Overview

• Coral Reefs extend back over 500 m.y.
• Grow in tropical seas with normal salinity
• Support a great variety of plant and animal life
• Cover less than 0.2% of sea floor
• Contain about 25% of marine life

What are Corals?

• Invertebrate marine organisms - Phylum Cnidaria, Class Anthozoa
• Simple radial body plan with one opening
• Makes external and internal skeletons
• Two types: (1) Reef-building (hermatypic or hard) corals; (2) non-reef building (ahermatypic or soft) corals
• Hard corals have zooxanthellae (algal symbionts)
Soft Corals

- Similar to hard corals but without a solid skeleton
- Do not have zooxanthellae and do not depend on sunlight
- Many are branching forms such as sea whips and sea fans

Great Barrier Reef

- Largest structure built by living organisms
- Only living structure visible from space
Biology

- Body is called a polyp, a hollow sac-like structure smaller than a pencil eraser
- Mouth surrounded by tentacles, which contain stinging structures called nematocysts for paralyzing prey
- Hard corals produce limestone skeleton
- Intricate patterns of hard corals produced by polyp shape and the calcareous skeleton it secretes
How a nematocyst works

- Trigger
- Hollow thread containing toxin
- Barbs

How coral colonies grow

- All coral colonies arise from a single polyp. Here we show two classic growth patterns. The mound-forming corals build up in layers, while the branching species develop in a longitudinal fashion to form more fragile twiglike growths.

Mound coral

- Living layer of polyps
- Original polyp
Corals and Zooxanthellae

- Algal cells live within polyp tissues in a symbiotic relationship
- Algae provide food (from photosynthesis) and oxygen; corals also eat zooplankton
- Corals provide CO$_2$, nutrients and protection
- Algae need sunlight; reefs only grow in photic zone
- Algae give corals their color
Feeding and Reproduction

- All are carnivorous; use nematocysts to paralyze their prey
- Tentacles of hard corals extend to feed only at night; soft corals feed during the day
- Reproduce both sexually and asexually
- Asexual reproduction occurs by budding; a colony develops by addition of new buds
- Grows very slowly, up to 2 cm/year
- Largest coral structures may be 100s of years old
- All colonies arise from a single polyp
Optimum Conditions for Reef Growth

- Thrive in shallow, clear, sunlit saltwater
- Between 16 - 36°C (61 - 97°F), optimum is 23 - 25°C (73 - 77°F)
- Salinity of 35 ppt, but can tolerate slightly wider range
- Clear water is necessary for sunlight (algae need it)
- Corals will suffocate in muddy water
- Must be exposed to currents for food since they cannot move

Locations

- Most found between 20°N and 20°S
- Three regions: Indo-Pacific, Western Atlantic, Red Sea
- Indo-Pacific is richest in coral and fish species
- 60% of reefs are in Indian Ocean/Red Sea; 25% in Pacific; 15% in Western Atl.
What Makes a Reef?

- It is of biological origin
- It is a rigid structure
- It stands topographically above the surrounding floor and, therefore, exerts local control on marine processes
Fringing Reefs

- Begin to develop in shallow water parallel to coast
- Actively growing part is on seaward face where conditions are more favorable
- Broadens into a platform extending out from the shore
- Trapped corals behind active reef gradually die
Barrier Reefs

- Elongated structures parallel to coast but further out to sea and separated from land by moderately deep water
- Form by rise in sea level or subsidence of land
- Large reefs occur mainly on eastern side of large landmasses due to global current systems
Atolls

- Develop similarly to barrier reefs but based on an island instead of a long shoreline
- Most abundant in central Indian Ocean and the Pacific
Fringing Reef Zones

- Lagoon - sandy with algae or sea grasses; diversity inhibited by high T & S and lack of currents; patch reefs
- Back reef - richer due to exposure to open water breaking over reef
- Reef flat - broad shallow area with strong wave action; encrusting calcareous algae
- Reef crest - highest point of reef on seaward side of reef flat; strong wave action
- Reef front - lower than crest; less wave energy
- Upper reef slope - most productive area; gentle slope to sheer drop; great diversity; abundant fish
- Lower slope - beyond depth most shallow water corals can tolerate; platelike corals and soft corals
Barrier Reef Zones

- Leeside face - towards the land; fronts on open ocean conditions rather than a lagoon; prolific coral growth
- Reef flat - much wider
- Reef crest - very exposed; high energy wave action
- Upper reef slope - fairly steep with dense coral growth
- Lower reef slope - may drop steeply
Reefs Are:

- Home and nursery for almost a million fish and other species, many that we rely on for food
- Some of Earth's most diverse living ecosystems
- Full of new and undiscovered biomedical resources that we've only begun to explore
- Important protection for coastal communities from storms, wave damage and erosion

Value of Coral Reefs

- Enrich sea life
- Provide food and shelter to many plants and animals
- Exchange energy and nutrients with adjacent ecosystems
- Break waves (boat anchorages), protect shorelines
- Supply fin fish and shell fish for subsistence, commercial, recreational and ornamental uses
- Seafood consumption exceeds pork or beef
Threats to Coral Reefs

- Highly sensitive to environmental conditions
- Natural threats include: sea level changes, storms, abnormal weather, temp fluctuations, heavy rains, disease, and predation
- Human threats: global warming, harmful fishing practices, mariculture, damage from boats and divers, coral mining, and pollution