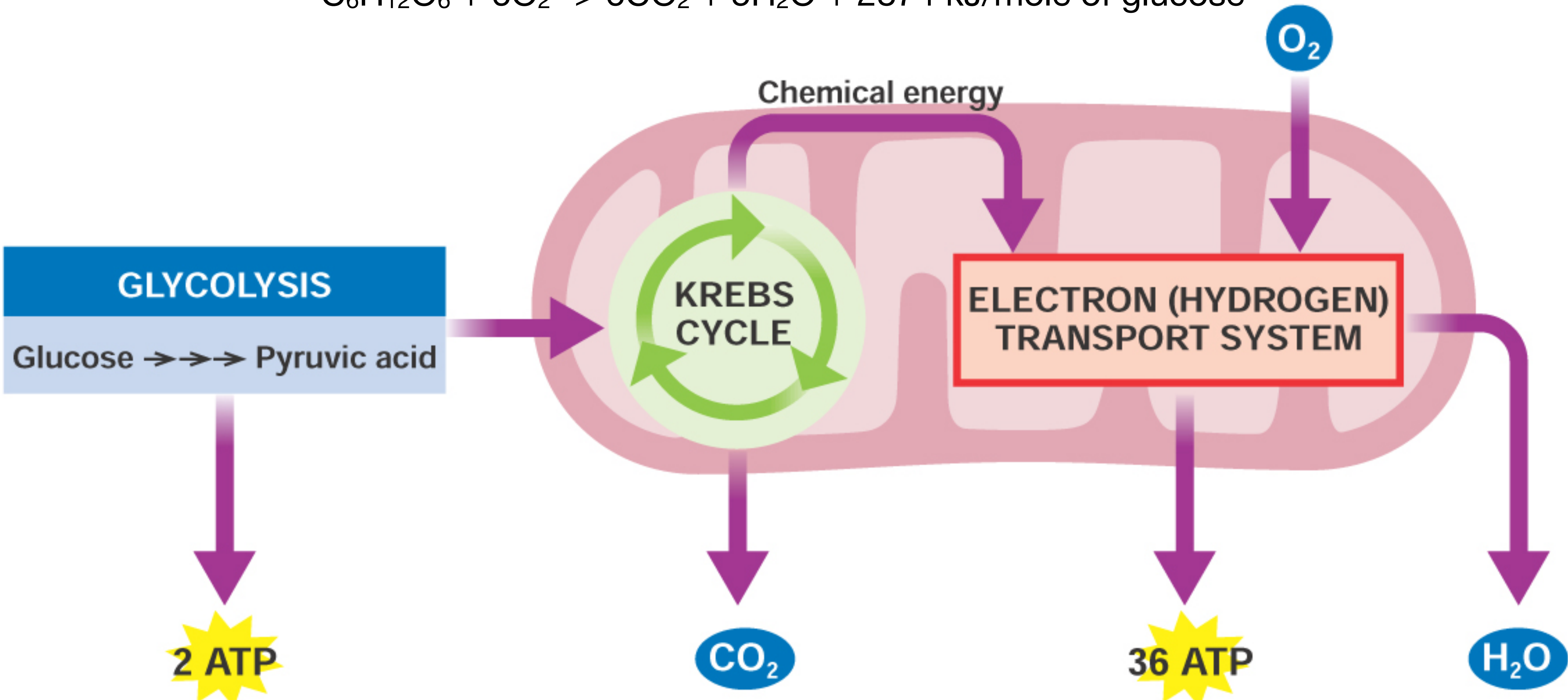
AEROBIC RESPIRATION -- SUMMARY

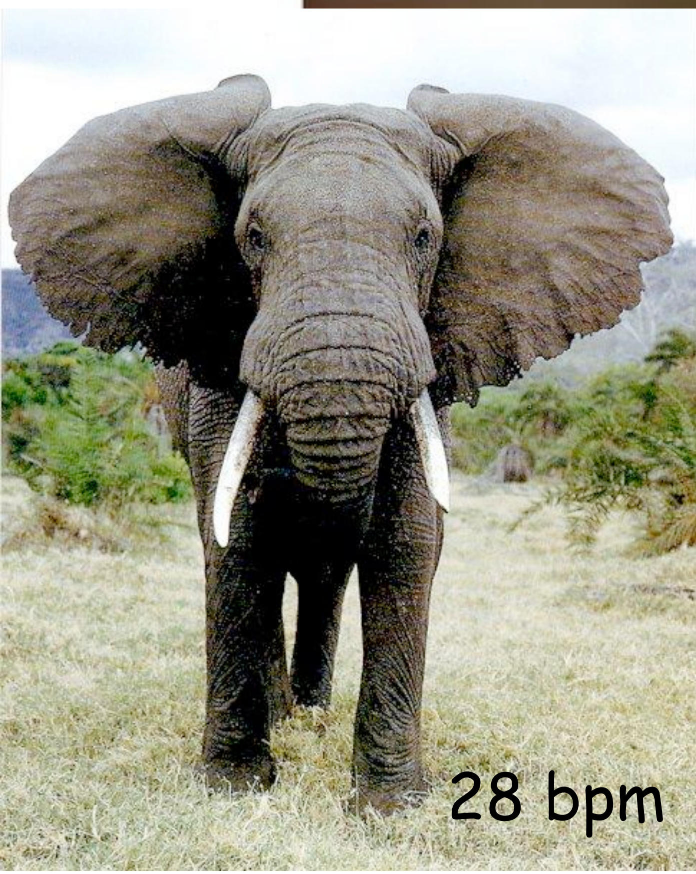
$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 5H_2O$ + 2874 kJ/mole of glucose

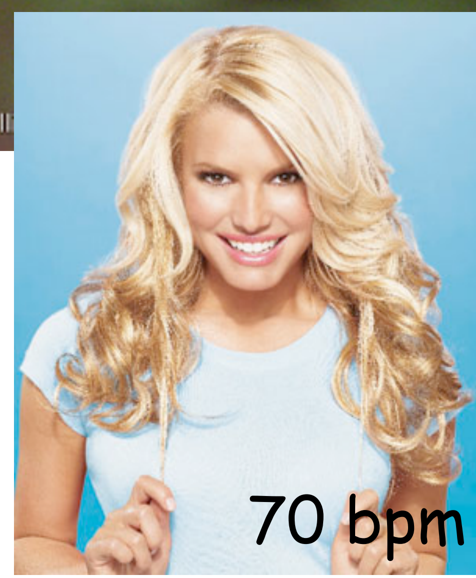


Anaerobic Pathway

+ HEAT

Live Fast Die Young?



