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AP Biology Insta-Review

Unit 8: Ecology

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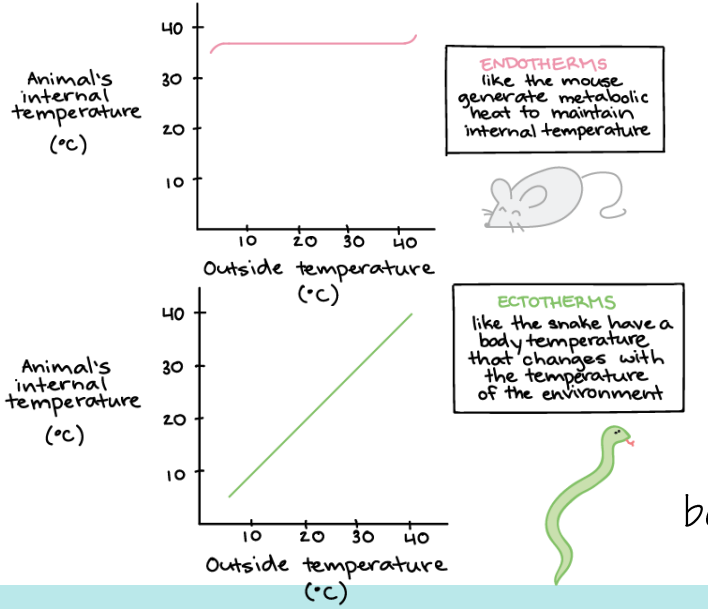
@apbiopenguins

AP Biology students are penguins because they are Dressed for Success! You are now an AP Bio Penguin!

Today's Plan:

Special Thank You to Mrs. McClinton (Chat Q&A)

Energy Flow
Population Ecology
Community Ecology
Practice Questions
Unit 8 Q&A



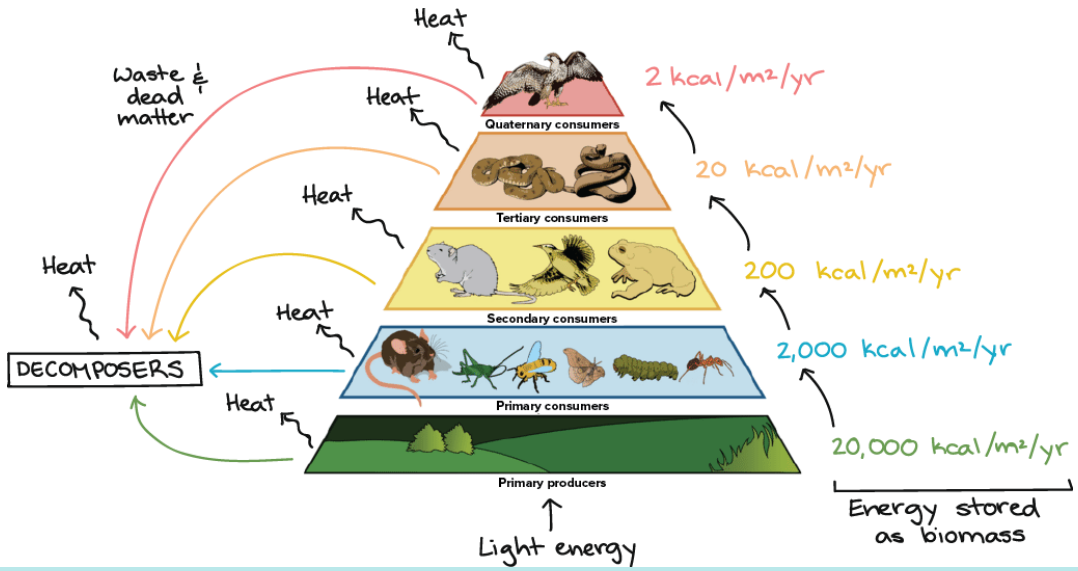
Body Temperature

Endotherm

Maintains body temperature through metabolism

Ectotherm

Maintains body temperature through behaviors (bask in sunlight, aggregation)



