

FRQ Friday – 4/30

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2018 #5

2017 #4

2016 #3



FRQ 2018 #5

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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. 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. Figure 1 shows the probability that nests containing only warblers or containing both warblers and cuckoos will be successful in an environment with predators. In a follow-up experiment, the researchers added cuckoos to a nest that contained only warblers (group 1) and removed cuckoos from a nest containing warblers and cuckoos (group 2).



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

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Description (1 point)

- Cuckoos are parasites (of the warbler).
- The cuckoo benefits from the relationship, and the warbler is harmed by the relationship.

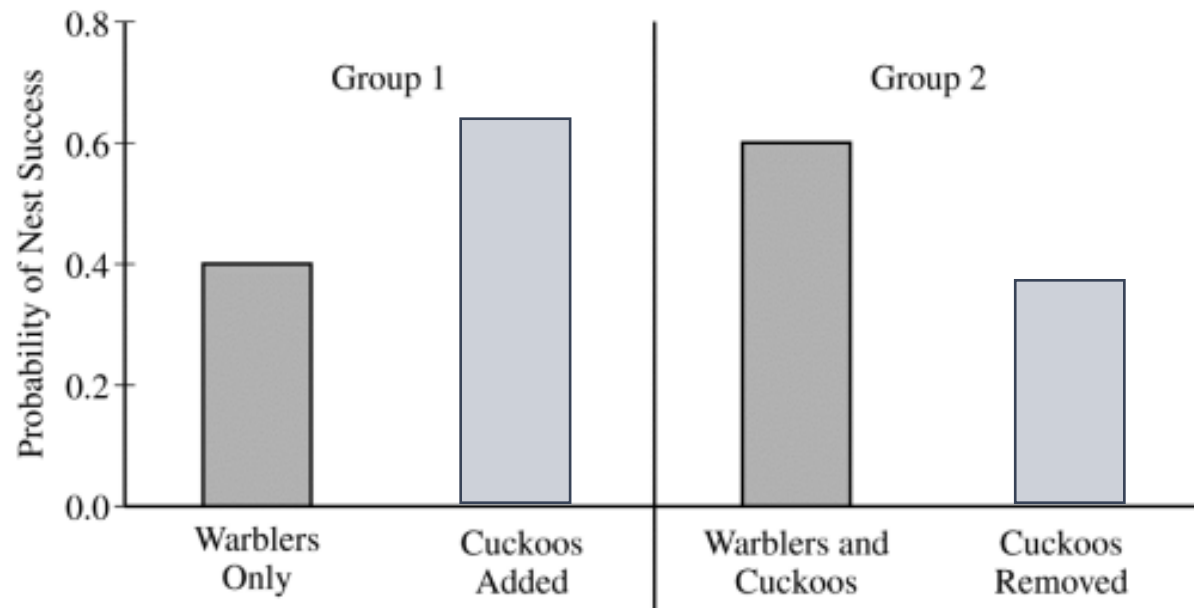


In some geographic areas, several species of nest predators are present. Researchers have found that cuckoo chicks, while in the nest, produce a smelly substance that deters nest predators. The substance does not remain in the nest if cuckoo chicks are removed. Figure 1 shows the probability that nests containing only warblers or

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(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)



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

Identification (1 point)

- Mutualism
- Both organisms benefit



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The table above 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		

