Unit 8: Ecology Study Guide

Topic	Learning Objective(s)
8.1 Responses to the Environment	**ENE-3.D** Explain how the behavioral and/or physiological response of an organism is related to changes in internal or external environment.
	IST-5.A Explain how the behavioral responses of organisms affect their overall fitness and may contribute to the success of the population.
8.2 Energy Flow Through Ecosystems	**ENE-1.M** Describe the strategies organisms use to acquire and use energy
	ENE-1.N Explain how changes in energy availability affect populations and ecosystems
	ENE-1.O Explain how the activities of autotrophs and heterotrophs enable the flow of energy within an ecosystem.
8.3 Population Ecology	**SYI-1.G** Describe factors that influence growth dynamics of populations.
8.4 Effect of Density of Populations	**SYI-1.H** Explain how the density of a population affects and is determined by resource availability in the environment.
8.5 Community Ecology	**ENE-4.A** Describe the structure of a community according to its species composition and diversity
	ENE-4.B Explain how interactions within and among populations influence community structure.
	ENE-4.C Explain how community structure is related to energy availability in the environment.
8.6 Biodiversity	**SYI-3.F** Describe the relationship between ecosystem diversity and its resilience to changes in the environment.
	SYI-3.G Explain how the addition or removal of any component of an ecosystem will affect its overall short-term and long-term structure.
8.7 Disruptions to Ecosystems	**EVO-1.O** Explain the interaction between the environment and random or preexisting variations in populations.
	SYI-2.A Explain how invasive species affect ecosystem dynamics.
	SYI-2.B Describe human activities that lead to changes in ecosystem structure and/ or dynamics.
	SYI-2.C Explain how geological and meteorological activity leads to changes in ecosystem structure and/or dynamics

Topic 8.1: Responses to the Environment

Learning Objective	**ENE-3.D** Explain how the behavioral and/or physiological response of an organism is related to changes in internal or external environment.
I can…	□ I can explain ways the behavioral response of an organism is related to changes in internal or external environment. □ I can explain ways the physiological response of an organism is related to changes in internal or external environment. □ I can explain ways organisms exchange information with one another in response to internal changes. □ I can explain ways organisms exchange information with one another in response to external cues. □ I can explain ways organism's behaviors change due to internal cues. □ I can explain ways organism's behaviors change due to external cues.

1. Identify two behavioral changes in an organism due to an internal cue.

An organism might go to sleep when tired or seek out food and eat when hungry.

2. Identify two behavioral changes in an organism due to an external cue.

An organism might hide or run when attacked or feed offspring when called or hunt prey when sighted. MIgration-circannual rhythm using the sun to track their position, fiddler crab mating in response to full and new moon

3. Identify two physiological changes in an organism due to an internal cue.

Internal physiological changes in response to an internal cue might include insulin secretion in response to elevated blood glucose or fat breakdown in response to low blood sugar. More examples: Release of histamine triggers blood vessels to dilate and become more permeable, sex hormones induce formation of secondary sex characteristics

4. Identify two physiological changes in an organism due to an external cue.

Internal physiological changes in response to an external cue might include increased melatonin secretion in the evening or salivary gland secretion in response to smelling a yummy meal. Light stimulus in eye causes pupils to constrict, drop in body temperature initiates increase in metabolism in endotherms

5. How does an organism's responses to internal changes or external cues change their behavior?

In order to maintain homeostasis (increase survival), organisms must regulate their bodies and respond to stimuli. People must eat when hungry, sleep when tired, hide or fight when threatened, etc. These are some of the things that keep us alive.

Learning Objective	**IST-5.A** Explain how the behavioral responses of organisms affect their overall fitness and may contribute to the success of the population.
I can…	□ I can explain ways the behavioral responses of organisms affect their overall fitness □ I can explain ways the behavioral responses of organisms affects the success of the population □ I can describe that individuals act on information □ I can describe how individuals communicate with others. □ I can describe signaling behavior that result in differential reproductive success □ I can describe ways animals communicate □ I can describe functions of animal communication □ I can describe innate behaviors □ I can describe learned behaviors □ I can describe ways cooperative behaviors increase the fitness of the individual □ I can describe ways cooperative behaviors increase the fitness of the population

6. What is differential reproductive success?

Reproductive success is the ability to survive and make babies who are able to grow up and make babies of their own. This is an evolutionary term that we'll talk about a lot.
Differential reproductive success just means that some organisms in a population are better able to reproduce than others.

7. How does communication result in differential reproductive success?

Organisms use a variety of signaling behaviors that can help increase the survival chance of other members of a population. Finding a mate, fighting off competitors, caring for offspring, alerting others of predators or prey, etc.

8. What are four types of signals individuals use to communicate with others? Explain.

visual (sight) - gestures, facial expressions, body postures, and coloration
auditory (sound) - conveys warnings, attracts mates, defend territories, and coordinate group behaviors
chemical (pheromones) - pheromones may attract the opposite sex, raise an alarm, mark a food trail, or trigger other, more complex behaviors - important in social insects and other animals
tactile (touch based) - grooming primates, waggle dance of bees in the dark
electric - helps fish in a school communicate

9. What is the function of animal communication?

Transmission and reception of signals between animals improves population success in obtaining mates, establishing dominance, coordinating behaviors, caring for young, etc.

Ex. honeybees use dance to communicate foraging locations, pheromones in injured fish or wasps alert others to danger and promote either fight or flight response.

10. What is an innate behavior?

behavior that's genetically hardwired in an organism and can be performed in response to a cue without prior experience. Nearly all individuals in a population behave alike. ex- male three spined sticklebacks have a territorial response to the color red

11. What is learned behavior?

The modification of behavior in an organism as a result of specific experiences. Ex. habituation, imprinting, etc.

12. What type of behaviors does natural selection favor?

Natural selection favors any behavior that increases survival and reproduction (innate and learned).
ex. bees- build hives, regulate temp, reproduce, forage, etc.

13. What is cooperative behavior?

Animals working together for some purpose, such as raising offspring, protecting each other, etc. These behaviors are an evolutionary response to reduce the competition between members of the same species (teamwork).

14. How does cooperative behavior increase the fitness of an individual and the survival of the population?

If group work increases survival and reproduction, then that would increase fitness. For example, it can increase foraging or hunting success, improve health (grooming), reduce competing offspring (lions killing other male's cubs to bring females into heat), increased fitness of the individual increases the survival of the population

15. What is altruism?

Behavior that reduces an animal's individual fitness but increases the fitness of other individuals in the population ex:stinging honeybee, naked mole rats sacrificing self to protect queen

16. How does altruism increase the population's reproductive fitness?

Altruism reduces the number of offspring an organism is likely to produce itself, but boosts the likelihood that other organisms in the population are able to produce offspring. If they are related (kin selection), then the organism gets genes into the next generation via relatives. If they are not, then it's more complex. Perhaps if many in the population act altruistically, then some of the individual's kin will be favored by another altruistic organism.

Topic 8.2: Energy Flow Through Ecosystems

Learning Objective	**ENE-1.M** Describe the strategies organisms use to acquire and use energy
I can…	□ I can describe the strategies organisms use to acquire and use energy. □ I can describe ways organisms use energy to regulate body temperature. □ I can describe endothermic. □ I can describe ways endotherms regulate their body temperature. □ I can describe ectotherms. □ I can describe ways ectotherms regulate their body temperature. □ I can describe ways organisms use energy for reproductive strategies. □ I can describe the relationship between metabolic rate per unit body mass and size of multicellular organisms. □ I can describe the result of a net gain in energy on growth of an organism. □ I can describe the result of a net gain in energy on energy storage. □ I can describe the result of a net loss of energy on the mass of organisms. □ I can describe the result of a net loss of energy on survival of an organism.

1. What is an endotherm?

Organisms that use thermal energy generated by metabolism to maintain homeostatic (stable) body temperatures. Ex. Mammals, birds (warm blooded)

2. How do endotherms regulate their body temperature?

Changes in heart rate, fat storage, muscle contractions. Increased cellular respiration and decoupling of electron transport with chemiosmosis. (Don't worry about that last bit until unit 3).

3. What is an ectotherm?

Organisms that lack efficient internal mechanisms to regulate and maintain body temperatures. Ex. reptiles, amphibians (cold blooded)

4. How do ectotherms regulate their body temperature?

They rely on behaviors to regulate temperature such as moving into or out of the sun

5. Which organism requires more food consumption in a cooler environment? ENDOTHERM or ECTOTHERM

Endotherm (they need energy to keep their body temperature stable/high enough. Ectotherms, however, cannot regulate body temperature, so they just slow down and wait for spring).