Energy Flow

Organisms use energy to maintain, organize, grow and reproduce

Trophic Structure

Autotroph

Capture energy from physical or chemical source

- Photosynthetic
  - sunlight
- Chemosynthetic
  - small inorganic molecules in environment (sometimes without oxygen)

energy

Heterotroph

Capture energy present in carbon compounds produced by other organisms

Metabolize carbohydrates, lipids, and proteins (notice: not nucleic acids) for energy through hydrolysis

Changes in Availability

Change in Energy Resource

Affects number and size of trophic levels

Change in Producer Level

Affects number and size of trophic levels

Animal Behavior

Communication

Signaling allows for changes in behaviors of organisms to allow for differential reproductive success

Types of Communication:

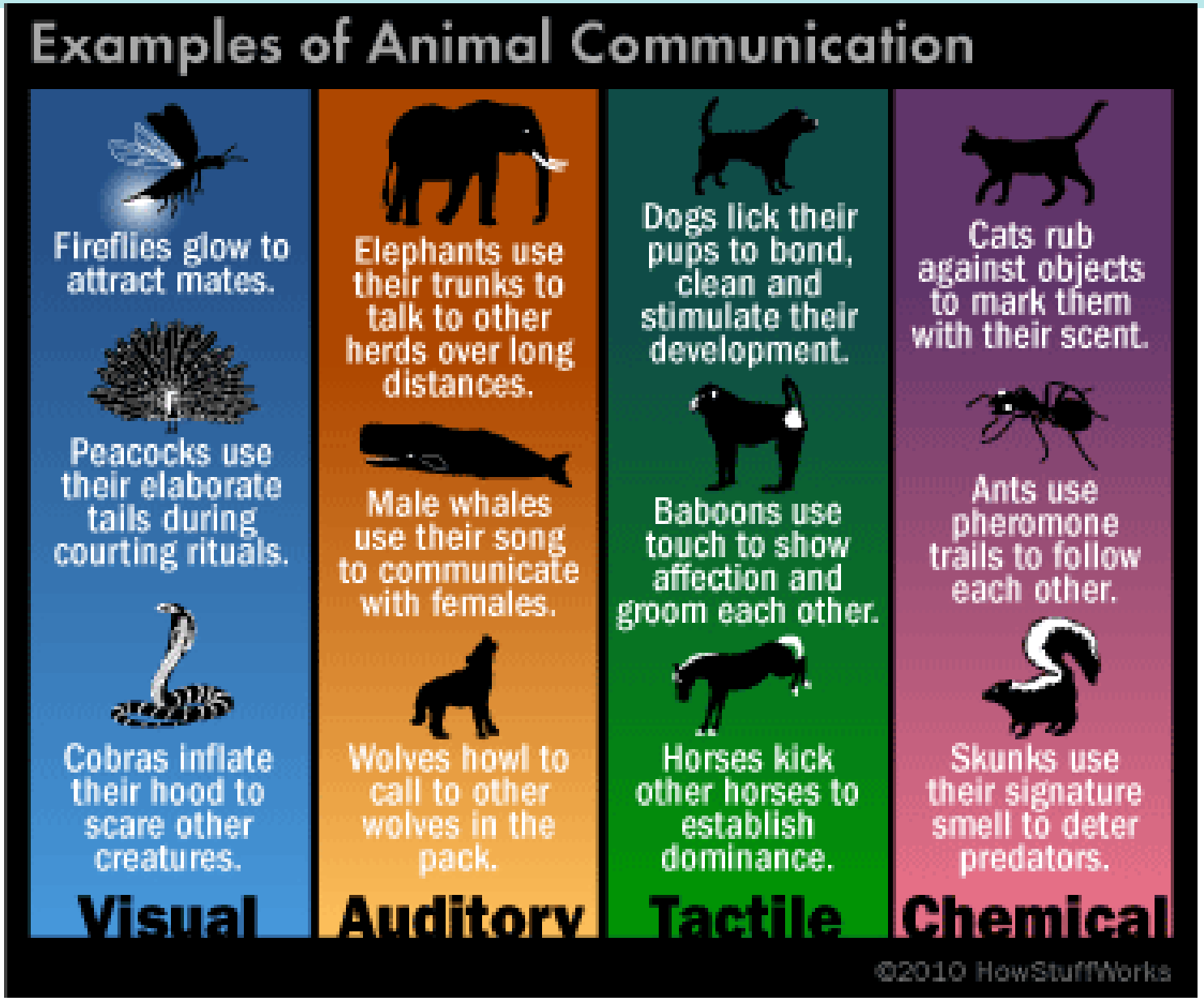
- Visual
- Auditory
- Electrical
- Chemical

