

THE FIRST LAW OF THERMODYNAMICS

YOU ARE THE PROUD OWNER OF A REMARKABLE MACHINE: THE HUMAN BODY. HOW IT IS CONSTRUCTED AND HOW IT FUNCTIONS ARE DESCRIBED IN THE SEEMINGLY HUNDREDS OF THOUSANDS OF PAGES THAT MEDICAL STUDENTS HAVE TO READ AND MEMORIZE. ANATOMY TELLS US ABOUT THE MOVEABLE PARTS THAT MAKE UP THE MACHINE; PHYSIOLOGY SHOWS US HOW THEY WORK; BIOCHEMISTRY TEACHES US HOW ATOMS, MOLECULES, MINERALS, HORMONES AND ENZYMES BUILD, REPAIR AND NOURISH THE INFINITE NUMBER OF CELLS THAT ARE THE REAL BUILDING BLOCKS OF LIFE.

LET'S TALK ABOUT ANOTHER AREA OF SCIENCE, HOWEVER, AND HOW IT RELATES TO YOU AND YOUR DAILY ACTIVITIES: PHYSICS. DO YOU REMEMBER THIS DIFFICULT SUBJECT FROM HIGH SCHOOL? YOU PROBABLY RECALL THAT IT USUALLY DEALS WITH INANIMATE OBJECTS, NAMELY BOUNCING BALLS, SOUND WAVES AND ACCELERATION DUE TO GRAVITY. STUDYING PRESSURE, VOLUME AND TEMPERATURE IS NOT AS EXCITING AS DISSECTING FROGS OR BUBBLING ORGANIC CHEMICALS. I BET THAT YOU FORGOT MOST OF THIS SUBJECT BY THE TIME OF GRADUATION, MAYBE EVEN SOONER.

BUT PHYSICS IS VERY MUCH A PART OF WHO WE ARE AND WHAT WE LOOK LIKE. SPECIFICALLY, AMERICA'S WORST VITAL SIGN, OUR WEIGHT, DEPENDS ALMOST ENTIRELY ON ONE OF THE INDISPUTABLE RULES OF SCIENCE: THE FIRST LAW OF THERMODYNAMICS. THIS IS ONE OF THOSE LAWS THAT EVEN A

JUSTICE OF THE SUPREME COURT CANNOT OVERRIDE; EVEN A CHARACTER REFERENCE FROM YOUR GRANDMOTHER CAN'T HELP. YOU KNOW THIS PRINCIPLE PARTIALLY FROM THE COLLOQUIAL EXPRESSION "YOU ARE WHAT YOU EAT" BUT THAT'S ONLY PART OF THE PICTURE.

THE FIRST LAW OF THERMODYNAMICS WAS DISCOVERED AROUND 1878 WHEN PHYSICISTS EXPLORED THE PROPERTIES OF HEAT, ENERGY AND CHEMICAL MOLECULES. THEY FOUND THAT "MATTER CAN NEITHER BE CREATED NOR DESTROYED IN A CHEMICAL REACTION". HERE'S A VERY SIMPLE EXAMPLE: WHEN WATER BOILS, IT CHANGES SHAPE (INTO STEAM, THEN VAPOR) AND HEAT IS TRANSFERRED FROM THE FLAME TO THE WARMER WATER VAPOR. PUT ANOTHER WAY, "ENERGY (HEAT) CAN BE TRANSFERRED FROM ONE SYSTEM TO ANOTHER IN MANY FORMS, BUT IT CANNOT BE CREATED NOR DESTROYED."

I BET THAT YOU ARE WONDERING HOW THIS APPLIES TO YOU. THINK OF YOURSELF AS THE AFOREMENTIONED "SYSTEM" AND FOCUS ON THE AFOREMENTIONED "TRANSFER OF ENERGY". LET'S CALL IT BY ITS USUAL NAME: EATING. EVERY MORSEL OF FOOD THAT YOU SWALLOW IS A POTENTIAL SOURCE OF ENERGY. THE PASTA THAT A MARATHON RUNNER EATS THE NIGHT BEFORE A COMPETITION GOES DIRECTLY TO HIS OR HER LEG MUSCLES AND LIVER TO BE CALLED ON THE NEXT DAY. OF COURSE YOU KNOW THE NAME THAT WE USE TO MEASURE THE AMOUNT OF POTENTIAL ENERGY IN A GIVEN FOOD: A CALORIE. AND, IN A RE-PHRASING OF THE FIRST LAW OF THERMODYNAMICS, YOU CANNOT GET

MORE ENERGY OUT OF A SYSTEM THAN YOU PUT INTO IT, JUST LIKE YOUR BANK ACCOUNT. IF YOU FIND OUT A WAY TO WITHDRAW \$10,000 AFTER A \$20 DEPOSIT, I GET THE FIRST TELEPHONE CALL.

AND JUST LIKE YOUR BANK ACCOUNT, THE HUMAN BODY IS EMINENTLY CAPABLE OF STORAGE. THE BANK KEEPS YOUR MONEY IN THE VAULT; YOU CAN EASILY SEE STORED "ENERGY" AROUND YOUR MIDRIF AND HIPS. THROUGH A REMARKABLE AND WELL-STUDIED SERIES OF BIOCHEMICAL TRANSFORMATIONS, EXCESS POTENTIAL ENERGY (AS CALORIES) THAT IS NOT CURRENTLY NEEDED IS PUT AWAY FOR A RAINY DAY, SO TO SPEAK. THE ORIGINAL COMPONENTS OF FOOD ARE BROKEN DOWN AND TRANSFORMED INTO THE STORAGE FORM OF SUGAR (GLYCOGEN) AND, WHEN THESE ARE MAXIMALLY CREATED, INTO THE MOST INFAMOUS STORAGE MOLECULE OF ALL, FAT. ATP, A COMPLEX MOLECULE THAT SUPPLIES THE "SPARK" YOUR MUSCLES NEED TO MOVE, IS ALSO STORED INSIDE TINY "CONTAINERS" (MITOCHONDRIA) IN EVERY LIVING CELL.