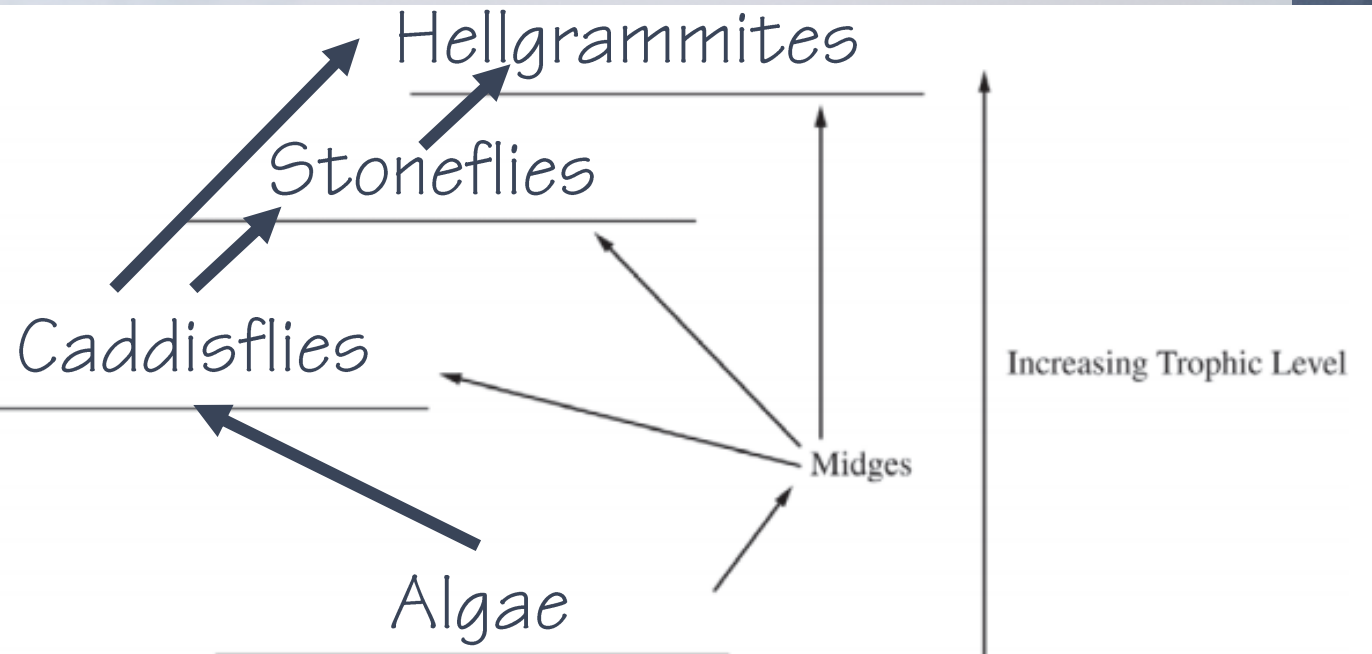
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(a) Based on the food sources indicated in the data table, **construct** a food web in the template below. Write the organism names on the appropriate lines AND draw the arrows necessary to indicate the energy flow between organisms in the ecosystem.

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- (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 the fungus will have the greatest short-term impact on the population of the stoneflies, the caddisflies, or the hellgrammites. **Justify** your prediction.

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Prediction (1 point)

- Stoneflies

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.

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The graph above illustrates the percent dry weight of different parts of a particular annual plant (plants that live less than one year) from early May to late August. The percent dry weight can be used to estimate the amount of energy a plant uses to produce its leaves, vegetative buds, stems, roots, and reproductive parts (seeds, receptacles, and flowers).

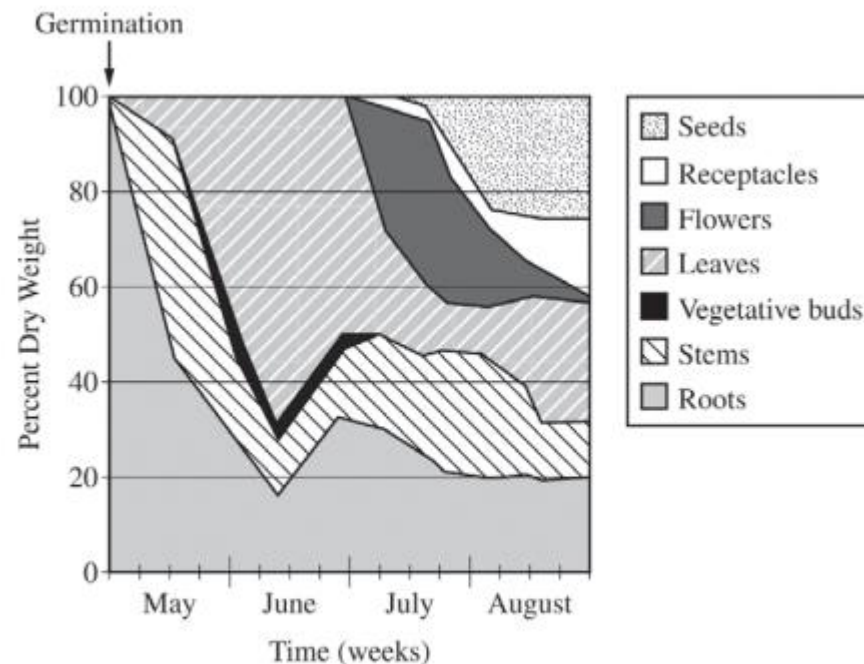


Figure 1. Percent dry weight of different plant structures during the growing season for an annual plant

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(a) **Identify** the direct source of the energy used for plant growth during the first week of May, and **identify** the part of the plant that grew the most during the same period.