Function:

- Indicate Dominance
- Foraging (Finding Food)
- Establish Territory
- Ensure Reproductive Success

Altruistic Behaviors

Reduces individual fitness but increases inclusive fitness.



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Intersexual Selection

Reproductive behaviors to attract a mate
Individuals of one sex choose members of the opposite sex

Examples

- Blue Footed Booby – mating dance (visual)
- Frogs – croaking (auditory)
- Pheromones – (chemical)

Intrasexual Selection

Reproductive behaviors to indicate dominance and compete for access to mates

Examples

- Deer: antler size
- Horned Beetles: strength and size of "horn"

Population Ecology

Exponential Growth

Unlimited growth of population

$r = b - d$

rate of increase = birth rate – death rate

$$\frac{dN}{dt} = rN$$

Example:

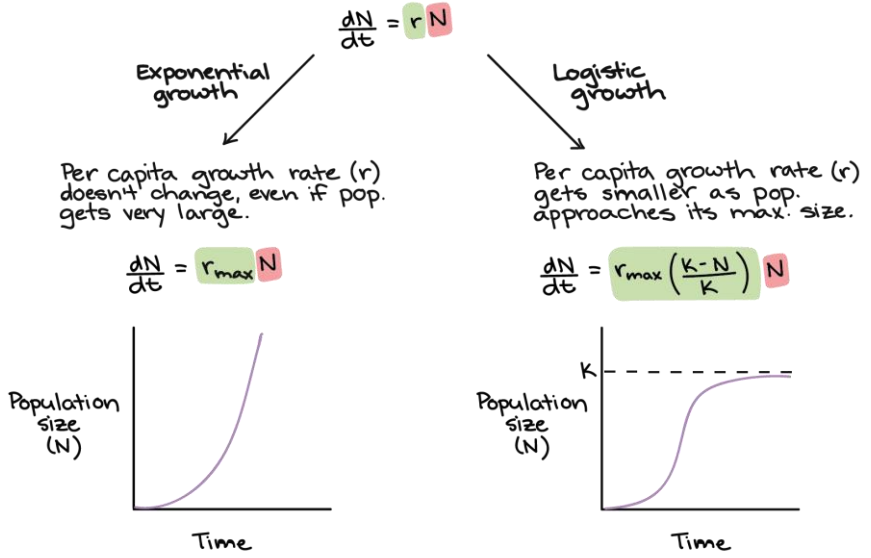
If a population has 400 individuals with a rate of increase of 0.5, how many individuals after 2 generations?

$$\frac{dN}{dt} = (0.5)(400) = 200$$

After generation 1: 600

$$\frac{dN}{dt} = (0.5)(600) = 300$$

After generation 2: 900



<u>Density Dependent Factors</u>

Factors that intensifies as population increases

Ex: competition, predation, disease

<u>Density Independent Factors</u>

Factors that affect all individuals regardless of size, population, density

Ex: natural disasters, human activity

Logistic Growth

Population size limited by carrying capacity

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right) = 200$$

Example:

If a population has 400 individuals with a rate of increase of 0.5 and a carrying capacity of 500, how many individuals after 2 generations?

$$\frac{dN}{dt} = (0.5)(400)\left(\frac{800-400}{800}\right) = 100$$

After generation 1: 500

$$\frac{dN}{dt} = (0.5)(500)\left(\frac{800-500}{800}\right) = 75$$

After generation 1: 575

Species Diversity

Simpson's Index: measures biodiversity (species composition and diversity)

$$Simpson\ Diversity = 1 - \sum (\frac{n}{N})^2$$

n = total number of organisms of particular species

N = total of organisms of all species

Species	Number
Sloth	18
Penguin	13
Total	31

$$1 - ((\frac{18}{31})^2 + \left(\frac{13}{31}\right)^2)$$

$$1 - ((0.58)^2 + (0.42)^2)$$

$$1 - (0.34 + 0.18)$$

$$1 - 0.52 = 0.48$$

Keystone Species

Organism with disproportionate to their abundance effect, and when they are removed from the ecosystem, the ecosystem often collapses.

