (animals) & _____ (plants) ● Coral take _____ out of ocean to create calcium carbonate _____ (the reef) & also provide CO₂ to the _____ ● Algae _____ & provide _____ (energy) to the coral through _____ <p> Both species rely on the other:</p> <ul style="list-style-type: none"> - Coral couldn't survive without _____ from algae. - Algae need the _____ of the reef & CO₂ from the coral
Intertidal Zones	<ul style="list-style-type: none"> ● Narrow band of coastline between _____ ● Organisms must be _____ to survive _____ & _____ during low tide Ex: Barnacles, sea stars, crabs that can attach themselves to rocks ● Shells & tough outer skin can prevent drying out (_____) during low tides <p> Diff. organisms are _____ to live in diff. Zones</p> <p>Ex: Spiral wrack (type of seaweed) curls up & secretes mucus to retain water during low tide</p>



Open Ocean

- Low _____/area as only _____ & _____ can survive in most of ocean
 🌍 So _____ though, that algae & phytoplankton of ocean _____ a lot of earth's _____ & _____ a lot of atmospheric _____
- _____ = area where sunlight can reach (photosynthesis)
- _____ (abyssal) = area too deep for sunlight

Practice FRQ 1.3



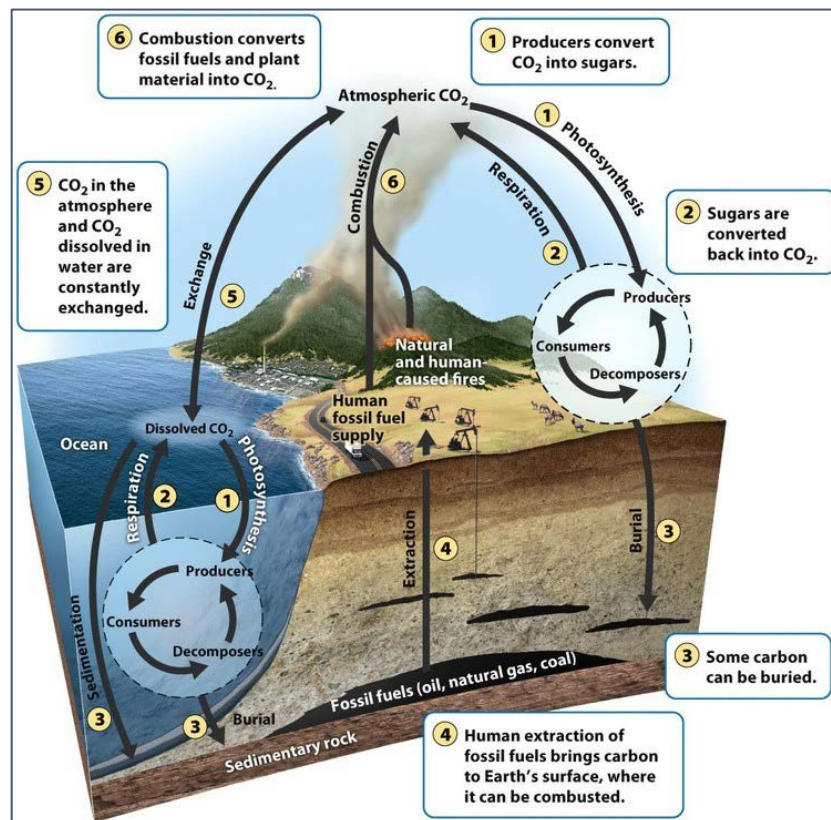
Identify an organism found in an aquatic biome and **explain**

	how that organism is uniquely adapted to live in that biome.
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1.4 The Carbon Cycle


Carbon Cycle Overview

- Movement of molecules that contain Carbon (_____, _____, _____) between _____ and _____
- 🌱 Some steps are very quick (_____); some are very slow (_____ & _____)
- 🌱 Leads to _____ in which reservoirs or sinks are storing carbon
- Atmosphere is key C reservoir; _____ levels of C in atm. Leads to _____
- _____: a carbon _____ that _____ more carbon than it _____
 - _____ (algae & sediments), _____, _____
- _____: processes that _____ C to _____
 - Fossil fuel (oil, coal, nat gas) _____
 - _____ (cow burps & farts = CH_4)
 - _____, releases CO_2 from trees




Photosynthesis & Cellular Respiration

- Plants, algae, phytoplankton

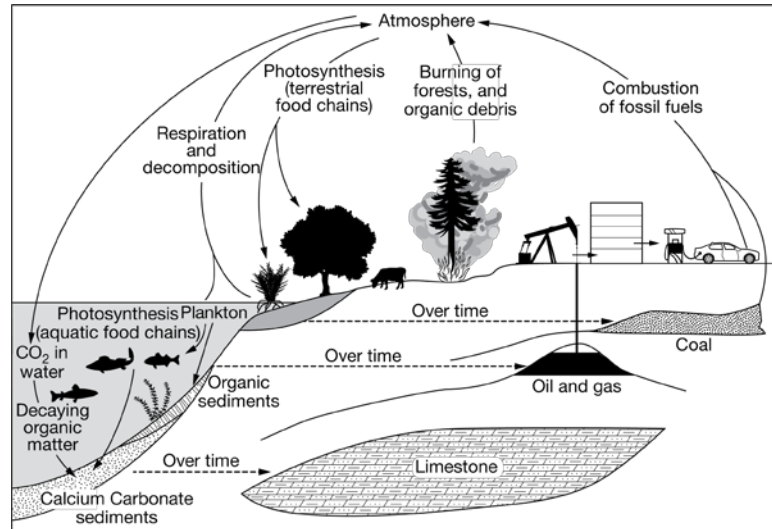
	<ul style="list-style-type: none"> ● Removes CO₂ from the atmosphere & converts it to glucose ● Glucose = biological form of C & stored (chemical) energy in form of sugar ● _____ <hr/> <ul style="list-style-type: none"> ● Done by plants & animals to release stored energy ● Uses O₂ to break glucose down & release energy ● Releases CO₂ into atmosphere ● _____ (adds CO₂ to atm.)
Ocean & Atmosphere	<ul style="list-style-type: none"> ● _____: CO₂ moves directly between _____ & the _____ by _____ into & out of ocean water at the surface  Happens very _____ & in _____, balancing levels of CO₂ between atm. & ocean ● B/c of direct exchange, _____ atm. CO₂ also _____ ocean CO₂, leading to _____ ● _____: take CO₂ out of the ocean & atm. through _____ <ul style="list-style-type: none"> ○ _____ reef & marine org. with _____ also take CO₂ out of the ocean to make _____ ● _____: when marine org. die, their bodies sink to ocean floor where they're broken down into sediments that contain C <ul style="list-style-type: none"> ○ _____: over, long, periods of time, pressure of water compresses C-containing sediments on ocean floor into sedimentary stone (limestone, sandstone) - long-term C reservoir
Burial, Extraction, & Combustion	<ul style="list-style-type: none"> ● _____: slow, geological process that stores C in underground sinks like sedimentary rock or fossil fuels ● _____ (bits of rock, soil, organic matter) compressed into sed. rock, or FF, by pressure from overlying rock layers or water ● _____: coal, oil, and Nat. gas are formed

from fossilized remains of org. Matter. Ex: dead ferns (coal) or marine algae & plankton (oil)

- _____: digging up or mining FFs & burning them as energy source; releases CO₂ into atm.

 _____ (formation of FFs) takes far _____ than **extraction & combustion**, which means they _____ of CO₂ in atmosphere

Practice FRQ 1.4

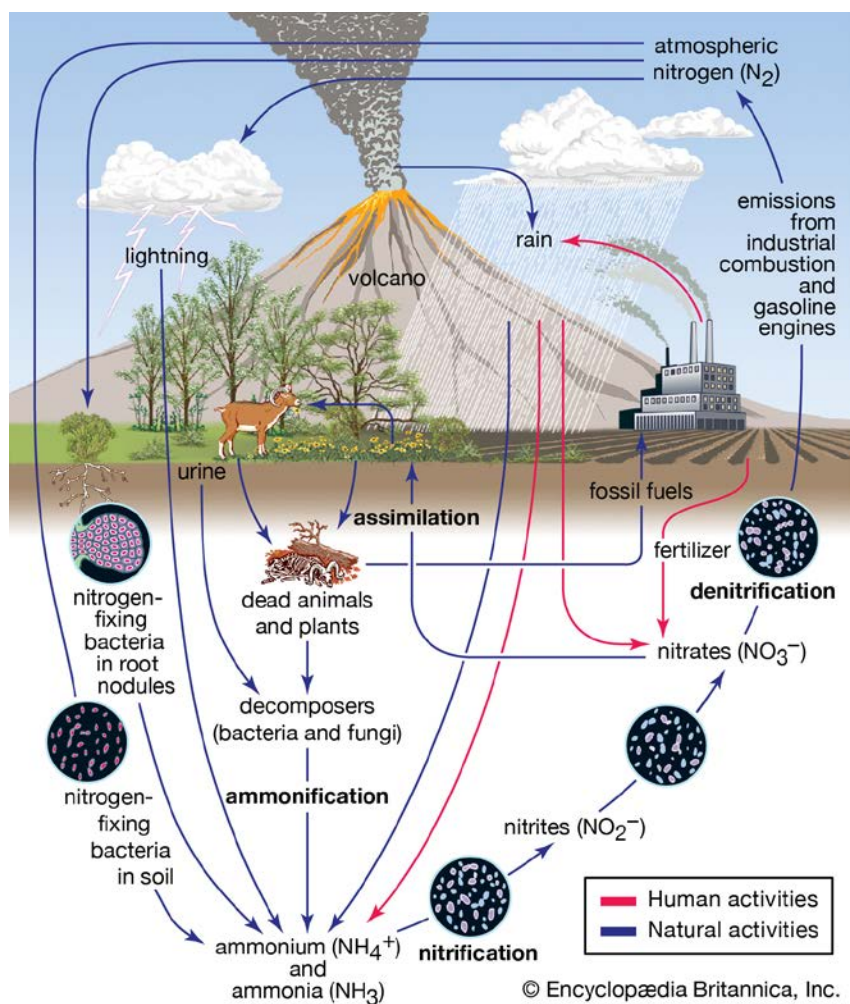


Identify ONE process in the diagram that happens quickly and ONE process that happens slowly.

Explain how the rate at which fossil fuels are transferred into the atmosphere, as shown in the diagram, has altered the carbon cycle during the past 250 years.

1.5 The Nitrogen Cycle

Nitrogen Cycle Overview	<p>Mvmnt of _____ between _____ & _____</p> <p>Sources release N into atmosphere; sinks take N out of the atmosphere in increasing amounts</p> <p>N _____ hold N for relatively _____ period of time compared to C cycle</p> <p>- Ex: _____ _____ = _____ N reservoir</p> <p>N in atm. exists mostly as _____ gas, not _____ by plants or animals</p> <p>N = critical plant & animal _____</p> <p>All living things need N for _____ & amino acids to make _____</p>
Nitrogen Fixation	<p>Process of N₂ gas being _____ into _____ (useable by plants) _____ or _____</p> <p>_____ fixation: certain bacteria that live in the _____, or in _____ relationship with plant _____ convert _____</p> <p>_____ live in root nodules of _____ (peas, beans) & _____ for them in return for _____ from the plant</p> <p>_____ : humans _____ to convert _____ gas into _____</p> <p>Nitrates are added to _____ like _____ & used in _____</p>



Other N Cycle Steps

_____ : plants & animals _____
 _____ and _____ it into their
 body

Plant roots take in _____ from soil; animals
 assimilate N by _____ plants or other animals

_____ : soil bacteria, microbes &
 decomposers _____ back into
 _____ and returning it to _____

_____ : conversion of _____ into
 _____ & then _____ by soil bacteria

_____ : conversion of soil N _____
 into _____ gas which returns to
 atmosphere

Human Impacts on N Cycle

_____ : N_2O (nitrous oxide) =
 _____ which warm earth's climate

Produced by _____ of nitrate in agricultural
 soils (especially when waterlogged / over watered)

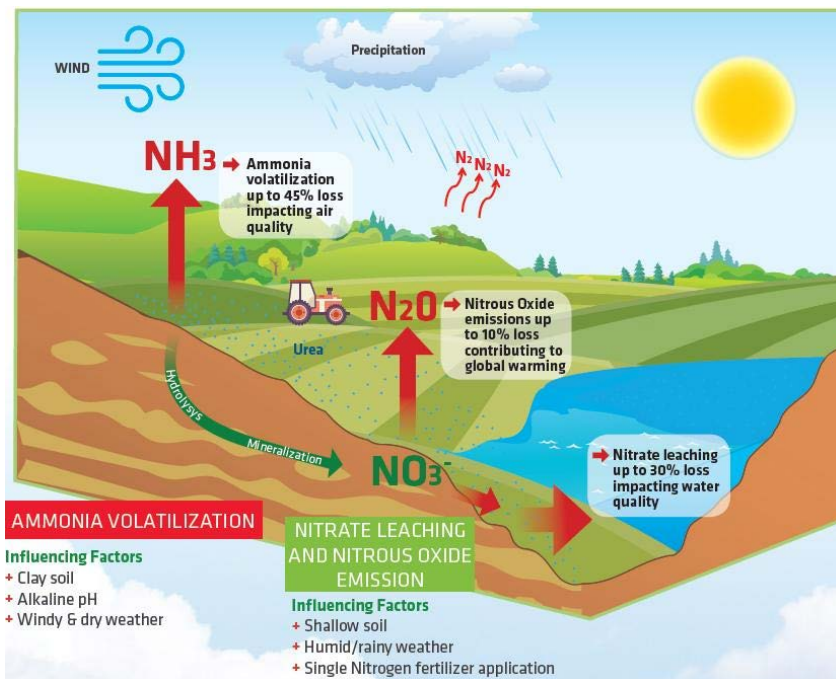
_____ : excess _____ use
can lead to _____ gas entering atm.