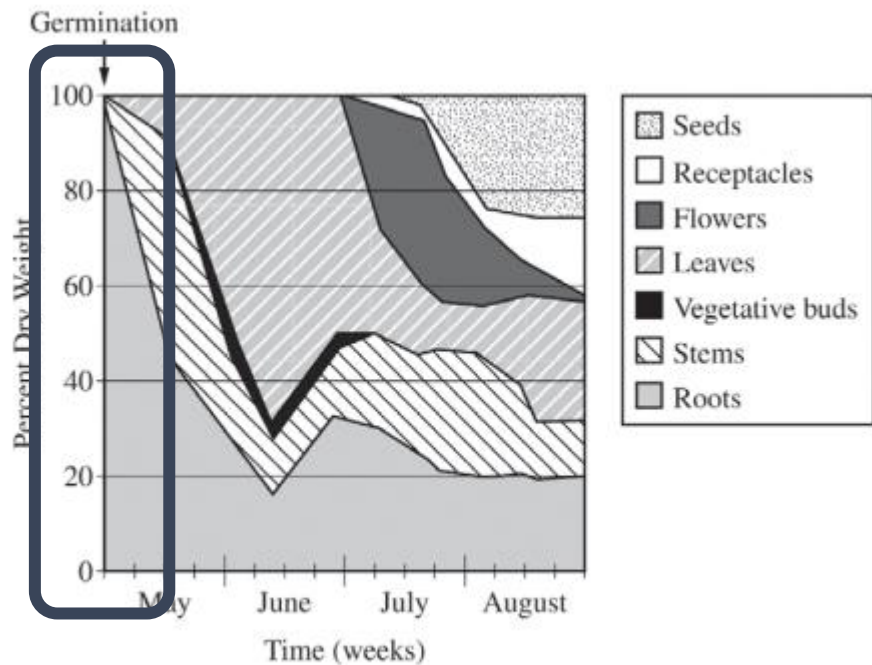


Figure 1. Percent dry weight of different plant structures during the growing season for an annual plant

Identify direct source of energy (1 point)

- Seed
- Stored organic nutrients/carbohydrates

Identify plant part (1 point)

- Roots



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(b) Based on the data on the graph, **estimate** the percent of the total energy that the plant has allocated to the growth of leaves on the first day of July.

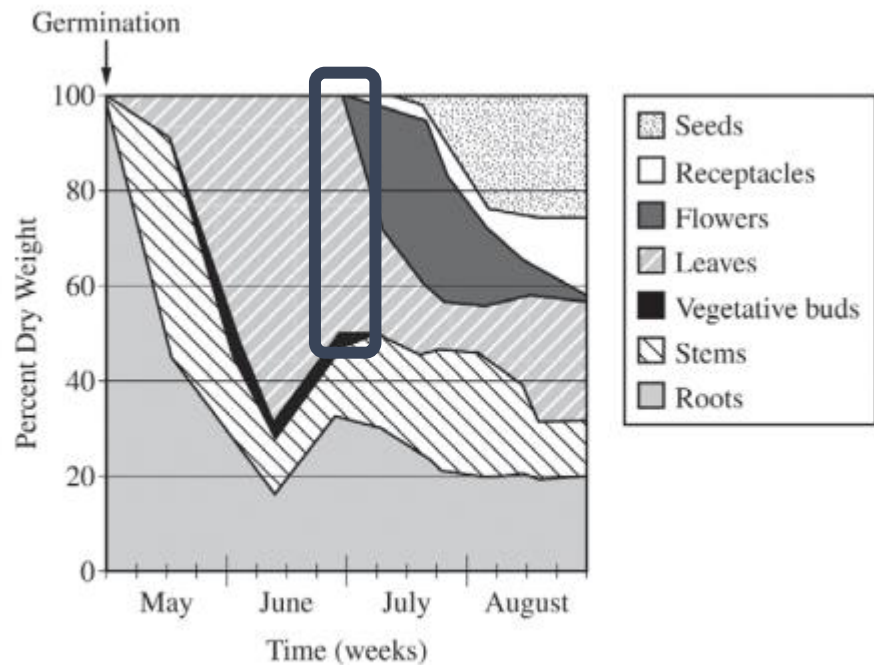


Figure 1. Percent dry weight of different plant structures during the growing season for an annual plant

Identification (1 point)

- Any value between 45-55 percent



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(c) Compared with perennials (plants that live more than two years), annual plants often allocate a much greater percentage of their total energy to growth of their reproductive parts in any given year. **Propose ONE** evolutionary advantage of the energy allocation strategy in annual plants compared with that in perennial plants.

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.



Next FRQ Friday (5/7)

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2017 #1

2016 #8

2015 #5

2014 #4



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