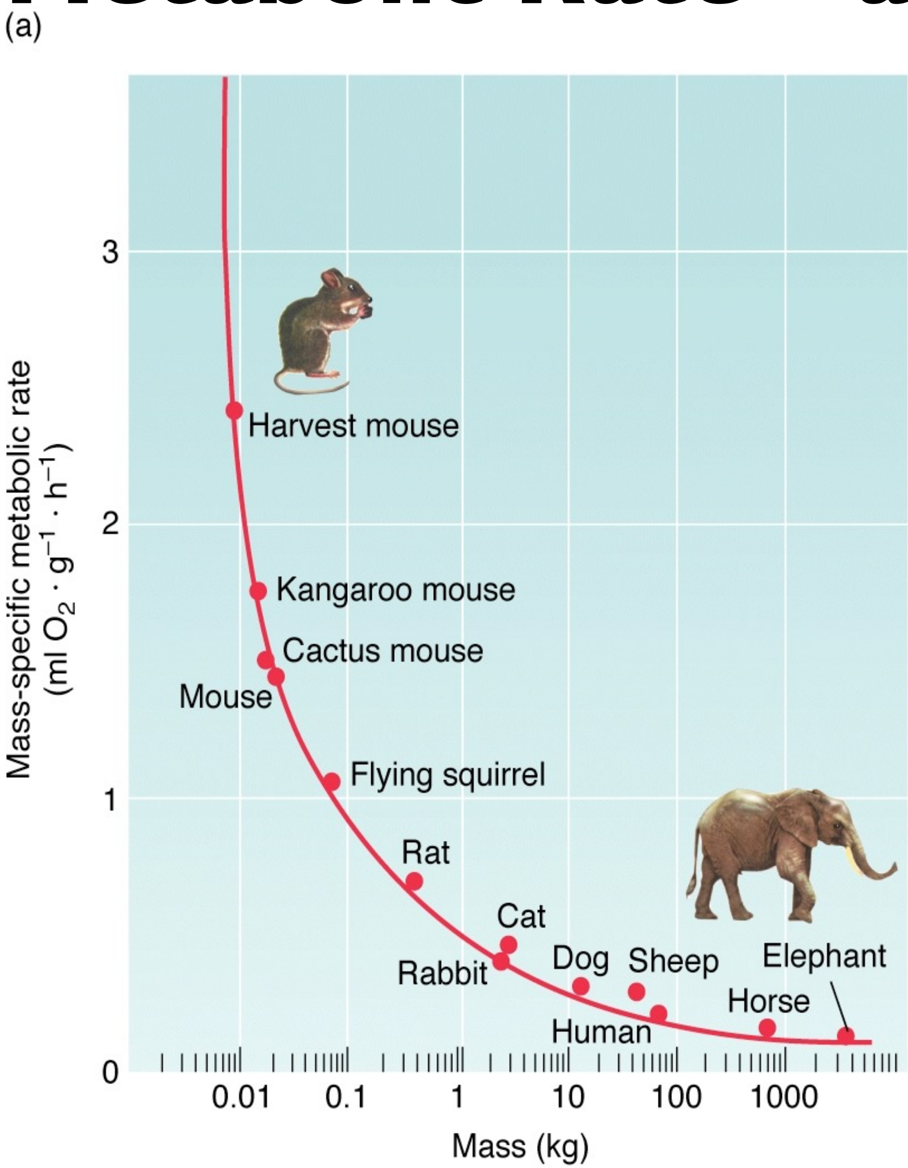


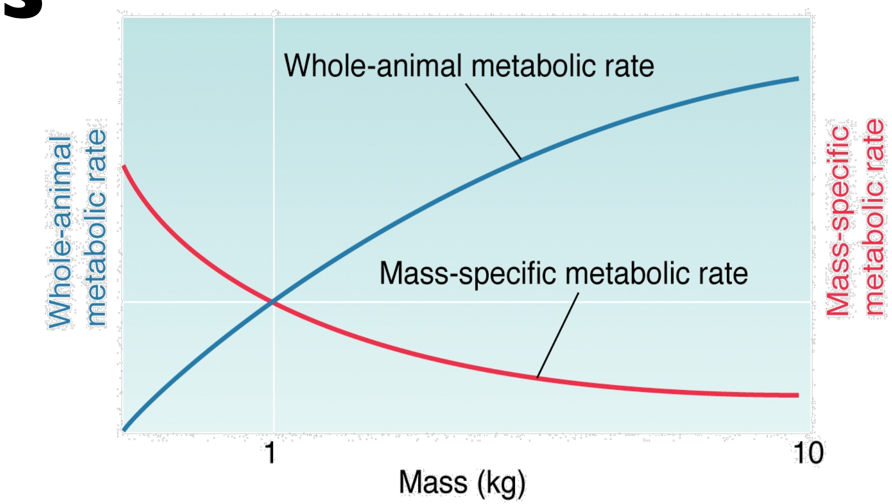
500 bpm

Live Fast Die Old?

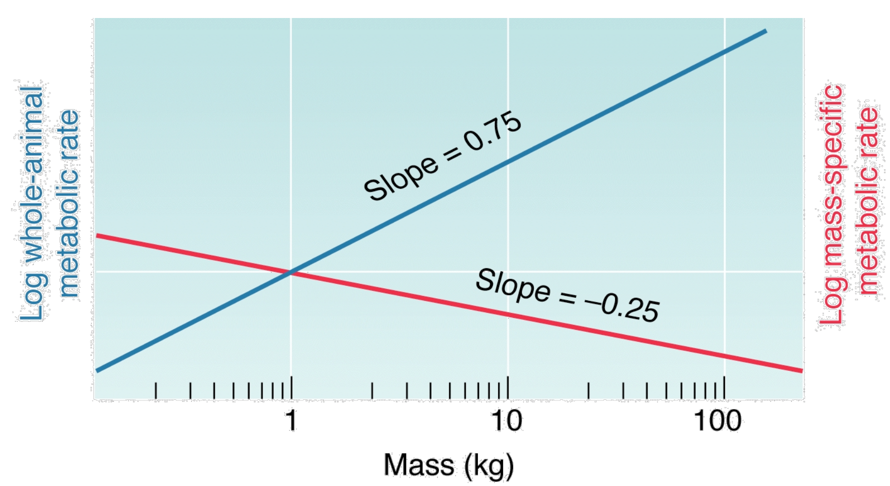
Metabolic Rate is a Power Function of Body Mass
"Mouse to Elephant Curve"

Metabolic Rate = a*Mass ^{b}





$MR = aM^b$ $MR/M = aM^{(b-1)}$



Why?