NH_3 gas in atm = _____ (rain) and
_____ in humans & animals

It also means _____ for crops to use for
growth (lost _____)

_____ : synthetic fertilizer use leads
to nitrates (NO_3) _____, or being carried out of soil by
water

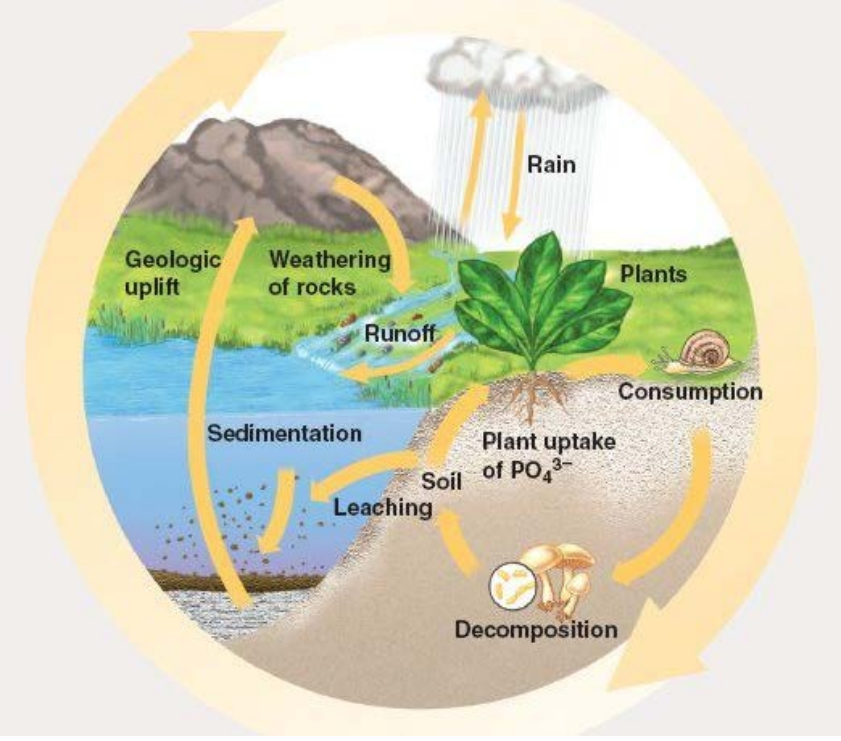
Nitrates _____ into local waters, causing
_____ that block sun & kill other aq.
plants

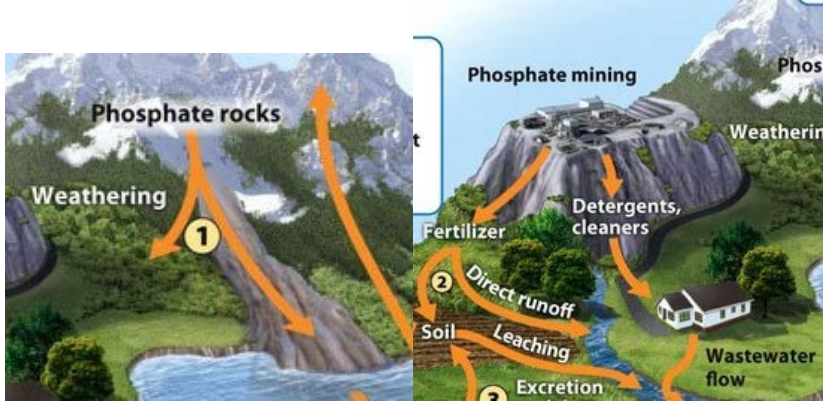



Practice FRQ 1.5

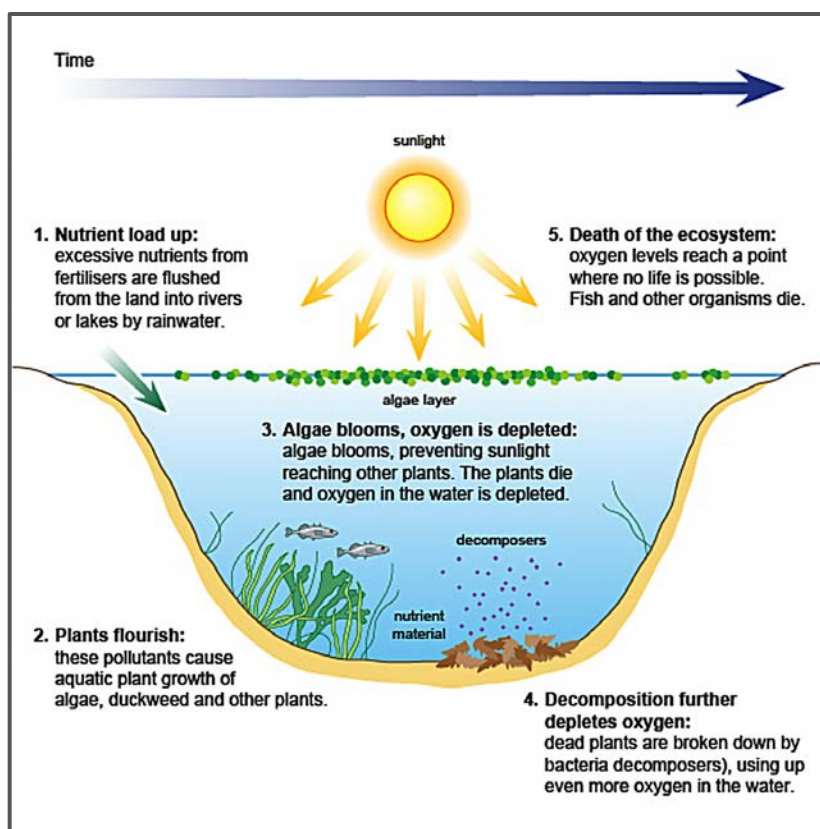
Describe ONE chemical transformation that occurs in the natural nitrogen cycle and **explain** the importance of that transformation to an ecosystem.

1.6 The Phosphorus Cycle

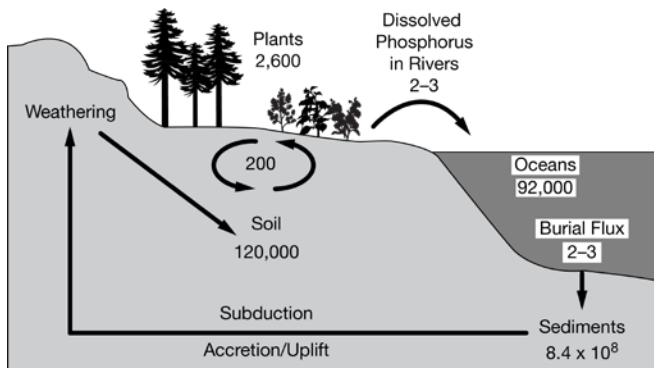
<p>Phosphorus Cycle Basics</p>	<ul style="list-style-type: none">● Movement of P atoms & molecules b/w _____ & _____ <p>🏞️ _____ containing P minerals = major reservoirs</p> <p>P cycle is _____ compared to C/H₂O/N cycles</p> <p>🏞️ Takes a long time for P minerals to be _____ out of rocks & _____ into soil/bodies of water</p> <p>🏞️ _____ of P (doesn't enter atmosphere)</p> <p>🏞️ B/c it cycles so slowly, it is a _____, meaning _____ in ecosystems is often limited by P availability in soil/water</p> <p>P is needed by all organisms for DNA, ATP (energy), bone & tooth enamel in some animals</p> 
<p>Phosphorus Sources</p>	<p>Major <u>natural</u> source of P is _____ that contain P minerals.</p> <p>Wind & rain break down rock & _____ is _____ and _____ into water; rain water</p>

	<p>carries phosphate into nearby _____ & bodies of water</p> <p>🌱 Weathering is so slow that P is often a limiting nutrient in _____ ecosystems</p> <p>_____ (human) sources of P = _____ phosphate minerals & adding to products like synthetic _____ & _____</p> <p>Synthetic _____ containing phosphates are added to _____; _____ carries P into nearby _____</p> <p>Phosphates from _____ & _____ enter bodies of water via _____ from homes</p>  <p>The diagram illustrates the phosphorus cycle. On the left, 'Phosphate rocks' are shown undergoing 'Weathering' (labeled 1), which releases phosphate into the soil. On the right, 'Phosphate mining' is depicted, leading to 'Fertilizer' production. Fertilizer is used on crops, leading to 'Direct runoff' into a river. Another path shows 'Detergents, cleaners' from a house entering 'Wastewater flow' into the same river. From the river, phosphate can be 'Leaching' into the 'Soil' (labeled 2) or 'Excretion' (labeled 3) from animals. The cycle then returns to the soil and back to plants.</p>
<p>Assimilation & Excretion/Decomp.</p>	<p>Just like N, P is _____ by plant roots & _____ into tissues; animals assimilate P by _____ plants or other animals</p> <p>Animal waste, plant matter & other biomass is broken down by _____ that return phosphate to soil</p> <p>🌱 _____ & _____ form a mini-loop within P cycle just like assimilation & ammonification in N Cycle, photosynth & resp. in C cycle</p>  <p>This diagram shows a 'mini-loop' within the phosphorus cycle. It features 'Plants' and 'Animals' (represented by cows) in a field. Arrows show phosphate moving from the soil to plants, then to animals. From animals, phosphate is returned to the soil through 'Excretion and decomposition' (labeled 3). There is also a 'Leaching' arrow from the soil back to a body of water.</p>
<p>Sedimentation & Geo. Uplift</p>	<p>Phosphate _____ very well into water; much of it forms solid bits of phosphate that fall to the</p>

	<p>bottom as _____ (sedimentation)</p> <p>P sediments can be _____ into _____ over long time periods by pressure of overlying water</p> <p>_____ = tectonic plate collision forcing up rock layers that form mountains; P cycle can start over again with weathering & release of phosphate from rock</p>
<p>Eutrophication (too much N & P)</p>	<p>**Can occur from _____, human/animal _____ contamination</p> <p>B/c they're limiting nutrients in aq. ecosystems, extra input of N & P lead to _____ (excess nutrients) which fuels algae growth</p> <p>Algae bloom _____ of water, _____ & _____ below surface</p> <p>Algae eventually die-off; _____ that break down dead algae use up _____ in the water (b/c decomp. = aerobic process)</p> <p>Lower O₂ levels (_____) in water _____ aquatic animals, especially fish</p>

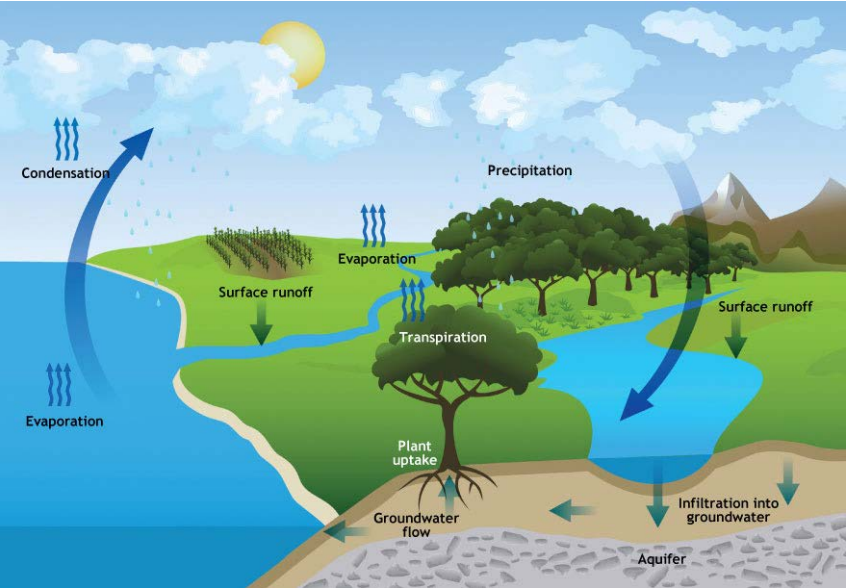


Practice FRQ 1.6

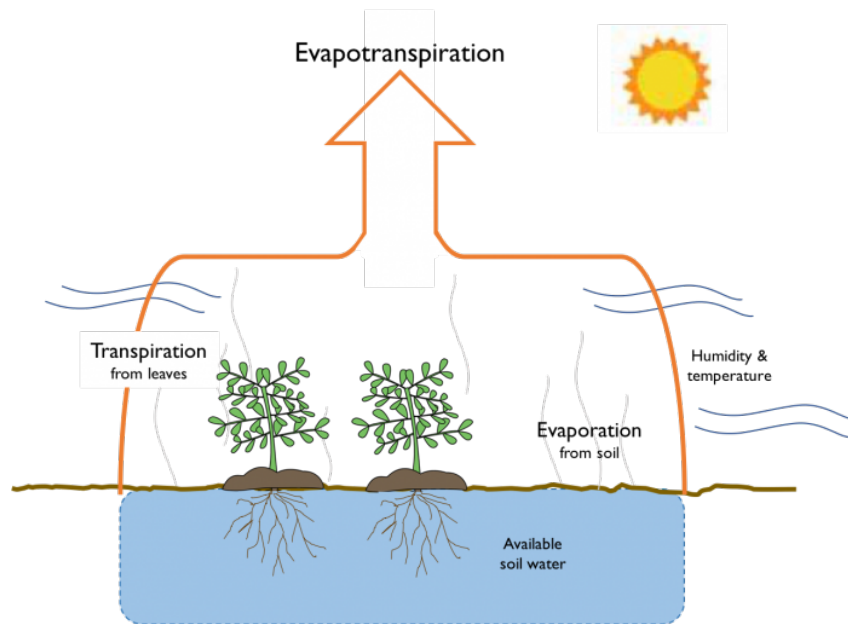


Choose 2 reservoirs depicted in the diagram above and **describe** how phosphorus moves from one to the other