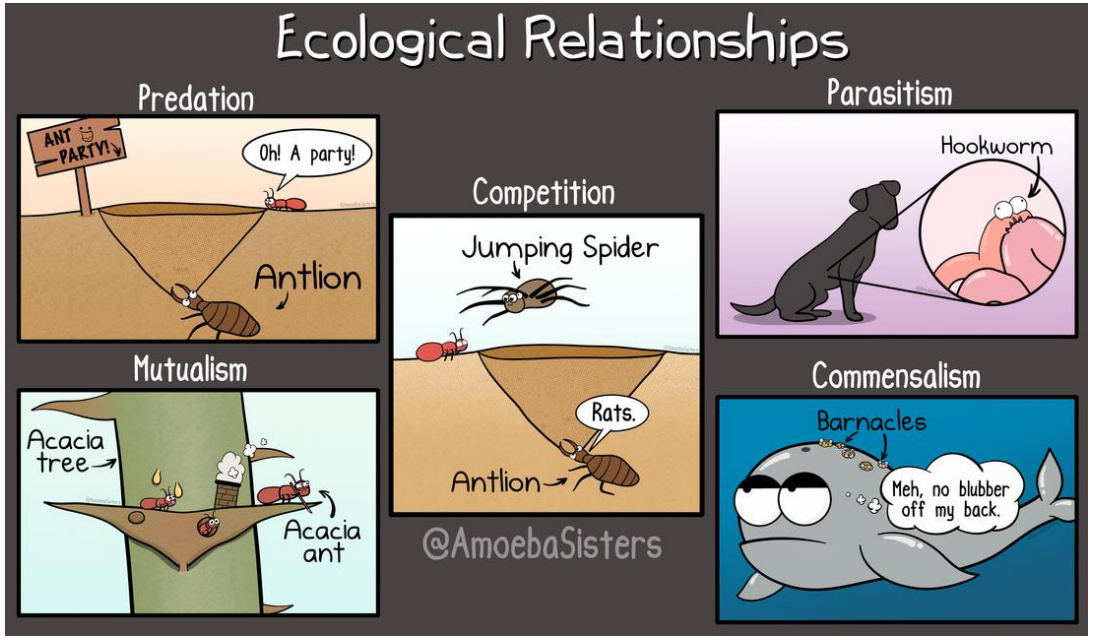
Examples: Sea Otter

Community Ecology

Interactions

Predator/Prey (+/-)
Herbivory (+/-)
Competition (-/-)

Symbiosis
Parasitism (+/-)
Mutualism (+/+)
Commensalism (+/0)



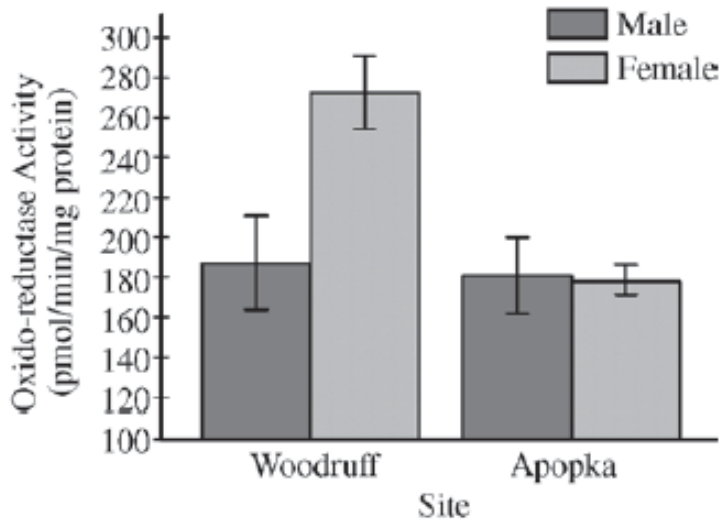
Invasive Species

Organism that is not indigenous, or native, to a particular area with no natural predators and unlimited resources

Examples:

- Zebra Mussel: clogging water way
- Lionfish: venomous species

Multiple Choice Practice



Testosterone oxido-reauctase 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.

