

Biology of Invertebrates

BIOL 337



Dr. Bob Podolsky

Lecture 1

“Classification and phylogeny”

or

“3 reasons why our course title has problems”

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Robert D. Podolsky: *vertebrate*



Evolutionary Ecology and Functional Biology of Marine Invertebrates

Associate Professor of Biology, College of Charleston
 Director, Grice Marine Laboratory
 Ph.D., University of Washington
 M.S., University of Florida
 A.B., Princeton University

Telephone: (843) 953-9186 (vox); (843) 953-9199 (fax)

E-mail: podolskyr@cofc.edu

Office: 214 Grice Marine Laboratory

Mailing Address: Grice Marine Laboratory, 205 Fort Johnson, Charleston SC 29412

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Interests

- Life-history evolution and ecology of invertebrate larvae
- Fertilization ecology and evolution of spawned gametes
- Physiological ecology of development in variable environments
- Plasticity of form and function during ontogeny
- Mechanical vs. physiological effects of temperature
- Quantitative, phylogenetic, and comparative methods

Course websites

[Biology 211: Biodiversity, Ecology, and Conservation Biology](#)



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Spiny C. Star : *“invertebrate”* #1!



Features

- unusual 5-part body symmetry
- no brain, but a nerve ring and radii
- exchanges gases through surface papulae
- uses hydraulic system for locomotion
- 1000s of appendages called tube feet
- everts stomach to feed
- uses an imbricating skeleton for body support
- can alter its own connective tissue(!)
- cannot function in fresh or even brackish water
- releases gametes to reproduce

“More than just the knowledge of its parts”

invertebrate diversity

PHYLUM	COMMON NAMES, DESCRIPTION	SPECIES
Ph. Placozoa	<i>Trichoplax</i> , discovered on aquarium walls	1
Ph. Porifera	Sponges	10,000
Ph. Cnidaria	sea anemones, jellyfish, corals etc.	9500
Ph. Ctenophora	comb jellies	90
Ph. Platyhelminthes	flatworms	25,000
Ph. Mesozoa	mesozoans	50
Ph. Nemertea	ribbon worms	900
Ph. Gnathostomulida	tiny worms, interstitial in marine sand	80
Ph. Gastrotricha	"hairy-bellies," meiofaunal worms	400
Ph. Rotifera	rotifers, microscopic primarily freshwater	2000
Ph. Nematoda	nematodes, worm shaped	80,000
Ph. Nematomorpha	horsehair worms	240
Ph. Kinorhyncha	spiny-crown worms, marine meiofauna	100
Ph. Loricifera	brush heads, marine meiofauna	10
Ph. Acanthocephala	spiny-headed worms, parasites	1000
Ph. Cycliophora	cycliophorans	1
Ph. Kamptozoa	entoprocts	150
Ph. Bryozoa	moss animals, ectoprocts	5000
Ph. Phoronida	phoronids, worm-shaped	10
Ph. Brachiopoda	lamp shells	335
Ph. Mollusca	chitons, snails, clams, squid etc.	110,000
Ph. Priapulida	phallus worms	16
Ph. Sipuncula	peanut worms	320
Ph. Echiura	spoon worms	140
Ph. Annelida	polychaetes, earthworms, echiurans	15000
Ph. Tardigrada	water bears, interstitial	700
Ph. Onychophora	velvet worms, terrestrial	80
Ph. Arthropoda		
Subph. Chelicerata	spiders, scorpions, horseshoe crabs, etc.	65,000
Subph. Crustacea	crabs, shrimp, barnacles, copepods, etc.	32,000
Subph. Tracheata	insects, centipedes, millipedes	860,000
Ph. Echinodermata	sea stars, brittlestars, sea urchins, etc.	6000
Ph. Chaetognatha	arrow worms	110
Ph. Hemichordata	acorn worms	90
Ph. Chordata		
Subph. Urochordata	tunicates	3000
Subph. Cephalochordata	amphioxus	23
Subph. Vertebrata	fish, amphibians, reptiles, birds, mammals	45,000