1.7 The Hydrologic (Water) Cycle

Water Cycle Overview	<p>Movement of _____ (in different states) b/w _____ & _____</p> <p>_____ (solid/liquid/gas) as well as _____ water is moving are key in H₂O cycle</p> <p>Ex: precipitation = atm. (gas) → land or surface water (liquid)</p> <p>_____ Energy from _____ drives the H₂O cycle</p> <p>Ex: heat from sun causes liquid water in ocean to become a gas (evaporation) in atm.</p> <p>_____ = largest water reservoir</p> <p>_____ & _____ are smaller reservoirs, but contain fresh, useable water for humans</p> 
Evaporation & Evapotranspiration	<p>2 main _____ of water (processes that cycle it from liquid on earth back into the atmosphere)</p> <p>Sometimes called “_____” since liquid water becomes water vapor (gas) in atm.</p> <p>_____: process _____ use to draw groundwater from _____ up to their _____</p> <p>Leaf openings called _____ open, allowing water to evap. into atm. from leaf</p> <p>Mvmnt of H₂O out of leaf creates low _____ in leaf, pulling H₂O up from roots</p> <p>_____: amount of H₂O that enters atm. from transpiration & evap. combined</p>

Both processes are driven by _____ from the _____



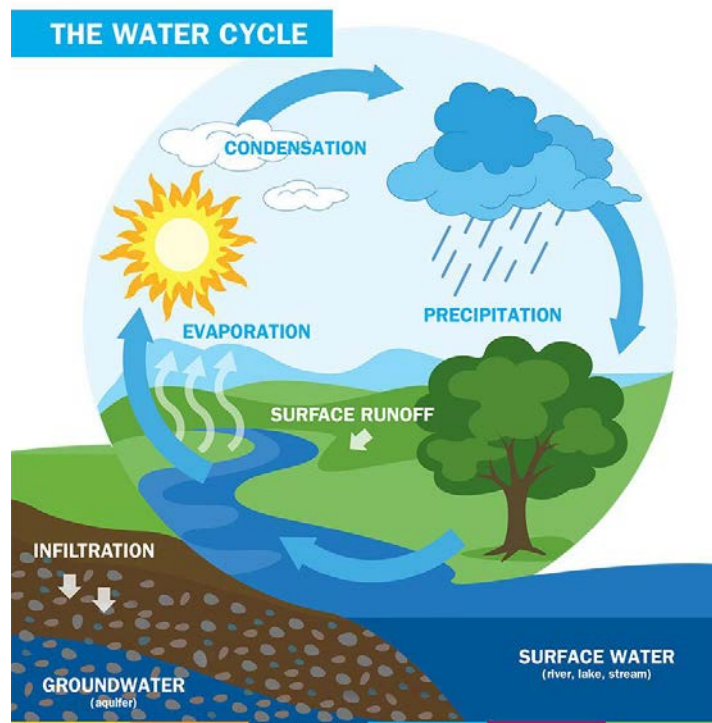
Runoff & Infiltration

Precipitation (rain) either _____ earth's surface into a body of water (runoff) or _____ soil down into groundwater aquifers (_____)

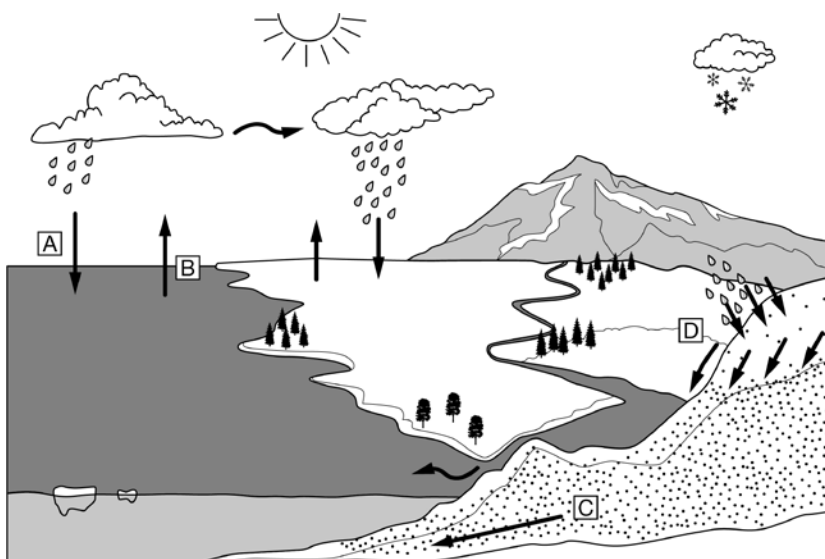
Groundwater (_____) & surface waters (lakes/ivers) are important _____ reservoirs for humans & animals

Precipitation _____ groundwater through infiltration, but only if ground is _____ (able to let water pass through)

Runoff recharges _____ waters, but can also carry _____ into water sources






Practice FRQ 1.7



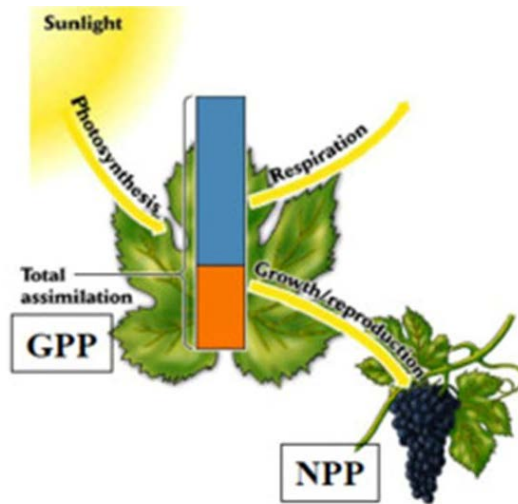
Choose a process from the diagram. **Identify** the process and **describe** how water is moving from one reservoir to another.

1.8 Primary Productivity

PP Basics	<p>Primary Productivity: rate that _____ energy is _____ into _____ compounds via _____ over a unit of _____</p> <p>Aka: rate of photosynthesis of all producers in an area over a given period of time</p> <p>Since photosynthesis leads to _____, you can also think of PP as the _____ of plant _____ in an area over a given period of time</p> <p>units: kcal/m²/yr.</p> <p>_____ PP = _____ plant growth = _____ of food & shelter for animals</p> <p> Ecosystems with _____ PP are usually more _____ (more div. of species) than ecosystems with low PP</p>
Calculating PP	<p> Respiration loss (RL): plants _____ up some of the _____ they generate via photosynthesis by _____ (movement, internal transportation, etc.)</p> <p><i>Think of RL as taxes plants need to play</i></p> <p>Gross Primary Productivity (GPP): The _____ amount of _____ energy (light) that plants capture and _____ to energy (_____) through photosynthesis</p> <p><i>Think of GPP as the total paycheck amount the plant earns</i></p> <p>NPP = GPP - RL</p>

 **Net Primary Productivity (NPP):** The amount of energy (_____) leftover for _____ after plants have used some for respiration

Think of NPP as the actual amount of the plant's paycheck it keeps after taxes



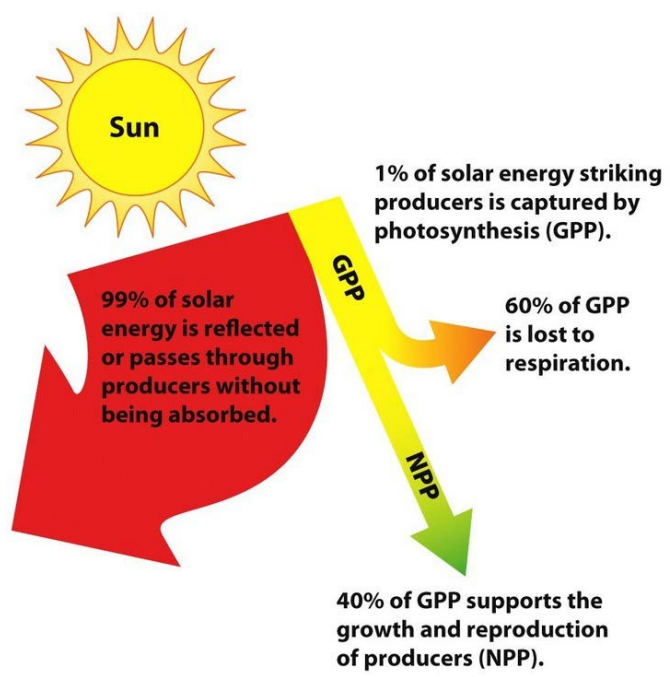


Ecological Efficiency

The portion of _____ solar energy that is captured by plants & converted into biomass (NPP or _____ for consumers)

Generally, only _____ of all incoming sunlight is captured & _____ into GPP via photosynthesis







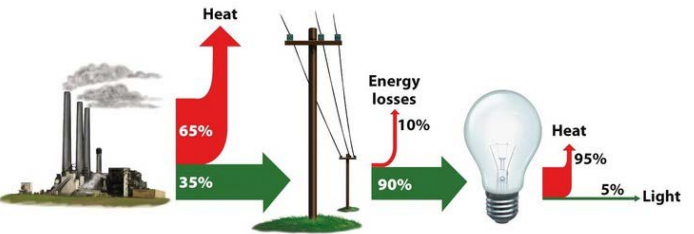
Of that 1%, only about _____ (or _____ of total incoming solar energy) is converted into _____/_____ (NPP)

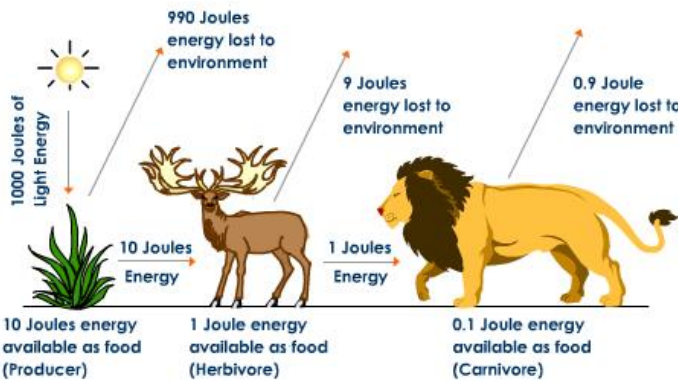
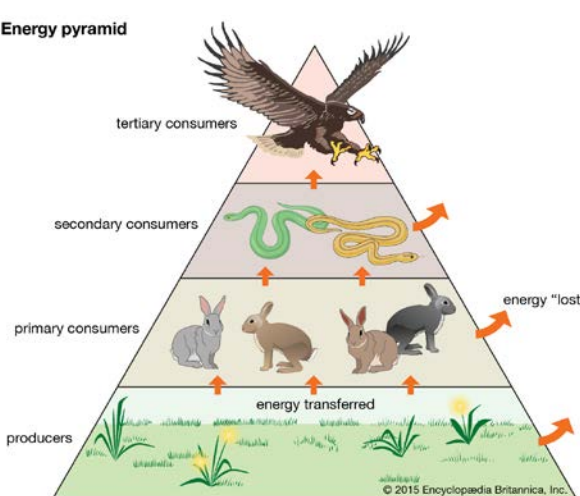
Some ecosystems are _____ (higher NPP) than others

