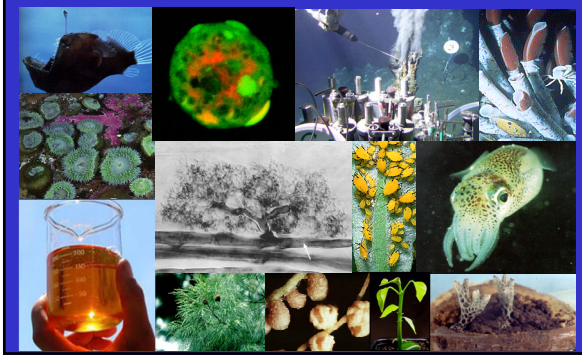
SYMBIOSIS



1

Why "Symbiotic Interactions"?

LIFE ON EARTH

- chemical basis (macromolecules)
  - carbon-based life on water-planet
- genetic code (DNA)
  - replication (hereditary)
  - transcription, translation (metabolism)
- cellular organization (membranes, organelles)
  - basic units of life
- evolution (natural selection)
  - intra-species competition
- symbioses (living together)
  - inter-species interactions
  - collective co-existence (ecology)

2

Course description

- Promote a broad and deep understanding of different symbiotic interactions
- covering a diverse array of symbioses in both terrestrial and marine environments
- explore potential applications and future directions in research and industry
- using interactive discussion workshops to address course content

3

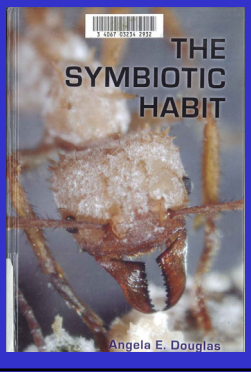
Reference text

The Symbiotic Habit

Angela E Douglas (2010)

ISBN: 978-0-691-11341-8

(Princeton University Press)



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Learning Objectives

- Symbiosis instrumental to life on Earth
  - from evolution of eukaryotes to regulation of ecosystems
- Broad term to describe interactive relationships
  - beneficial mutualism, neutral commensalism, detrimental parasitism
- Many partnerships yet to be resolved
  - bio-discovery, level of interaction, mode of operation
- Potential utilization
  - applications for science, business and industry

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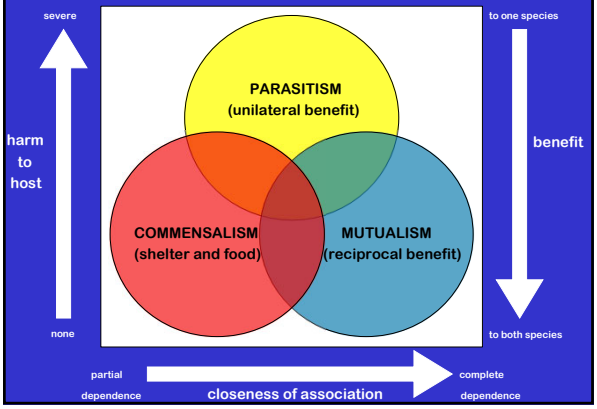
SYMBIOSES (living together)



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Survey of Benefits Gained from Symbiosis and Non Persistent Mutualisms	
Relationship	Examples
Access to metabolic capability	
Inorganic Carbon Fixation	Cyanobacteria-derived plastids in algae and plants
	Algae /Cyanobacteria in lichenized fungi, protists, and animals
	Chemosynthetic bacteria in animals
Aerobic respiration	Bacteria-derived mitochondria in eukaryotes
NItrogen fixation	Bacteria (eg Rhizobia, Cyanobacteria in lichenized fungi Bacteria in a few insects (termites)
Cellulose degradation	Bacteria in vertebrates Protists in a few insects (eg lower termite, woodroaches) Fungi in Macrotermitidae
Nutrient biosynthesis (eg vitamins, essential amino acids)	Bacteria or fungi in animals, especially insects, and in protists
Degradation of toxins	Bacteria in animal guts
Toxin Production	Bacterial in animals (eg insects, bryozoans, sponges)
Hydrogen Consumption	Methanogenic bacteria in anaerobic protists

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Survey of Benefits Gained from Symbiosis and Non Persistent Mutualisms	
Relationship	Examples
Protection from antagonists	
Protection from herbivores	Ants associated with plants remove or deter herbivores
Protection from Predators	Ants deter predators / parasitoids of hemipteran insects and lycaenids Sea anemones /hydroids protect hermit crabs
Removal of ectoparasites	From client fish by cleaner fish; from ungulates (eg gazelle) by pecking birds
Protection from pathogens	Microbiota in animal guts and plant rhizosphere (immediate environments around roots)
Dispersal / Mobility	
Biotic pollination	Male gamete (pollen) transport to stigma of plants by insects, birds, mammals
Biotic Seed Dispersal	Seeds transported away from parent plant by birds, mammals and ants
Ant-tended hemipterans	Transport to suitable feeding sites on host plants
Agriculture	Cultivation of fungi by bark and ambrosia beetles, termites and attinine ants.

Adapted from Douglas (2010)

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Case studies & Group discussions

Establish basics!

Where does the interaction occur?
Intracellular / Extracellular / Environment/ Ecology

Who are the partners involved?
Hosts / Microbes (Prokaryotic / Eukaryotic)

Evolutionary history of Interaction?
What has driven the relationship to develop?
(Parasitism; Commensalism; Mutualism)
(Gene transfer; Coevolution)

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Case studies & Group discussions

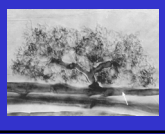
Nature of relationship!

Mechanisms (molecular) of onset and maintenance?

Translocation / communication?

Causes of relationship breakdown?

Functional and ecological roles and significance?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Case studies & Group discussions

Utility!

Research Potential and Links with Industry?

Anthropogenic Factors?

Climate Change?



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Schedule

- What is Symbiosis?
- Deep Sea Vents / Chemoautotrophy
- Rumen Ecosystem and Herbivory
- Vertebrate Guts and Human Microbiome
- Nitrogen Fixation and Legumes
- Endophytic Fungi
- Mycorrhizae
- Plant Pathogenesis
- Insect Symbioses
- Marine Symbioses


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