CLASSIFICATION OF DIVERSITY: taxon size

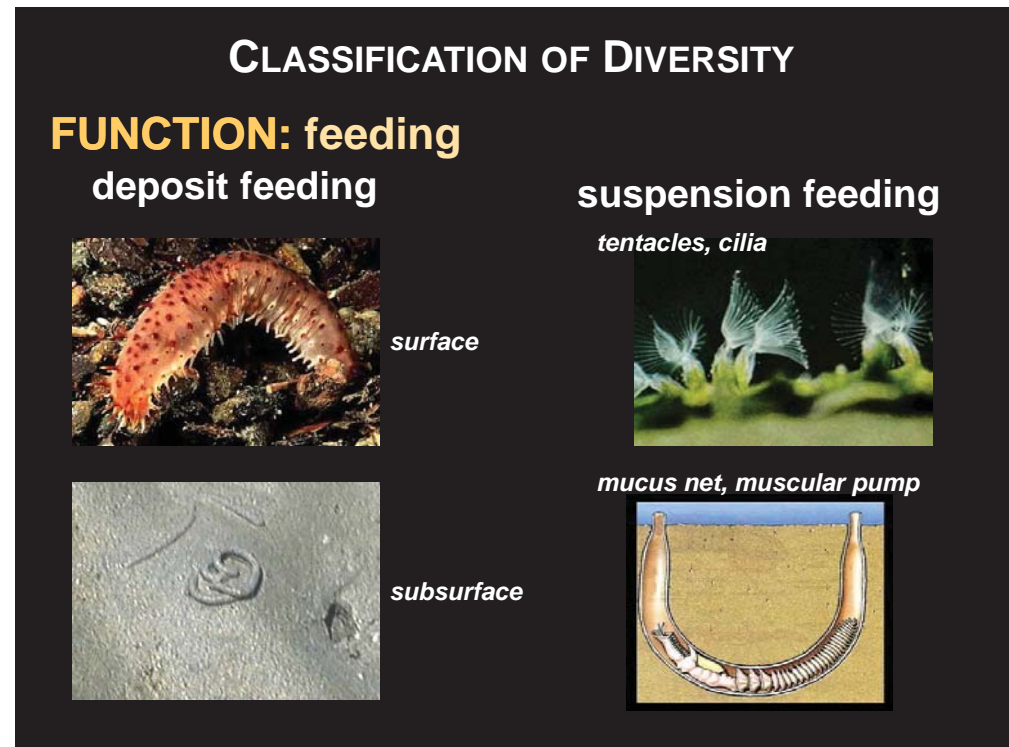