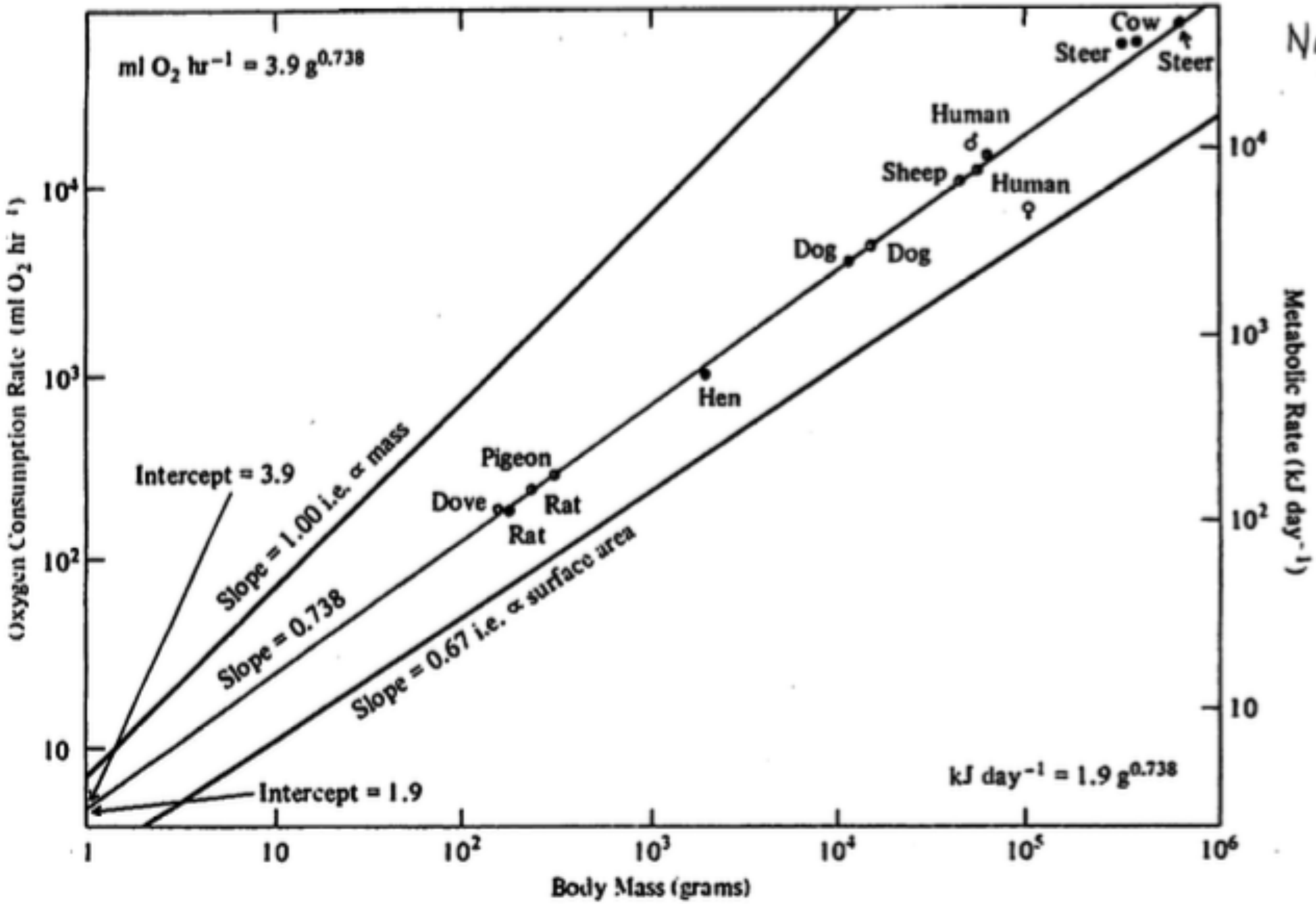
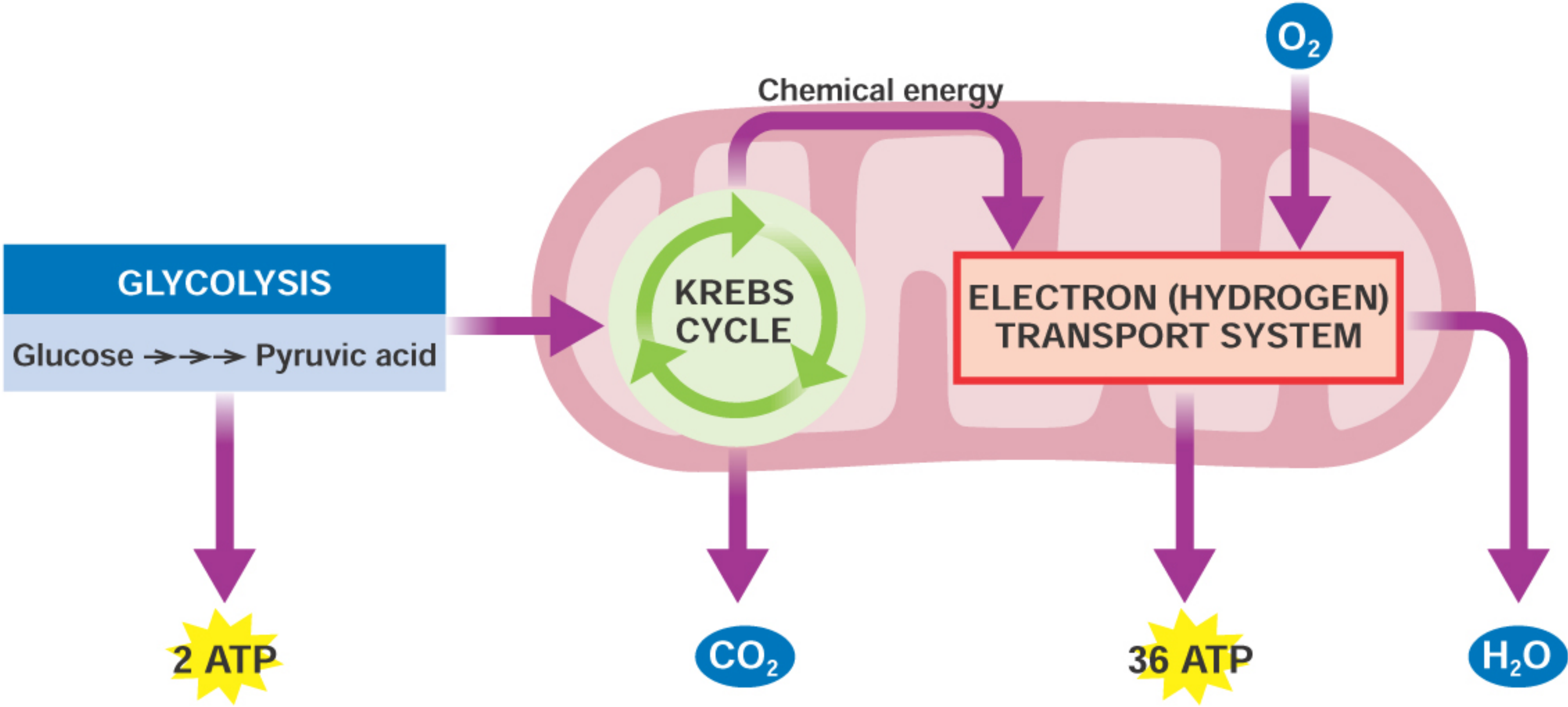