6. How would temperature affect oxygen consumption in an endotherm?

When it is too cold, endotherms must do more cellular respiration/consume more oxygen in order to survive.

7. What is the relationship between metabolic rate per unit body mass and the size of multicellular organisms?

Generally, the smaller the organism, the higher the metabolic rate.

8. What does a net gain in energy result in for an organism?

energy storage or growth

9. What does a net loss in energy result in for an organism?

loss of mass and eventually death

Learning Objective	**ENE-1.N** Explain how changes in energy availability affect populations and ecosystems
I can…	□ I can explain ways changes in energy availability affect populations and ecosystems. □ I can explain the result of a change in energy availability on population size. □ I can explain the result of a change in energy availability on ecosystem. □ I can explain the effect of a change in sunlight on number and size of trophic levels. □ I can explain the effect of a change in the producer level on number and size of other trophic levels.

10. How does a change in energy available affect population size?

If energy decreases, there is less energy available, so population size decreases. For example, if half of the producers in an ecosystem are destroyed, then there will be fewer herbivores because they have less to eat. Each mating pair may produce more offspring, however, in an unstable environment because fewer are expected to survive.

11. How does a decrease in sunlight affect the number and sizes of each trophic level?

Decrease in sunlight means fewer producers thus fewer organisms in each of the trophic levels above it

12. How does an increase in sunlight affect the number and sizes of each trophic level?

More sunlight, more producers, more primary consumers and so on up the pyramid (assuming there is enough water, etc.)

13. How does a decrease in producers affect the number and size of other trophic levels?

A decrease in producers would decrease the number/size of the other trophic levels because there wouldn't be as much energy for the higher trophic levels

14. How does an increase in producers affect the number and size of other trophic levels?

An increase in producers would increase the number/size of the other trophic levels because there would be more energy to support the higher trophic levels

Learning Objective	**ENE-1.O** Explain how the activities of autotrophs and heterotrophs enable the flow of energy within an ecosystem.
I can…	□ I can explain ways the activities of autotroph and heterotroph enable the flow of energy within an ecosystem. □ I can describe the function of autotrophs in capturing energy. □ I can describe ways photosynthetic organisms capture energy. □ I can describe ways chemosynthetic organisms capture energy.

	□ I can describe the function of heterotrophs in capturing energy. □ I can identify heterotrophs sources of energy.

15. What is an autotroph?

Organisms that capture energy from physical or chemical sources in the environment. (You are probably more familiar with photoautotrophs, but chemoautotrophs also exist).

16. What is the function of an autotroph in capturing energy?

An autotroph converts sunlight energy or energy from inorganic substances to organic chemical energy (food) and provides the energy for the ecosystem.

17. How do photosynthetic organisms capture energy?

Photosynthetic organisms (plants, some protists, some bacteria) capture energy from the light (usually the sun) during photosynthesis to produce usable energy by the plant in the form of carbohydrates (sugars).

a. Identify one example of a photosynthetic organism. algae, plants, cyanobacteria

18. How do chemosynthetic organisms capture energy?

Chemosynthetic organisms capture energy by moving electrons from small inorganic molecules (hydrogen sulfide, methane, or ammonium) to convert carbon dioxide into sugar (carbohydrates). More on this in unit 3 - for now, know that they are producers/autotrophs. They serve the same function as photosynthetic organisms in their food web.

a. Identify one example of a chemosynthetic organism. Bacteria in the Yellowstone hot springs or bacteria in symbiotic relationships along the hydrothermal vents on the ocean floor.

19. True or False: Oxygen is required for the photosynthetic and chemosynthetic organism to capture energy.

20. What is a heterotroph?

A heterotroph is an organism that eats/consumes the carbon compounds produced by other organisms, or present in other organisms.

21. What macromolecules can a heterotroph use for sources of energy?

carbohydrates, proteins and lipids

Topic 8.3: Population Ecology

Learning Objective	**SYI-1.G** Describe factors that influence growth dynamics of populations.
I can…	□ I can describe factors that influence growth dynamics of populations. □ I can describe ways populations interact with one another. □ I can describe ways populations interact with the environment. □ I can describe adaptations for obtaining energy and matter in the environment. □ I can describe adaptations for using energy and matter in the environment. □ I can describe factors that population growth dynamics depend on. □ I can calculate population growth. □ I can calculate birth rate (per capita). □ I can calculate death rate (per capita). □ I can describe exponential growth of a population. □ I can describe factors that allow for exponential growth of a population. □ I can calculate exponential growth rate. □ I can calculate per capita growth rate of a population.
Formula Sheet	**RELEVANT EQUATION** Population Growth— $\frac{dN}{dt} = B - D$ where: dt = chage in time B = birth rate D = death rate N = population size **RELEVANT EQUATION** Exponential Growth— $\frac{dN}{dt} = r_{max}N$ where: dt = change in time N = population size r_{max} = maximum per capita growth rate of population

1. What makes up a population?

Organisms of the same species in a particular area

2. How do populations interact with one another?

They interbreed more with one another than with individuals from other populations

3. How do populations interact with the environment?

Populations obtain and use energy in an environment

4. Identify two adaptations for obtaining energy and matter in the environment.

Some plants have root nodules with symbiotic, nitrogen-fixing bacteria which help them obtain nitrogen. Many animals have claws and teeth for hunting and eating, etc.

5. Identify two adaptations for using energy and matter in the environment.

Plants use chlorophyll to capture light energy and roots to absorb water and nutrients. Carbon dioxide moves through stomata on the leaf/stem surfaces.

6. Identify two factors that population growth dynamics depend on.

Number of offspring produced, frequency of reproduction, survivorship of offspring to reproductive maturity, death rate, immigration rate, emigration rate. (Also, stuff that affects the previously mentioned stuff, like food availability, competition, water availability, etc.).

7. What is population growth?

An increase in population size (due to higher rates of birth and immigration compared to rates of death and emigration).

8. How do you solve for B? =dN/dt+D

9. How do you solve for D? =B-dN/dt

10. If a population has 300 individuals, then 20 new individuals are born and 40 individuals die. What is the population growth of this population?

a. Solve for B 20

b. Solve for D 40

c. Solve for dN/dt. -20 (So the new population would have 280 individuals)

11. What is exponential growth?

A population's growth in ideal conditions, j shaped curve

12. What allows for a population to undergo exponential growth?

Ideal conditions, resources are abundant, wastes are not accumulating, more individuals are reproducing

13. How do you solve for r?

R = B-D

r = R/N

14. If a population has 300 individuals, then 40 new individuals are born and 20 individuals die. What is the population size after 3 generations?

rmax = (dN/dt)/N = 20/300 = 0.067

	number start	add how many	number end
end of gen 1	300	20	320
end of gen 2	320	21.33333	341.3333
end of gen 3	341	22.73333	363.7333

The population after 3 generations is 364 individuals.

Topic 8.4: Effect of Density of Populations

Learning Objective	**SYI-1.H** Explain how the density of a population affects and is determined by resource availability in the environment.
I can…	□ I can explain ways the density of a population affects resource availability in the environment. □ I can explain ways the density of a population is determined by resource availability in the environment. □ I can identify density-dependent factors. □ I can identify density-independent factors. □ I can describe the effect of density-dependent factors on a population's growth. □ I can describe the effect of density-independent factors on a population's growth. □ I can calculate logistic growth rate of a population. □ I can describe carrying capacity. □ I can describe population growth rate as the population size approaches the carrying capacity.
Formula Sheet	**RELEVANT EQUATION** $\frac{dN}{dt} = r_{max} N\left(\frac{K-N}{K}\right)$ where: dt = change in time N = population size r_{max} = maximum per capita growth rate of population K = carrying capacity

1. What is density?

Density of individuals in a population means how closely individuals within a population live near one another

2. What is carrying capacity?

The number of individuals per area (density) that a system's resources can sustain.

3. What are density-dependent factors?

Abiotic or biotic factors whose effect on population size relies on a population's density.

a. Identify three density-dependent factors.

Resources (food, water, space/territoriality), infectious disease (parasites), predation

b. How do density-dependent factors affect a population's growth?