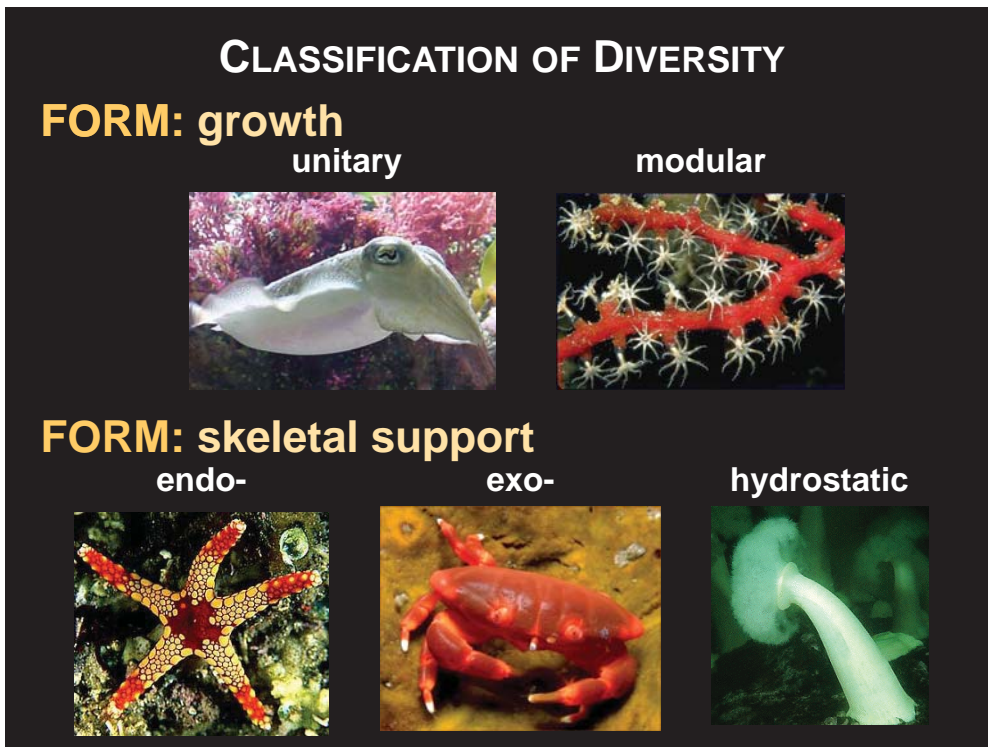
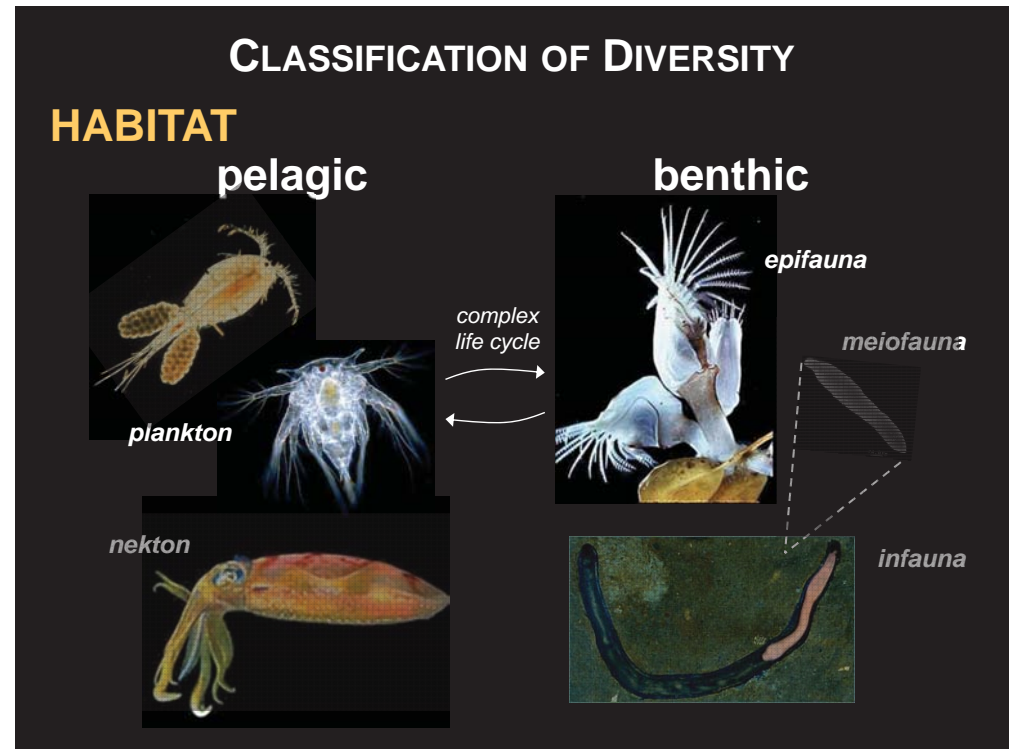
☐ ≥ 10,000 species