FIGURE 4–6 Relationship between $\log_{10}$ metabolic rate and $\log_{10}$ body mass for mammals and birds. *(Modified from Kleiber 1932.)*

AEROBIC RESPIRATION -- SUMMARY

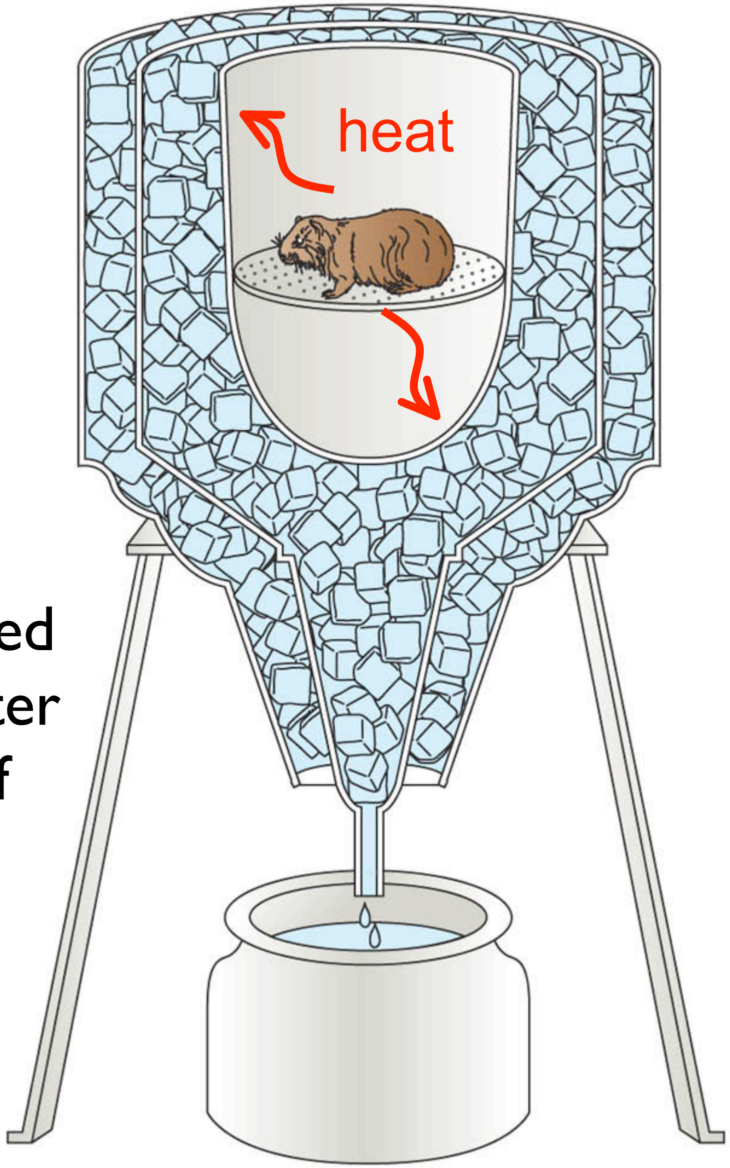


Anaerobic Pathway

+ HEAT

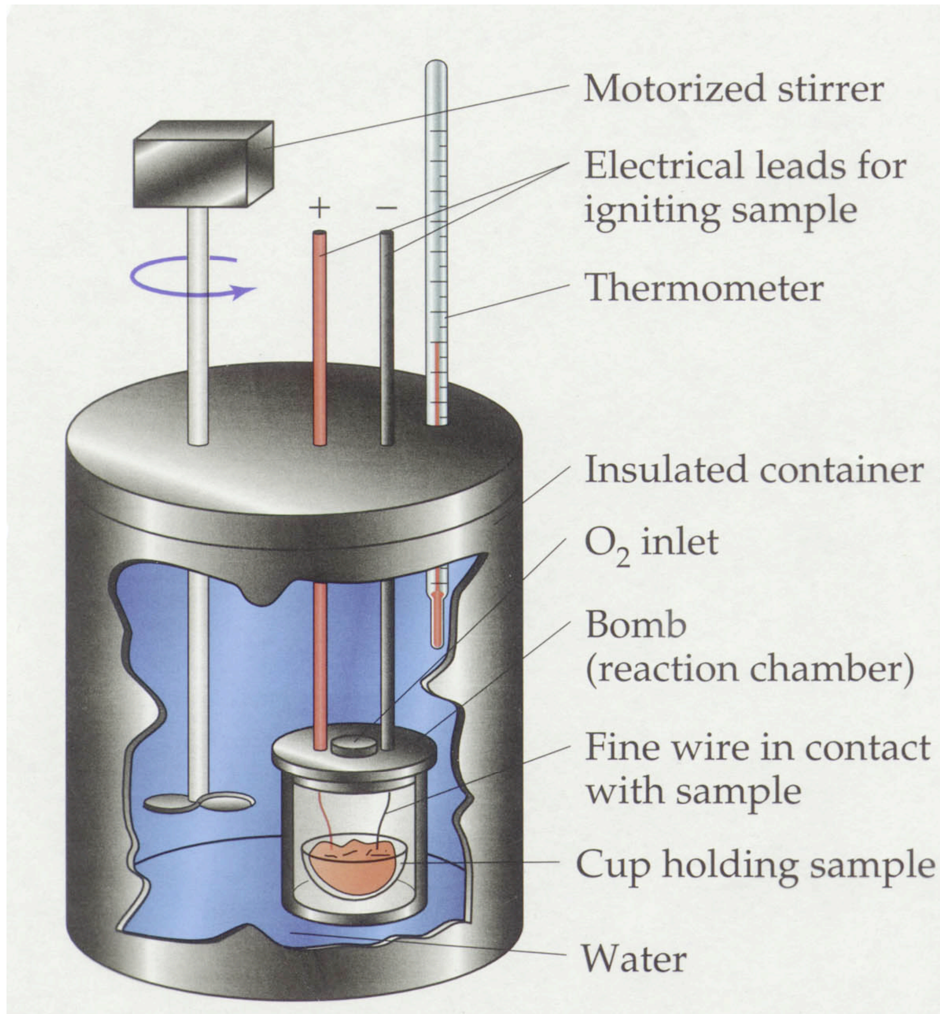
Direct Calorimetry