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Choice Practice

Testosterone oxic
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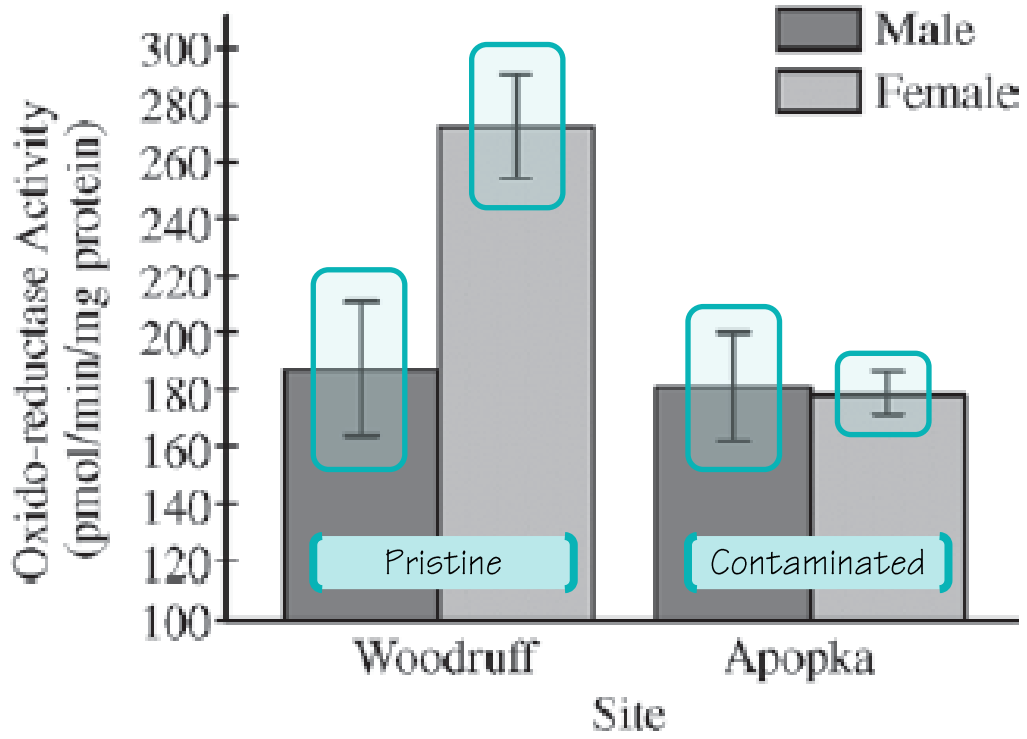
from Lake Woodru
suffered severe c



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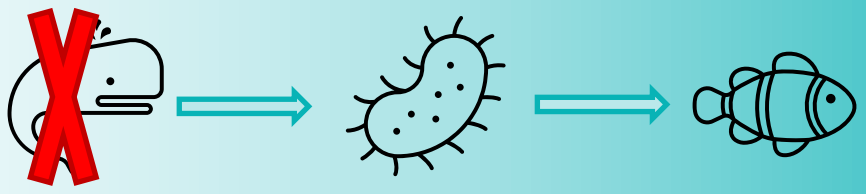


Multiple Choice Practice

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.