	 <p>Sun</p> <p>99% of solar energy is reflected or passes through producers without being absorbed.</p> <p>1% of solar energy striking producers is captured by photosynthesis (GPP).</p> <p>GPP</p> <p>60% of GPP is lost to respiration.</p> <p>NPP</p> <p>40% of GPP supports the growth and reproduction of producers (NPP).</p>
<p>Trends in Productivity</p>	<p> The more _____ a biome is, the _____ the _____ of animal life it can _____ (high. biodiv.)</p> <p>***Try to predict the most & least productive terrestrial and aquatic biomes ***</p> <p> Water _____, _____ temperature, and _____ availability are all factors that lead to _____ NPP</p> <p>Shortage of any of these three factors will lead to decreased NPP</p> <p>Ex: Desert (low H₂O & nutrients)</p> <p>Tundra (low temp & liquid H₂O)</p> <p>Open ocean (low nutrients)</p>

	<p>Continental ecosystems</p> <table border="1"><thead><tr><th>Ecosystem</th><th>Net primary productivity (g C/m²/year)</th></tr></thead><tbody><tr><td>Swamps and marshes</td><td>2500</td></tr><tr><td>Tropical rainforest</td><td>2000</td></tr><tr><td>Tropical seasonal forest</td><td>1500</td></tr><tr><td>Temperate rainforest</td><td>1300</td></tr><tr><td>Temperate seasonal forest</td><td>1200</td></tr><tr><td>Boreal forest</td><td>800</td></tr><tr><td>Savanna</td><td>700</td></tr><tr><td>Cultivated land</td><td>600</td></tr><tr><td>Woodlands/Shrublands</td><td>550</td></tr><tr><td>Lakes and streams</td><td>500</td></tr><tr><td>Temperate grassland</td><td>500</td></tr><tr><td>Tundra</td><td>150</td></tr><tr><td>Desert scrub</td><td>100</td></tr><tr><td>Extreme desert</td><td>50</td></tr><tr><td>Marine ecosystems</td><td></td></tr><tr><td>Coral reefs</td><td>2000</td></tr><tr><td>Salt marshes</td><td>1800</td></tr><tr><td>Upwelling zones</td><td>500</td></tr><tr><td>Continental shelf</td><td>400</td></tr><tr><td>Open ocean</td><td>200</td></tr></tbody></table> <p>Net primary productivity (g C/m²/year)</p>	Ecosystem	Net primary productivity (g C/m²/year)	Swamps and marshes	2500	Tropical rainforest	2000	Tropical seasonal forest	1500	Temperate rainforest	1300	Temperate seasonal forest	1200	Boreal forest	800	Savanna	700	Cultivated land	600	Woodlands/Shrublands	550	Lakes and streams	500	Temperate grassland	500	Tundra	150	Desert scrub	100	Extreme desert	50	Marine ecosystems		Coral reefs	2000	Salt marshes	1800	Upwelling zones	500	Continental shelf	400	Open ocean	200
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Practice FRQ 1.8	<p>Describe the process of net primary productivity (NPP).</p> <p>Describe the relationship between primary productivity and biodiversity.</p>																																										

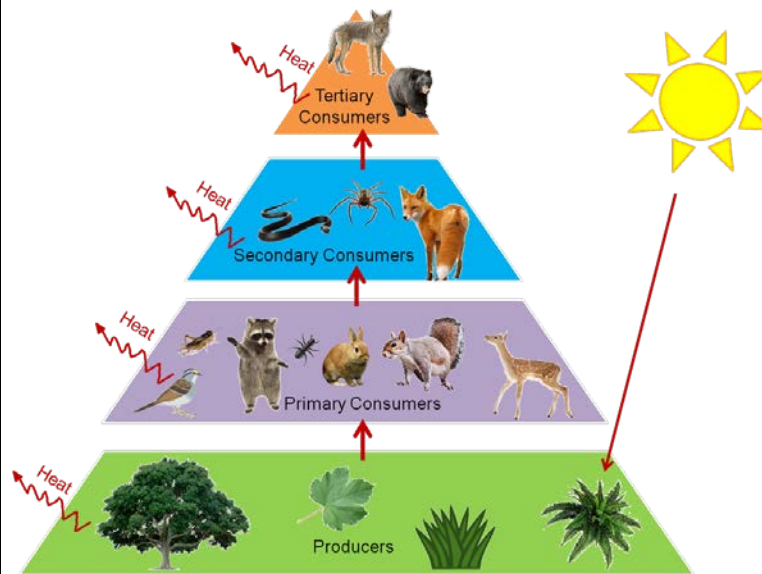
1.9 & 1.10 Trophic Levels & The 10% Rule

<p>Conservation of Matter & Energy</p>	<p> Matter & energy are never _____ or _____; they only _____</p> <p>Ex: Tree dies & the C/N/H₂O/P are returned to the soil & atmosphere</p> <p>Ex: Sun rays (_____ energy) hit leaves & are _____ into glucose (_____ energy)</p> <p> _____ of _____: energy is never created or destroyed</p> <p>_____ demonstrate conservation of matter (C/N/H₂O/P)</p> <p> _____ demonstrate conservation of energy</p> <p>Ex: When a rabbit eats a leaf, the energy from the leaf (glucose) is transferred to the rabbit & stored as body tissue like fat/muscle</p>
<p>2nd Law of Thermodynamics</p>	<p> Each time energy is transferred, some of it is _____ as _____</p> <p><u>Applied to food webs:</u> the amount of <u>useable</u> energy decreases _____ as you move _____ the food chain (organisms use up most of it for movement, development, etc.)</p> <p> Because <u>*available*</u> energy decreases with each step up the food chain, a _____ (troph = nourishment or growth) is used to _____ how energy moves _____ an ecosystem</p> <p> <u>10% Rule:</u> in trophic pyramids, only about _____ of the energy from _____ makes it to the _____; the other _____ is _____ by the organism & _____ as heat</p> <div data-bbox="446 1680 1136 1911"></div> <p>Calculation: (35%) × (90%) × (5%) = 1.6% efficiency</p>

	 <p style="text-align: center;">Progressive Loss of Energy in Food Chain</p>  <p style="text-align: center;">© 2015 Encyclopædia Britannica, Inc.</p>
Trophic Levels & 10% Biomass	<p>_____ Consumers: animals that eat secondary consumers or carnivores & omnivores (aka - top/apex predators)</p> <p>_____ Consumers: animals that eat primary consumers or herbivores (aka - carnivores & omnivores)</p> <p>_____ Consumers: animals that eat plants (herbivores)</p> <p>_____ (plants) “produce”- really convert sun’s light energy into chemical energy (glucose)</p> <p>🌱 10% rule also applies to _____ (or mass of all living things at each trophic level) Since energy is needed for growth & only 10% of energy transfers from one level to the next, only 10% of the biomass can be grown/supported</p>
Calculating Biomass & Energy	<p>🌱 To calculate biomass or energy available at the next level up, _____ the _____ to the V _____ (or _____ by 10)</p>

Calculating Biomass & Energy

Try calculating biomass




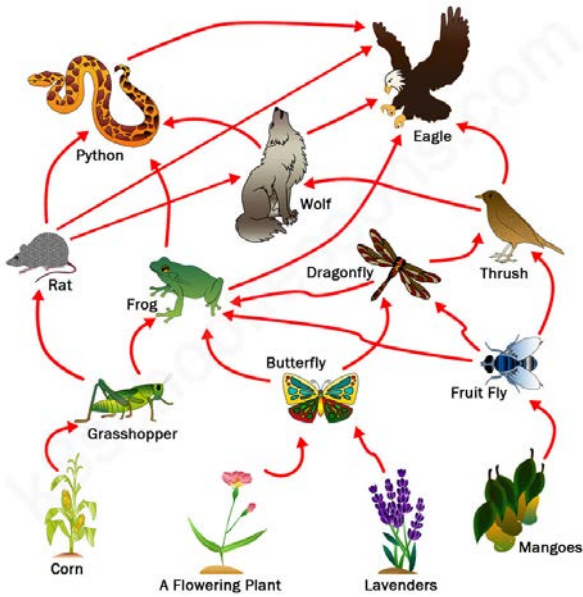
Practice FRQs 1.9 & 1.10

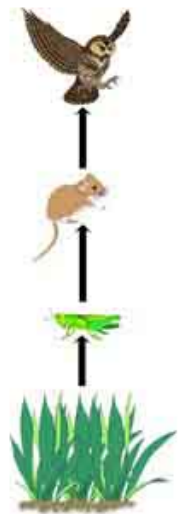
Explain why a relatively large forest can only support a small number of wolves.

Calculate the amount of energy available to a tertiary consumer in the following ecosystem.

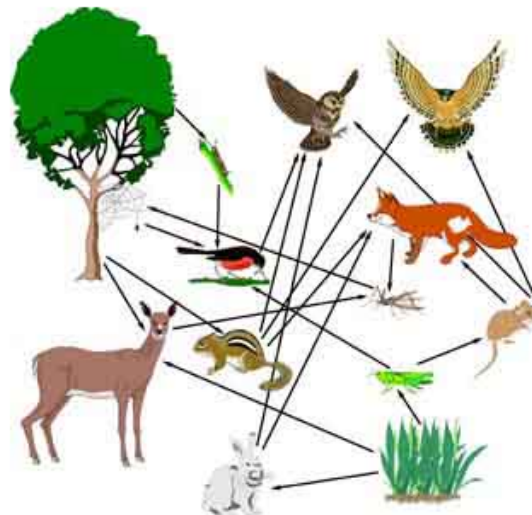
100,000 J of energy produced by plants in the ecosystem

1.11 Food Chains & Food Webs

<div>Food Web Basics</div>	<div>Shows how _____ & _____ flow _____ an ecosystem, from organism to organism</div> <div>When one organism _____ (eats) _____, the matter (C/N/H₂O/P) and energy (glucose, muscle tissue, etc.) are _____ on to the _____</div> <div> _____ in food webs indicate _____ of _____ (point to the org. taking in the energy)</div> <div><div>A Food Web</div></div>
<div>Food Web vs. Chain</div>	<div>Food chains just show _____, _____ of energy & matter</div> <div>Food webs have <u>at least 2</u> different, _____ food chains</div> <div>Webs show that organisms can exist at different trophic levels</div> <div>grass → hare → owl (sec. cons.)</div> <div>grass → grasshopper → robin → owl (tert. cons.)</div>



FOOD CHAIN
(just one path of energy)



FOOD WEB
(everything is connected!)

**Interactions &
Trophic Cascade**

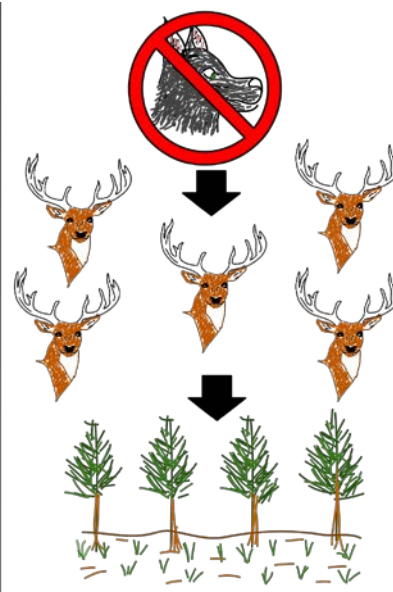
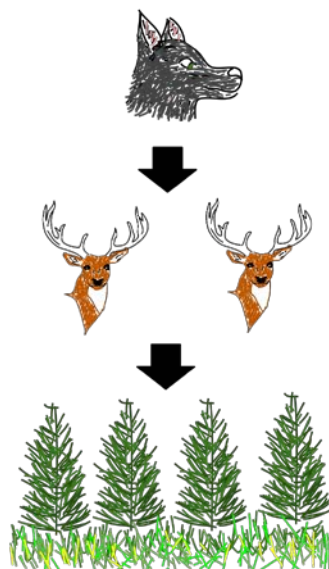
Food webs show how _____ or _____ in _____ of a given species _____ the rest of the food web

Ex: Increase in python pop.

