

- 1 Coral Reefs
- 2 Identify the distribution of coral reefs (latitude, oceans) and limiting factors.
 - Water needs to be oligotrophic: clean, clear
 - Water temperature needs to be at least 20C or 68F
 - Dissolved oxygen needs to be high >7-8 ppt
 - Requires flowing water
 - If dirt, excess nutrients like N or P, or any toxins are carried in the water the corals will die
 - Found largely between the Tropics of Cancer and Capricorn, latitudes 20N and 20S
- 3 Identify and describe the types of coral reefs.
 - Fringing reef: border continents and islands, common in Caribbean & Hawaiian Islands
 - Barrier reef: occurs farther offshore; may be due to subsidence; Great Barrier reef of Australia, Caribbean & Indo-Pacific
 - Atoll: surrounded small island; island subsided; reef remains; lagoon in center of crater
- 4 Fringing Reef at Bora Bora
- 5 Great Barrier Reef
 - Largest known coral deposit in the world (about 2010 km/1250 mi)
 - Off eastern coast of Australia
 - About 1,500 species of fish and more than 400 species of coral
 - Made up of many different reefs
 - Only living thing on Earth that can be seen from outer space
- 6 Explain how atolls form.
 - As islands form due to hot spots or due to sea floor spreading, they provide habitat for corals.
 - Corals may arrive by rafting on pieces of pumice that floats from other reefs.
 - The corals form a fringing reef around the island.
 - The island continues to subside leaving the coral reef in a doughnut shape behind with a lagoon in the volcano's crater in the center.
- 7 Atolls in the Maldives & Midway
- 8 Compare and contrast coral reefs in the Atlantic ocean with coral reefs in the Pacific Ocean
 - 1
 - Indo-Pacific Oceans
 - Usually found around islands on steep banks
 - Only grow to 60 m
 - 80 genera and 700 species of corals
 - Has soft or alcyonacean corals, Sarcophyton
 - A reef builder, Acropora, has 200 species
 - Most species diurnal
 - 5000 species of mollusks-has giant clams
 - Has anemones w fishes
 - Less sponges, usually w photosynthetic symbionts
 - Fishes main grazers
 - 2
 - Atlantic Ocean
 - Rest on shallow banks or platforms
 - Grow to 100 m
 - 36 genera and 62 species of corals
 - More sea fans/whips (Gorgonian corals)
 - Acropora has 3 species
 - 1200 species mollusks, no giant clams
 - No anemones, but has anemone fish
 - No coral eating starfish
 - No protective shrimp/crabs
 - Most species nocturnal
 - Many sponges-not symbiotic with algae
 - Echinoderms are main grazers

