


## Some terms to know

	Ectotherms	Endotherms
Thermo-Conformers	<b>Poikilotherms</b> (most insects, fish, microorganisms and plants)	(not common)
Thermo-Regulators	<b>Behavioral Thermoregulators</b> (many herps and insects)	<b>Homeotherms</b> (most mammals and birds)




Antarctic Fish - 1.8°C  
*(Very constant)*



**Dr. Londraville's Research**



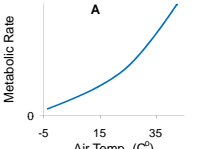
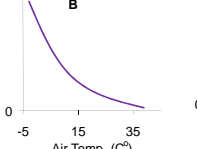
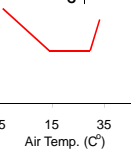
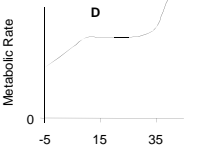
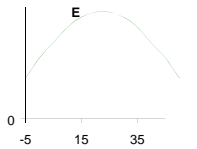
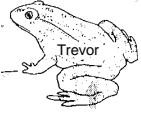
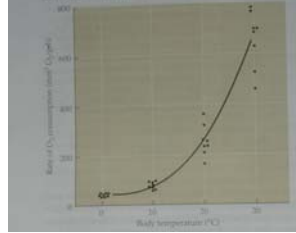
Desert pupfish 40°C  
*(Highly variable)*

© John Rinne

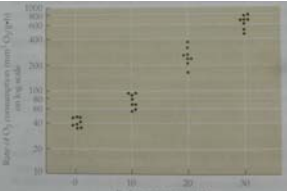
## Importance of first names

- Several students have the same last names – everyone please provide a first name as well as last on assignments and clickers
- One pair has the same first names, last names and middle initials – see me!
  - Steiner

### Which graph should best describe how Trevor's Metabolic rate might change with Air Temperature?

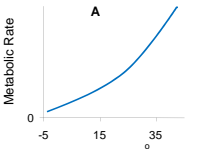
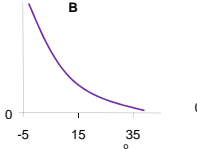
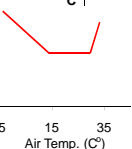
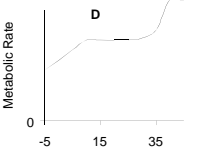
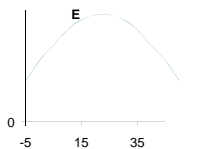








Metabolic Rate and body temperature in tiger moth caterpillars

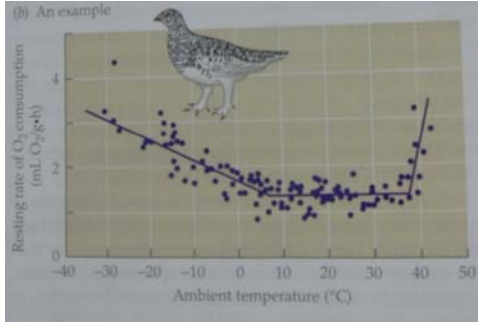


from Hill et al. 2010 Animal Physiology

### Which graph should best describe how Joel's Metabolic rate might change with Air Temperature?

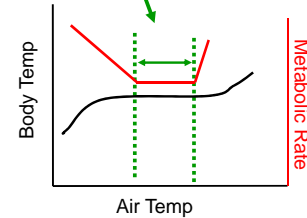

### Metabolism-Temperature relation for White-tailed Ptarmigan (*Lagopus leucurus*)



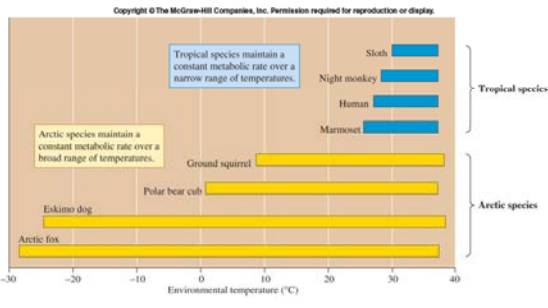
from Hill et al. 2010 Animal Physiology

### Endotherms have a 'Thermal Neutral Zone'

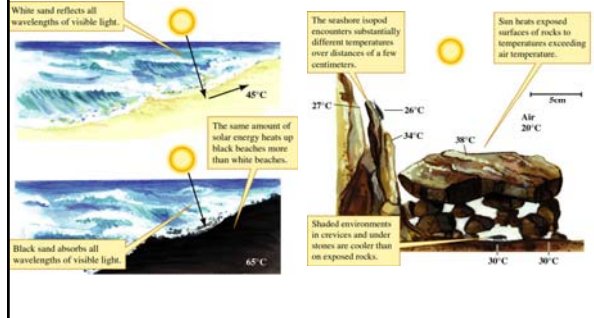
The range of environmental temperatures over which the metabolic rate does not change