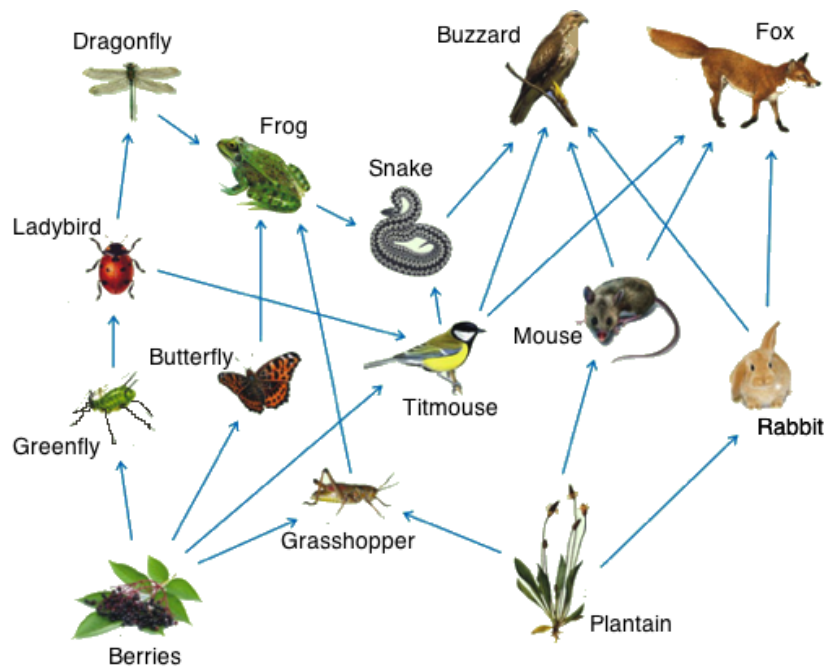
- Decrease in frog & rat pops.
- Increase in grasshopper pop.
- Decrease in corn

_____ : removal or addition of a
_____ has a _____ effect
_____ through lower troph. levels

Ex: decline in wolf pop. = increase in deer pop. which leads to overgrazing & decline in trees



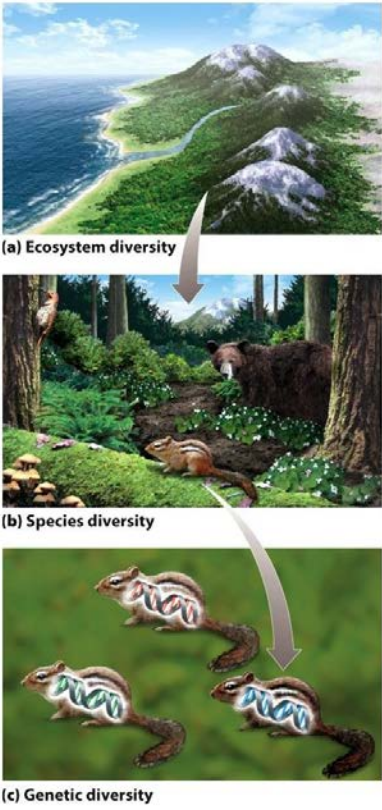
Practice FRQ 1.11



Describe one direct effect that a decline in the frog population would have on the food web.

Identify an organism that is both a secondary and tertiary consumer.

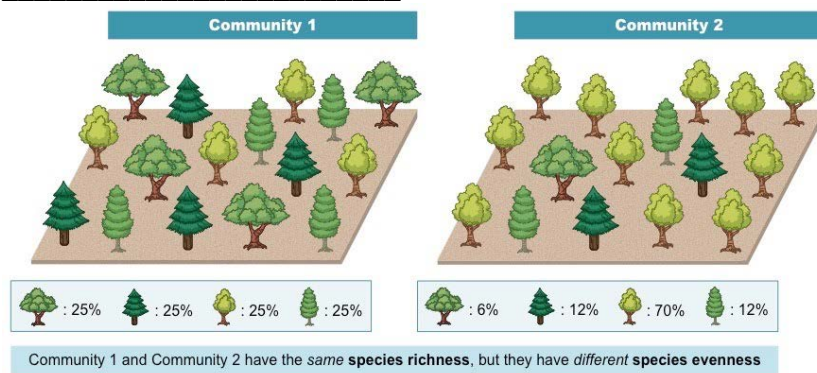
2.1 Intro to Biodiversity

<p>Biodiversity Basics</p>	<p>_____ of _____ in an ecosystem; _____ on _____ different levels:</p> <p>_____: the _____ of diff. _____ available in a given area</p> <p>_____: the _____ of diff. _____ in an ecosystem and the balance or _____ of the pop. sizes of all species in the ecosystem</p> <p>_____: how _____ the genes are of individuals within a population (group of the same species)</p> <p>_____ biodiversity = _____ ecosystem / population health</p> <div data-bbox="597 856 976 1661"><p>(a) Ecosystem diversity</p><p>(b) Species diversity</p><p>(c) Genetic diversity</p></div>
<p>Species Richness & Evenness</p>	<p>_____ (r) is just the _____ of different species found in an ecosystem</p> <p>High (r) is generally a good sign of ecosystem health (more _____ means more quality)</p>

_____ like H₂O & soil)

_____ 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 pop. sizes are _____



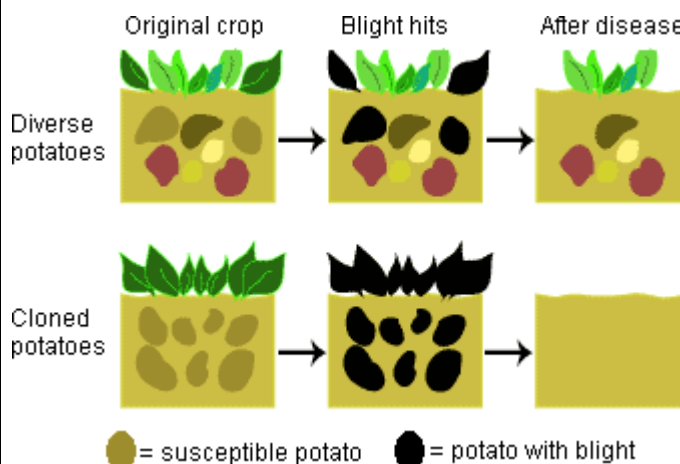
Genetic Diversity is Beneficial

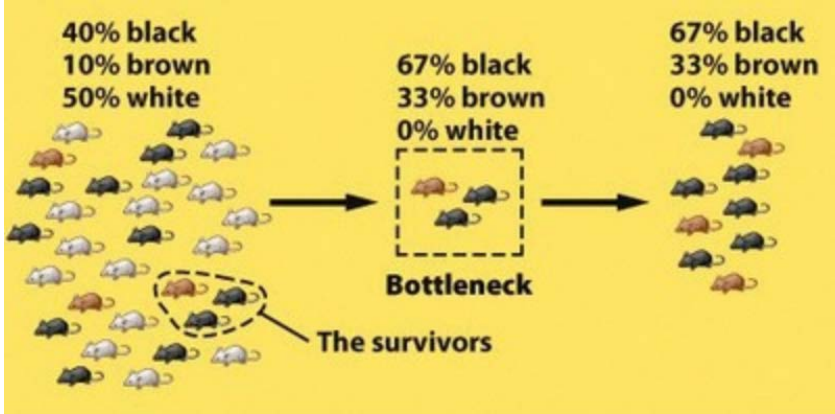

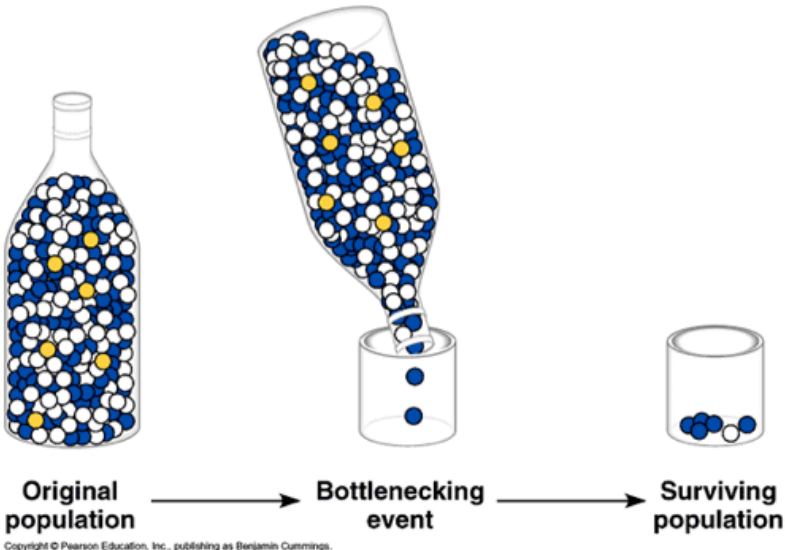
_____ = measure of how different the _____ (set of genes) are of the _____ within a population of a given species




There is genetic diversity in all pops. because _____ in copying of DNA & _____ of chromosomes in sex cells of parents leads to new gene combinations & new traits in offspring

 The more _____ in a pop. the better the _____ can respond to env. _____ like drought, disease, or famine



More gen. div. = higher chance that _____ of the individuals in a pop. have _____ that allow them to _____ the env. stressor










<p>Bottleneck Event</p>	<p>An env. _____ (natural disaster/human hab. destruction) that drastically _____ & kills organisms regardless of their _____</p> <p>Surviving pop. is _____ and because individuals died _____, it doesn't represent the genetic _____ of the _____ pop.</p>  <p>The diagram illustrates a bottleneck event using mice. On the left, the 'Original population' consists of 40% black, 10% brown, and 50% white mice. An arrow points to a 'Bottleneck' stage where only a few mice survive, labeled 'The survivors'. On the right, the 'Surviving population' consists of 67% black, 33% brown, and 0% white mice.</p> <p> Bottleneck events _____ genetic _____</p> <p>Because the pop. is _____ & less genetically _____, it's even more _____ to future env. _____</p>  <p>The diagram shows a bottle of beads representing the 'Original population' (mostly blue and white, with some yellow). The bottle is tilted, and beads are poured into a small cup, representing the 'Bottlenecking event'. The cup contains only a few beads, representing the 'Surviving population'.</p> <p>Original population → Bottlenecking event → Surviving population</p> <p><small>Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.</small></p>
<p>Inbreeding Depression</p>	<p>Inbreeding is when organisms _____ with closely related " _____ " members</p> <p>Leads to higher chance of offspring having _____</p>

	<p>genetic _____ because they're getting similar _____ from both parents</p> <p>_____ populations are _____ likely to experience inbreeding (difficult to find non-related mate)</p> <p>Ex: Florida panther pop. _____ down to 30 in 1900s due to _____ & _____. Inbreeding depression = kinked tails, heart defects, low sperm count, undescended testicles (saved in 95' by pumas from Texas)</p>
Ecosystem Resilience	<p>_____ = the ability of an ecosystem to _____ to its _____ after a major _____ (wind storm, fire, flood, clear-cutting, etc.)</p> <p> _____ species diversity = _____ ecosystem resilience</p> <p>High sp. div means _____ to repopulate disturbed ground, anchor soil, and provide food & habitat for animal species</p> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>(a)</p> </div> <div style="text-align: center;">  <p>(b)</p> </div> </div>
Practice FRQ 2.1	<p>Describe one of the three levels of biodiversity.</p> <p>Explain how high biodiversity at the level you described is beneficial to ecosystems.</p>

2.2 Eco\$y\$tem \$ervices

<p>Ecosystem Services = \$\$\$</p>	<p> _____ that come from _____ or _____ / _____ that ecosystems _____ that have _____ economic / financial _____ to _____</p> <p>_____</p> <p>Goods _____ from ecosystems or _____ nat. resources (wood, paper, food)</p> <p>_____</p> <p>Nat. ecosystems regulate _____ / _____, reducing _____ & _____ costs</p> <p>_____</p> <p>Nat. ecosystems support _____ we do _____, making them _____ & _____ (bees pollinate crops)</p> <p>_____</p> <p>_____ generated by recreation (parks, camping, tours) or _____</p>
<p>Humans Disrupt Ecosystem Services</p>	<p> Human activities _____ the _____ of ecosystems to _____, which _____ the _____ of _____ they _____</p> <p>_____</p> <p>This has _____ (natural) and _____ (money-based) consequences</p> <p><u>Examples</u></p> <ul style="list-style-type: none">● _____ for ag./cities _____ that _____ (more CO₂ in atm. = more CC = more storm damage & crop failure)● _____ leads to _____ (lost fishing jobs and lower fish sales in the future)

Provisioning Services	<p>_____ directly provided to humans for _____ by ecosystems</p> <p>Ex: _____, hunting _____, (wood for furniture/buildings) naturally grown _____ like berries, seeds, wild grains, honey</p> <p>_____ that are _____ from natural resources that ecosystems provide</p> <p>Ex: _____, _____, _____</p> <p> Disrupted by _____, _____, _____ for ag / urbanization</p>
Regulating Services	<p> Benefit provided by ecosystem processes that _____ natural conditions like _____ and _____</p> <p><u>Examples</u></p> <ul style="list-style-type: none"> • _____ in a forest _____ (store) _____ through _____ which _____ rate of _____ _____ & _____ damage caused by rising _____ & reduces crop failure from _____ • Trees _____ air by _____ air pollutants which _____ health care _____ for treating diseases like asthma and bronchitis <p> Disrupted by _____</p>
Supporting Services	<p> Natural ecosystems _____ processes we do ourselves, making them _____ and _____ for us</p> <p><u>Examples</u></p> <ul style="list-style-type: none"> • _____ plant roots _____, leading to _____ that we don't have to pay as much to _____ with expensive water treatment plants • _____ & other insects _____ our

	<p>_____, leading to more _____ _____ & higher _____</p> <p> Disrupted by pollinator _____ & filling in wetlands for _____</p>
Cultural Services	<p> _____ from _____ _____ (hunting/fishing licenses, park fees, tourism-related spending) & _____ from scientific _____ made in ecosystems (health/ag./educational knowledge)</p> <p><u>Examples</u></p> <ul style="list-style-type: none">● Beautiful _____ draw _____ who _____ to _____ parks, _____ money at local _____, or camping fees● _____ pay for fishing _____ to catch fish in clean rivers● _____ learn about plant _____ that can lead to creation of new _____ which are _____ for _____ <p> Disrupted by _____, _____, _____</p>
Practice FRQ 2.2	<p>Describe an ecosystem service that intact forest ecosystems provide for humans.</p> <p>Identify one human activity that could degrade this ecosystem service and explain how the activity decreases the value of the ecosystem service.</p>

