Seminars

Apr. 21 “Invasion! Immigration and spread of Bromus tectorum genotypes across North America: genetic and historical evidence”, *Richard N. Mack, Professor, School of Biological Sciences, Washington State University, Pullman, WA*

May 19 “Indirect effects of fishing on predators and their prey”, *Chris Stallings, Affiliate Scientist, Florida State University Coastal and Marine Laboratory, St. Teresa, FL*

May 26 “What can ice worms (Mesenchytraeus solifugus) tell us about glacial history of the Pacific Northwest?”, *Peter Wimberger, Associate Professor, Biology Dept., University of Puget Sound, Tacoma, WA*

Temperature Regulation and Adaptation

I. Introduction
- A. Reasons for regulating temperature

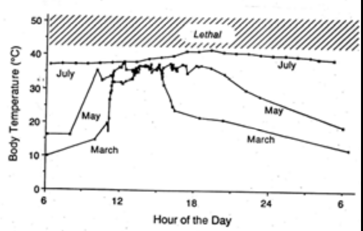
II. Basic heat balance equation
- A. The components
- B. The equation
- Terms: homeotherms, endotherms, poikilotherms, ectotherms

III. Adaptations for temperature regulation and tolerance
- A. Regulating – manipulating the heat balance equation
- B. Avoiding – dormant stages

Tolerance – effects of environmental change?

Chuckwalla, Valley of Fire

Figure 13.6. Body temperatures of a male chuckwalla throughout three different days in March, May, and July. Midday body temperatures (especially in July) were near temperatures that are lethal to chuckwallas.



http://www.richard-seaman.com/Reptiles/Usa/Nevada/ValleyOfFire/

Temperature regulating behaviors in lizards

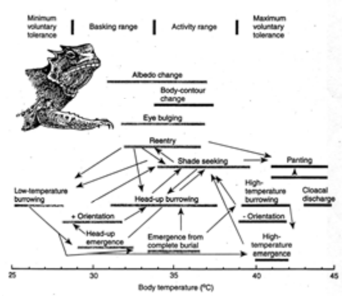
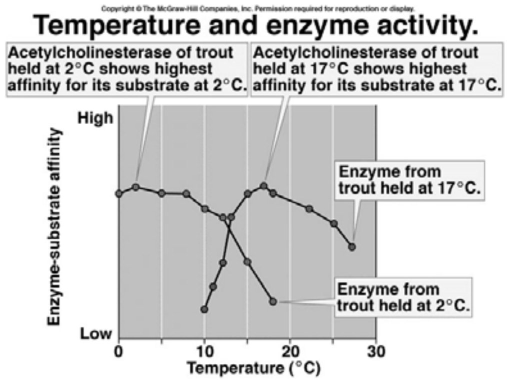


Figure 6.9 Behavioral mechanisms in the regulation of body temperature by the horned lizard (*Phrynosoma coronatum*). (From Heath 1965.)

I. Introduction

A. Reasons for regulating temperature
1. Metabolic limits, enzyme kinetics
2. Behavioral consequences

Q_{10}



Behavioral consequences - animals

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Ehrlich & Roughgarden (1985)

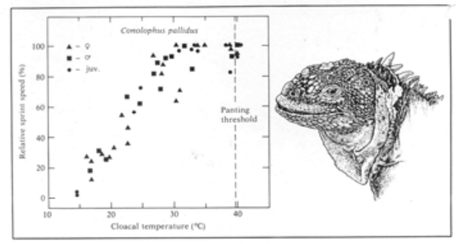
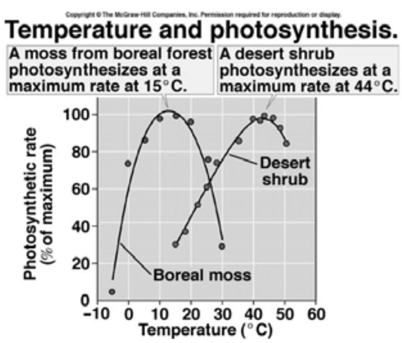


FIGURE 3–1 Sprint rates of individual Galapagos land iguanas, normalized to each individual's fastest sprint, as a function of body temperature. (After Christian and Tracy 1981.)