Multiple Choice Practice

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

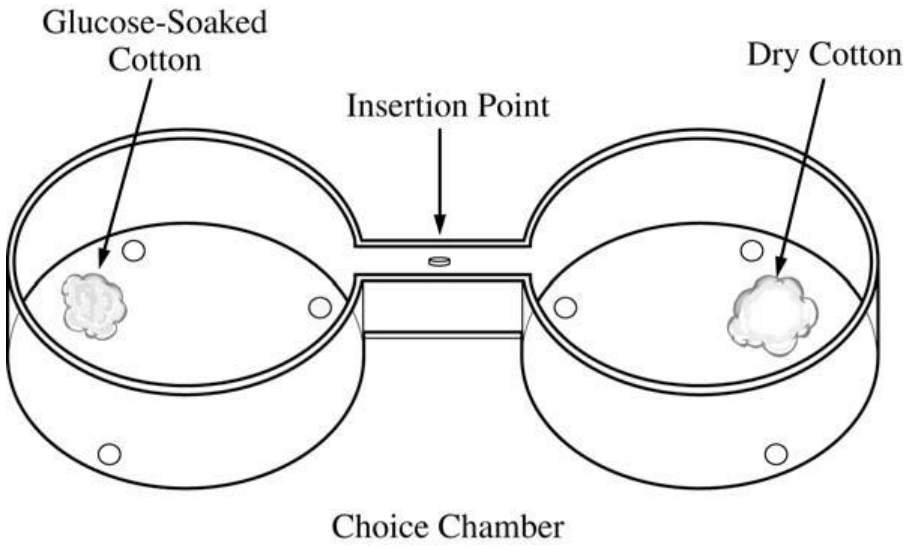
d. Building ponds in the areas of dry land to promote interbreeding between the separated populations

Free Response Practice

(c) The experiment described above is repeated with ripe bananas at one end and unripe bananas at the other end. Once again the positions of the flies are observed and recorded every minute for 10 minutes. The positions of flies after 1 minute and after 10 minutes are shown in the table below.

Perform a chi-square test on the data for the 10-minute time point in the banana experiment. Specify the null hypothesis that you are testing and **enter** the values from your calculations in the table below.

(d) **Explain** whether your hypothesis is supported by the chi-square test and **justify** your explanation.



DISTRIBUTION OF FLIES IN CHOICE CHAMBER

Time (minutes)	Position in Chamber		
	End with Ripe Banana	Middle	End with Unripe Banana
1	21	18	21
10	45	3	12

Free Response Practice

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1	21	18	21
10	45	3	12

Null Hypothesis:

The presence of the banana (ripe or unripe) has no effect on the location of the flies in the choice chamber. The flies will be equally distributed between the regions of the choice chamber.

	Observed (o)	Expected (e)	$(o-e)^2/e$
End with ripe banana	45	20	31.25
Middle	3	20	14.45
End with unripe banana	12	20	3.2
Total	60	60	48.9

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Chi-Square Table

p value	Degrees of Freedom							
	1	2	3	4	5	6	7	8
0.05	3.84	5.99	7.81	9.49	11.07	12.59	14.07	15.51
0.01	6.63	9.21	11.34	13.28	15.09	16.81	18.48	20.09

(d) **Explain** whether your hypothesis is supported by the chi-square test and **justify** your explanation.

48.9 > 5.99

At a p = 0.05 with 2 degrees of freedom, the calculated value is greater than the table value so we will reject the null hypothesis. The banana ripeness has an affect on the fly distribution.

Free Response Practice

The table below shows how much each organism in an aquatic ecosystem relies on various food sources. The rows represent the organisms in the ecosystem, and the columns represent the food source. The percentages indicate the proportional dietary composition of each organism. High percentages indicate strong dependence of an organism on a food source.

DIETARY COMPOSITION OF ORGANISMS IN AN AQUATIC ECOSYSTEM

Organism	Food Source (% of diet)				
	Algae	Stoneflies	Midges	Hellgrammites	Caddisflies
Algae					
Stoneflies			90		10
Midges	100				
Hellgrammites		20	10		70
Caddisflies	70		30		

Free Response Practice

(a) Based on the food sources indicated in the data table, construct a food web in the template below. Write the organism names on the appropriate lines AND draw the arrows necessary to indicate the energy flow between organisms in the ecosystem.