The greater the population size, the more that factor affects the population. For example, if there are a gazillion rabbits around in a small area, there will probably be more rabbit parasites (so easy for the parasites to be passed back and forth) and there will probably be more hawks eating the rabbits up because it's easy to catch the rabbits when there are so many of them. There will also be fewer plants to eat since other rabbits are grazing. All the best places for rabbit dens are already taken also…. The factor (e.g. overgrazing) may degrade the habitat (grass that isn't there can't hold the soil, so rain might wash it away), decreasing the carrying capacity.

4. What are density-independent factors?

Biotic or abiotic factors that affect populations regardless of population density.

a. Identify three density-independent factors.

Floods, hurricanes, forest fires, pollution

b. How do density-independent factors affect a population's growth?

The size of the population doesn't matter - the factor affects the individuals whether the population is large or small. For example, if there are a gazillion rabbits around in a small area, a forest fire will probably kill most of them. If there are very few rabbits around in this area, a forest fire will still probably kill most of them. Similarly, a hurricane might wipe out most of the iguanas on an island, whether there was a high or low population density before the hurricane. The factor (hurricane, pollution, etc.) may degrade the habitat, decreasing the carrying capacity.

5. If a population has 300 individuals and the environment can support 400 individuals, then 50 new individuals are born and 10 individuals die. What is the logistic growth rate of this population?

This question is a bit of a fail - sorry. They really need to give you r_{max}, so you can plug everything into the equation. I should have changed the question before I printed all of these!!

The growth (logistic or otherwise) is 40 new individuals per generation. We don't need to use the equation for that. We can figure out r_{max}, though:

$\frac{dN}{dt}=r_{max}(N)(\frac{K-N}{K)}$

$\frac{50-10}{dt}=r_{max}(300)(\frac{400-300}{400)}$

$40=r_{max}(300)(\frac{100}{400)}$

$40=r_{max}(300)(.25)$

$40=r_{max}(75)$

$r_{max}=.533$

Here's what I stole from another teacher:

dn/dt=rmaxN[(K-N)/K dn/dt= (.1333)(300)[(400-300)/400]= 10

r=40/300= .13 K= 400, N= 300

6. What happens to the growth rate as the population size approaches the carrying capacity?

The exponential growth of the population (that was present initially) will slow and end with a relatively stable population size (zero net growth by the time the population reaches carrying capacity (S- shaped curve).

Topic 8.5: Community Ecology

Learning Objective	**ENE-4.A** Describe the structure of a community according to its species composition and diversity
I can…	□ I can describe the structure of a community according to its species composition and diversity.

	☐ I can describe ways the structure of a community is measured. ☐ I can describe ways the structure of a communication is described in terms of species composition and species diversity. ☐ I can apply Simpson's Diversity Index to a population. ☐ I can describe properties of a diverse population.
Formula Sheet	**RELEVANT EQUATION** Simpson's Diversity Index— $\text{Diversity Index} = 1 - \Sigma\left(\frac{n}{N}\right)^2$ n = the total number of organisms of a particular species N = total number of organisms of all species

1. How is the structure of a community measured?

It is described according to species composition and diversity living together in the same location and interacting with one another.

2. What is a species?

We define a species as a group of organisms that can potentially mate and produce fertile offspring.

3. What is species composition?

The different species that are present in the community. (Species richness is the number of species in a community).

4. What is species diversity?

Species diversity includes a measure of the number of species in a community (richness), and a measure of the abundance of each species. More species diversity means a more stable population (less likely to be impacted by problems in the environment). There are various ways to calculate it. One way is Simpson's diversity index.

5. Identify two properties of a diverse population.

They are generally more productive and better able to withstand and recover from environmental stresses. They are more stable year to year in their productivity.

6. Complete the Practice Problem for Simpson's Index (from http://www.countrysideinfo.co.uk/simpsons.htm):

Calculate the Simpson's Index of a sample from the woods:

1. Complete the Practice Problem for Simpson's Index (from http://www.countrysideinfo.co.uk/simpsons.htm):
   Calculate the Simpson's Index of a sample from the woods:

Species	Number (n)
Woodrush	2
Holly (seedlings)	8
Bramble	1
Yorkshire Fog	1

Sedge	3
Total (N)	15

Using the equation on your reference sheet:

Species	Number (n)	n/N	(n/N)^2	
Woodrush	2	0.13	0.02	
Holly (seedlings)	8	0.53	0.28	
Bramble	1	0.07	0.00	
Yorkshire Fog	1	0.07	0.00	
Sedge	3	0.20	0.04	
Total (**N**)	**15**		0.35	sum
			0.65	1-sum

So the answer is 0.65. Occasionally, they'll give you a different formula to use. We'll practice this when school starts, but here is another way to calculate it (using a different formula). The answer comes out almost the same:

Putting the figures into the formula for Simpson's Index

$$D = \frac{\Sigma\, n(n-1)}{N(N-1)}$$

$$D = \frac{64}{15(14)}$$

$$D = \frac{64}{210}$$

D = 0.3 (Simpson's Index)

Then:

Simpson's Index of Diversity 1 - D = 0.7

Learning Objective	**ENE-4.B** Explain how interactions within and among populations influence community structure.

I can…	□ I can explain ways interactions within and among populations influence community structure. □ I can explain ways communities change over time depending on interactions between populations. □ I can explain ways interactions among populations determine how they access energy and matter within a community. □ I can describe positive interactions between populations. □ I can describe negative interactions between populations. □ I can describe predator/prey interactions. □ I can describe trophic cascades. □ I can describe niche partitioning. □ I can explain ways competition drives population dynamics. □ I can explain ways predation drives population dynamics. □ I can explain ways symbioses drives population dynamics. □ I can explain ways parasitism drives population dynamics. □ I can explain ways mutualism drives population dynamics. □ I can explain ways commensalism drives population dynamics.

7. How do interactions among populations affect their ability to access energy and matter within a community?

Competition can limit access to energy or matter in the form of food or habitat. Mutualism may increase matter and energy access. For example, nitrogen fixing bacteria can help legume plants to gain usable nitrogen that they can incorporate into their proteins and nucleic acids. If nitrogen is no longer a limiting factor, then the plant may be able to grow more and therefore do more photosynthesis. Bacteria and other decomposers may help increase nutrient availability for other organisms due to decomposition and recycling, etc., etc. Early succession plants may help change the environment for later succession plants, etc.

8. What are positive interactions between populations?

Both species benefit as in mutualism or cooperation (both benefit) (+/+) as described above, or commensalism in which one species benefits but the other is not harmed or helped (+/0)

9. What are negative interactions between populations?

Predator-prey where one species uses another for a food source

Parasitism- one species benefits at the expense of another (+/-)

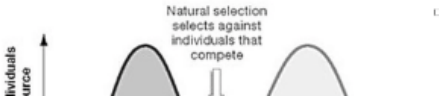
Competition - both are using the same limited resources

10. What are trophic cascades?

Trophic cascades are interactions between populations that affect more than the two populations interacting. For example, predators eat prey, which limits prey abundance and behavior. This can affect the density and/or behavior of the prey's prey (usually increasing the prey's prey density). So, the predators indirectly increase the abundance of their prey's prey. So if the predator is removed, the prey will likely increase, and the prey's prey will likely decrease, interrupting the flow of energy through the ecosystem and resource availability

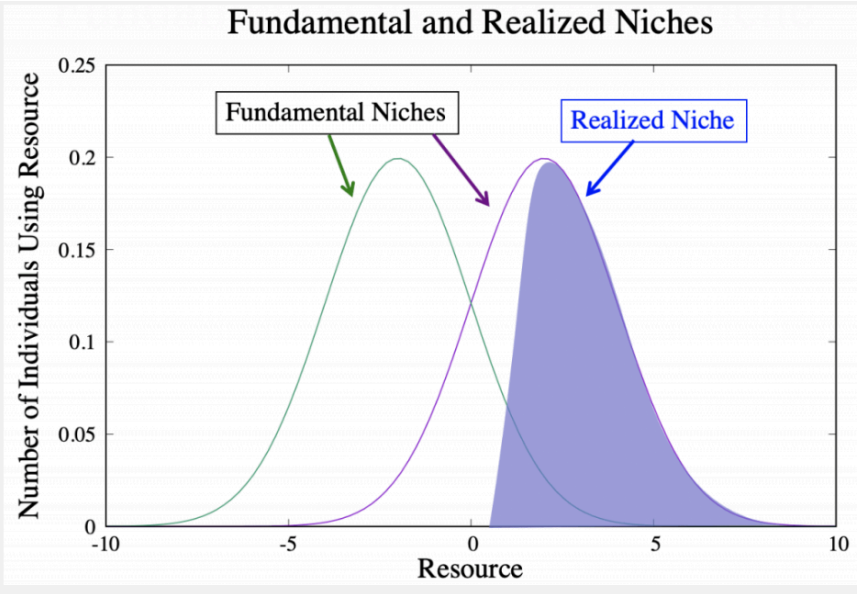
11. What is niche partitioning?