Lavoisier & Laplace (1780)



heat loss calculated from mass of water and latent heat of melting ice.

Indirect Calorimetry: Bomb Calorimeter

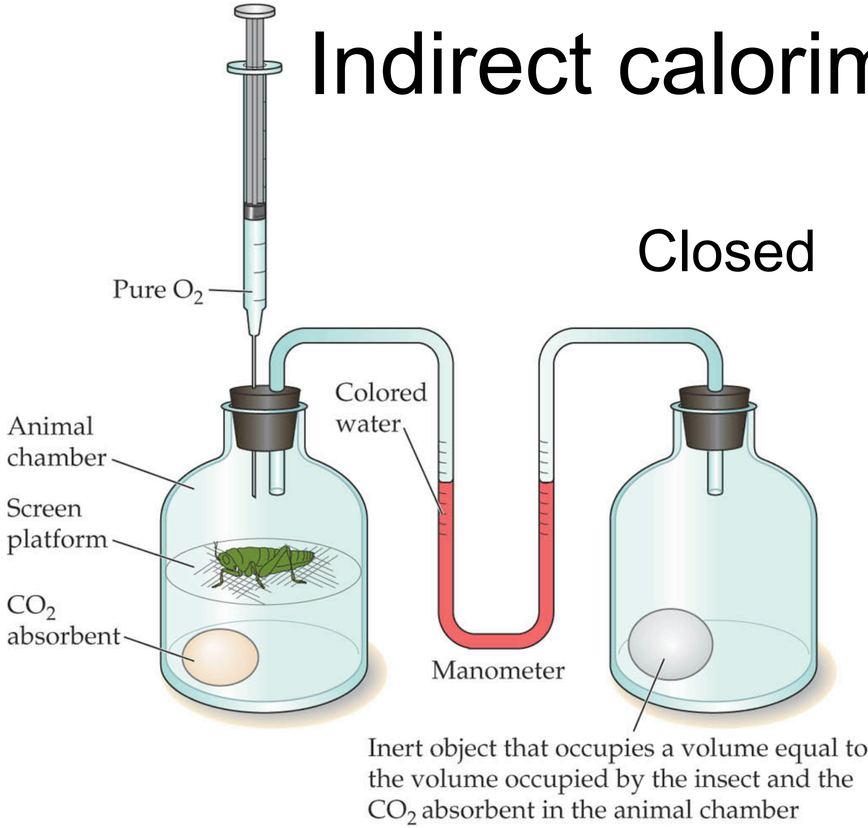


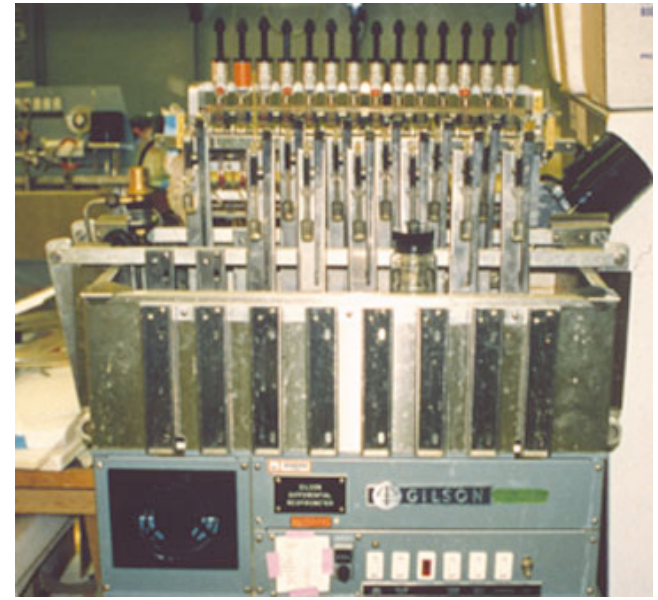
Energy content of:

food intake - waste excretion = metabolic rate (heat produced)

