

Question 3

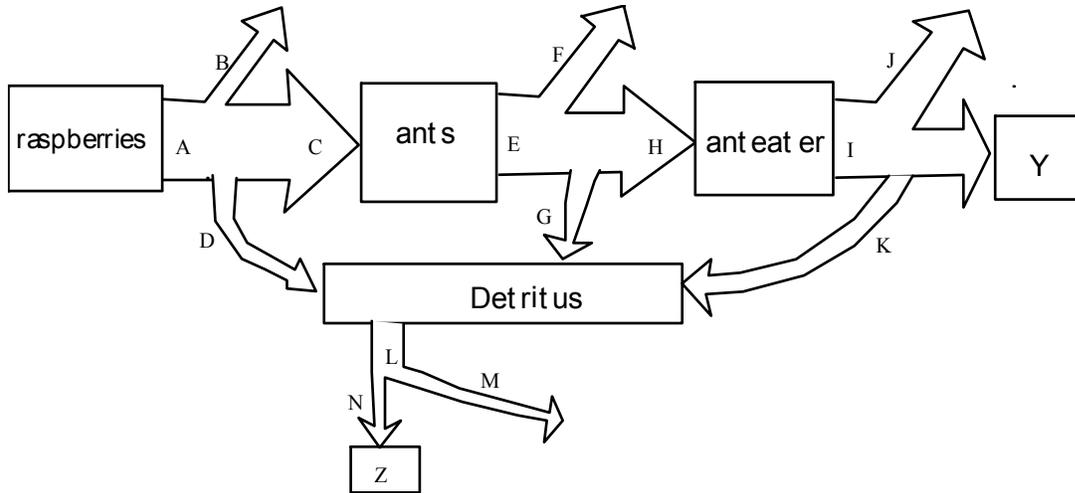
Walking down the infinite corridor one day, you and your friend are suddenly engulfed in a space-time distortion and transported to a barren world covered with fake-looking rocks and sparse vegetation, strikingly similar to a set from the original Star Trek. After an indeterminate period of blind panic, you and she realize you may be stuck there for a long time, and begin to assess the situation. You find that there are only three non-microbial organisms on the planet: raspberry bushes, ants, and anteaters. Having just finished 7.014, you both realize that your introduction into this ecosystem is bound to disrupt it and, to maximize your survival, you should be careful of what you eat. Your friend starts to study the situation, and she draws the following energy flow diagram to represent the ecosystem (next page):

a) You look at your friend's diagram

i) What do the arrows B, F, and J represent?

ii) Why do both plants and animals "lose" energy by the process in part (i) above?

Question 3, continued



iii) Assuming that the thickness of all lines is proportional to the amount of energy transferred by that route, what mistake has she made in drawing the diagram?

b) Write expressions for the following, using the variables (A, B, etc.) on the diagram.

i) Net Primary Productivity (NPP).

ii) Net Ecosystem Productivity (NEP), include A in your formula.

c) Her diagram contains more than is immediately visible in your environment (i.e. raspberries, ants, and anteaters)

i) What is "detritus"

ii) What is represented by box "Z"?

d) Your friend starts to apply her knowledge from 7.014 to decide which you should eat to get the most out of the available food supply: raspberries, ants (yuck) or anteaters (tastes like chicken!).

i) As a human eating these three things, from which food source will you get the highest exploitation efficiency and why?

ii) As a human eating these three things, from which food source will you get the highest assimilation efficiency and why?

Question 3, continued

iii) Which of these things will have the highest production efficiency (an intrinsic property of the organism)?

e) You realize that your friend has been wasting her time, because you know the answer without worrying about the analysis. What should you eat to get the highest ecological efficiency out of the system and why?