Niche partitioning is the process by which natural selection drives competing species to use slightly different resources (thus exist in different niches). This decreases competition over limited



resources between two similar species because each is accessing resources differently. This prevents competitive exclusion (the local extinction of one species if it occupies exactly the same niche as another, better species).

A similar concept is realized niche and fundamental niche. This should have been on this review - sorry to leave it out!! Fundamental niche is the entire possible niche for a particular species. Realized niche is the smaller niche that the species actually occupies in a particular environment; it is smaller than the fundamental niche, since it is limited by some other species that is out competing it for those resources.



12. Identify the following as positive or negative interactions?

a. Predation/prey interactions Negative for prey, positive for predator

b. Trophic cascades Negative for the prey, but positive for the prey's prey

c. Niche partitioning I would call this positive because it helps keep both species present.

13. What is competition?

Competition is an interaction that decreases access to energy and matter (because someone else wants it, too!)

a. How does competition drive population dynamics?

When resources are limited, only some individuals get everything they need.

14. What is predation?

(+/-) One species uses another for a food source

a. How does predation drive population dynamics?

Predator numbers may rise initially as prey numbers fall, but both should stabilize at a new carrying capacity. There will always be more organisms (biomass) at the lower trophic levels.

15. Identify the three types of symbiosis.

Parasitism, Mutualism, Commensalism

16. What is parasitism?

(+/-) One species benefits at the harm of another (ex. a tapeworm living in dog)

a. How does parasitism drive population dynamics?

Parasites remove available resources from their host, reducing host survival rate.This can, however, be beneficial to a competitor of the host.

17. What is mutualism?

(+/+) Interactions that benefit members of both of the interacting species (ex. Nemo and the sea anemone)

a. How does mutualism drive population dynamics?

The interactions between species in mutualistic relationships reciprocally increase each other's fitness by their actions. (ex. Nemo gets a safe place to live and left over scraps of food (thanks anemone) and the sea anemone gets a pretty fish to lure unsuspecting, delicious fish over to the sessile sea anemone for lunch).

18. What is commensalism?

(+/0) Interaction between two organisms where one benefits and the other is neither helped nor harmed

a. How does commensalism drive population dynamics?

The organism that benefits from commensalism may receive food or shelter from the relationship, thus increasing its productivity. The other organism is not affected in any way by the relationship so it neither benefits nor is harmed and its productivity in the environment does not change as a result of the relationship. For example, a bird uses a tree for a nest. Thanks tree! The tree is neither helped nor harmed from this relationship.

Learning Objective	**ENE-4.C** Explain how community structure is related to energy availability in the environment.
I can…	□ I can explain ways communication structure is related to energy availability in the environment. □ I can explain ways cooperation between organisms can result in enhanced movement of/access to matter and energy. □ I can explain ways cooperation between populations can result in enhanced movement of/access to matter and energy. □ I can explain ways cooperation between species can result in enhanced movement of/access to matter and energy.

19. What is cooperation?

Cooperation is a process in which groups of organisms work or act together for mutual benefits.

20. How does cooperation affect access to matter and energy?

Cooperation or coordination between organisms, populations, and species can result in enhanced movement of, or access to, matter and energy.

Topic 8.6: Biodiversity

Learning Objective	**SYI-3.F** Describe the relationship between ecosystem diversity and its resilience to changes in the environment.
I can…	□ I can describe the relationship between ecosystem diversity and its resilience to changes in the environment. □ I can describe the effect of fewer components and little diversity among the parts. □ I can describe keystone species. □ I can describe producers. □ I can describe essential abiotic factors. □ I can describe essential biotic factors. □ I can describe ways keystone species, producers, and essential abiotic/biotic factors maintain diversity of an ecosystem.

1. In terms of component parts and diversity, what type of ecosystem is more resilient to changes in the environment?

An ecosystem with high species diversity is more resilient to changes in the ecosystem. Part of this is that the food webs are complex, so the loss of a few links in the web will not destroy the entire food web. Also, with many different species, there is a higher chance that there will be some species with traits that help them to adapt to the changing environment.

2. What are keystone species?

A keystone species is one which has a disproportionately large effect on its natural environment relative to its abundance. So it may not be very abundant, but it's loss changes the whole ecosystem dramatically. (see the sea otter example below).

a. How do they maintain diversity in an ecosystem?

If they are lost, it could increase the abundance of other species in the ecosystem, which could then lead to the destruction of other organisms. ex. loss of sea otter causes an increase in sea urchins, which might over graze on kelp and can destroy the kelp forests.

3. What are producers?

Producers are also known as autotrophs. They produce their own organic molecules from inorganic molecules (as in, they make their own food). These can be photoautotrophs like plants, algae and cyanobacteria, that use light energy to convert carbon dioxide (inorganic carbon) to sugar (organic matter), or they can be chemoautotrophs which are bacteria that use chemical reactions to convert carbon dioxide (inorganic carbon) to sugar (organic matter). Many live at deep sea hydrothermal vents. When you think about this stuff, think about energy conversions. Light energy to chemical potential energy, etc. Energy is never created or destroyed, so be careful NOT to say that producers create energy. They do not! They do convert energy into a form that I can eat, though! Thanks, rice and corn!! More on these processes later….

(for the truly curious among you, look up radiotrophic fungi cuz omg!!).

a. How do they maintain diversity in an ecosystem?

Producers are the beginning of all food webs (the base of the trophic levels). They create the food that the herbivores need. Without them, the ecosystem would collapse from lack of available energy.

4. What are abiotic factors?

Non living factors, such as oxygen, water, sand, etc.

a. What abiotic factors are essential in maintaining the diversity in an ecosystem?

water, soil, climate, temperature, wind, nutrients, pH, sunlight

5. What are biotic factors?

living factors, such as competitors, parasites, pollinators, etc.

a. What biotic factors are essential in maintaining the diversity in an ecosystem?

predation, competition, parasitism, cooperation, mutualism

Learning Objective	**SYI-3.G** Explain how the addition or removal of any component of an ecosystem will affect its overall short-term and long-term structure.
I can…	□ I can explain ways the addition of any component of an ecosystem will affect its overall short term structures. □ I can explain ways the removal of any component of an ecosystem will affect its overall short term structures. □ I can explain ways the addition of any component of an ecosystem will affects its long-term structure. □ I can explain ways the removal of any component of an ecosystem will affect its long-term structure. □ I can describe ways the diversity can influence the organization of ecosystem. □ I can describe the effects of keystone species on the ecosystem.

6. How does the diversity of a species within an ecosystem influence the organization of the ecosystem?

An ecosystem with high species diversity is more resilient to changes in the ecosystem. Part of this is that the food webs are complex, so the loss of a few links in the web will not destroy the entire food web. Also, with many different species, there is a higher chance that there will be some species with traits that help them to adapt to the changing environment. Sorry - this one is a repeat.

7. Identify an example of an addition to an ecosystem and its effect…

The invasive species cheatgrass (from Europe and eastern Asia) was introduced to North America in the 1800s. Because of overgrazing, cheat grass was able to outcompete native plant species in grasslands, which has completely changed the long term structure of the prairie. Cheatgrass is an annual, so it dies off every fall and dries up quickly. It also grows densely and has fine leaves and stems. These adaptations provide more fuel for the West's fire season and causes the fires to burn hotter, which, in turn, destroys more native grass species. Cheatgrass can survive the hotter fires because its seeds can survive. Since native plants are not as well adapted to frequent, hot wildfires, cheatgrass invades the empty, burned spaces and expands its range more and more. The loss of the native plants affects the soil structure, since cheatgrass roots are more shallow. The diverse native plant communities are now almost a monoculture of this annual grass, which does not support the needs of the animal species that live there. Cheatgrass is more difficult to eat and does not stay green throughout the summer and fall. It does not provide hiding or nesting areas for animals. All of this affects both short term and long term ecosystem structure.

8. Identify an example of a removal from an ecosystem and its effect on…

Ocean ecosystem off the coast of California and Oregon:

Sea otters and sea stars eat sea urchins. Sea urchins eat kelp. By preying on sea urchins, sea otters and sea stars keep urchin populations in check, which allows kelp forests to thrive. Kelp forests are important because many species live in them, so they support high species diversity.

