

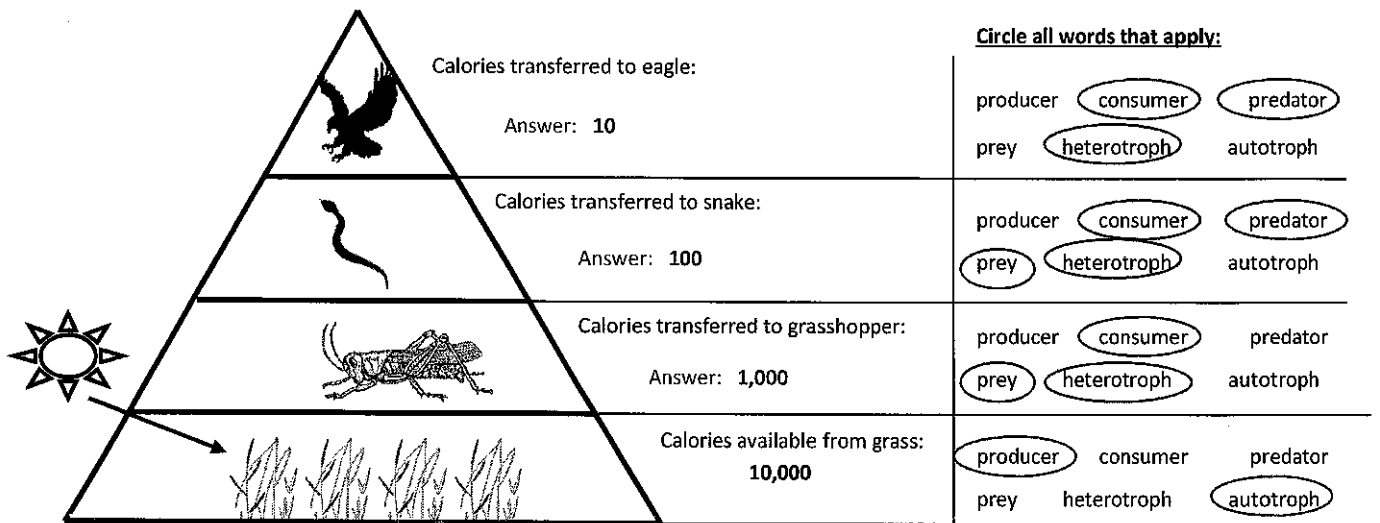
Kew

Name _____ Period _____ Date _____

Energy through Ecosystems Worksheet

The amount of available energy at each trophic (feeding) level decreases as it moves through an ecosystem. As little as 10 percent of the energy at any level is transferred up to the next level.

In the energy pyramid below, calculate the amount of energy that is passed up from one trophic level to the next, assuming only 10% of the energy from the previous level is available for the next level. For each trophic level, circle all the words that apply to identify each organism as either a producer or consumer and as either an autotroph or a heterotroph. If the organism could be considered a predator and/or prey, circle those words also.



Questions

1. Assume that the grasshopper in the food pyramid above must eat half its body weight in grass each day. If an average-size grasshopper weighs 2 grams, and 1 blade of grass weighs 0.1 grams (one tenth of a gram), how many blades of grass does the grasshopper need to eat each day?

Answer: 10 blades of grass (=1/2 the weight of a grasshopper, or 1 g)

2. Assume a snake must eat 5 grasshoppers per day, while an eagle must eat 2 snakes per day. Use this information along with your answer from Question #1 to calculate how many blades of grass are needed to keep an eagle alive for a day?

Answer: 100 blades of grass (=10 blades/grasshopper x 5 grasshoppers/snake x 2 snakes/eagle)

3. How many blades of grass are needed to support a family of four eagles for a week?

Answer: 2800 blades of grass (=100 blades/eagle x 4 eagles x 7 days/week)

Key

Student responses should resemble the following statement of purpose: The purpose of this lab was to use knowledge of trophic levels and the laws of thermodynamics to investigate the consequences of different food choices.

Student responses to reflection questions should be graded AP style: half points for set-up, half points for correct answer; correct answer with no work shown = zero points; an incorrect answer that is carried to a subsequent problem may earn full points in the subsequent problem if set-up is correct (no double penalty).

1. Soybeans → grasshopper → chicken → farmer
2. Producer = soybean; primary consumer = herbivore = grasshopper; secondary consumer = chicken; tertiary consumer = human/farmer. Chickens and humans may also be listed as omnivores. Students may also list chicken as carnivore in this example.
3. Answers will vary: light intensity, rainfall, wind speed, soil type, cloud cover, etc.
4. $1 \text{ chicken} \times (25 \text{ grams/day}) \times (365 \text{ days/year}) = 9125 \text{ grasshoppers per year per chicken}$
 - a. $1 \text{ farmer} \times (1 \text{ chicken/day}) \times (365 \text{ day/year}) \times (9125 \text{ grasshoppers/chicken year}) = 3,330,625 \text{ grasshoppers per year to support the chickens that feed one farmer}$
 - b. $3,330,625 \text{ grasshoppers/year} \times (1 \text{ kg}/1000 \text{ g}) = 3330.625 \text{ kilograms of grasshoppers per year to feed chickens that feed one farmer}$
 - c. $3,330,625 \text{ grasshoppers/year} \times (30 \text{ grams soy/grasshopper}) \times (1 \text{ kg}/1000 \text{ grams}) = 99,918.75 \text{ kilograms soy per year to feed the grasshoppers that feed the chickens that feed one farmer}$
5. $3,330,625 \text{ grasshoppers/year} \times (1 \text{ year}/365 \text{ days}) \times (1 \text{ farmer day}/600 \text{ grasshoppers}) = 15.2 \text{ farmers/humans could survive for one year if they ate grasshoppers directly}$
6. $99,918.75 \text{ kg soy/year} \times (1 \text{ year}/365 \text{ days}) \times (1000 \text{ g}/1 \text{ kg}) \times (3.3 \text{ cal/g}) \times (1 \text{ farmer day}/3000 \text{ cal}) = \text{approximately } 301 \text{ farmers/humans could survive for one year if they ate soybeans directly}$
7. $1.5 \text{ kg/chicken} \times (1 \text{ chicken/day}) \times (365 \text{ days/year}) = 547.5 \text{ kilograms chicken/year}$

Farmer = 60 kg
Chicken = 547.5 kg
Grasshoppers = 3330.625 kg
Soybeans = 99,918.75 kg

Answers will vary. Pros for eating only plants/plant products may include support more people, health benefits, less cost, and ethical considerations regarding slaughter of animals. Cons for eating only plants/plant products may include difficulty in acquiring enough iron and some types of protein in a vegetarian diet, taste, and societal pressures/consequences.