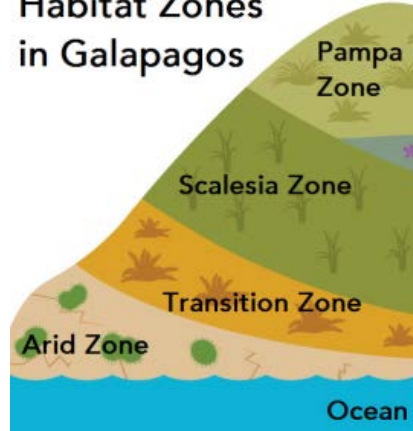
Theory of Island Biogeography

<p>Island Biogeography</p>	<p>Study of _____ & _____ on _____</p> <p>- Islands can be actual islands in a body of water or figurative _____ such as central park in New York City or National Parks (nat. habitats surrounded by human developed land)</p> <p>Two basic “rules” or _____ of Island Biogeography</p> <p>_____ Islands support _____ total</p> <ul style="list-style-type: none">• The _____ the island, the _____ the _____• Greater ecosystem diversity = _____ & _____• _____, or “roles” organisms can play in the ecosystem <p>Islands _____ to the “mainland” support _____</p> <ul style="list-style-type: none">• _____ for _____ to get to island from mainland• More _____ = more _____ in new pop. <div data-bbox="467 1207 1151 1856"><p>The diagram illustrates the Theory of Island Biogeography. It features a map of the British Isles with islands labeled 'large', 'small', 'near', and 'far' relative to the 'Mainland'. A legend indicates that the height of the island represents the 'Increasing Number of Species'. Two graphs are included: one showing 'No. of spp.' vs 'Island Area' with a positive linear relationship, and another showing 'No. of spp.' vs 'Distance from Mainland' with a negative linear relationship.</p></div>
<p>Larger Islands Support More Species</p>	<ul style="list-style-type: none">• Larger islands =<ul style="list-style-type: none">○ higher _____○ More available “_____” or roles

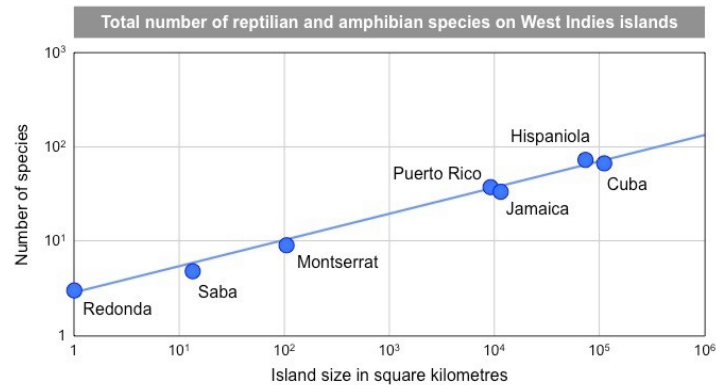
- Ex: all the different food sources available to birds on Galapagos

- _____ pop. sizes (more genetically _____ and more _____ to env. _____)
- Lower _____ (species less likely to die off)

Habitat Zones in Galapagos



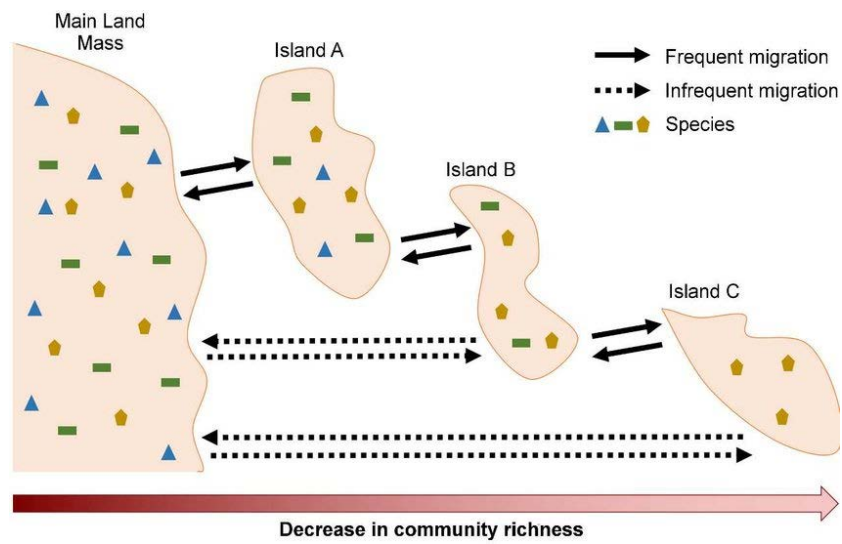
- _____ between island _____ & species _____



Distance to Mainland

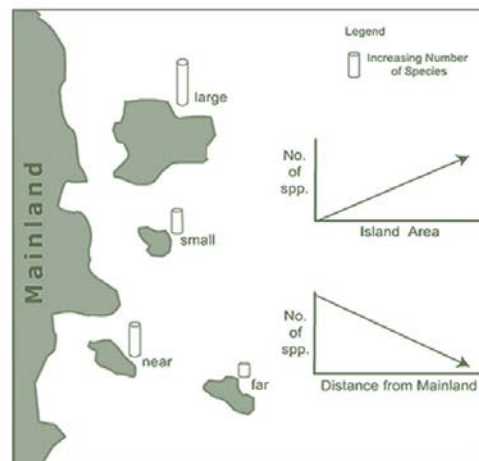
_____ to mainland = higher species

- Easier for more species to _____ to island from mainland (swim/fly)
- More _____ migration of individuals to the island habitat
 - Frequent migration brings more _____ & _____ pop. size

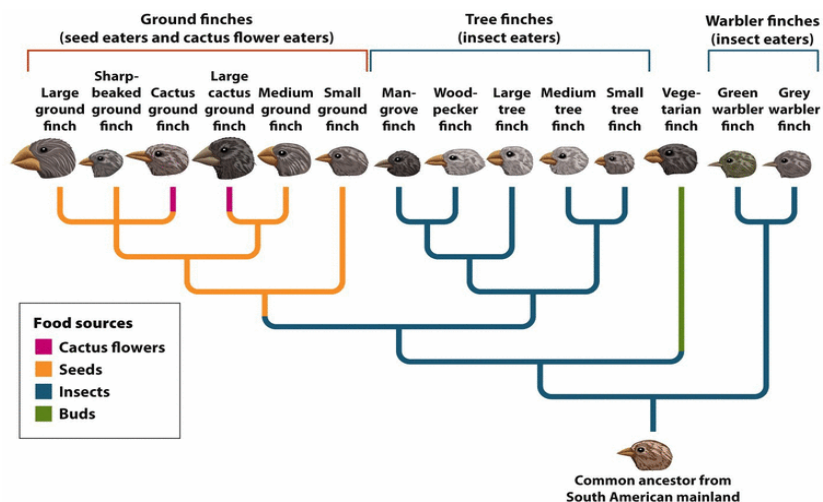



- _____ between island
_____ from mainland & species

- The _____ away from mainland, the
_____ species





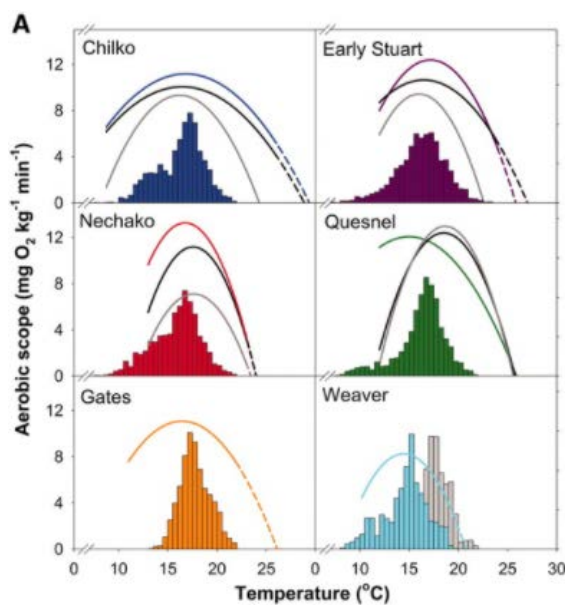
Evolution on Islands




	<ul style="list-style-type: none"> ● Different beaks quickly _____ to fit variety of different _____ on Island ● _____ colonizing species from mainland quickly _____ to many slightly _____ species to _____ to new island cond. <p>Habitat Zones in Galapagos</p> 
Practice FRQ 2.3	<p>Describe the processes of colonizing an island habitat.</p> <p>Describe how the island's distance from the mainland influences the number of species that will colonize the island habitat.</p>


2.4 Ecological Tolerance


Ecological Range of Tolerance	<p> _____ of _____ such as _____, _____, _____, or _____ that an organism can _____ before _____ or _____ results</p> <p> _____ and _____ organisms both have a _____ of _____ for all the different environmental _____ of their _____</p> <p>Ex: Salmon have a _____ range of tolerance for _____ from 6° to 22° C. But some individual salmon have _____ that give them a range of tolerance that is outside the basic range for the species.</p> <ul style="list-style-type: none"> ● Due to genetic _____ ● Makes _____ of salmon more _____ to disturbances, like global warming
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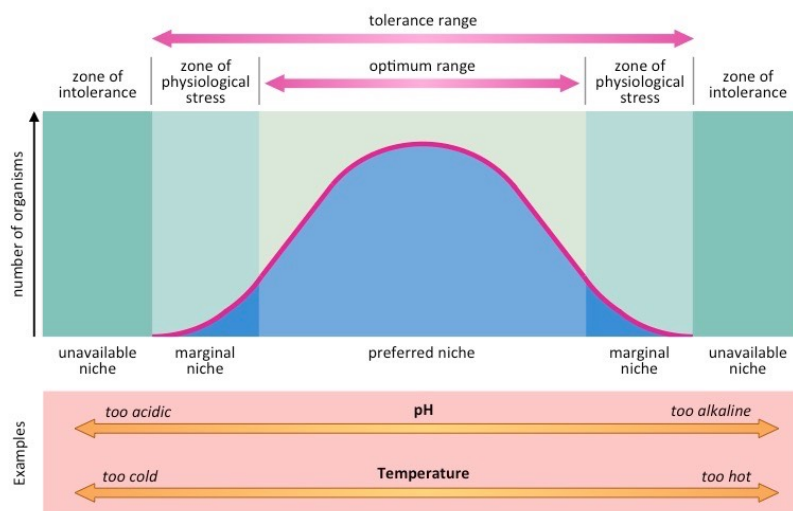
Ecological Range of Tolerance - Zones

 _____: range where organisms
_____, _____, and _____

 **Zone of** _____: range where organisms _____, but experience some _____ such as _____, lack of _____, decreased _____, etc.