Behavioral consequences - plants



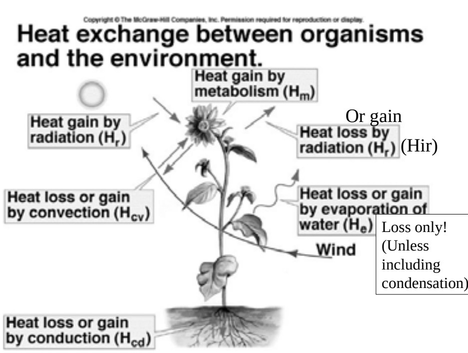
Terms

Homeotherms
Endotherms
Poikilotherms
Ectotherms

Heterotherms

II. The heat balance equation

A. The components



Or gain (Hir)

Loss only! (Unless including condensation)

Body size and basal metabolic rate

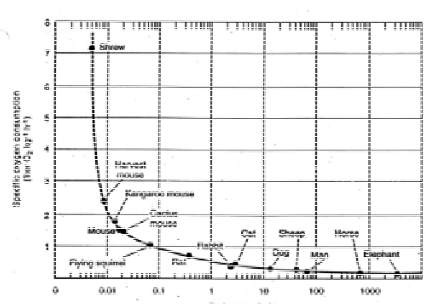
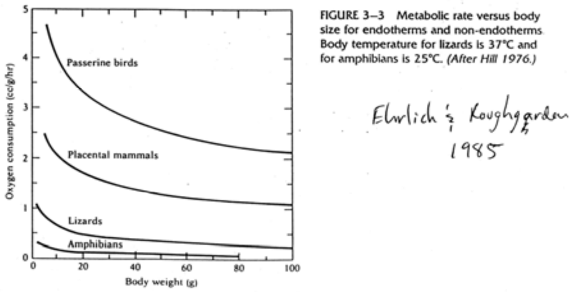


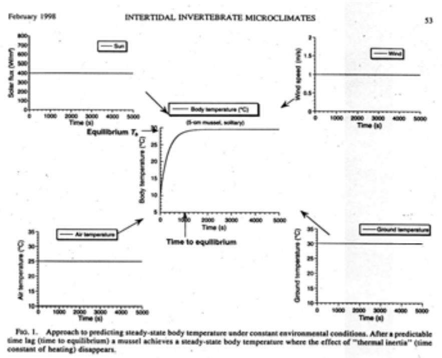
Figure 6.11 Observed rates of specific oxygen consumption per unit body mass by various mammals. Oxygen consumption increases rapidly with decreasing body mass. Note that the abscissa has a logarithmic scale and the ordinate an arithmetic scale. (After Schmidt-Nielson 1979:1985.)

Basal metabolic rate – endos & ectos

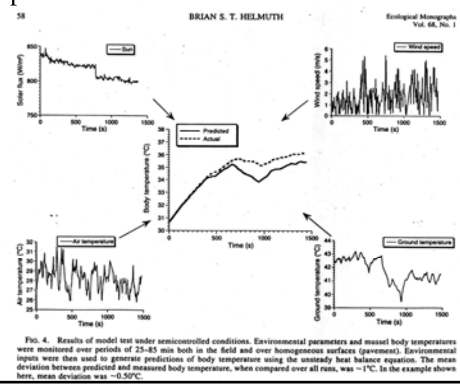


B. The equation

Temp balance for a mussel – constant conditions



Temp balance for a mussel – variable conditions



III. Adaptations for regulation & tolerance

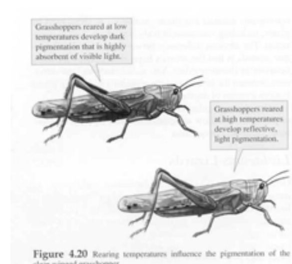
A. Regulation – manipulating components of the energy balance equation.