Sea otters were hunted to near local extinction in this area, leaving mainly the sea star as the urchin predator. In 2013, sea star wasting disease decreased sea star populations. Sea urchin populations increased. Kelp forests decreased dramatically, as did species diversity overall. Kelp forests recovered quickly when sea otters were reintroduced, thus increasing species diversity overall.

9. Identify a keystone species.

The sea otter, which, even with small numbers, affects the entire ecosystem as described above.

a. What would occur if this keystone species was removed from the ecosystem?

The removal of sea otters increased the sea urchin population, which decreased the kelp forest population, which dramatically decreased species diversity overall.

Topic 8.7: Disruptions to Ecosystems

Learning Objective	**EVO-1.O** Explain the interaction between the environment and random or preexisting variations in populations.
I can…	□ I can explain the interaction between the environment and random variation in the populations. □ I can explain the interaction between the environment and preexisting variations in populations. □ I can explain adaptations. □ I can explain ways that adaptations are selected in a population. □ I can explain where mutations come from. □ I can explain that mutations are random with no direction for selective pressures.

1. What is an adaptation?

A trait that helps an organism survive and reproduce in a particular environment (selective advantage).

2. How do adaptations get introduced?

Random mutations are the original source of variation. These mutations can get mixed up and recombined through sexual reproduction (meiosis and random fertilization).

3. How are adaptations selected for in a population?

The environment selects the adaptations. Those organisms with adaptations that help them survive and reproduce will be more heavily represented in the next generation.

4. What is a mutation?

A mutation is a change in DNA - the particular mutation is always random and may be good, bad, or neutral. Some organisms do have a higher mutation rate, however, like viruses.

5. Where do mutations come from?

Mutations are random. They can come from DNA polymerase inserting the wrong nucleotide, or from mutagens in the environment, etc.

Learning Objective	**SYI-2.A** Explain how invasive species affect ecosystem dynamics.
I can…	□ I can explain ways invasive species affect ecosystem dynamics. □ I can describe ways invasive species enter an area. □ I can describe ways invasive species are able to exploit an area. □ I can describe the population growth rate of an invasive species.

6. What is an invasive species?

An invasive species is a species that is not native to a specific area. It could be a plant, animal, fungus, etc. It spreads/expands beyond the original introduction site because it is a better competitor than native organisms. It may not have any natural predators or parasites that have evolved in the new environment. Because of this, it has the potential to overpopulate and harm other species and the environment. Examples of invasive species in the US include cheatgrass, spongy moth, and purple loosestrife.

7. How are invasive species able to exploit an area?

Because they are new, they have no natural predators or parasites. Therefore, they can often outcompete native species for resources.

8. What does the population growth rate curve look like?

For an invasive species, it will start out looking like exponential growth.

9. How do invasive species affect ecosystem dynamics?

They will often outcompete natural species in the ecosystems for resources and can collapse the ecosystem by growing uncontrollably.

Learning Objective	**SYI-2.B** Describe human activities that lead to changes in ecosystem structure and/ or dynamics.
I can…	□ I can describe human activities that lead to changes in ecosystem structure. □ I can describe human activities that lead to changes in ecosystem dynamics. □ I can describe the distribution of global ecosystems. □ I can describe the effect of disease introduction. □ I can describe the effect of human activities on habitats.

10. What is a local ecosystem?

A local ecosystem is all of the organisms (biotic factors, communities) and nonliving components (abiotic factors) living in a particular area.

11. What is a global ecosystem?

The global ecosystem contains all of the organisms (biotic factors, communities) and nonliving components (abiotic factors) in/on our planet (and atmosphere). This includes millions of species of organisms interacting with each other and with the abiotic factors in a very complex pattern.

12. How does the distribution of an ecosystem change over time?

Patterns of interactions can change over time as species interact and evolve, resources are used or introduced, climate patterns change, etc.

13. What happens to an ecosystem when a new disease is introduced?

An ecosystem with lots of variation is more resilient to the impacts of disease because there is a greater chance that some individuals will already have a natural/genetic resistance to the new disease. These organisms are likely to survive and reproduce.

14. What happens to an ecosystem due to human activity?

Humans often cause habitat loss, pollution, deforestation, etc., all of which may disrupt the ecosystem by causing species loss, which can collapse the ecosystem (if there are no other organisms to fill that niche).

Learning Objective	**SYI-2.C** Explain how geological and meteorological activity leads to changes in ecosystem structure and/or dynamics
I can…	□ I can explain ways geological activity leads to changes in ecosystem structure. □ I can explain ways meteorological activity leads to changes in ecosystem structure. □ I can explain ways geological activity leads to changes in ecosystem dynamics. □ I can explain ways meteorological activity leads to changes in ecosystem dynamics.

15. How do geological events affect habitat change and ecosystem distribution?

Geological processes can affect habitat in many ways. A river can bring fertile silt to a river valley. A change in the river direction can change the area that gets the silt. The rise of a mountain range can separate populations (maybe contributing to speciation events), can make rain shadows, thus affecting the amount of rainfall that an area gets. A volcanic eruption can destroy habitats but also bring rich soil to an area. Glaciers make it really hard to live because it's so cold! etc, etc.

16. What is biogeography?

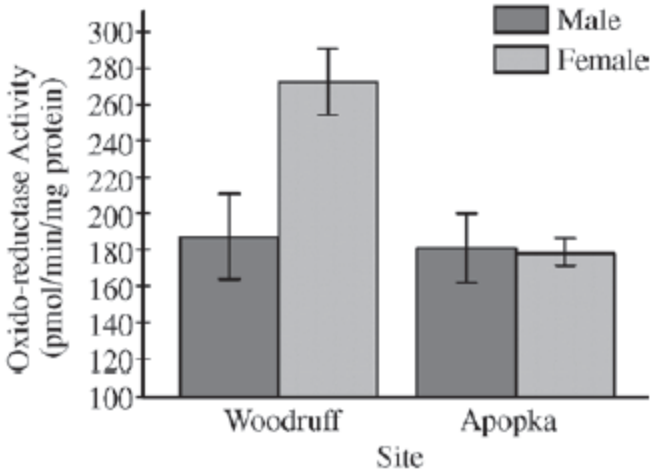
Biogeography is the geographic distribution of plants and animals.

17. How did the habitats and ecosystems change when Pangaea split apart?

When Pangaea split apart, climate changed for many organisms because the continents moved toward warmer or cooler parts of the planet. Species got separated by seas and oceans and speciation occurred. Individuals that could once interbreed were reproductively isolated from each other and eventually acquired random mutations, leading to adaptations that made them incompatible.

Multiple Choice Practice

1. Testosterone oxido-reductase is a liver enzyme that regulates testosterone levels in alligators. One study compared testosterone oxido-reductase activity between male and female alligators from Lake Woodruff, a relatively pristine environment, and from Lake Apopka, an area that has suffered severe contamination. The graph above depicts the findings of that study.



The data in the graph best support which of the following claims?

a. Environmental contamination elevates total testosterone oxido-reductase activity in females.
b. Environmental contamination reduces total testosterone oxido-reductase activity in females.
c. Environmental contamination elevates total testosterone oxido-reductase activity in males.
d. Environmental contamination reduces total testosterone oxido-reductase activity in males.

Use the following information to answer question 2.

A student placed 20 tobacco seeds of the same species on moist paper towels in each of two petri dishes. Dish A was wrapped completely in an opaque cover to exclude all light. Dish B was not wrapped. The dishes were placed equidistant from a light source set to a cycle of 14 hours of light and 10 hours of dark. All other conditions were the same for both dishes. The dishes were examined after 7 days and the opaque cover was permanently removed from dish A. Both dishes were returned to the light and examined again at 14 days. The following data were obtained.

	Dish A		Dish B	
	Day 7 Covered	Day 14 Uncovered	Day 7 Uncovered	Day 14 Uncovered
Germinated seeds	12	20	20	20
Green-leaved seedlings	0	14	15	15
Yellow-leaved seedlings	12	6	5	5
Mean stem length below first set of leaves	8 mm	9 mm	3 mm	3 mm

2. The most probable cause for the difference in mean stem length between plants in dish A and plants in dish B is which of the following?
   a. Shortening of cells in the stem in response to the lack of light
   b. Elongation of seedlings in response to the lack of light
   c. Enhancement of stem elongation by light
   d. Genetic differences between the seeds

3. Which of the following statements most directly supports the claim that different species of organisms use different metabolic strategies to meet their energy requirements for growth, reproduction, and homeostasis?
    a. During cold periods pond-dwelling animals can increase the number of unsaturated fatty acids in their cell membranes while some plants make antifreeze proteins to prevent ice crystal formation in tissues.
    b. Bacteria lack introns while many eukaryotic genes contain many of these intervening sequences.
    c. Carnivores have more teeth that are specialized for ripping food while herbivores have more teeth that are specialized for grinding food.
    d. Plants generally use starch molecules for storage while animals use glycogen and fats for storage. (we'll cover this in unit 1 as well)

4. Figure I shows the growth of an algal species in a flask of sterilized pond water. If phosphate is added as indicated, the growth curve changes as shown in Figure II.