- 9 Explain how coral reefs form and the rate of growth of coral reefs.
- net growth rate of a reef is the combination of total carbonate production less carbonate losses by biological, chemical and physical factors
 - The rate of accretion also varies with the amount of sunlight available.
 - Corals appear to have definitive growth limits-they stop growing when they have maxed out for that species.
 - Grow about .8mm to 26 mm in Atlantic and about 2-5 mm in parts of Pacific; other areas grew up to 80 mm in Pacific, but that was in 1955, before pollution became a problem to the extent that corals have bleached and died
- 10 Describe the general anatomy of Scleractinian corals
- 11 Explain the relationship between oligotrophic waters, zooxanthellae, and hermatypic corals.
- Hermatypic corals are stony corals or the main reef builders
 - Soft corals, or ahermatypic corals, do not use calcium carbonate to form protection for their polyps
 - Scleractinia is the order of stony corals
 - These corals are heterotrophic-carnivorous and possess nematocysts.
 - They live symbiotically with zooxanthellae-algae. The algae use photosynthesis to make small sugars that supply the coral with nutrition. The coral contributes to the nutrition and protection of the algae. If the coral is in danger due to warming, eutrophication, or other factors, they expel the zooxanthellae. Bleaching soon follows.
- 12 Coral polyps and zooxanthellae
- 13 Describe the assemblage of organisms (animals/plants) that live on coral reefs (may need to differentiate by location.)
- Sponges: among first to colonize, many different species on reefs, provide habitat to fishes, shrimps, crabs, and other small animals, may be single or colonial, may be soft or glass, display a variety of colors
 - Sea anemones: close relatives of corals; Indo- Pacific reef anemones are known for their symbiotic relationships with clownfish and anemonefishes; an anemone's tentacles provide refuge for these fishes and their eggs; some of these fish protect anemones from predators, may clean them, and may feed the anemones
 - Bryozoans: encrust the reef; microscopic invertebrates form branching colonies over coral skeletons and reef debris; may contribute to cementing reef structure
 - Worms: flatworms, polychaetes, Sabellids, and Errantia
 - Sea stars, sea cucumbers, and sea urchins
 - Shrimps, crabs, lobsters, and other crustaceans
 - Octopuses, squids, clams, scallops, marine snails, and nudibranchs are all molluscs
 - schooling and solitary fishes
 - Turtles:green, loggerhead, and hawksbill sea turtles live at the Great Barrier Reef.
 - Sea snakes: in the Pacific, small, all poisonous
- 14 Explain the relationship between structure and abundance and structure and diversity found in coral reef assemblages.
- The more complex the structure, the greater the diversity of other species
 - Coral reefs have great diversity and great abundance 1500g/m² compared to open ocean at 18-20 g/m²
- 15 Explain competition on coral reefs and predation of coral reefs.
- No open space on coral reefs leading to competition between coral species as well as other species
 - Tall, branching corals can outgrow or shade encrusting or massive corals, killing those corals
 - Massive coral polyps develop filaments that branch from their gastrovascular cavity that digest tissue they touch-like other species of coral
 - Most other organisms, other than fish, hide to avoid predation
 - Predators develop the ability to exploit the crevices in which their prey hide

- 16 Explain diurnal differences and how that impacts competition and predation.
- Not only are corals diurnal or nocturnal, many other species are as well
 - Diurnal species come out in day light and feed
 - Nocturnal come out at night and feed
 - Almost like two completely different ecosystems
- 17 Identify factors and their sources that can cause coral reefs to bleach, or die.
- Anthropogenic: human activities
 - Pollution
 - Overfishing
 - destructive fishing practices using dynamite or cyanide
 - collecting live corals for the aquarium market
 - mining coral for building materials
 - Global warming
- 18 **Human threats**
- Over fishing
 - Blast fishing
 - Cyanide fishing
 - Coastal development
 - Runoff → overflow of nutrients
- 19 **Global warming**
- Coral bleaching – when coral expel their symbiotic algae due to extreme stress
 - If stress is short, color and algae return
 - If stress is prolonged, coral eventually dies
- 20 **Natural Threats**
- Changing sea level
- 21 **Crown-of-thorns sea star**
- Eat hard coral – current population boom
- 22 Explain why these factors should be addressed and suggest ways they could be addressed.
- (Coral reef biological/ecological/economic functions.)
- Coral reefs are among the oldest ecosystems on Earth.
 - Coral reefs are the largest living structure on the planet.
 - Although coral reefs cover less than 1% of the Earth's surface, they are home to 25% of all marine fish species.
 - 500 million people rely on coral reefs for their food and livelihoods.
 - Coral reefs form natural barriers that protect nearby shorelines from the eroding forces of the sea, thereby protecting coastal dwellings, agricultural land and beaches.
 - Without the existence of coral reefs, parts of Florida would be under water.
 - Coral reefs have been used in the treatment of cancer, HIV, cardiovascular diseases and ulcers.
 - Corals' porous limestone skeletons have been used for human bone grafts.
 - It is estimated that coral reefs provide \$375 billion per year around the world in goods and services.
 - If the present rate of destruction continues, 70% of the world's coral reefs will be destroyed by the year 2050.
- 23 Explain the effects of weather patterns on reef growth and reef sustainability.

- Global warming causes bleaching
- Storms cause weathering and erosion
- Sedimentation (can also be from storms) causes bleaching