1. Adaptations & acclimations
2. Similarities and differences among plants, endos & ectos.

Similarities – radiation, coloration

Encelia farinosa – desert brittlebush

http://www.botgard.ucla.edu/html/botanytextbooks/generalbotany/shootfeatures/generalstructure/leafcolor/a0893tx.html



Clear-winged grasshopper

What about the arctic fox?

Winter coloration

Summer coloration

http://www.biosbcc.net/ocean/marinesci/04benthon/arclife.htm

Radiation: Orientation

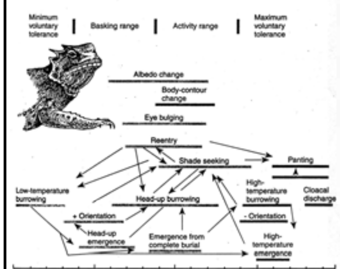


Figure 6.9 Behavioral mechanisms in the regulation of body temperature by the horned lizard (*Phrynosoma coronatum*). (From Heath 1965.)

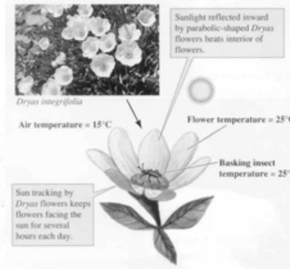
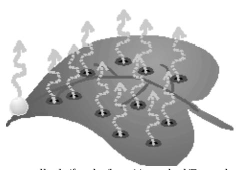


Figure 4.1 Sun-tracking behavior of the arctic plant, *Dryas integrifolia*, heats the reproductive parts of its flowers, making them attractive to pollinating insects.

Evaporative cooling

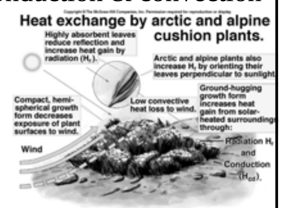
http://www.ci.ann-arbor.mi.us/SafetyServices/EmergencyManagement/EMD/heatwave.html



http://www.css.cornell.edu/faculty/hmv1/watrshed/Etrans.htm

http://www.kateconnick.com/postcards/bcpant.jpg

Morphology/growth form: conduction & convection



Black-tailed jackrabbit

http://homestudy.ihea.com/wildlifeID/043jackrabbit.htm

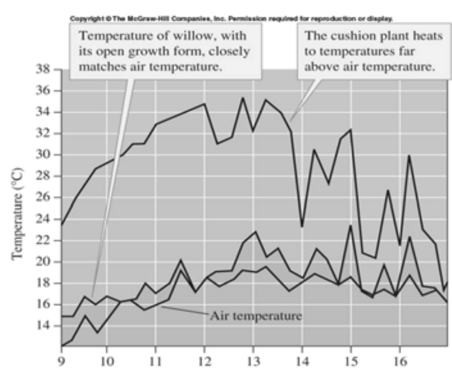
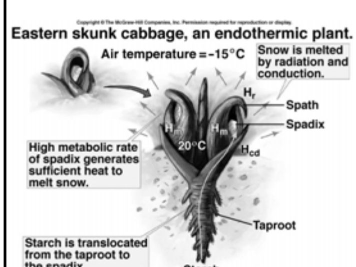
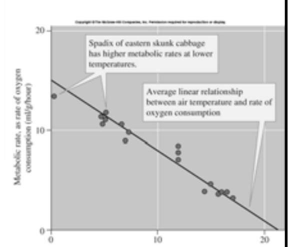


Fig. 4.17 (4th)
Fig. 5.19 (5th)

Metabolic heat





Differences

Does the prevalence of some mechanisms differ among plants, endotherms, and ectotherms?

Which ones? Why?

B. Avoidance

Dormancy – plants (seeds, cold tolerance)

Burrowing, torpor, hibernation & estivation - animals

Summary

Range shifts often tied to temperature extremes.

We can understand components of heat balance individually.

Adaptations for heat gain/loss: understand in the context of individual components of heat balance equation.