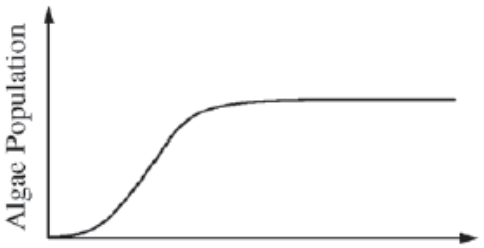


Figure I

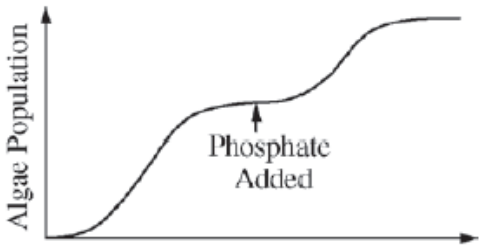
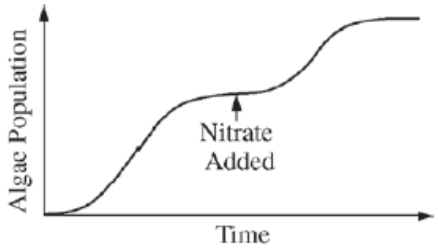
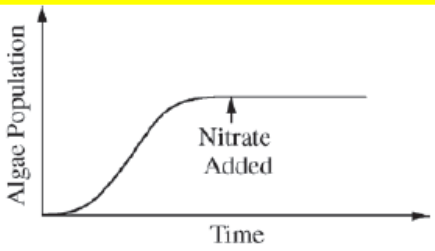
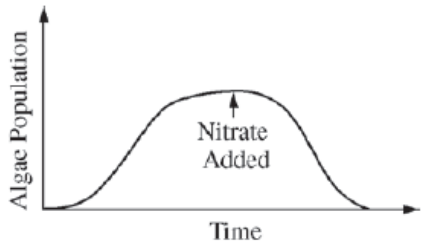


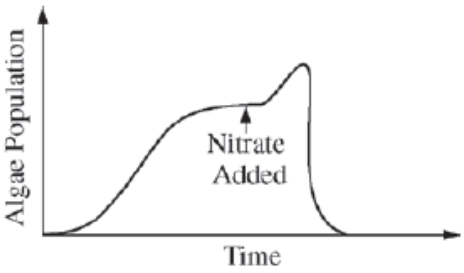
Figure II

Which of the following is the best prediction of the algal growth if nitrate is added instead of phosphate?

a.


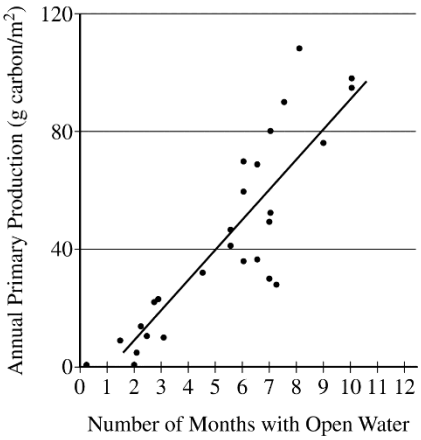
c.


b.


d.


5. In the Arctic Ocean, the predominant primary producers are phytoplankton. Phytoplankton are consumed by zooplankton, which in turn are eaten by codfish. In years when there is more open water (less ice coverage), there are more zooplankton and fish than in years with less open water (more ice

coverage). Based on the graph above, the difference is most likely because



a. when there is less open water, light is blocked from the zooplankton, so they cannot produce as much food for the fish
b. when there is more open water, the temperature is warmer, so the zooplankton and fish populations increase in size
c. the ice blocks the light, so in years with more ice coverage, there is less photosynthesis by the phytoplankton
d. the ice increases the light available for photosynthesis, so primary production increases and zooplankton populations increase in size

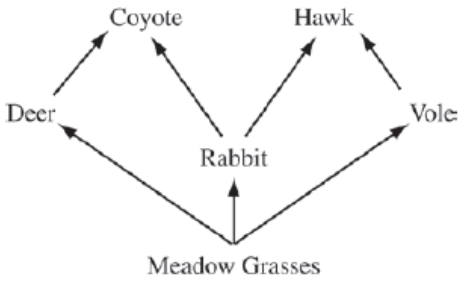
Use the following information to answer question 6.

An experiment to measure the rate of respiration in crickets and mice at 10°C and 25°C was performed using a respirometer, an apparatus that measures changes in gas volume. Respiration was measured in mL of O_2 consumed per gram of organism over several five-minute trials and the following data were obtained.

Organism	Temperature (°C)	Average respiration (mL O_2/g/min)
Mouse	10	0.0518
Mouse	25	0.0321
Cricket	10	0.0013
Cricket	25	0.0038

6. According to the data, the crickets at 25°C have greater oxygen consumption per gram of tissue than do the crickets at 10°C. This trend in oxygen consumption is the opposite of that in the mice. The difference in trends in oxygen consumption among crickets and mice is due to their
   a. relative size
   b. mode of nutrition
   c. mode of internal temperature regulation
   d. mode of ATP production

7. Beaked whales feed at various depths, but they defecate at the ocean's surface. Nitrogen-rich whale feces deposited in surface waters supply nutrients for algae that are eaten by surface dwelling fish. Which of the following best predicts what would happen if the whale population decreased?
   a. There would be a reduction in surface nitrogen concentration, which would cause an algal bloom.
   b. The surface fish populations would decline due to reduced populations of algae.
   c. The remaining whales would accumulate mutations at a faster rate.
   d. The remaining whales would be forced to forage in the deepest parts of the ocean.
8. The following is a food web for a meadow habitat that occupies 25.6 km^2. The primary producers' biomass is uniformly distributed throughout the habitat and totals 1,500 kg/km^2.



Developers have approved a project that will permanently reduce the primary producers' biomass by 50 percent and remove all rabbits and deer.

Which of the following is the most likely result at the completion of the project?

a. The biomass of coyotes will be 6 kg, and the biomass of hawks will be 0.5 kg.
b. The biomass of coyotes will be dramatically reduced.
c. The coyotes will switch prey preferences and outcompete the hawks.
d. There will be 50 percent fewer voles and 90 percent fewer hawks.

Use the following information to answer questions 9-12.

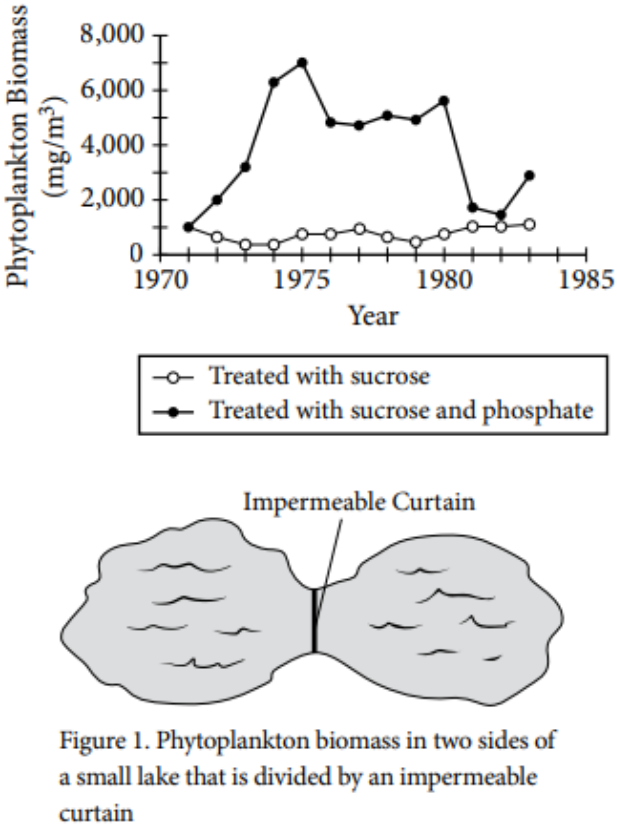


Figure 1. Phytoplankton biomass in two sides of a small lake that is divided by an impermeable curtain

In the early 1970s, researchers hypothesized that carbon was the limiting nutrient in many aquatic ecosystems. To test this hypothesis, the researchers divided a small lake in two roughly equal halves with an impermeable curtain that was fastened and sealed to the bedrock of the lake. Beginning in 1971 the researchers treated one side of the lake with sucrose and the other side with both sucrose and phosphate. From 1971 to 1983 the researchers monitored the phytoplankton biomass in both parts of the lake. The results are shown in Figure 1.

