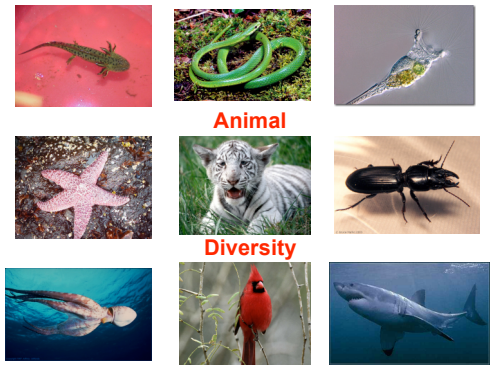
Lecture 1

Overview of Animal Diversity

(Text Chapter 3)



What is an animal?

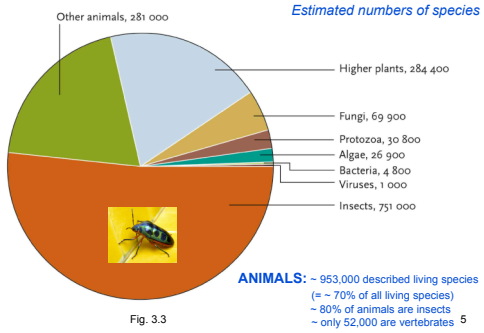
- multicellular, eukaryotic organism
- possess tissues that develop from embryonic layers of cells
- heterotroph: obtains its energy externally by ingesting and digesting other organisms
- taxonomically belongs to Kingdom Animalia

Animal Form and Function

Many forms

Limited number of functions

Biodiversity



ANIMALS: ~ 953,000 described living species
(= ~ 70% of all living species)
~ 80% of animals are insects
~ only 52,000 are vertebrates

Fig. 3.3

Major challenge in Biology

How does one explain and understand the diversity of past and present life forms?

A set of “themes” pervades all of modern Biology

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Theme 1
Evolution
The Unifying & Organizing Theme of Biology

- Evolution makes sense of everything we know about living organisms
- Organisms living on Earth are modified descendents of common ancestors

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Evolution accounts for the unity and diversity of life

- “*Nothing in Biology makes sense except in the light of evolution*”

  Quote from Theodosius Dobzhansky
  (one of the founders of the Modern Synthesis of Evolutionary Biology)

- Evolution unifies Biology at different scales of size throughout the history of life on Earth

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Theme 2
New properties emerge at each level of biological organization

- biological functions are due to the particular arrangement and interactions of parts of a whole system
- example: *vision* is an emergent property of complex networks of nerve cells in the eye and brain

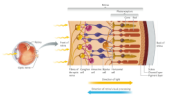




Fig. 34.24

Theme 3
Organisms interact with their environments, exchanging matter and energy

- one-way flow of energy from sunlight to producers to consumers

- exchange of energy between an organism and its environment often involves the transformation of energy from one form to another
  (e.g. sunlight [radiation] energy → chemical energy [sugar molecules])
- cycling of nutrients (minerals) in the ecosystem

Theme 4
Structure and function are correlated at all levels of biological organization

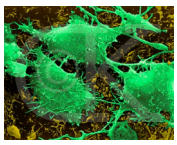
- Structure and function of living organisms are closely related.
- Example: bird flight (function) & bird wings (structure)

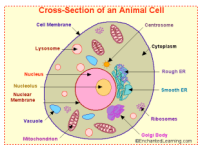
Wings for flight

Hollow bones reduce body mass and facilitate flight

Theme 5
Cells are an organism's basic units of structure and form

The cell is the lowest level of organization that can perform all activities required for life

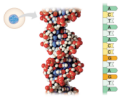




Theme 6
Continuity of life is based on heritable information contained in DNA

- Evolution by descent depends on inheritance of traits from ancestors through transmission (inheritance) of genes (DNA) from parents to offspring

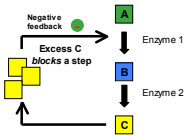
- DNA controls the development and maintenance of organisms



Campbell et al. (2008)

Theme 7
Feedback mechanisms regulate biological systems

- self-regulation: many biological processes are able to self-regulate by a feedback process
- feedback regulation: the output or product of a process regulates that very process
- feedback mechanisms can be either negative or positive



Organizing the Diversity of Life
Grouping Species: The Basic Idea

- Taxonomy is the branch of biology that names and classifies species into groups of increasing breadth
- Domains, followed by Kingdoms, are the broadest units of classification

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The Three Domains of Life

- The three-Domain system is currently used, and replaces the previous five-Kingdom system
- **Domain Bacteria** and **Domain Archaea** comprise the prokaryotes
- **Domain Eukarya** includes all eukaryotic organisms

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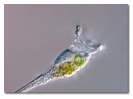
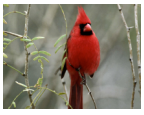
Domain Eukarya



Protists
(multiple Kingdoms)

Kingdom Plantae

Kingdom Fungi



Kingdom Animalia

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Evolutionary timeline

~ 4.6 bya	Origin of Earth	
~ 3.5 bya	First living organisms:	
	Prokaryotes	
~ 2.1 bya	Eukaryotes	
~ 1.2 bya	Multicellularity	
~ 600 mya	Animals	
~ 200,000 ya	Humans (*Homo sapiens*)	

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Terminology refresher

- Phylogeny
  evolutionary history of an organism
- Systematics
  discipline of determining evolutionary relationships
- Cladistics
  placing organisms into a group (clade) based on common descent
- Monophyletic clade
  grouping wherein all members descended from a common ancestor
- Taxonomy
  discipline of naming and classifying organisms

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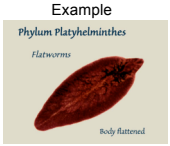
Levels of classification within the Kingdom Animalia

- Phylum is the highest unit
  - most basic shared derived characteristics
  - 32 animal phyla

Example



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- Species is the lowest level
  - populations of individuals that can interbreed and produce viable fertile offspring
  - share a close genetic relationship
  - usually cannot breed with other groups

Linnean Hierarchical Classification

Domain *Eukarya*
Kingdom *Animalia*
Phylum *Chordata*
Class *Mammalia*
Order *Rodentia*
Family *Castoridae*
Genus *Castor*
Species *Castor canadensis*

Dear
King
Philip
Came
Over
From
Great
Spain

Beaver

***Science*, 333: 1083 (2011)**

Next Lecture Topic

Evolution by selection:
Descent with modification