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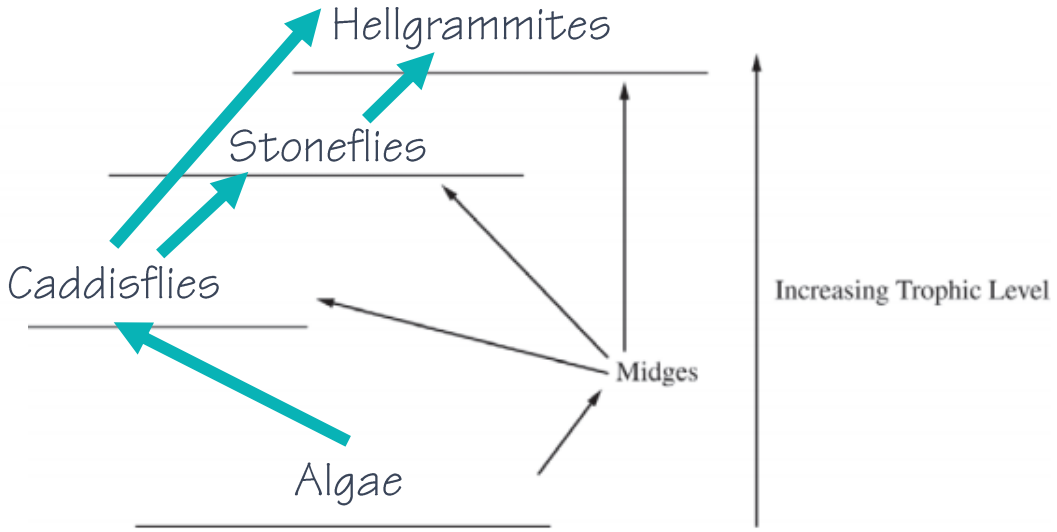

Free Response Practice

(b) In an effort to control the number of midges, an area within the ecosystem was sprayed with the fungus *Metarhizium anisopliae*, which significantly decreased the midge population. Based on the data in the table, **predict** whether the spraying of fungus will have the greatest short-term impact on the population of the stoneflies, the caddisflies, or the hellgrammites. **Justify** your prediction.

Prediction (1 point)

- Stoneflies

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Stoneflies			90		10
Midges	100				
Hellgrammites		20	10		70
Caddisflies	70		30		

Justification (1 point)

- Stoneflies have a higher dependence on the midges than do the hellgrammites and caddisflies.
- Midges are 90 percent of the stonefly diet, while 30 percent of the caddisfly and 10 percent of the hellgrammite diet are midges.

Free Response Practice

Some birds, including great spotted cuckoos, lay their eggs in the nests of other birds, such as reed warblers. The warbler parents raise the unrelated chicks and provide them with food that would otherwise be given to their biological offspring. A researcher conducted an investigation to determine the type of relationship between warblers and cuckoos in an environment without predators. The researcher found that nests containing only warblers were more likely to be successful than nests containing warblers and cuckoos (data not shown). A successful nest is defined as a nest where at least one chick becomes an adult warbler.

In some geographic areas, several species of nest predators are present. Researcher chicks, while in the nest, produce a smelly substance that deters nest predators. Th remain in the nest if cuckoo chicks are removed. Figure 1 shows the probability that n warblers or containing both warblers and cuckoos will be successful in an environment follow-up experiment, the researchers added cuckoos to a nest that contained only v removed from a nest containing warblers and cuckoos (group 2).

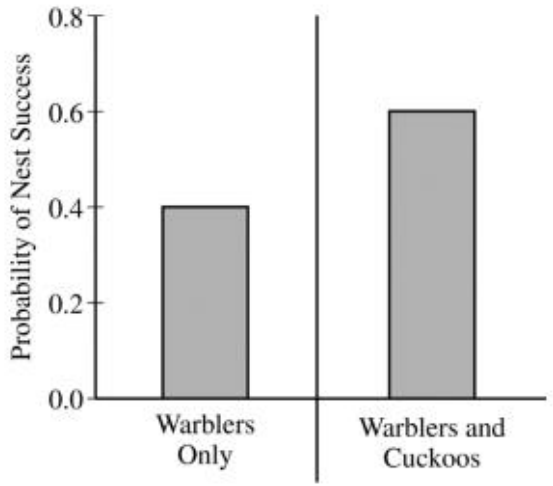


Figure 1. Probability of nest success in an environment with predators

Free Response Practice

(a) **Describe** the symbiotic relationship that exists between the cuckoo and warbler in an environment without predators.