9. Which of the following claims is best supported by the data?
    a. Carbon was a limiting factor for phytoplankton in the lake.
    b. Phosphate was a limiting factor for phytoplankton in the lake.
    c. Both carbon and phosphate were limiting factors for phytoplankton in the lake.
    d. Neither carbon nor phosphate was a limiting factor for phytoplankton in the lake

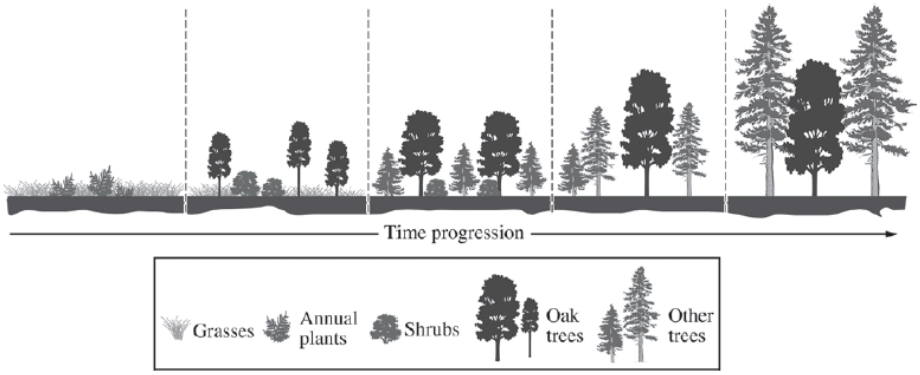
10. The average growth rate of the phytoplankton population from 1971 to 1975 in the side of the lake treated with sucrose and phosphate is closest to which of the following?
    a. 125 (mg/m^3)/year
    b. 1,000 (mg/m^3)/year
    c. 1,500 (mg/m^3)/year
    d. 6,000 (mg/m^3)/year

11. Which of the following treatments would have been the best control treatment for the experiment?
    a. An untreated section of the lake (we'll cover this in our first unit)
    b. A section of the lake that was treated with phosphate but not sucrose
    c. A different lake that was treated with sucrose and phosphate
    d. A small pool of the lake water maintained in a controlled laboratory environment

12. Which of the following was most likely a direct consequence of the addition of phosphate to the lake?
    a. The amount of biomass in the first trophic level decreased.
    b. The amount of biomass in the second trophic level decreased.
    c. The amount of energy available to producers in the lake increased.
    d. The amount of energy available to consumers in the lake increased

13. Thrips are insects that feed on rose pollen. Scientists noted that the thrips population increased in the spring and decreased dramatically during the summer. The researchers hypothesized that food abundance was the limiting factor for the population. Which of the following types of data would be most useful for the scientists to collect at regular intervals on a designated test plot of rose plants?
    a. Amount of sunlight (hours/day)
    b. Mean temperature (°C)
    c. Density of rose pollen produced (g/m^2)
    d. Amount of pollen produced by each flower (g/flower)

14. The diagram below shows the progression of ecological events after a fire in a particular ecosystem. Based on the diagram, which of the following best explains why the oak trees are later replaced by other trees?



a. Eventually the other trees grow taller than the oak trees and form a dense canopy that shades the understory.
b. Oak trees alter the pH of the soil, making the forest better suited for shrubs and other trees.
c. Roots of shrubs proliferate in the soil of the forest and prevent the oak trees from obtaining water.
d. Oak trees succumb to environmental pollutants more readily than do either the shrubs or the other trees.

Use the following information to answer questions 15-17.

The figures below show the changes in populations of two species of flour beetles, Tribolium confusum (Figure I) and Tribolium castaneum (Figure II), in cultures without parasites (o) and in cultures infected with a parasite (•). Each data point represents the mean population size from ten culture dishes of equal size and food content.

FIGURE I: NUMBER OF *TRIBOLIUM CONFUSUM* OVER TIME

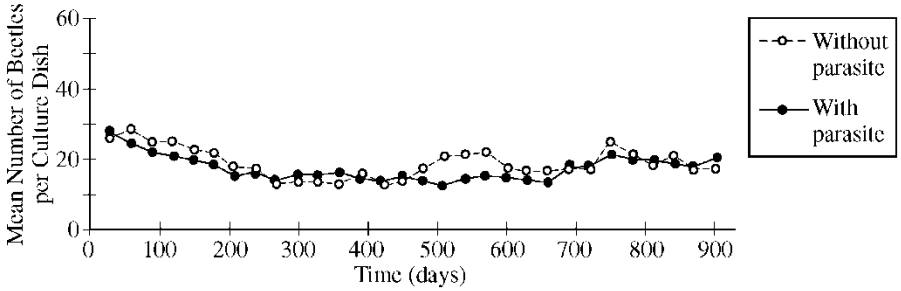
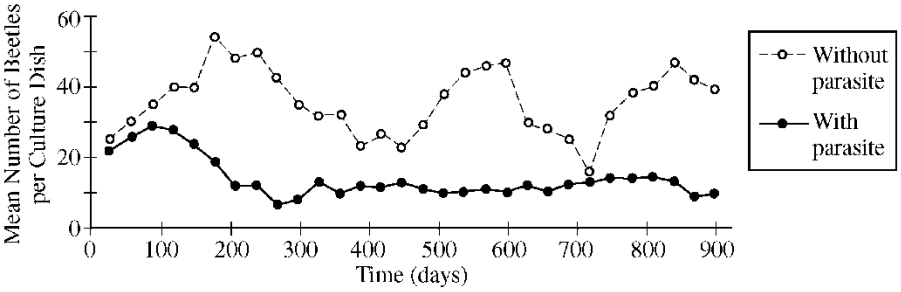


FIGURE II: NUMBER OF *TRIBOLIUM CASTANEUM* OVER TIME



15. Under which of the following conditions is the observed number of beetles per culture dish the greatest?
    a. *T. confusum* with parasite at 500 days
    b. *T. confusum* without parasite at 300 days

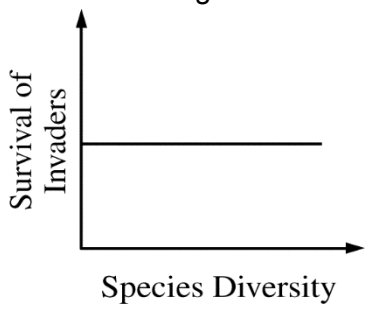
c. *T. castaneum* with parasite at 100 days
d. *T. castaneum* with parasite at 600 days

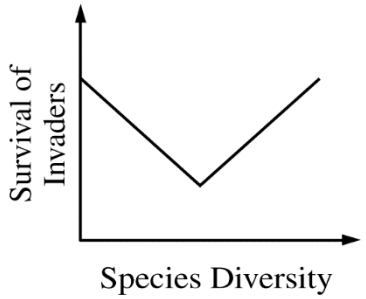
16. The data over the duration of the experiment provide the strongest support for which of the following conclusions regarding the effect of the parasite on *Tribolium* populations?
    a. *T. confusum* is adversely affected by the parasite, while *T. castaneum* is not.
    b. *T. castaneum* is adversely affected by the parasite, while *T. confusum* is not.
    c. Both *T. confusum* and *T. castaneum* are adversely affected by the parasite.
    d. Both *T. confusum* and *T. castaneum* show increased fitness in the presence of the parasite.

