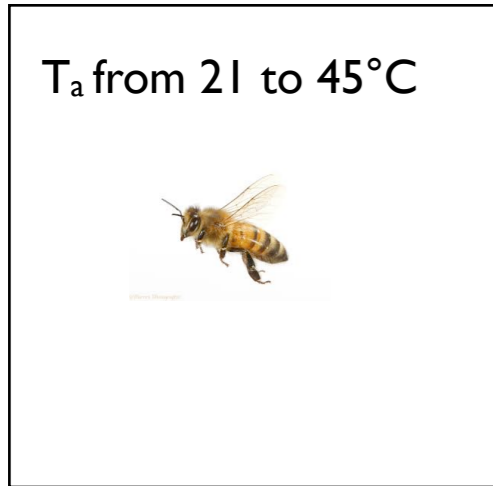


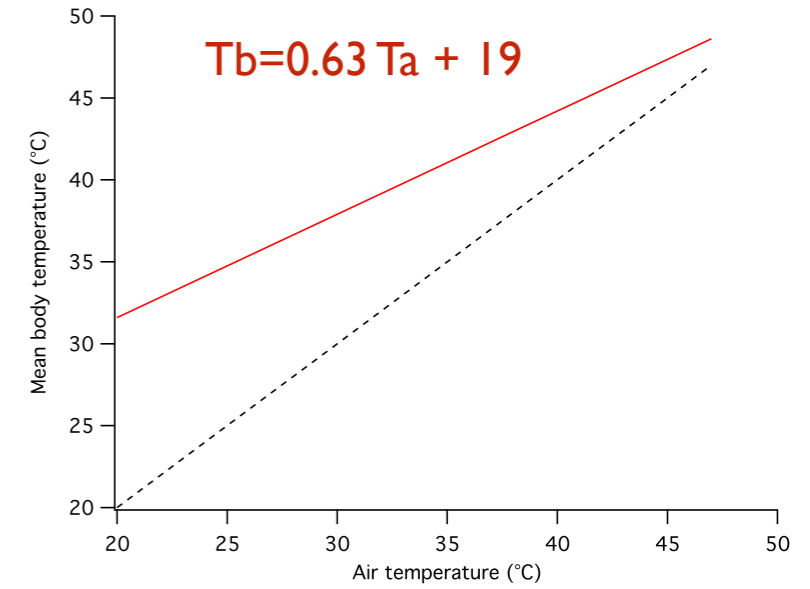
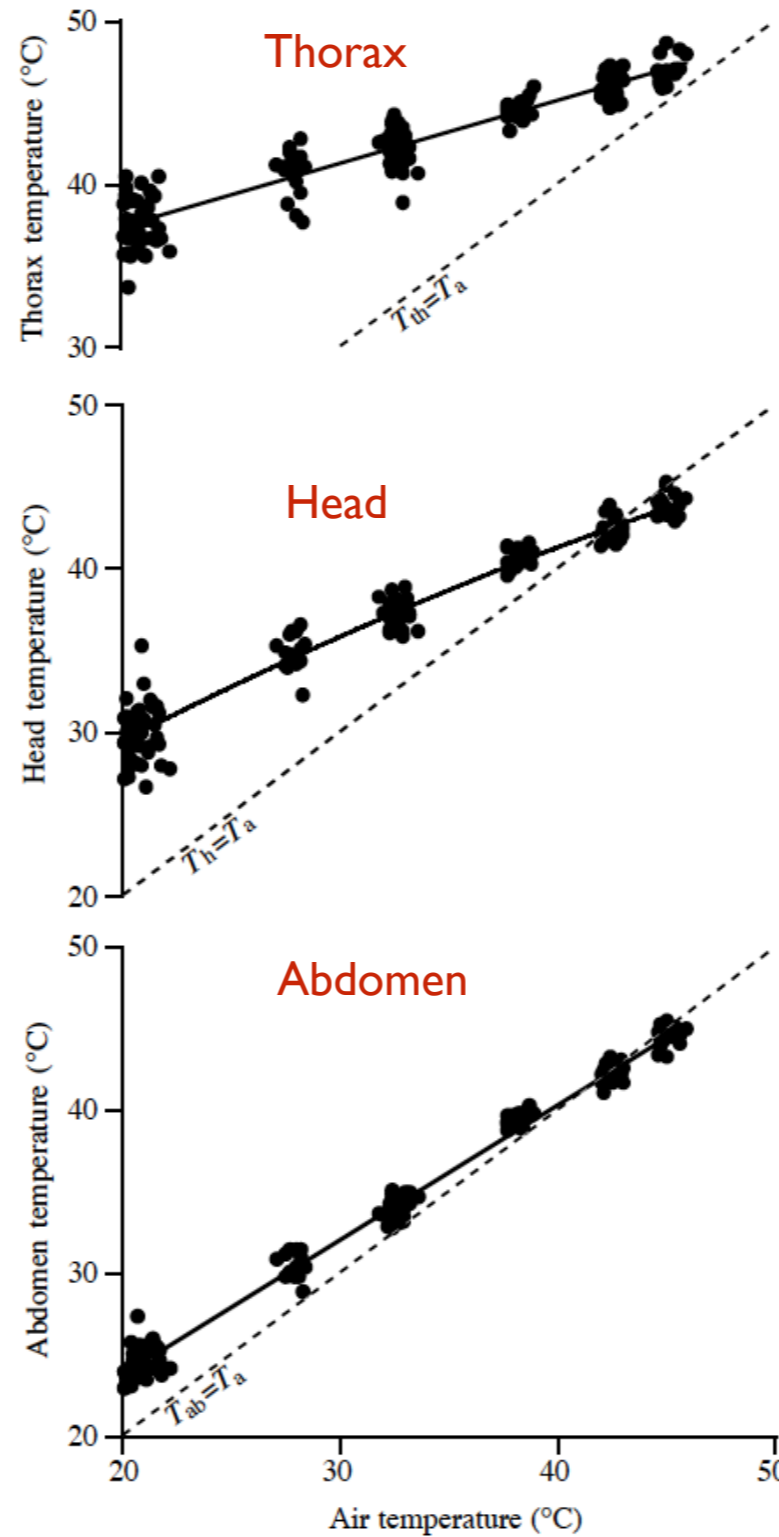
The honeybee problem



