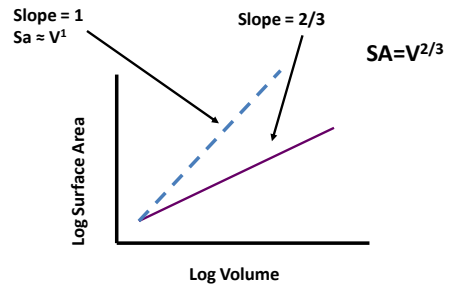
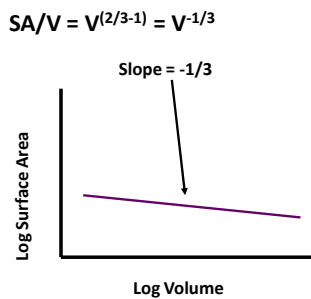


Biology 2672a Review Lecture

Scaling of Surface Area-Volume



Surface area per unit volume



Surface area: volume ratios...

- Assuming spherical animals with density of 1200 g/m<sup>3</sup>

Animal	Mass (kg)	Surface Area (m <sup>2</sup> )	SA:Volume
Rotifer	0.0000001	0.00000092	11071:1
Bee	0.0018	0.007	422:1
Hummingbird			
Pygmy Shrew	0.0025	0.008	379:1
Ostrich	130	0.296	10:1
Blue Whale	177000	3.278	0.9:1

Note that these were the wrong way round on the original handout!!

Metabolic Rate is not directly proportional to Body Mass

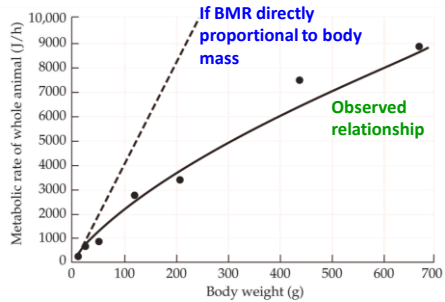
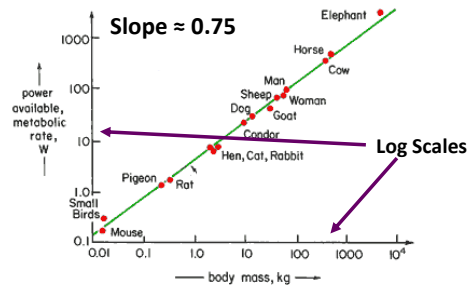


Fig. 6.7

The 'Mouse to Elephant' Curve



## The Allometric Scaling Relationship

- Allos = 'Different' (ie: not directly proportional)

$$M = aW^b$$

Metabolic Rate

Slope

Intercept

Body Mass

$$\text{Log } M = \text{Log } a + b \text{ Log } W$$

Equation 5.3

## Mass-specific metabolic rate:

$$M = aW^b$$

Fig. 5.4

## Mass-specific metabolic rate:

$$\frac{M}{W} = aW^{(b-1)}$$

Fig. 5.4

## Smaller mammals have a higher mass-specific MR...

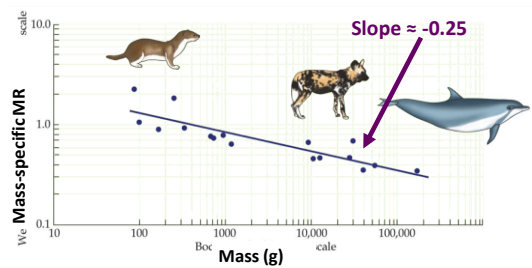


Fig 5.10a

## What to know about formulae?

- It helps to know (or at least recognise) the formula
- It is extremely important to know what the terms mean.

