

Bioenergetics

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Energy Forms

Matter and energy are basically the same
it is often convenient to consider energy a
property of matter (kcal/g feed)

nutritive value of food items is often
reflected by calories

what you are used to seeing in the store is
not calories, but kilocalories (kcal's)

common form of energy in the cell is ATP

Energy Forms

All processes in the animal body involve changes in energy

the word “**energy**” was first introduced in 1807, and defined as “ability to work”

found in many forms: heat, kinetic, electromagnetic, radiant, nuclear and chemical for our purposes, chemical energy is the most important (e.g., ATP)

Heat Energy

The measurement of energy requires converting it from one form to another what we typically measure is heat , according to the **first law of thermodynamics**, all forms of energy can be converted quantitatively into heat energy heat energy is represented by the various constituents of the diet

Heat Energy

however, the body is not a heat engine,
heat is an end product of reactions

it is only useful to animals to keep the body
warm

chemical reactions either generate heat
($+\Delta H$) or require heat ($-\Delta H$)

Units of Heat Energy

The basic unit of energy is the **calorie** (cal)
it is the amount of heat required to raise the
temperature of 1g of water 1 degree
Celsius (measured from 14.5 to 15.5°C)
it is such a small unit, that most nutritionists
prefer to use the **kcal** (or 1,000 calories)
the kcal is more common (it's what you read
in the supermarket as **Calories**)

Units of Heat Energy

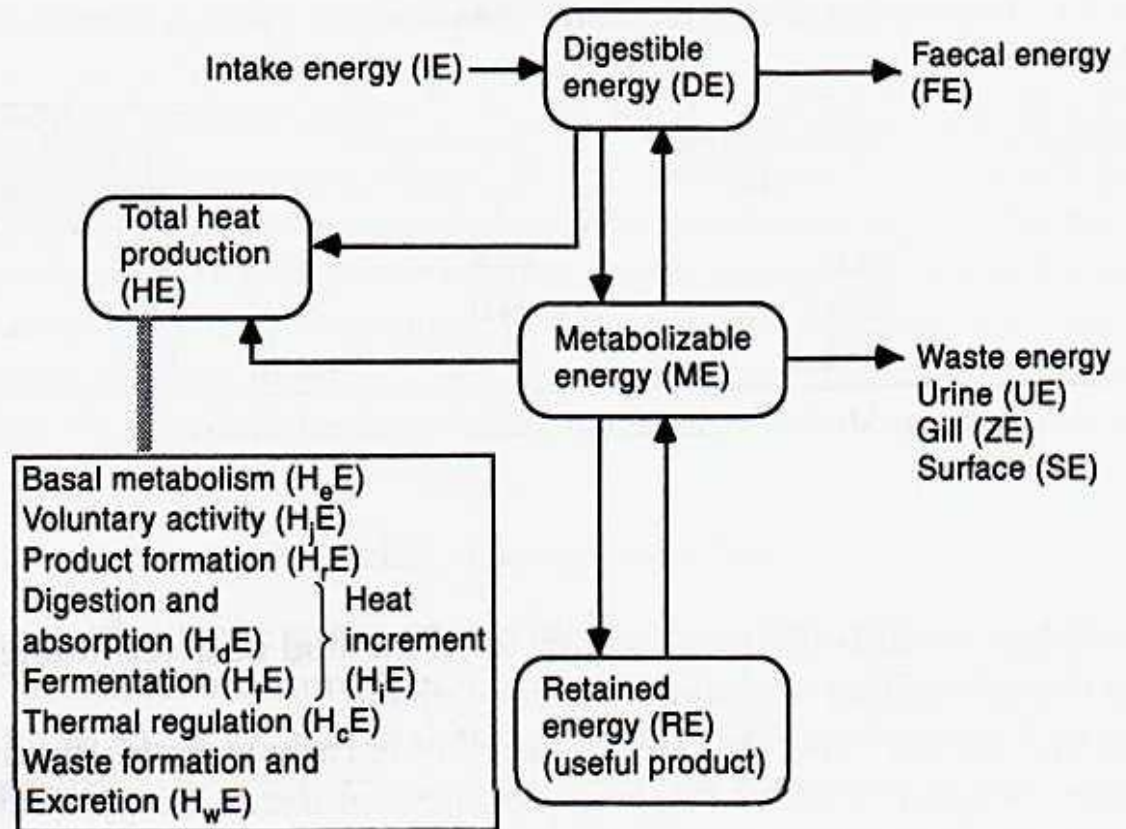
BTU (British Thermal Unit) = amount of heat required to raise 1 lb of water 1°F

international unit: the **joule** - 1.0 joule = 0.239 calories or 1 calorie = 4.184 joule

a **joule** (J) is the energy required to accelerate a mass of 1kg at a speed of 1m/sec a distance of 1m

Energy Terms

Energy flow is often shown as a diagram: every text has its own idea of a suitable diagram:



Energy flow in an aquatic organism.

Energy Terms

Gross energy (GE): energy released as heat resulting from combustion (kcal/g)

Intake Energy (IE): gross energy consumed in food (COH, lipid, protein)

Fecal Energy (FE): gross energy of feces (undigested feed, metabolic products, gut epithelial cells, digestive enzymes, excretory products)

Digestible Energy (DE): $IE - FE$

Energy Terms (cont.)

Metabolizable energy (ME): energy in the food minus that lost in feces, urine and through gill excretion:

$$ME = IE - (FE + UE + ZE)$$

urinary energy (UE): total gross energy of urinary products of unused ingested compounds and metabolic products

gill excretion energy (ZE): gross energy of products excreted through gills (lungs in mammalian terrestrials), high in fish

surface energy (SE): energy lost to sloughing of mucus, scales, exoskeleton