 **Zone of** _____: range where the organism will _____

Ex: _____, _____, _____ of _____



FRQ Writing Tips





On FRQs about _____ activities or natural
_____ that cause environmental _____,
connect answer to _____

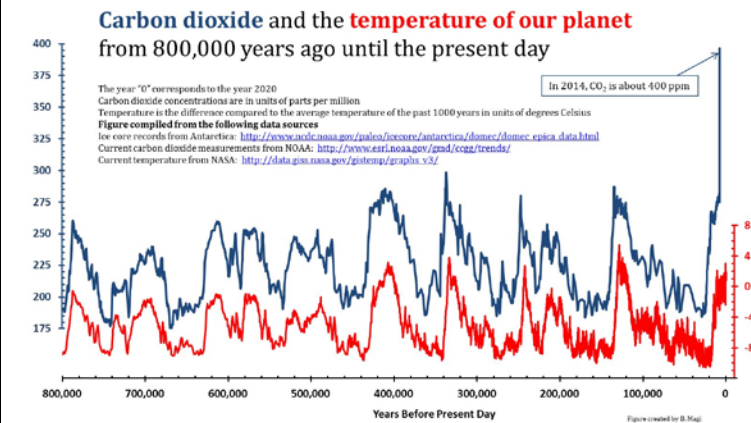
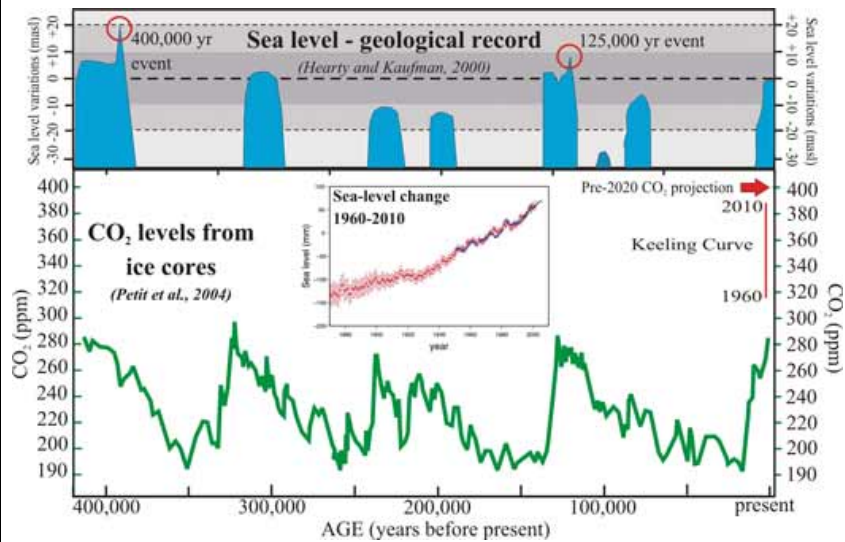
If possible, connect _____ to

	<p>_____</p> <ul style="list-style-type: none"> ➤ (electricity generation, transportation, agriculture) all release _____ which causes _____ and _____ ➤ Global warming _____ <u>outside the range of tolerance</u> for many _____ species, causing their _____ to _____ OR ➤ Global warming _____ the _____, shifting _____ <u>outside range of tolerance</u> for many _____ species causing _____
<p>FRQ Writing Tips</p>	<p>Try to connect a shift in _____ of _____ to a specific kind of _____</p> <p>Ex: suffocation, thermal shock, lack of water/food/nutrients/oxygen</p> <ul style="list-style-type: none"> ➤ Global warming warms the _____, shifting temperature <u>outside range of</u> _____ for many _____ species. Since global warming increases ocean temperature and warm water holds less _____, fish may _____. ➤ Global warming can increase _____. With increased droughts, _____ patterns may shift <u>outside the range of tolerance</u> for many _____ species. Without enough rainfall, these species may suffer population _____ as their _____.
<p>Practice FRQ 2.4</p>	<p>Chinook salmon are important members of freshwater and ocean food webs. Salmon transport nutrients from the ocean to freshwater habitats. Traces of nutrients from salmon can be found in everything from trees to bears! Salmon also support sport and commercial fisheries, and are used for ceremonial purposes by Native Americans. Climate change poses a threat to salmon populations by warming the waters of streams and rivers where they reproduce. To maintain healthy populations, salmon rely on cold, freshwater habitats and may go extinct as temperatures rise in coming decades. Warm temperatures can cause large salmon die-offs. However, some salmon individuals have higher thermal tolerance, or the ability to withstand and live in warm temperatures. These individuals may be better able to survive when water temperatures rise.</p> <p>Salmon individuals with certain gene variants that give them higher thermal tolerance may be better able to survive in warmer waters. Scientists want to know whether there is a genetic basis for the variation observed in salmon's thermal tolerance. If differences in certain genes control variation in thermal tolerance, scientists can identify the location on the genome responsible for this very important adaptation. Once identified, management agencies could then screen for these genes in populations of Chinook salmon in order to identify individuals that could better survive in a future warmer environment. Hatchery programs could also breed thermally tolerant fish in an attempt to preserve this important fish species.</p>

	Identify the author's claim.
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2.5 Natural Disruptions to Ecosystems

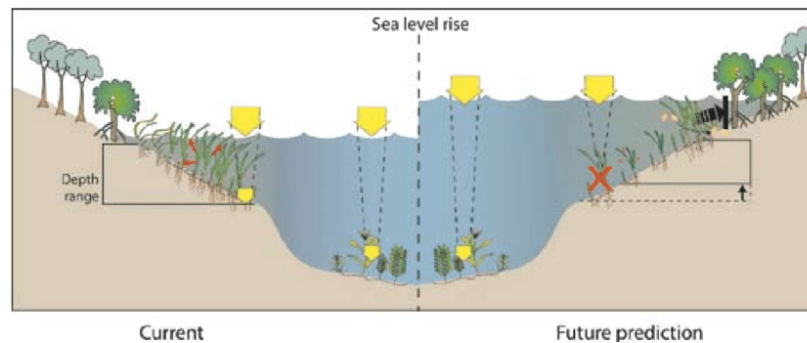
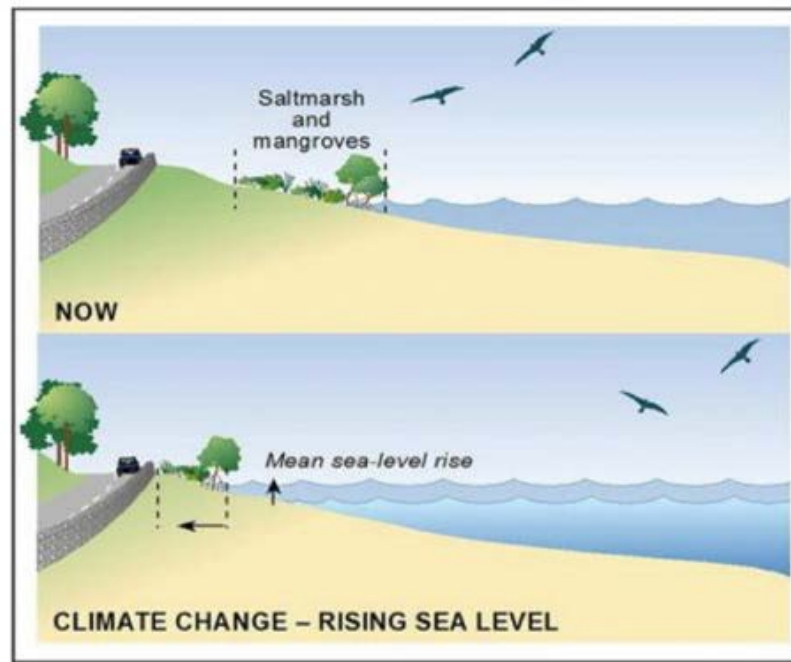
<p>Natural Disturbances</p>	<p> A natural _____ that _____ the _____ and or _____ of an ecosystem</p> <p>Ex: _____</p> <p>_____</p> <p> Natural disturbances can be even _____ than _____ disruptions</p> <p>Can occur on _____, _____, or _____ time frames</p> <p>_____ : occurs with regular _____ (ex: _____)</p> <p>_____ : _____ events with _____ frequency (ex: _____)</p> <p>_____ : _____ regular frequency (ex: _____)</p>
<p>Natural Climate Change</p>	<p> Earth's _____ has _____ over _____ for numerous reasons</p> <p>Ex: Slight changes in earth's _____ & _____ cause mini ice ages & warmer periods</p> <div data-bbox="446 1327 1161 1728"> <p>The diagram illustrates the three Milankovitch cycles that influence Earth's climate. It shows Earth's elliptical orbit around the Sun, with the degree of ellipticity (eccentricity) varying over 100,000 and 413,000 years. It also shows the Earth's axial tilt wobbling in a circle over 41,000 years, and the Earth's axis rotating in a circle (precession) over 19,000 to 24,000 years.</p> </div> <p> _____ has _____ over geological time as _____ on earth _____ & _____</p> <p>_____ levels lead to _____ temp, _____ of _____ & sea level</p>




Env. Change = Hab.
Disruption

_____ environmental _____ result
in widespread _____ and or _____

Ex: Rising sea level _____ coastal & estuary

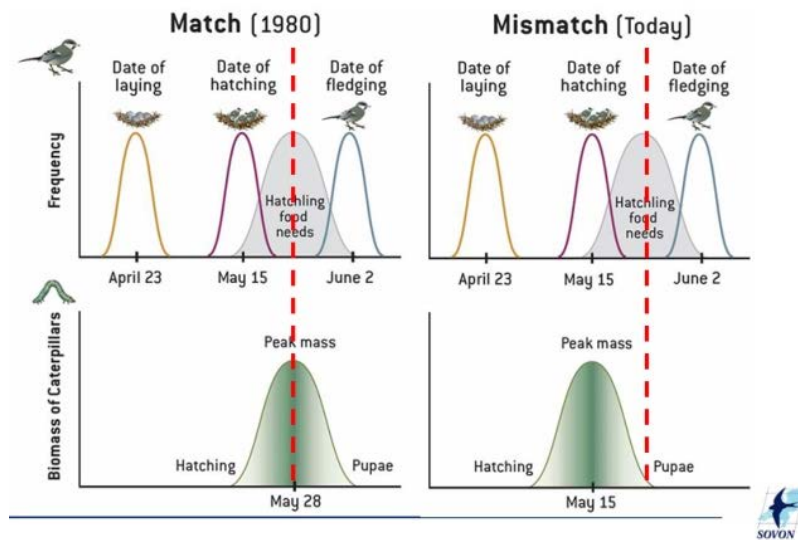
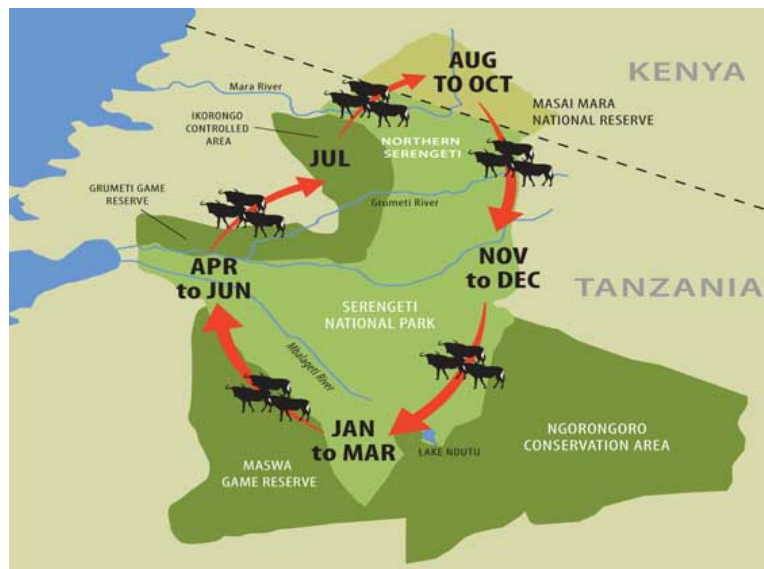


Migration

 **Wildlife may _____ to a new habitat as the result of _____**

Ex: wildebeests migrating to follow _____ of African savanna

- Ocean species moving further _____ as water temperature _____
- Bird _____ & _____ shifting _____ as _____ hatching shifts earlier with _____ climate

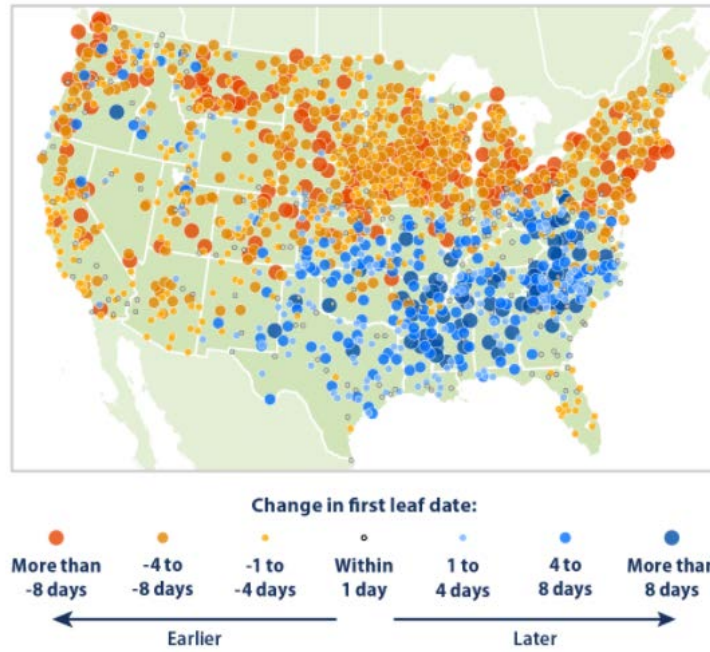


Practice

FRQ

2.5



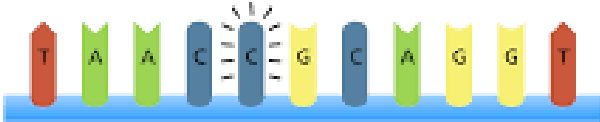
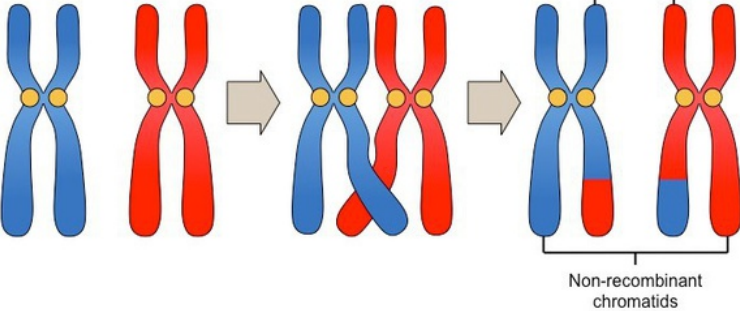


Figure 2. Change in First Leaf Date Between 1951–1960 and 2006–2015



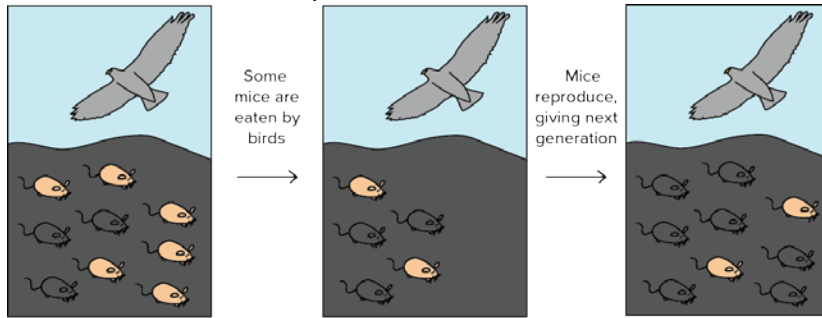
Describe the relationship between latitude and change in first leaf date depicted in the graph.