Question 3

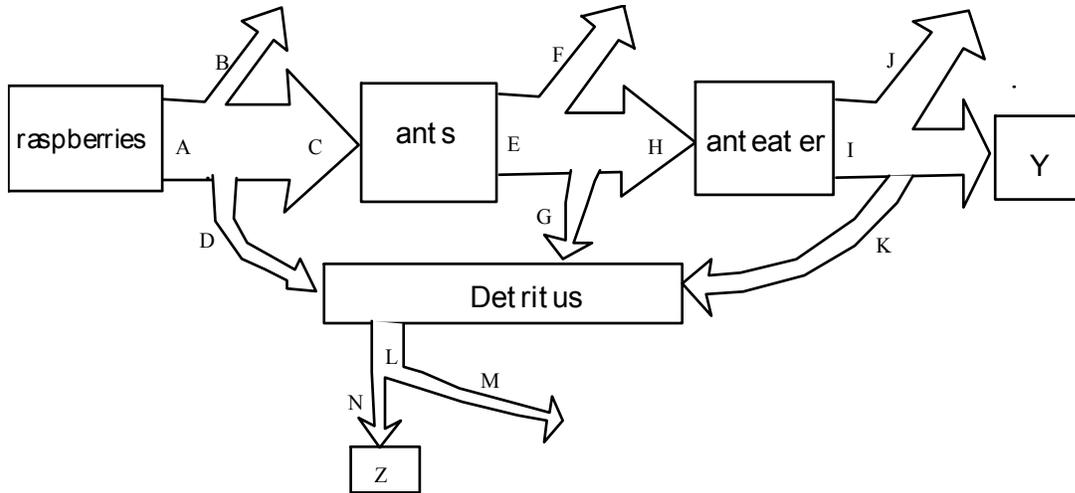
Walking down the infinite corridor one day, you and your friend are suddenly engulfed in a space-time distortion and transported to a barren world covered with fake-looking rocks and sparse vegetation, strikingly similar to a set from the original Star Trek. After an indeterminate period of blind panic, you and she realize you may be stuck there for a long time, and begin to assess the situation. You find that there are only three non-microbial organisms on the planet: raspberry bushes, ants, and anteaters. Having just finished 7.014, you both realize that your introduction into this ecosystem is bound to disrupt it and, to maximize your survival, you should be careful of what you eat. Your friend starts to study the situation, and she draws the following energy flow diagram to represent the ecosystem (next page):

a) You look at your friend's diagram

i) What do the arrows B, F, and J represent? *Respiration: B = raspberry; F = ant; J = anteater.* ii) Why do both plants and animals "lose" energy by the process in part (i) above?

The process of respiration generates ATP by gradually capturing the energy of the breakdown of glucose into CO₂. That process is 60% efficient, while 40% of energy in glucose is lost to heat. The ATP generated is used to power the organism, and is thus, unavailable to the next trophic level.

Question 3, continued



iii) Assuming that the thickness of all lines is proportional to the amount of energy transferred by that route, what mistake has she made in drawing the diagram?
Energy is lost at each trophic level. She drew $A=E=I$, not $A>E>I$.

b) Write expressions for the following, using the variables (A, B, etc.) on the diagram.

i) Net Primary Productivity (NPP).

$A - B - D$ or $A - B$

ii) Net Ecosystem Productivity (NEP), include A in your formula.

$A - B - D - F - G - J - K (=Y)$

c) Her diagram contains more than is immediately visible in your environment (i.e. raspberries, ants, and anteaters)

i) What is "detritus"

All energy (reduced carbon) not in a living organism, but still available to detritivores

ii) What is represented by box "Z"?

Refractory carbon - reduced carbon that is unavailable to detritivores such as fossil fuels

d) Your friend starts to apply her knowledge from 7.014 to decide which you should eat to get the most out of the available food supply: raspberries, ants (yuck) or anteaters (tastes like chicken!).

i) As a human eating these three things, from which food source will you get the highest exploitation efficiency and why?

Ants because you can eat them whole and catch them easily.

ii) As a human eating these three things, from which food source will you get the highest assimilation efficiency and why?

Anteaters because they are most similar to humans, therefore will be most readily digestible.

Question 3, continued iii) Which of these things will have the highest production efficiency (an intrinsic property of the organism)?

Plants would because they generate ATP by photophosphorylation, not just respiration, therefore less energy (reduced carbon) is spent on metabolism. Furthermore, they are sessile (don't move) and, therefore, don't spend energy on movement.

e) You realize that your friend has been wasting her time, because you know the answer without worrying about the analysis. What should you eat to get the highest ecological efficiency out of the system and why?

The lower the trophic level you eat, the less energy is lost to respiration and detritus, therefore you should eat raspberries.