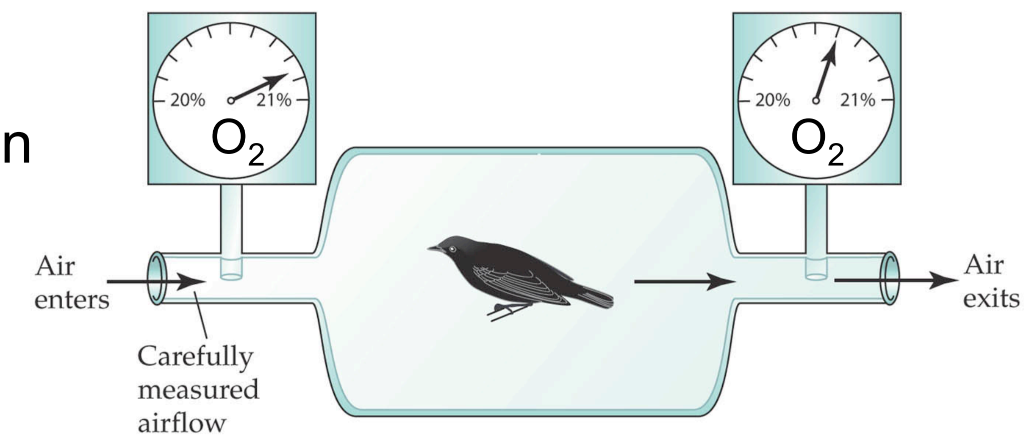
Indirect calorimetry: Respirometers

Closed





Open



Rhinos galloping in the wild

https://www.instagram.com/p/BqQmEycHvMG/

Black rhino at the Honolulu Zoo

(Aerobic) Metabolic Scope

describes the # times increase in max MR above BMR

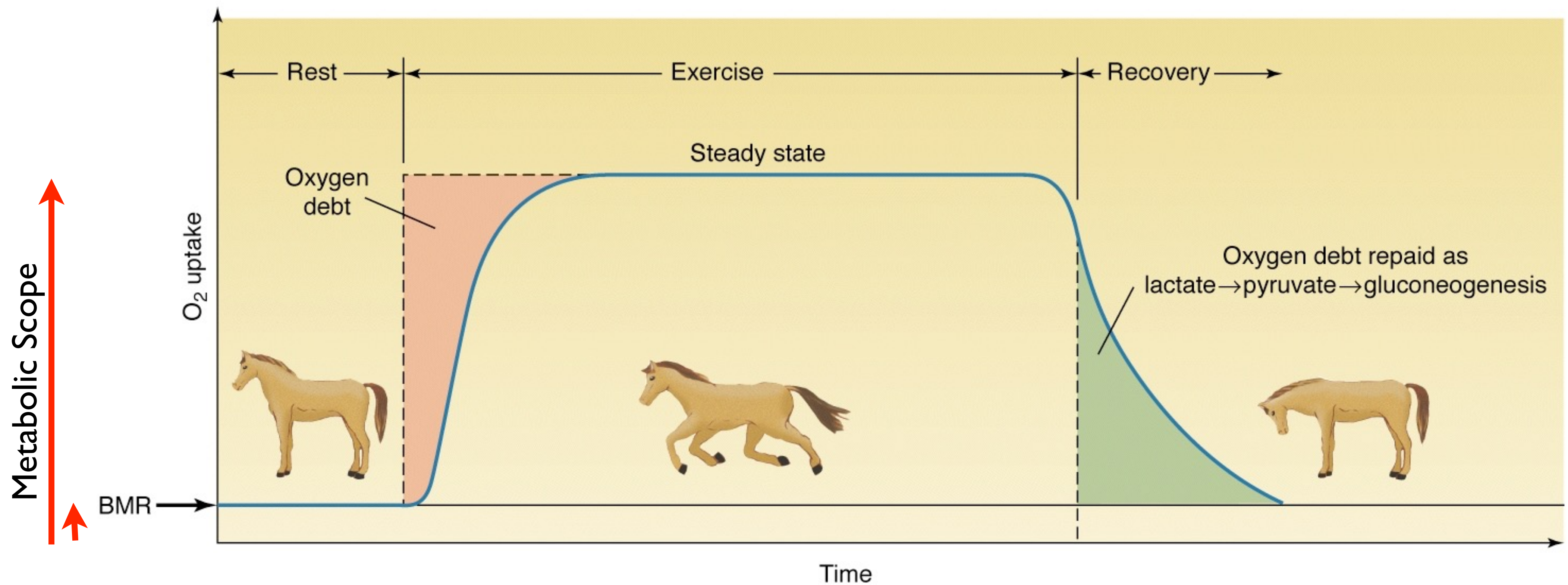


TABLE 4–10

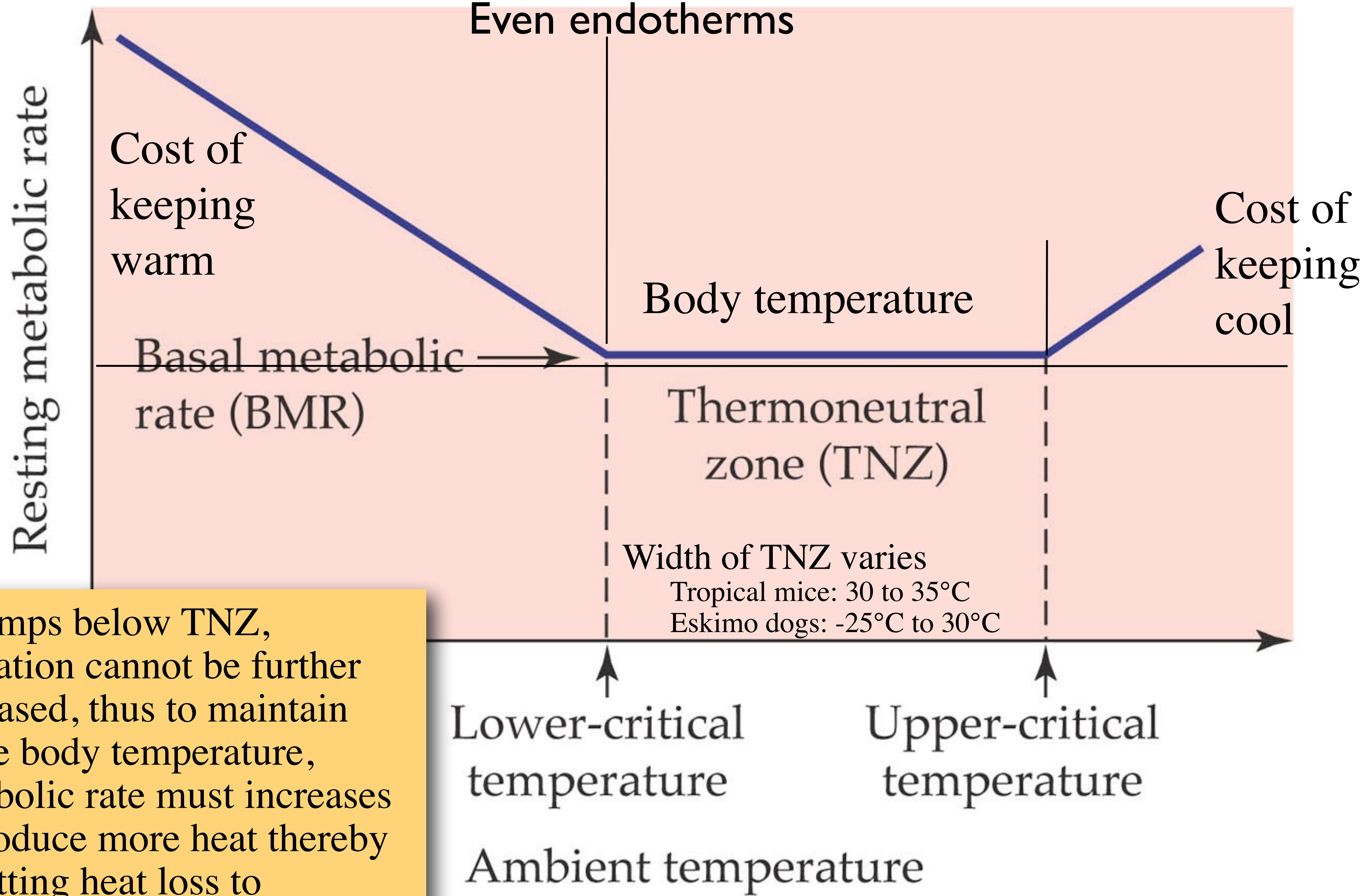
Human basal metabolic rate and metabolic rate with various forms of graded activity. Values are J min^{-1}. *(Data from Passmore and Durnin 1955.)*

Basal	4.2
Lying at ease	6.3
Sitting at ease	6.7
Standing at ease	7.1
Walking: 1 km hr^{-1}	8.4
Driving car	11.7
Walking: 4 km hr^{-1}	14.2
Walking: 6 km hr^{-1}	20.9
Cricket batting	25.1