○ ≤ 100 species

○ "worm"

> 1,200,000 "Invertebrate" species
45,000 Vertebrate species

#2!



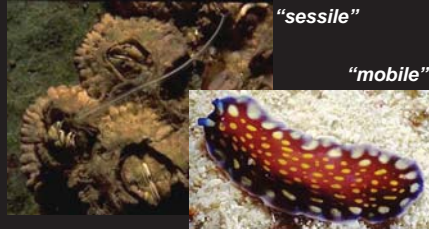
CLASSIFICATION OF DIVERSITY

FUNCTION: reproduction

broadcast spawning



internal fertilization
copulation



spermcast spawning



CLASSIFICATION OF DIVERSITY

TAXON SIZE

HABITAT

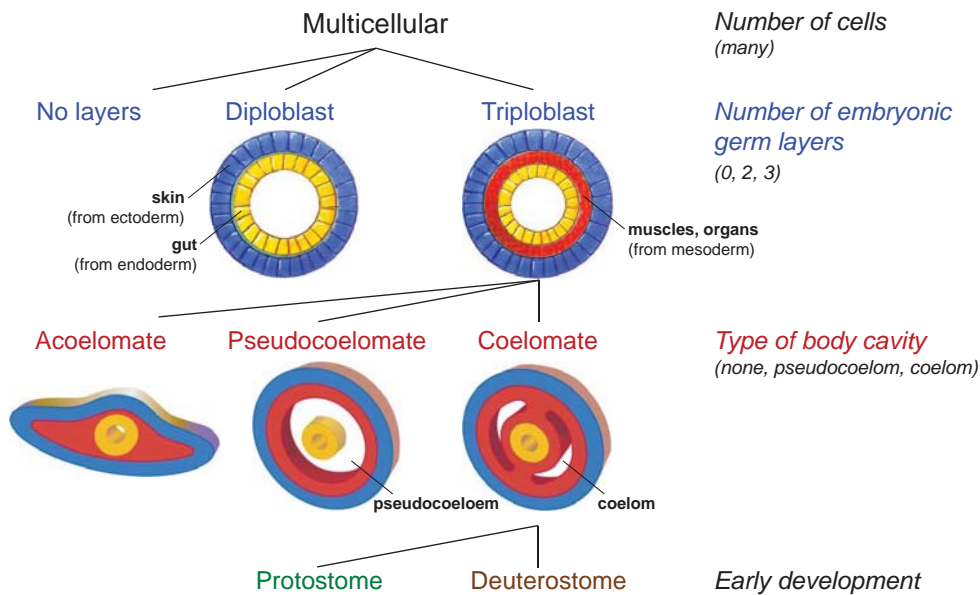
FORM

- growth
- skeletal support

FUNCTION

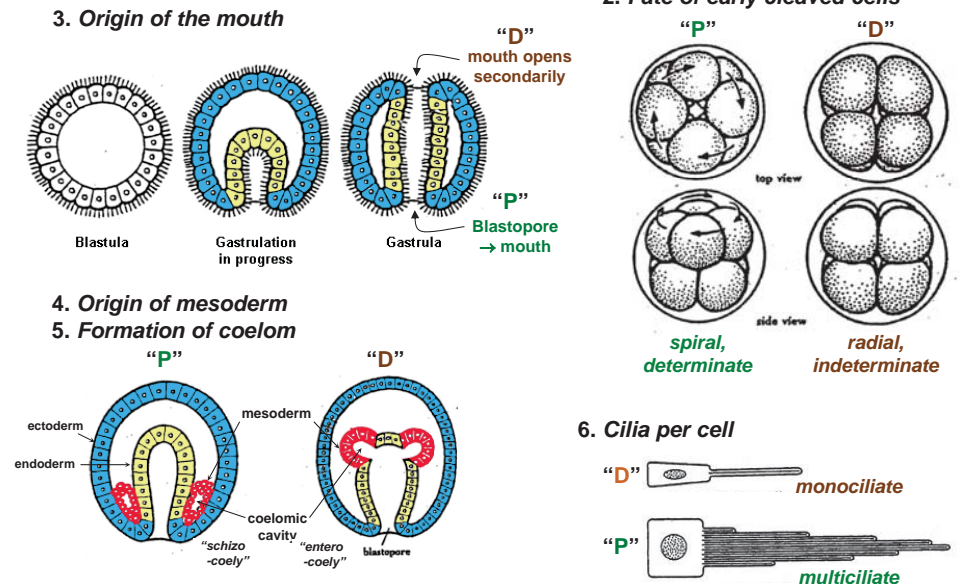
- feeding
- reproduction
- locomotion
- protection/defense
- gas exchange
- circulation
- excretion
- nervous control and sensory systems