BUT YOU HAVE ONLY HEARD ABOUT ONE-HALF OF THE STORY; WE NOW CAN LOOK AT THE OTHER SIDE OF THE COIN, NAMELY THE EXPENDITURE OF ENERGY. YOU KNOW IT AS "BURNING OFF CALORIES", AND THE EXPRESSION IS A PARTICULARLY DESCRIPTIVE ONE. AS THE MARATHON RUNNER RACES AROUND THE CITY, HE OR SHE IS CALLING UPON THOSE STORED FORMS OF ENERGY IN WAYS THAT ARE VISIBLY QUITE OBVIOUS: THE LEG MUSCLES ARE MOVING VERY QUICKLY AND THE ATHLETE IS VERY

WARM. WE CANNOT KNOW IF THE INDIVIDUAL IS "BURNING OFF" FOOD FROM BREAKFAST, YESTERDAY'S PASTA MEAL OR THANKSGIVING DINNER. WE DEFINITELY KNOW, HOWEVER, THAT A CAR WITHOUT FUEL GOES NOWHERE.

AMERICANS AND THEIR OVERWEIGHT BRETHERN ALL OVER THE WORLD ARE CONVINCED THAT THERE IS A WAY TO EAT THEMSELVES TO THINNESS. PEOPLE HAVE SEARCHED FOR A DIET THAT ALLOWS YOU TO EAT FOOD THAT SOMEHOW CIRCUMVENTS THE METAMORPHOSIS OF EXCESS CALORIES INTO FAT. BUT SINCE WE ARE BIOCHEMICAL MACHINES MADE UP OF ORGANIC MOLECULES THAT MUST OBEY THE FIRST LAW OF THERMODYNAMICS, THIS IS IMPOSSIBLE. I FIND THIS SAD BUT TRUE FACT VERY LIBERATING: IT'S JUST ONE OF THOSE GREAT SECRETS ABOUT LIFE AND OUR FASCINATING BODIES. BUT YOU MAY FIND THIS VERY DEPRESSING. GET OVER IT.

CAN WE NOW SPELL OUT HOW THE FIRST LAW OF THERMODYNAMICS APPLIES TO YOU AND EVERYONE, THIN OR FAT, THAT YOU HAVE EVER KNOWN? LET'S FOCUS ON WHAT I LIKE TO REFER TO AS THE MATHEMATICS OF DIETING. IN BRIEF, 3500 CALORIES OF FOOD IS EQUIVALENT TO ONE POUND OF BODY WEIGHT. HOWEVER, WHENEVER AND WHATEVER YOU EAT, THIS RULE IS INFLEXIBLE. IF YOU EAT "TOO MUCH" OF ANYTHING, YOU WILL "STORE" THE OVERAGE ACCORDING TO THAT EQUATION.

ON THE OTHER HAND, VARIOUS ACTIVITIES ARE POTENTIAL WAYS OF "BURNING IT OFF". AND SINCE THE FIRST LAW OF THERMODYNAMICS APPLIES TO BOTH INTAKE AND OUTPUT (OR

DEPOSITS AND WITHDRAWALS, TO FOLLOW THE BANK METAPHOR), YOU MUST SOMEHOW UTILIZE AN EXTRA 3500 CALORIES IN ORDER TO LOSE ONE POUND OF BODY FAT. THESE 3500 CALORIES CANNOT BE "BURNED OFF" AT ONCE: SITTING IN A STEAM ROOM, TAKING A WATER PILL AND FASTING ARE NOT VIABLE WAYS OF LOSING WEIGHT. ACCORDING TO THE MATHEMATICS OF DIETING, SOME ACTIVITIES ARE MORE TIME-EFFICIENT THAN OTHERS, BUT SOME MIGHT NOT BE REALISTICALLY WITHIN YOUR ABILITIES.

NEVERTHELESS, PHYSICAL EXERCISE CREATES WHAT IS REFERRED TO IN PHYSICS AS A "SINK"--A WAY TO LIBERATE FOOD FROM ITS STORED FORM, TURN IT BACK INTO USEABLE FUEL AND RETURN IT BACK TO THE OUTSIDE WORLD (AS HEAT, SWEAT, CARBON DIOXIDE, WATER AND A FEW VERY SMELLY SUBSTANCES). DEPENDING ON YOUR PREFERENCES, ABILITIES, DETERMINATION AND SOCIAL APPROVAL, YOU CAN ERASE THE CALORIC LOAD OF CHEESEBURGERS, SUSHI OR SALADS BY GARDENING (-250 CALORIES/HOUR), JOGGING (-500 CALORIES/HOUR), SKIPPING ROPE (-700 CALORIES/HOUR) AND DOZENS OF OTHER LESS STRENUOUS WAYS.

THE PARK AVENUE PLAN ENLISTS THE UNPRECEDENTED AID OF SEVEN EXPERTS IN AREAS RANGING FROM NUTRITION TO SKINCARE, FROM HAIRSTYLING TO INTERPERSONAL SKILLS. THESE SCIENCES OF COURSE ARE SOMEWHAT LESS PRECISELY DEFINED THAN ANATOMY, BIOCHEMISTRY AND YOUR NEW FAVORITE, PHYSICS.

YOU MAY BREAK THE TRAFFIC RULES, YOU MIGHT EVEN VIOLATE THE TEN COMMANDMENTS, BUT YOU WILL NEVER, EVER DISOBEY THE FIRST LAW OF THERMODYNAMICS.