Explain why you think this relationship exists.

2.6 Adaptations

<p>Fitness & Adaptation</p>	<p> All _____ have some _____, or _____ in genomes of _____; Genetic diversity exists because:</p> <p>❖ Random _____ while DNA is being copied create new traits</p> <p>Original sequence</p>  <p>Point mutation</p>  <p>❖ _____ in parent chromosomes creates new combinations of genes (and therefore traits)</p> <p>Homologous chromosomes aligned Chromosome crossover Recombinant chromatids</p>  <p>Non-recombinant chromatids</p> <p> _____: a new trait that increases an organism's _____ (ability to _____ and _____)</p>
<p>Adaptation & Natural Selection</p>	<p> _____: organisms that are better adapted to their env. _____ and _____ more offspring</p> <p>❖ Individuals with adaptations pass them on to _____ & individuals without adaptations _____, which leads to the entire population having the adaptation over time (_____)</p> <p>❖ _____: the</p>

environmental _____ that kills individuals without the adaptation



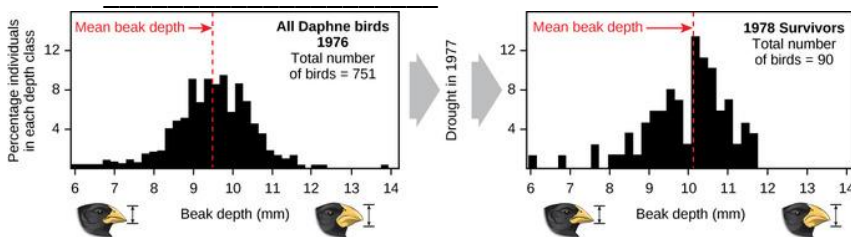
_____ (_____) = selective pressure

Environmental Change & Evolution

The _____ an organism lives in determines which _____ are _____

❖ As environments _____, different traits may become _____ & old traits may become _____

❖ Ex: a _____ can kill off finches with _____ beaks, making _____ beaks for cracking _____ seeds an



Pace of Evolution

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

❖ If the pace of env. change is too rapid, many species may _____ out of the env. or _____ completely

❖ Ex: if the _____ warms too _____, many species of _____ may not be able to _____ before they run out of _____ and _____

The more _____ in a _____, the better they're able to _____ to env. _____ (higher chance that _____ individuals have good _____)

The longer the _____ of the organism, the _____ the rate of _____

❖ Ex: _____ & _____ can adapt and

evolve in _____



Humans evolution = thousands-mil. years

Practice FRQ 2.6



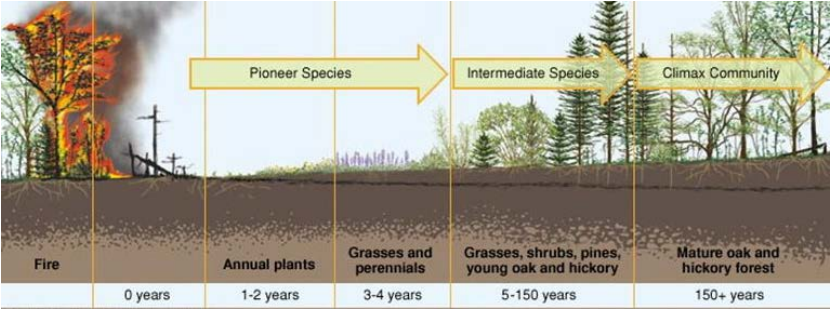


This data table shows the beak size of 20 finches from two different islands in the Galapagos.

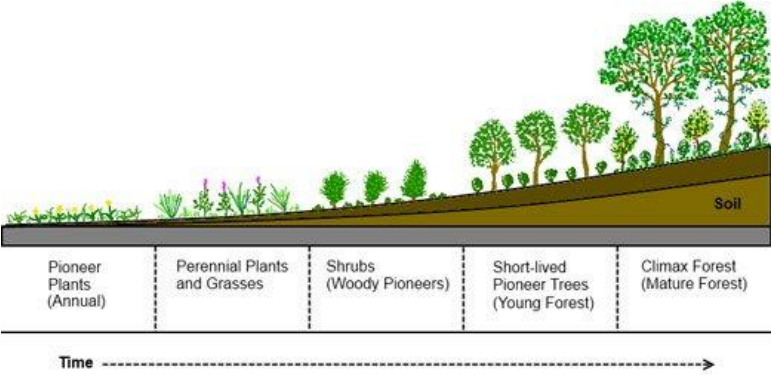

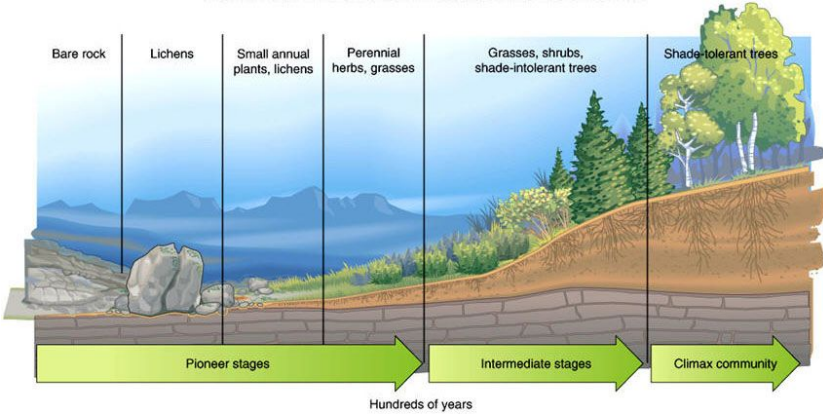

Daphne Island Beak Size (mm)	Santa Cruz Island Beak Size (mm)
9.55	10.05
8.70	9.74
9.62	10.27
9.22	9.81
8.79	10.46
9.61	10.24
9.02	10.02
7.85	10.30
9.01	10.43
8.26	10.52

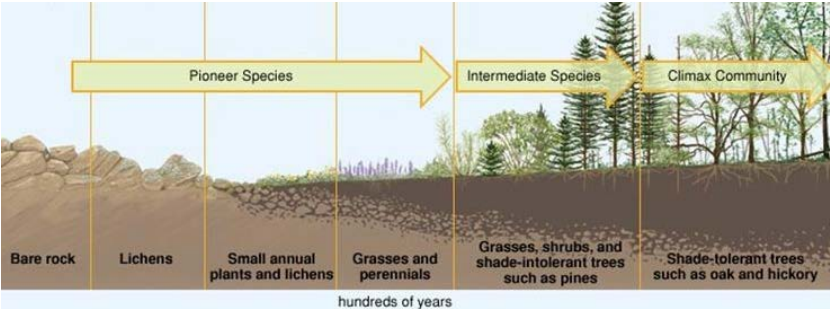


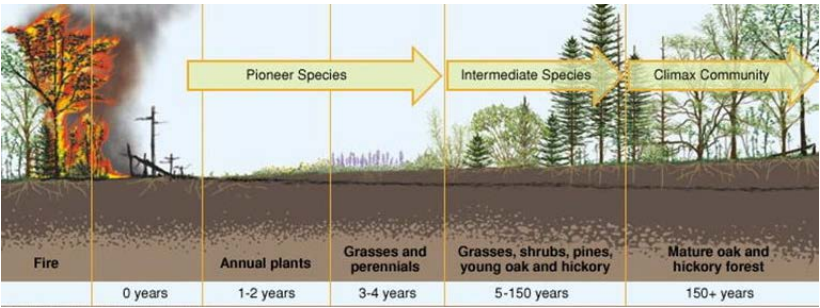
Describe the difference in beak size between the two islands.

Make a claim about the reason for this difference in beak size.

2.7 Ecological Succession

Ecological Succession	<p>A _____ of predictable _____ of _____ that a _____ goes through</p> <p>Two types of succession:</p> <p> _____ Succession: starts from _____ in an area with _____ previous _____ formation _____ & _____ spores carried by the _____ grow directly on _____, breaking them down to form _____ -</p> <p> _____ Succession: starts from <u>already</u> _____, in an area where a _____ (fire/tornado/human land clearing) cleared out the majority of _____ life</p> <p>Grasses, sedges, wildflowers, and berry bushes have _____ dispersed by _____ or animal _____</p> 
Stages of Succession	<p>_____ are characterized by which types of _____ species _____ the _____; different species are _____ to the _____ of the different _____</p> <p> _____ or _____ species appear first, when the ground is simply bare _____, or bare _____ after a disturbance</p> <p>Characteristics: seeds spread by _____ or _____, _____, tolerant of _____ and _____</p> <p>Ex: moss, lichen (bare rock) wildflowers, raspberries, grasses/sedges</p> <p> _____ species appear _____ pioneer species have helped develop _____ with _____</p>

	<p>_____ by their cycles of growth/death</p> <p>Characteristics: relatively _____, _____ plants that need _____ with _____ than pioneers, _____</p> <p>Ex: shrubs, bushes, fast-growing trees like aspen, cherry, and pine</p> <p style="text-align: center;">Stages of Forest Succession</p>  <p>The diagram illustrates the stages of forest succession on a hillside. From left to right, the stages are: Pioneer Plants (Annual), Perennial Plants and Grasses, Shrubs (Woody Pioneers), Short-lived Pioneer Trees (Young Forest), and Climax Forest (Mature Forest). The soil layer is shown at the base of the hillside, and a time axis points to the right.</p>
Stages of Succession	<p> _____ or _____ species appear _____, after _____ is _____ and _____ with _____ by cycles of _____ and _____ by early & mid successional species</p> <p>Characteristics: _____, _____ trees that are _____ of _____ and require _____ for large _____</p> <p>Ex: maples, oaks, other large trees</p>  <p>The diagram illustrates the stages of forest succession on a hillside. From left to right, the stages are: Bare rock, Lichens, Small annual plants, lichens, Perennial herbs, grasses, Grasses, shrubs, shade-intolerant trees, and Shade-tolerant trees. The diagram is divided into Pioneer stages, Intermediate stages, and Climax community. The time scale is labeled as 'Hundreds of years'.</p>
Primary Succession	<p>Occurs in an area that hasn't previously been _____ by plants (_____)</p> <p>Ex: _____, rock exposed after _____</p> <p> _____ and _____ (spores _____ by wind) are able to grow directly on rock by _____</p>

	<p>_____ that break down rock & _____ _____ containing nutrients they need (_____)</p> <p>_____ of rocks by moss & lichen combined with _____ from moss & lichen _____ form initial shallow soil</p>  <p>The diagram illustrates the stages of primary succession over hundreds of years. It shows a cross-section of the ground with different plant communities at various stages. Above the ground, three yellow arrows indicate the progression: Pioneer Species, Intermediate Species, and Climax Community. The ground is divided into six vertical sections corresponding to these stages: Bare rock, Lichens, Small annual plants and lichens, Grasses and perennials, Grasses, shrubs, and shade-intolerant trees such as pines, and Shade-tolerant trees such as oak and hickory.</p>
Secondary Succession	<p>Occurs in an area that already has _____ _____, but has had most plant life _____ by a _____ -</p> <p> Pioneer species are still _____ seeds of plants that are _____ and _____ _____, but _____ instead of moss/lichen</p>  <p>Soil is already _____ & sometimes even _____ by nutrient-rich _____ from _____; overall more _____ process than primary succession</p>  <p>The diagram illustrates the stages of secondary succession over time. It shows a cross-section of the ground with different plant communities at various stages. Above the ground, three yellow arrows indicate the progression: Pioneer Species, Intermediate Species, and Climax Community. The ground is divided into six vertical sections corresponding to these stages: Fire, Annual plants, Grasses and perennials, Grasses, shrubs, pines, young oak and hickory, and Mature oak and hickory forest. Below the ground, a timeline indicates the time in years for each stage: 0 years, 1-2 years, 3-4 years, 5-150 years, and 150+ years.</p>
Practice FRQ 2.7	<p>Based on the graph below, explain whether spruce trees are an early, middle, or late successional species.</p>

