Eating at Lower Trophic Levels:
Answer Key

1. Grasshoppers a hen needs per year

$$1 \: \cancel{hen} * \frac{25 \: grasshoppers}{\cancel{hen} \: \cancel{day}} * \frac{365 \: \cancel{days}}{year} = 9125 \: grasshoppers/year$$

2. How many grasshoppers are needed for a year's supply of hens for a farmer each year?

$$1 \: \cancel{farmer} * \frac{365 \: \cancel{hens}}{\cancel{farmer}} * \frac{9125 \: grasshoppers}{\cancel{hen} \: year} = 3,330,625 \: grasshoppers/year$$

3. What is the total mass, in Kg, of the grasshoppers needed to feed all the hens for one year?

$$\frac{3,330,625 \: \cancel{grasshoppers}}{year} * \frac{1 \: kg}{1000 \: \cancel{grasshoppers}} = 3,330.625 \: kg/year$$

4. How many kilograms of soybeans are needed to feed all the grasshoppers for one year?

$$\frac{3,330,625 \: \cancel{grasshoppers}}{year} * \frac{30 \: \cancel{g \: soy}}{1 \: \cancel{grasshopper}} * \frac{1 \: kg \: soy}{1000 \: \cancel{g \: soy}} = 99,918.75 \: kg \: soy/year$$

5. How many people could the grasshoppers feed in a year if a person ate grasshoppers?

$$\frac{3,330,625 \: \cancel{grasshoppers}}{1 \: \cancel{year}} * \frac{1 \: \cancel{year}}{365 \: \cancel{days}} * \frac{1 \: person \: \cancel{day}}{600 \: \cancel{grasshoppers}} = 15.2 \: people = 15 \: people$$

6. Farmer needs 3,000 Cal/day. How many people would the soybean crop feed?

$$\frac{1 \: farmer \: \cancel{day}}{3000 \: \cancel{Cal}} * \frac{1 \: \cancel{year}}{365 \: \cancel{days}} * \frac{99,918.75 \: \cancel{kg \: soy}}{1 \: \cancel{year}} * \frac{3.3 \: \cancel{Cal}}{1 \: \cancel{g \: soy}} * \frac{1000 \: \cancel{g \: soy}}{1 \: \cancel{kg \: soy}} * = 301 \: farmers$$

7. Biomass pyramid

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                              │    │◄──── person
                              └────┘
┌──────────────────┐     ┌──────────────┐
│ Not drawn to scale! │     │     hens     │
└──────────────────┘   ┌──┴──────────────┴──┐
                       │ 33,330.625 kg grasshoppers │
                   ┌───┴─────────────────────────┴───┐
                   │      99,918.75 kg soy              │
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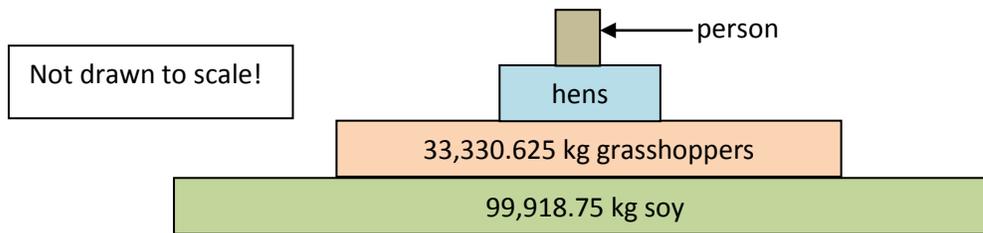
8. Should people generally eat at a lower trophic level?
    a. Pros: planet could sustain far more people. When the farmer was eating hens, the ecosystem could supply just one farmer. When the farmer ate soybeans, could sustain over 300 farmers. Eating the producers rather than feeding on the 3rd trophic level could support 300 times more people in this situation. An additional pro is that eating vegetables Is healthier, especially if eating a well balanced diet. Too much meat can be bad for your health.

    Cons: Eating lower on the food chain could result in broader areas used for monoculture, therefore getting rid of much biodiversity. Also, without the hens, the grasshopper population could explode, causing a decrease in the soy population. Until the grasshopper population stabilized, there would need to be higher soy production to support both the farmers and the grasshoppers.

    b. In countries where food is scarce, it makes more sense for people to eat the producers rather than the consumers. Much energy is lost between the producers and cows, then between the cows and the people. Developing nations (as well as developed nations) could support more people or have a lower environmental impact if people ate at lower trophic levels.

9. Omnivores, such as coyotes, rats and humans, can eat on multiple trophic levels. This allows them to eat higher when the food is available, but lower on the food chain when meat is scarce. Having the ability to eat both meat and vegetables increases the opportunities to find food.

10. Foods eaten (answers will vary, but mine: cereal, milk, cheese, bread, onion and pesto pizza)

    a. Most food came from the first trophic level (cereal, bread, onion, pesto, pizza dough); though some came from the second trophic level (milk, cheese, butter on bread).
    b. Approximately 75% of the mass came from the first trophic level, 25% from the 2nd.
    c. When I eat fish, I primarily eat salmon, which is on the 3rd trophic level (salmon eat krill which eat phytoplankton). Less than 10% of my diet is from the 3rd trophic level.

11. Bioaccumulation: Chemicals such as mercury are not excreted by animals or plants. When a plant takes up the mercury, all of that mercury is taken into the next trophic level (likely the zooplankton, such as krill). Krill need to consume quite a lot of phytoplankton to sustain themselves, and therefore eat a lot of mercury. In turn, the salmon eat the krill, and therefore accumulate more mercury. Finally, we eat the fish, so the mercury becomes a part of us.