### Thermal neutral zones are 'adapted' to the organism's environment

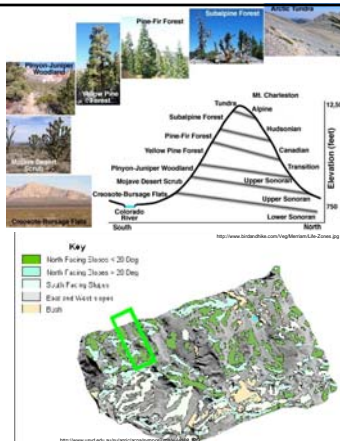


### Microclimates vary in temperature



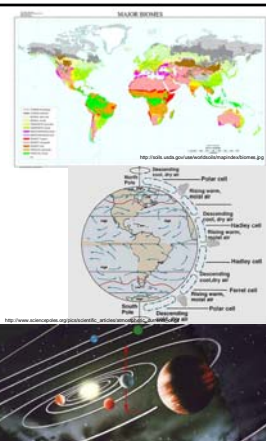
### Know about the effects of these microclimate terms from the book:

- Altitude
- Aspect
- Vegetation
- Color of the ground



### Macroclimate from the book (Chapters 2 & 3)

- Know about the major terrestrial and aquatic biomes
- Know about global patterns of temperature, atmospheric circulation, and precipitation, e.g.,
  - Why and where is it cold in the winter and warm in the summer?
  - Why is there more rain at the equator?



## Ectotherms

- Thermal photograph of a frog in the hands of an endotherm
- Blue for cool, yellow and white for warm



## In a very hot, sunny desert, which Bedouin would be hotter?



- A) The man in black
- B) The man in white
- C) They will be the same temperature
- D) Not enough information to tell

Be prepared to explain your answer

Shkolnik et al. 1980 Nature 283, 373-375

- Black robes gain 2 or 3x more heat through radiation
- Yet temperature next to skin is the same
- Predicting temperatures from biophysical principles is very complicated

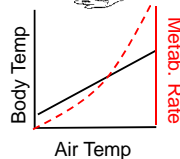
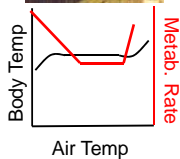
$T_{lizard} = T_{model}$   
 $r^2 = 0.86$

### Dr. Niewiarowski's Research

Lizard thermal ecology  
Using microhabitat to thermoregulate

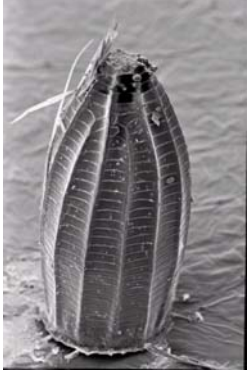

## Endotherms vs. Exotherms

- Self-test
- Can you explain why these graphs are different?



## How have the butterflies of the Rockies dealt with low winter temperatures?



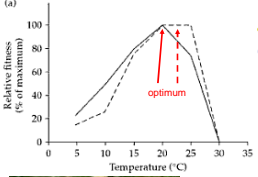

[http://www.cbi1.gc.ca/lpp\\_pages/butterflies/species/PineWhite\\_e.php](http://www.cbi1.gc.ca/lpp_pages/butterflies/species/PineWhite_e.php)

The alpine butterfly *Neophasia menapia* (the Pine White) overwinters as an egg

[www.bath.ac.uk/ceosol/Insects3.html](http://www.bath.ac.uk/ceosol/Insects3.html)

## Typical Response to Temperature

- Gradual increase in performance to an optimum temperature
  - Response here is rate of population growth
- Rapid drop past optimum
- These Aphid differ in their response
  - *Macrosiphum euphorbiae* (dashed line)
  - *Myzus persicae* (solid line)

Data from Barlow 1962 Can. J. Zool. 40:145-156 (from Angilleta, 2009. Thermal Adaptation, Oxford, Pg 36)