Walking: + 15% incline/3 km hr^{-1}	26.4
Tennis	29.7
Walking: 8 km hr^{-1}	33.5
Rapid marching	40.6
Squash	42.7
Climbing vertical ladder	48.1
Walking in loose snow: 20 kg load	84.5
Ax work: 51 blows min^{-1}	100.9
Carrying 60 kg upstairs	128.4

MR's are not directly comparable between individuals (differ in mass, sex, etc.)

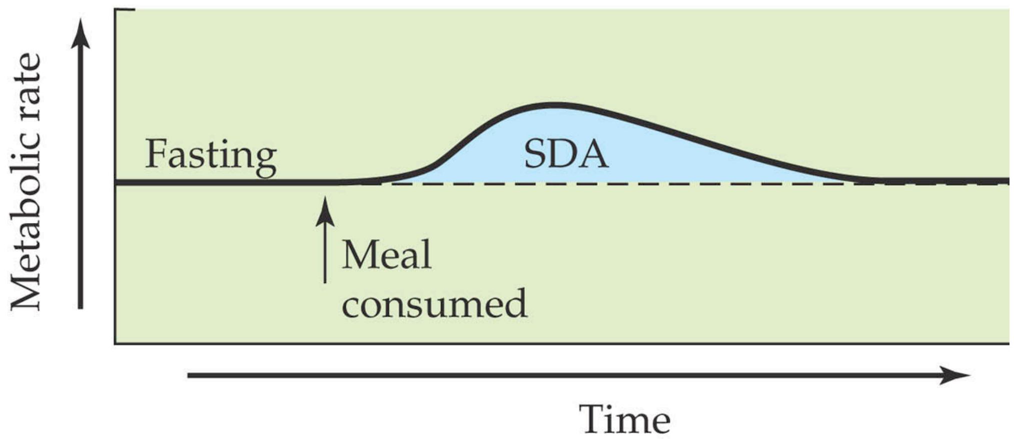
But you can use the scope to calculate how many X some activity elevates BMR.

Temperature is important to all animals



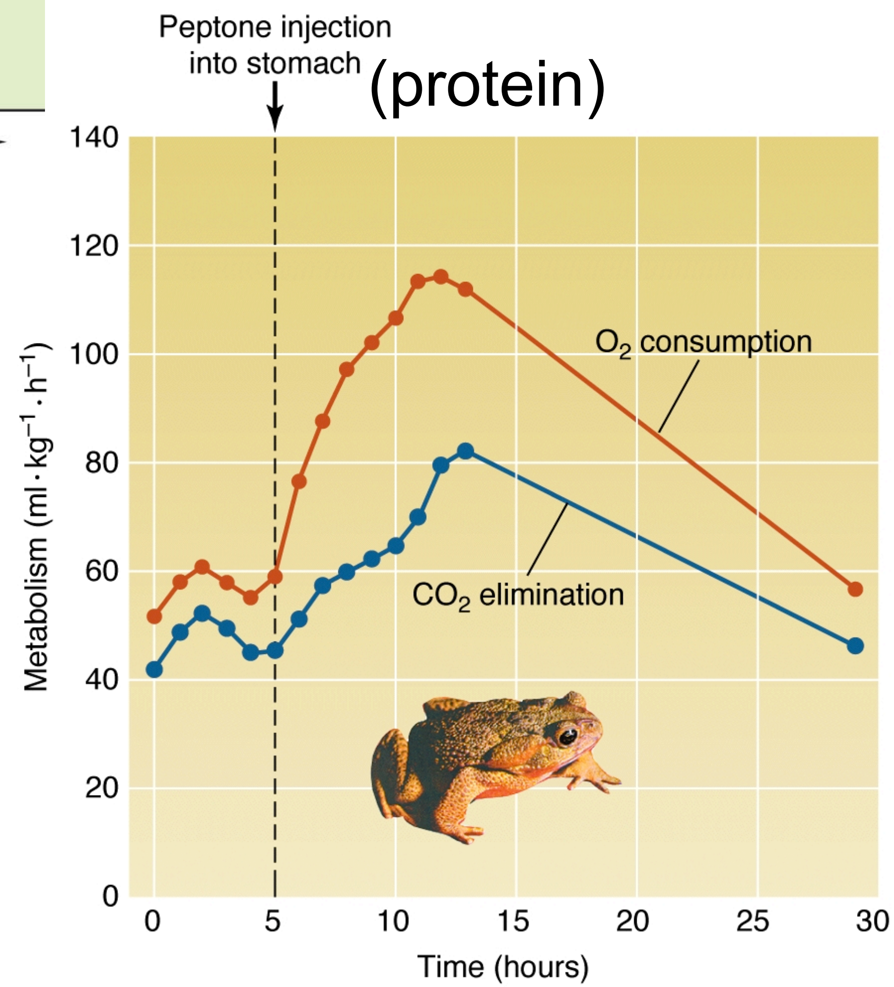
At temps below TNZ, insulation cannot be further increased, thus to maintain stable body temperature, metabolic rate must increases to produce more heat thereby offsetting heat loss to environment

