BIOLOGY 3320: COMPARATIVE PHYSIOLOGY
SPRING 2007

Instructor: David Carrier, carrier@biology.utah.edu
Office hours: 3:30-4:30 Monday and 9:30-10:30 Tuesday,
123 South Biology

Teaching Assistants: Jessamyn Markley, Markley@biology.utah.edu, office - 226
SE corner of 2nd floor South Biology, office hour: 11:45 to
12:45 on Thursdays in 226 SB

TJ Uriona, Uriona@biology.utah.edu, Office 124E South
Biology, office hour hour: 10:30-11:30 Monday


http://courses.biology.utah.edu/carrier/3320/
What is comparative physiology?

- Study of how animals work.
- Study of how species are adapted to their environment.
- Study of why animals came to be the way they are.
  - Evolutionary history
  - Evolutionary processes
  - Innovations and constraints

Science:
  - exploration
  - testing
  - application
I have found you an argument; but I am not obliged to find you an understanding.

Samuel Johnson

Science is not defined by its product. It is a process.
Themes in comparative physiology:
- Relationship between structure and function
- Adaptation and Acclimatization
- Constraint and Tradeoff
- Integration
- Homeostatsis
- Effects of size
Structure/Function Relationships

ICHTHYOSAUR
Leading edge tubercles on humpback whale (*Megaptera novaeangliae*) flippers?
Humpback whale attacks its prey by encircling them in a "bubble net"—a turbulent cylinder of bubbles the whale creates by expelling air through its blowhole as it spirals upward toward the ocean surface. The path of the whale has been traced for clarity by a series of columns of bubbles. The bubble net can be as small as five feet in diameter. Such tight turning is made possible by the hydrodynamic lift generated by the whale’s long pectoral flippers.

Fluid—whether liquid or gaseous—passing over a wing (blue arrows) creates lift (upward-pointing arrow). But what distinguishes the humpback’s flipper from an ordinary wing is the presence of tubercles, or bumps, on the flipper’s leading edge (above left). The tubercles enable the flipper to create lift at angles as steep as roughly seventeen degrees, because the water gets accelerated into an organized, rotating flow behind the troughs formed by the tubercles. A flipper with a smooth leading edge (above right) would stall, or cease to provide lift, at such an angle, because the water would be spun into a disorganized series of eddies.

Acclimation

Hypobaric (Decompression) Chamber

Acclimatization

Adaptation

Bar-headed Goose
Ron Saldino
Optimal versus good enough?

Constraint

Functional tradeoff

Optimal versus good enough?
1. convective
\[ V_{O_2} = V_{\beta_{gas}}(P_{I_{O_2}} - P_{E_{O_2}}) = G_{vent} (\Delta P_{O_2}) \]

2. diffusive
\[ V_{O_2} = D_{L_{O_2}} (P_{A_{O_2}} - P_{cap_{O_2}}) = G_{diff} (\Delta P_{O_2}) \]

3. convective
\[ V_{O_2} = Q_{\beta_{blood}} (P_{a_{O_2}} - P_{v_{O_2}}) = G_{perf} (\Delta P_{O_2}) \]

4. diffusive
\[ V_{O_2} = D_{M_{O_2}} (P_{a_{O_2}} - P_{mit_{O_2}}) = G_{diff} (\Delta P_{O_2}) \]
Homeostasis - The tendency of organisms to regulate and maintain relative internal stability.
Effects of size
The Human Portrait

What is this animal?
Where did it come from?
And why is it still here?

Robert Mapplethorpe
Life span

Body mass

$T_{\text{span}} = 11.8 M_b^{0.20}$

mammals

primates

human