## Antifreeze proteins

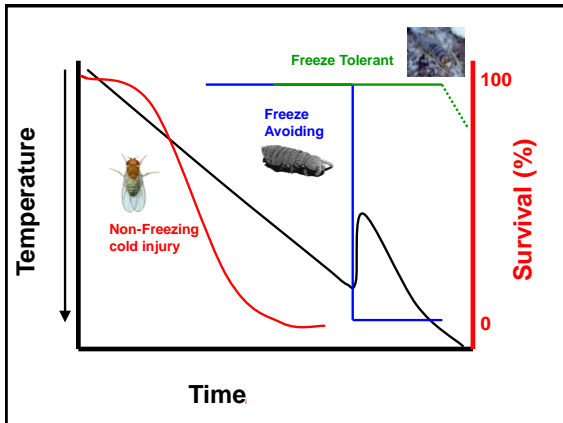
- 'non-colligative'
  - MP depression is dependent on 'stuff' in solution
  - FP depression is determined by interactions between proteins and ice crystals
  - Difference between mp and fp = 'thermal hysteresis'

## Antifreeze proteins

- Associated with both main cold tolerance strategies
  - Freeze Avoiding
    - Stop ice crystals growing
    - Prevent ice nucleation
  - Freeze tolerant
    - Stop recrystallisation

Which of the following adaptations would you associate with freeze tolerance in insects?

- 1) Carbohydrate cryoprotectants;
  - 2) Antifreeze proteins;
  - 3) Ice nucleating proteins;
  - 4) Low supercooling points.
- a) 1, 2 and 3.
  - b) 1, 2 and 4.
  - c) 1, 3 and 4.
  - d) 2, 3 and 4.
  - e) 1, 2, 3 and 4.



## Rapid cold-hardening

A rapid increase in cold tolerance in response to a pre-treatment at a low temperature

- Shown by many insects that otherwise suffer from NFCI
- Works in response to diurnal temperature changes and ecologically-relevant cooling rates.

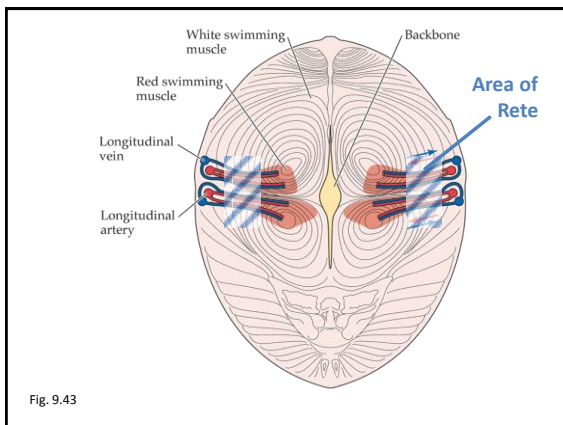
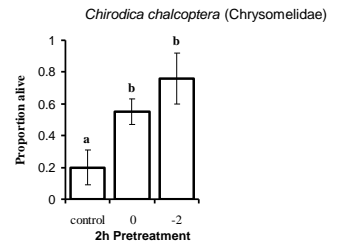
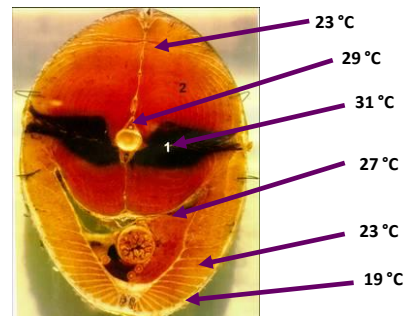


Fig. 9.43

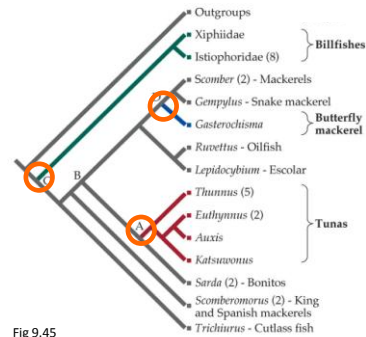
Tuna temperature gradients in 19 °C Water – Regional Endothermy



### Where does the heat come from?

- Heat comes from the normal heat produced by contractile activity of the red muscles
  - The only difference is that the heat is retained

### Regional endothermy evolved in bony fishes on at least three separate occasions



### Fish breathing air (also goes for diversity of gills)

- Know that there is a diversity of structures involved
  - It might help to know a few of these structures and how they are plumbed into the system