- measurement of $d[CO_2]/dt$ and $d[H_2O]/dt$
- measurement of body temperature at different times

Mean body mass 75 mg
 Mean surface areas
 head 27 mm²
 thorax 80 mm²
 abdomen 63 mm²
 total 170 mm²

Metabolic power 640 mW/g
 Flight mechanical power 27 mW/g



Surface weighted average body temperature

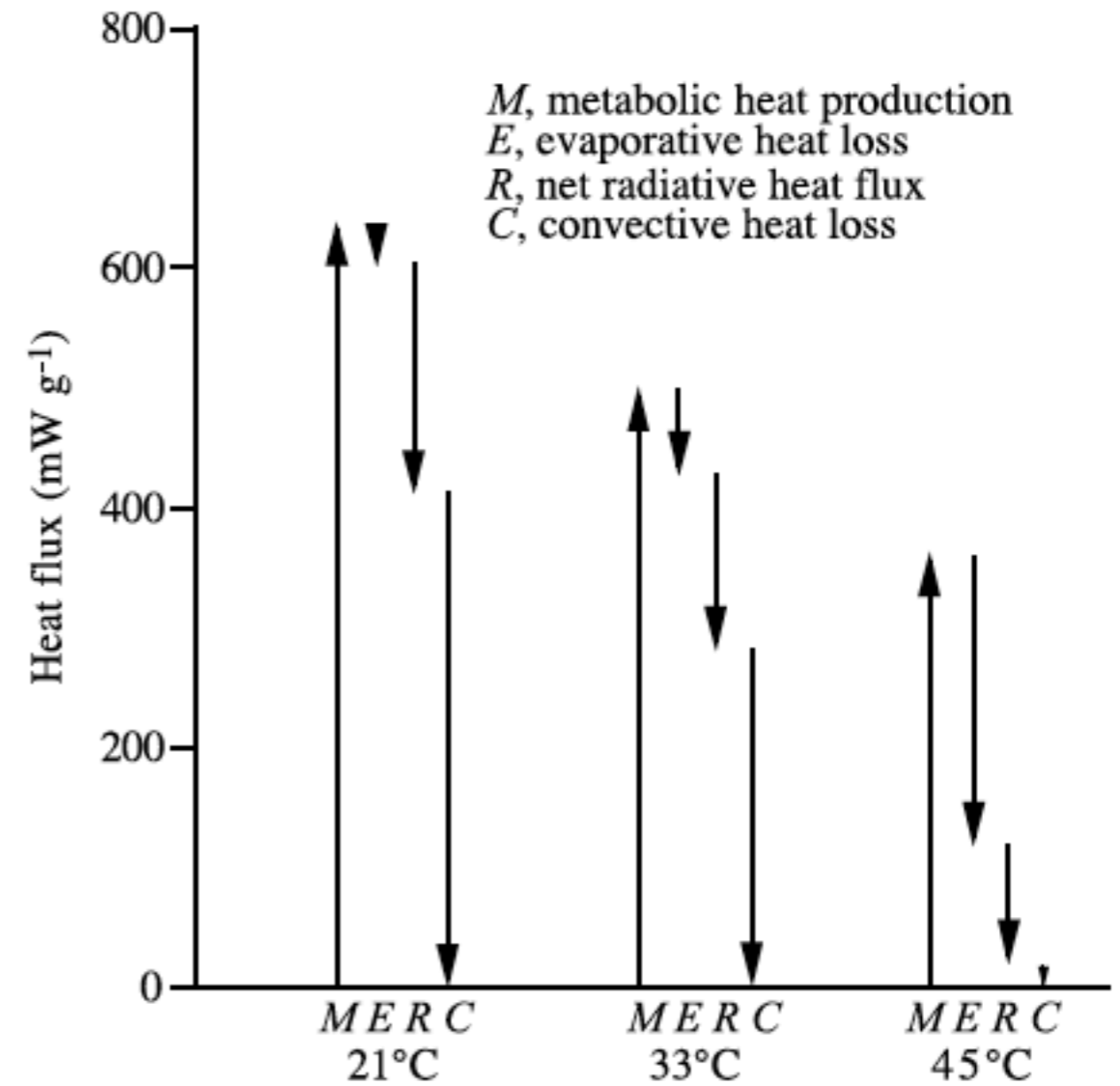
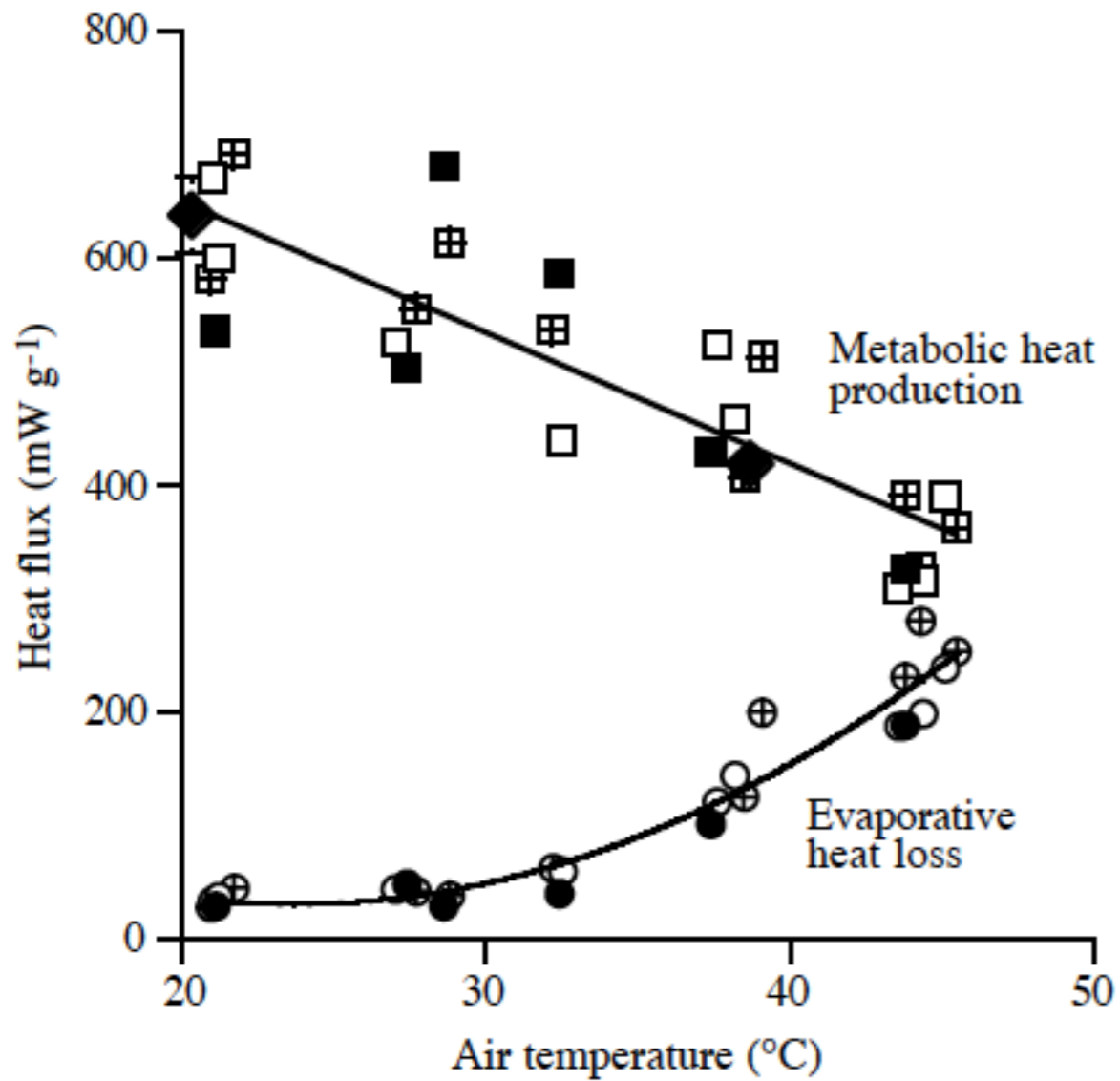
Body temperatures are independent of time

The honeybee problem



What are the different mechanisms involved in heat exchange ?
Write the overall heat balance

The honeybee problem



C is not measured but deduced from the overall heat balance

The honeybee problem



How can we estimate independently the heat transfer from the bee to the air ?

Is it dominated by diffusion or convection ?

If we evaluate an order of magnitude of this heat flux, is it consistent with the other measurements ?

Physical properties of air :

density ρ 1 kg/m³

specific heat C_p 1000 J/kg.K

thermal conductivity λ 0.025 W/m.K