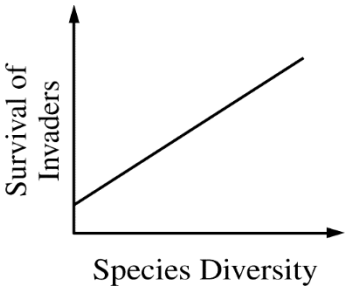
17. In Figure I, the difference between the two curves can best be attributed to which of the following?
    a. The difference between controlled laboratory conditions and the natural environment
    b. The effect of the host on its parasite
    c. The influence of competition for limited resources
    d. The natural variation among populations
18. If the experiment was continued for an additional 500 days, the population density of *T. castaneum* with the parasite would most likely stabilize at a value closest to which of the following?
    a. 5 beetles/culture dish
    b. 10 beetles/culture dish
    c. 20 beetles/culture dish
    d. 25 beetles/culture dish

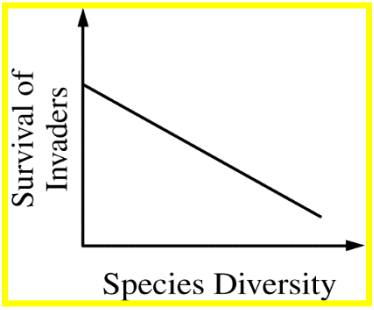
19. A researcher is investigating the relationship between the existing species diversity in a community and the ability of an introduced nonnative species to destabilize the community.

    Which of the following graphs is most consistent with the claim that communities with high diversity are more resistant to change than are communities with low diversity?

a.


b.


c.


d.


20. Scientists have found that the existing populations of a certain species of amphibian are small in number, lacking in genetic diversity, and separated from each other by wide areas of dry land. Which of the following human actions is most likely to improve the long-term survival of the amphibians?
    a. Cloning the largest individuals to counteract the effects of aggressive predation
    b. Reducing the population size by one-fifth to decrease competition for limited resources
    c. Constructing a dam and irrigation system to control flooding

d. Building ponds in the areas of dry land to promote interbreeding between the separated populations

21. Which of the following best describes altruistic behaviors?
    a. a defensive behavior in which organisms huddle all together
    b. a selfless behavior to save the population but risk yourself
    c. a protective behavior describing how organisms migrate
    d. a reproductive behavior for attracting a mate through a ritual

22. A fruit fly vibrates its wings to serenade a potential mate. Which of the following describes the type of behavior?
    a. audible
    b. tactile
    c. electrical
    d. chemical

23. A cheetah urinates on a tree. Which of the following types of signals is the cheetah using?
    a. visual
    b. audible
    c. tactile
    d. chemical

24. A cheetah urinates on a tree. Which of the following describes the purpose of this signal?
    a. indicate dominance
    b. establish territory
    c. find food
    d. ensure reproductive success

25. Which of the following best describes the body temperature regulation for an alligator?
    a. ectotherm that maintains body temperature through metabolism
    b. ectotherm that maintains body temperature through behaviors
    c. endotherm that maintains body temperature through metabolism
    d. endotherm that maintains body temperature through behaviors

26. Which of the following best describes the relationship between metabolic rate per unit body mass and the size of multicellular organisms?
    a. the smaller the organism, the higher the metabolic rate
    b. the larger the organism, the higher the metabolic rate
    c. the higher the surface area to volume ratio of the cells, the higher the metabolic rate
    d. the lower the surface area to volume ratio of the cells, the higher the metabolic rate

27. Which of the following best describes the changes to the trophic structure with a decrease in plant population?
    a. increase in primary and secondary consumers
    b. decrease in primary and secondary consumers
    c. decrease in secondary consumer, increase in primary consumer
    d. increase in secondary consumer, decrease in primary consumer

28. Which of the following describes the energy resource used by chemosynthetic organisms?
    a. small inorganic molecules present in their environment

b. organic molecules broken down by the mitochondria
c. photons absorbed by chlorophyll in the chloroplast
d. air movement turns hairs on organismal surface

29. In a population of 100 individuals, 20 individuals are born and there are 5 deaths. What is the r value?
Recall: r = per capita growth rate of population
a. .05
b. .15
c. .20
d. .25

30. If the population size is 100 individuals and there is a r value of 0.3, what is dN/dt?
Recall: dN/dt = rN
a. 10
b. 15
c. 30
d. 60

31. As the population size approaches carrying capacity, dN/dt...
a. increases steadily
b. increases slowly
c. decreases slowly
d. decreases steadily

32. Which of the following describes the relationship of the mistletoe that gains resources and harms the mesquite tree that it grows on?
a. parasitism
b. commensalism
c. mutualism
d. predator/prey

33. Which of the following describes the disadvantage of little species diversity in a community?
a. less likely to have immigration
b. more likely to be consumed by predators
c. more likely to have mutations
d. less resilient to changes in the environment

34. Which of the following is an organism that is disproportionate relative to their abundance and when removed from the ecosystem causes it to collapse?
a. dominant species
b. invasive species
c. keystone species
d. primary consumer

35. A group of bacteria are resistant to antibiotics. Which of the following describes HOW the bacteria became resistant?
a. the bacterial population got changed by the antibiotic in the environment
b. the bacterial population had random mutations making them favorable in the presence of the antibiotic
c. the bacterial population consumed the antibiotic providing a food source
d. the bacterial population uses the antibiotic for reproduction

36. Which of the following is NOT a reason for exponential growth of an invasive species?
a. outcompete other organisms
b. free of predators
c. free of competition
d. free of prey

Free Response Scoring Guidelines

<table>
<tr><th colspan="3">2019 #2</th></tr>
<tr><th>Part</th><th>Scoring Guidelines</th><th>Topic</th></tr>
<tr><td>(a)</td><td>Completion (3 points)
Correctly plotted lines for remaining two treatments
Correctly labeled axes including units
Correctly labeled data lines</td><td></td></tr>
<tr><td>(b)</td><td>Reasoning (1 point)
Reduced initial population sizes keep the total number of organisms the same in all containers.
Reduced initial population sizes serve as a control for population density.</td><td>8.3</td></tr>
<tr><td>(c)</td><td>Evidence (1 point per row; 2 points max.)<table><tr><th>Comparison of Groups</th><th>Evidence</th></tr><tr><td>I-A to II-A</td><td>• Growth rate is faster in I/slower in II</td></tr><tr><td>I-A to II-A</td><td>• Grows to a higher population density in I/lower population density in II</td></tr><tr><td>I-B to II-B</td><td>• Growth rate is faster in I/slower in II</td></tr><tr><td>I-B to II-B</td><td>• Grows to a higher population density in I/lower population density in II/ II dies out/II goes to zero</td></tr></table></td><td>8.4</td></tr>
<tr><td>(d)</td><td>Prediction (2 points)

Acceptable factors include:
Food
Space
Metabolic waste
Dissolved oxygen</td><td>8.5</td></tr>
<tr><td>(e)</td><td>Prediction (1 point)
The contractile vacuole will be more active.
Justification (1 point)
The environment is hypotonic with respect to the cell.
The cell is hypertonic with respect to environment.
Water has entered the cell (which could cause lysis).
The cell has lower water potential than the environment/the environment has higher water potential than the cell.</td><td>2.8</td></tr>
</table>

2018 #5		
Part	**Scoring Guidelines**	**Topic**
(a)	**Description (1 point)** • Cuckoos are parasites (of the warbler). • The cuckoo benefits from the relationship, and the warbler is harmed by the relationship.	8.5
(b)	**Graph (2 points)** • Cuckoo added (group 1): Bar must be HIGHER than the "Warblers Only" bar. • Cuckoo removed (group 2): Bar must be LOWER than the "Warblers and Cuckoos" bar.	8.5
(c)	**Identification (1 point)** • Mutualism • Both organisms benefit	8.5

2016 #3		
Part	**Scoring Guidelines**	**Topic**
(a)	**Identify direct source of energy (1 point)** • Seed • Stored organic nutrients/carbohydrates **Identify plant part (1 point)** • Roots	3.7
(b)	**Identification (1 point)** • Any value between 45-55 percent	3.7
(c)	**Proposed advantage (1 point)** • Increased chance of reproduction before the plants die. • If the plants do not use the strategy, they decrease the likelihood they will ever reproduce.	7.1 8.2

2015 #6		
Part	**Scoring Guidelines**	**Topic**
(a)	**Description (1 point)** • Lacked genetic diversity/variation • Was an aged/post-reproductive population/not enough young snakes • Had unfavorable sex ratio/too few males • Possessed a harmful mutation/disease	8.3
(b)	**Proposal (1 point)** • Increased genetic diversity in the population • Increased reproductive success • Established beneficial sex ratio/sufficient proportion of males for reproduction • Introduced resistance to disease that was affecting the original population	8.3 8.7

(c)	**Description (1 point)** • Population can/does grow • If resources are limited population would not grow	8.4