Metabolic Cost of Digestion: Specific Dynamic Action



SDA: increase in metabolic rate following ingestion

(protein)

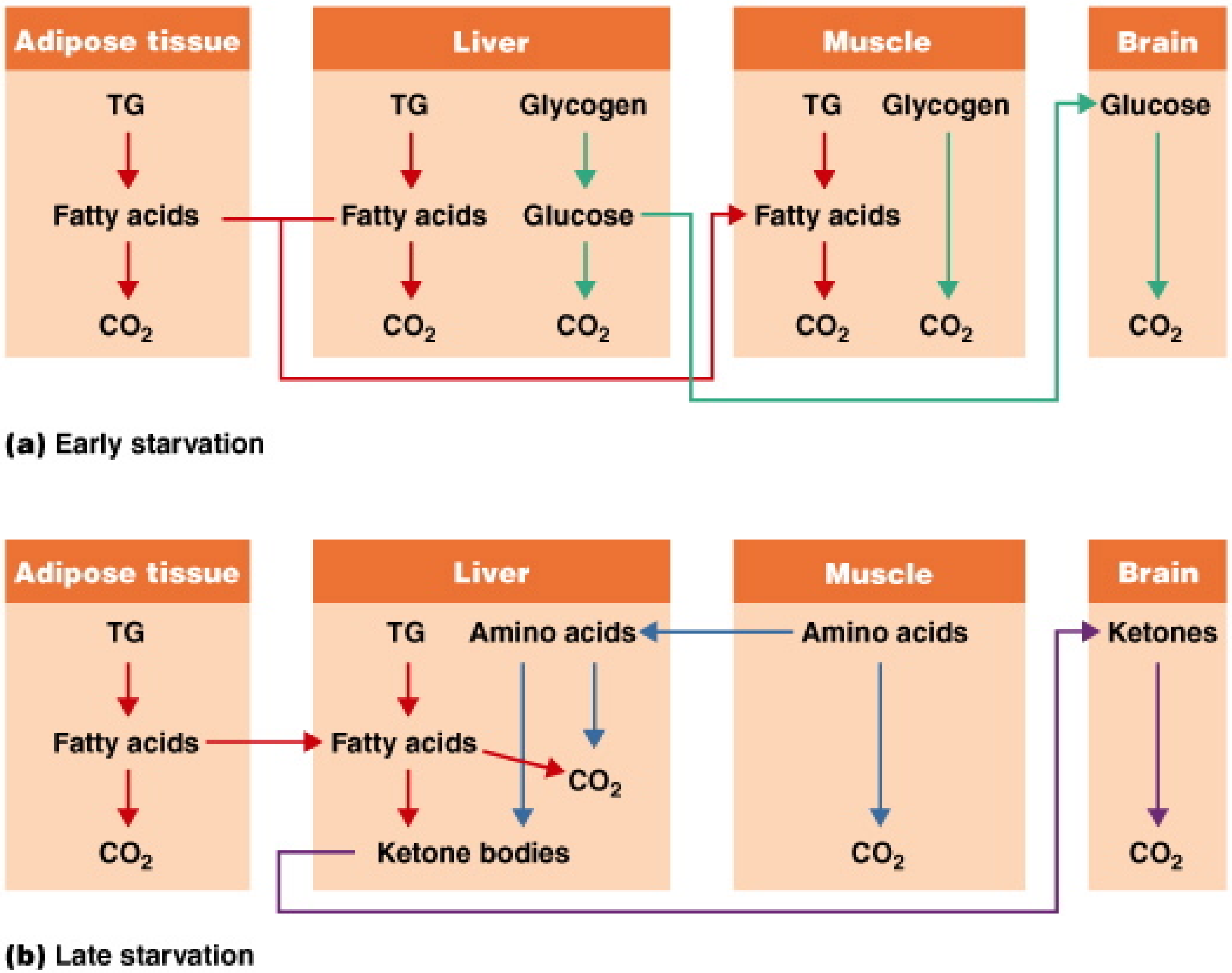


<u>SDA is highest for proteins</u>

CHO, fats: 5-10% of E ingested
Proteins: 25-30% of E ingested

Starvation Response

- Reorganization of metabolism to ensure long-term survival
- Preserve glucose to protect glucose-dependent tissues, e.g., nervous tissue
- Muscles shift to lipid metabolism



- Once lipid and glucose stores are depleted protein breakdown accelerates; amino acids can be converted to fatty acids and carbohydrates
- At this point degradation occurs (muscles, other tissues) because there are no protein stores

Our friend Kimo

After trying unsuccessfully to lose weight on his own, our friend Kimo finally consulted a nutritionist/trainer. Kimo had been skipping breakfast and lunch to lose weight, but ended up eating a large dinner. He had also been doing very little exercise (he thought the dieting strategy would get him off the hook with the exercise). The nutritionist told him to:

- eat 5 small meals a day rather than one large one,
- add more protein to his diet at breakfast, and
- do 30 min. of moderate exercise every day.