

Science and Children : Science 101

How Does the Human Body Turn Food into Useful Energy?

2/27/2006 - Bill Robertson

Question:

How does the human body turn food into useful energy?

Answer:

As with just about everything else involving the human body, it is absolutely amazing that we can chow down on various things and somehow use this basic action to grow, move, breathe, and all other kinds of stuff. You probably expect that the process is complicated, and it is. Pick up a textbook on biochemistry if you need to be convinced of that. On the other hand, the basic idea is pretty simple. I'm going to address the simple part in this column.



Food contains stored energy. You put energy into it (digestive processes) to get useful energy out of it. Brian Diskin

Consider This

Suppose you want to build a cabin in a mountain valley. Unfortunately, there's an old barn sitting right where you want to build your cabin. You'll have to knock that old barn down first, right? Being a clever person, you look around and think that if only there was a large boulder on top of one of those surrounding hills, you could just start the boulder rolling down the hill aimed at the barn, and you would end up knocking down the barn just like that.

Well, it turns out there's just such a boulder sitting in a valley near you at a much higher elevation. The problem is

that pesky hill in between. You're so fond of your plan, though, that you figure it's worth putting in a little bit of energy to get that boulder up to the top of the hill in order to get a lot more energy out as the boulder heads down toward the barn.

Nutrition is a whole lot like the situation with the boulder. Foods contain lots of stored chemical energy. Just as that boulder in the high valley isn't much use to you in its present position, the chemical energy stored in foods isn't, in its current state, much use for the human body. You can't smear a plate of spaghetti on your legs and expect that to help you run faster. So, you put some energy into the food in order to get out of it the useful energy that's stored in its chemical bonds.

How do you put energy into the food? First you chew it, and then enzymes in your digestive system progressively break down the molecules in the food. Eventually you end up with sugars and fats, and finally a special molecule called adenosine triphosphate (ATP). This special molecule is the energy source your body has worked for. Individual cells in your body transform ATP into a similar molecule, adenosine diphosphate (ADP). This transformation from ATP to ADP, the equivalent of the boulder rolling down the large hill, releases energy that the cells use for bodily functions.

A couple of clarifications. First, not all foods are sources of energy. Carbohydrates and fats are good sources of energy, but proteins, vitamins, and minerals are primarily sources of molecules that the body uses as building blocks for various processes. Second, going from the energy release from ATP to an action like the motion of walking is still quite a complicated process. To understand this fully, you have to know how all of the human body systems work, both independently and together, and you have to know how these systems get their energy from the ATP to ADP transformation. Sorry, but there's not enough space here to go into all that.

Take In, Take Out

There's another important energy concern with the human body, and it's the large-scale picture of how the body deals with the "balance" between the input of energy from food and the output of energy in the form of bodily functions. If you take in more food energy than your body uses (through breathing, exercise, etc.), then your body stores this excess energy as fat. If you take in less food energy than your body uses, your body relies on the fat storage for needed energy.

Clearly this balance, or lack thereof, has a lot to do with whether you gain weight, lose weight, or maintain your weight. More input energy than output energy and you gain weight. Less input energy than output energy and you lose weight. This makes a prescription for gaining or losing weight pretty simple. If you want to lose weight, eat less and exercise more.

Of course, there are specialty diets, such as the Atkins Diet, that take advantage of what we know about how the body gets energy. In that diet, you eat lots of protein and few carbohydrates and fats. Because the body gets most of its energy from carbohydrates and fats, it is forced to rely on body fat as a source of energy. Of course, that's a bit oversimplified. Your body gets more than just energy from carbohydrates, so the total effect of various diets can go beyond simple weight loss. The safe bet is the diet-exercise connection.

As you take a look at resources that describe the entire process of food energy to body energy, it's easy to get lost in all the vocabulary of the biology and the chemical reactions. If you keep in mind the big picture—putting in energy to get more out, and the balance or lack of balance between input and output—the process is a lot easier to understand.