CLASSIFICATION OF DIVERSITY: taxonomy using traditional features



Early development: six features that go together

protostomes vs. deuterostomes



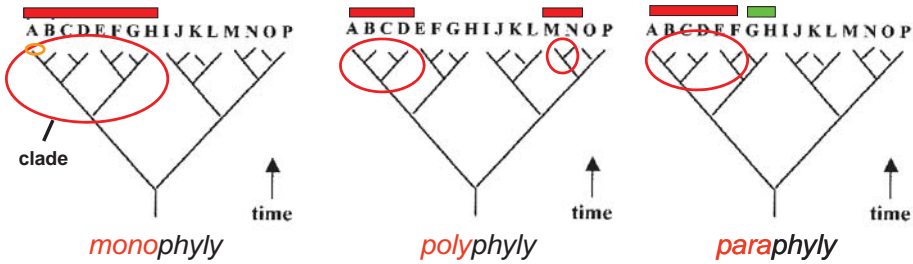
CLASSIFICATION should reflect degree of RELATEDNESS
(taxonomy) (phylogeny)

TAXONOMY...

Kingdom	Animalia
Phylum	Echinodermata
Class	Asteroidea
Order	Forcipulatida
Family	Asteriidae
Genus	Pisaster
Species	<i>Pisaster ochraceus</i>



...PHYLOGENY

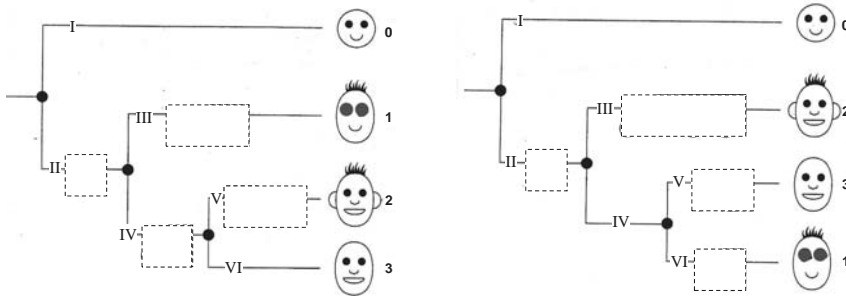
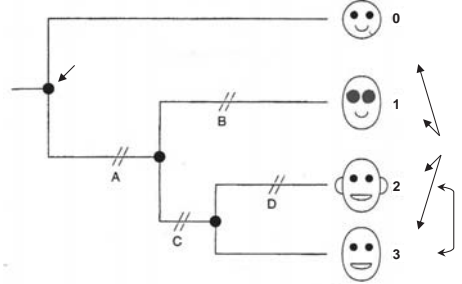


Evolutionary classification based on cladistic methods

Cladistics: a method for inferring the true pattern of evolutionary relationships based on "shared, derived characters" (synapomorphies)

- Ex 1.** Event A: head (short vs. long)
Event B: eyes (small vs. large)
Event C: mouth (narrow vs. wide)
Event D: ears (absent vs. present)

- Ex 2.** Event E: nose (absent vs. present)
Event F: hair (absent vs. present)

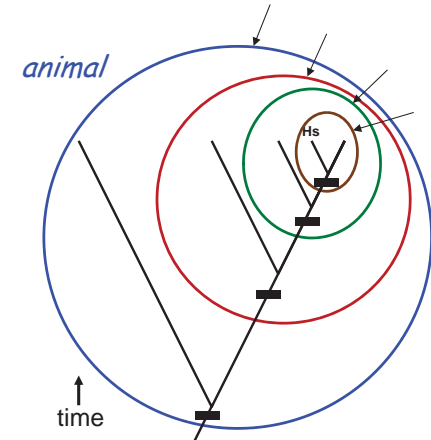


Q1: Which phylogenetic hypothesis has better support?
Q2: What is the third phylogenetic hypothesis?

Anya K. Podolsky: vertebrate, mammal, primate...



Homo sapiens



K. Animalia = "Metazoa"