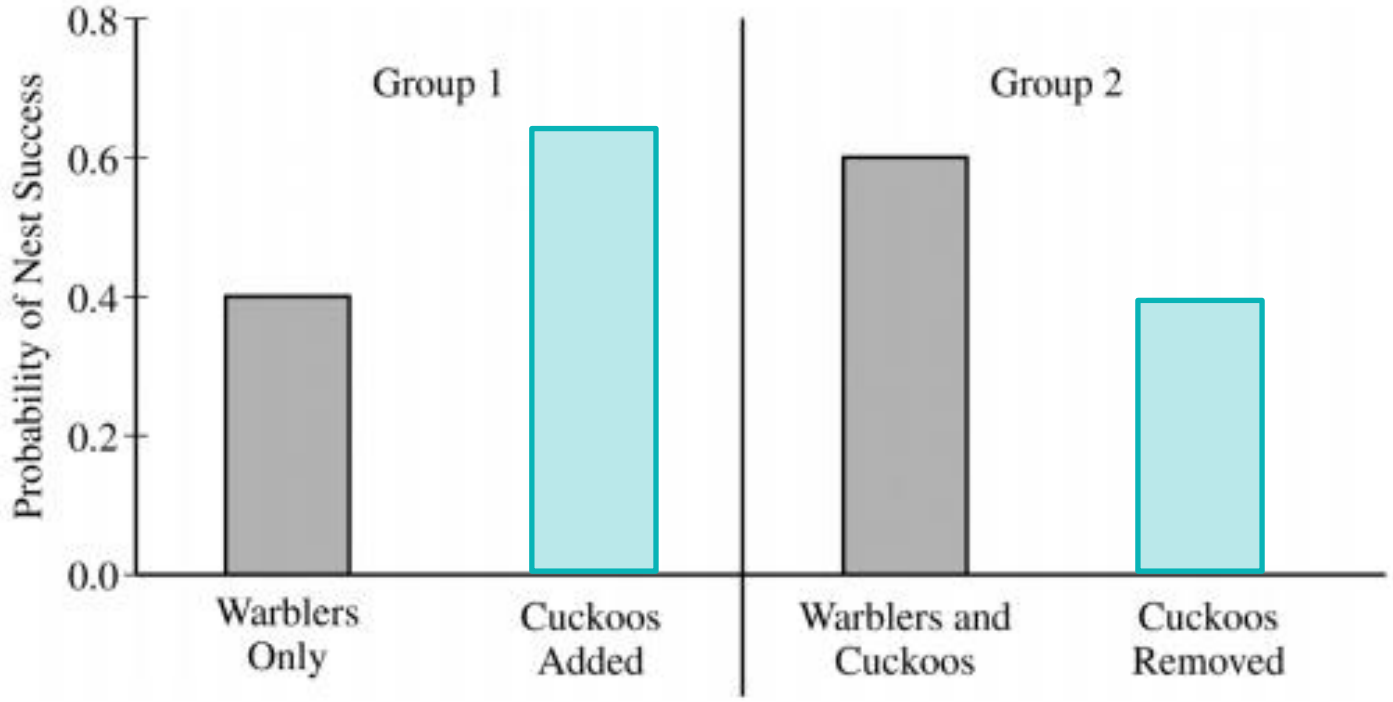
Cuckoo are parasites to the warblers because the cuckoo is benefited while the warbler is harmed in the relationship.

Recall: Cuckoos lay their eggs in the nests of warblers. The warbler parents raise the unrelated chicks and provide them with food that would otherwise be given to their biological offspring.

Free Response Practice

(b) On the template provided, draw bars in the appropriate locations to predict the relative probability of success for the nest in the presence of predators where:

* the cuckoos were added to the nest containing only warblers (group 1)
* the cuckoos were removed from the nest containing warblers and cuckoos (group 2)



Free Response Practice

(c) **Identify** the symbiotic relationship that exists between the cuckoo and the warbler in the presence of predators.

Cuckoo bird and the warbler are in a mutualistic relationship.

Recall: Researchers have found that cuckoo chicks, while in the nest, produce a smelly substance that deters nest predators. The substance does not remain in the nest if cuckoo chicks are removed.

Q & A

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