

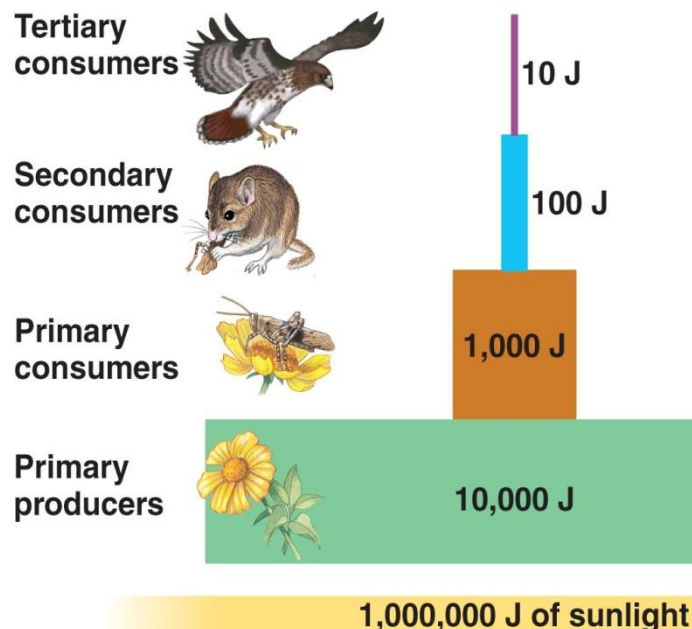
The 10% Rule

All of the energy on Earth originally comes from the sun. Producers, or plants, can use that radiant energy and turn it into chemical energy (glucose) that the plant can use. An energy pyramid's shape shows the amount of useful energy that enters each level. Each level in a food chain is called a trophic level. The chemical energy, in the form of food, decreases as it is used by the organisms in that level.

Both plant and animal cells need energy to survive and grow. They can break down glucose to release the chemical energy inside. This process is called cellular respiration. The problem is that even though a lot of energy may be taken in at any level, the energy that is stored and available to the next level is far less. Scientists have calculated that an average of 90% of the energy entering each level is stored and stays at that level. Only 10% of the energy is available to the next level.

For example, a plant will use 90% of the energy it gets from the sun for its own growth and reproduction. When it is eaten by a consumer, only 10% of its energy will go to the animal that eats it. That consumer will use 90% of that energy and only 10% will go on to the animal that eats it. By the time you get to the top level, there is only a minor fraction of the original energy.

The tertiary consumers at the top of the energy pyramid will have much less available energy to support them than the primary and secondary consumers below them. That's why their population numbers are fewer in most food chains. The amount of useful energy left eventually cannot support another level. That's why energy flow is shown in the shape of a pyramid and most chains are rarely longer than three or four trophic levels.



Materials

10 small cups
beaker

triple beam balance
calculator

500g sand
plastic spoon

Procedure

1. Find the cup labeled "Energy from the Sun". It contains 500g of sand. This represents the amount of energy from the sun that is available to producers.
2. Use the flow chart to determine how many grams of energy would go to each category. Remember that if you need to multiply by a percent, turn it into a decimal first by moving the decimal two spaces to the left. For example, 50% would be .50
You can use the calculator. Fill in the correct values on the flow chart.
3. Once the flow chart is complete, divide the 500g of energy from the sun into the cups labeled for "Unused Sunlight", "Reproduction", "Energy Storage", "Photosynthesis", and "Respiration" for the Producer level.
4. Take all of the cups except the "Energy Storage" cup and dump them into the beaker. This is energy that has been used and cannot pass to the next level (primary consumers).
5. Take the sand left in the "Energy Storage" cup and divide up based on your calculated weights for the primary consumer level. You will have a cup for "Digestion", "Reproduction", "Energy Storage", "Movement", and "Respiration".
6. Set aside the "Energy Storage" cup. Dump the contents of the rest of the cups into the beaker. This is energy that has been used and cannot pass to the next level.
7. Finally, split the remaining "Energy Storage" sand into cups for the secondary consumers. Notice how the amount of energy is drastically reduced at each level.