Coral Reef Adventure

Teacher Workshop

Monday, October 9, 2006, 9:30-2:30

New Mexico Museum of Natural History and Science

(1801 Mountain Rd, NW)

NEW MEXICO MUSEUM OF NATURAL HISTORY & SCIENCE

New Mexico Department of Cultural Affairs

Albuquerque Aquarium

(2601 Central Ave, NW)

ABQ BIOPARK

CITY OF ALBUQUERQUE TRICENTENNIAL 1706-2006 NEW MEXICO

Martin J. Chávez, Mayor

The BioPark is a division of the City of Albuquerque's Cultural Services Department.

Coral Workshop – Content Outline

1. WHAT IS CORAL?

A. Corals are members of the Phyla Cnidarian
   1) Jellyfish, sea anemones, Portuguese man-o-war, sea pens etc.

B. What do cnidarians all have in common?

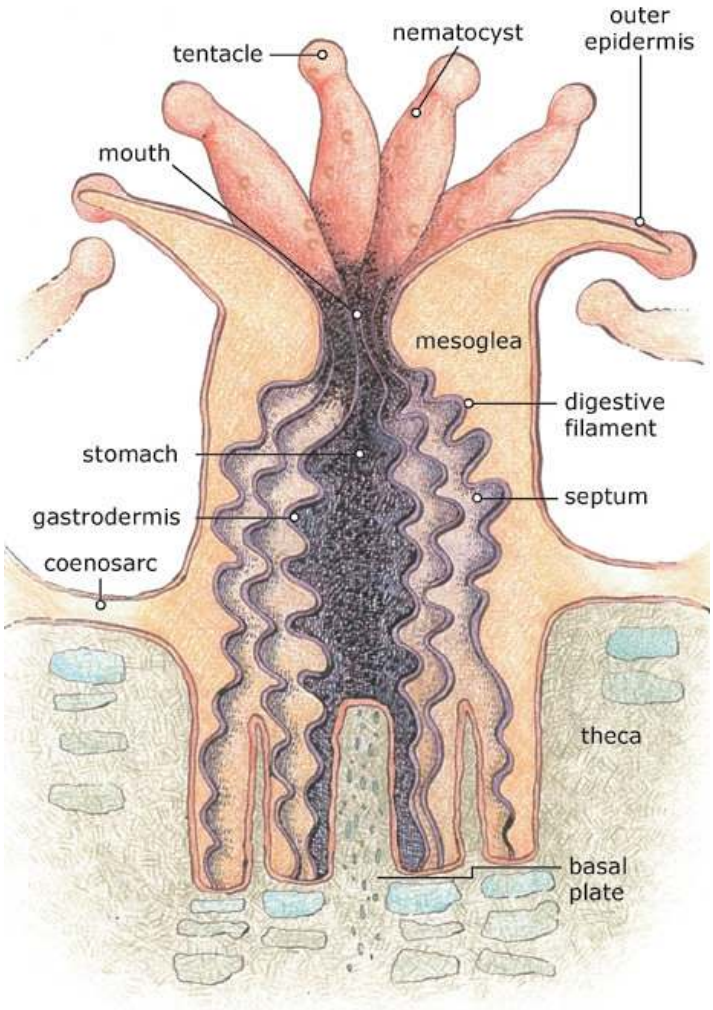
1) Nematocysts – stinging cells – on tentacles and sometimes on the body
   a) Most can't hurt you – like tape sticking to your finger
   b) Others can be more dangerous:
      i) Sea nettle, box jellies, Portuguese man-o-war
         - Severe pain, even death, can occur after a sting

2) Radial symmetry

3) No gills or lungs – O_2 diffuses through the body into the cells

4) Simple sac – food comes in and waste goes out through the same opening

5) Simple "nerve net" – no central nervous system, though they do not have a brain, most have light sensitive organs, others well developed eyes



2. CORAL TAXONOMY – corals are classified as follows:

A. Class Anthozoa (sea pens, sea anemones, corals)

1). Subclass Alcyonaria (= Octocorallia) (eight tentacles)

a) Alcyonacea (soft corals)

b) Gorgonacea (sea fans, sea feathers)

c) Helioporacea (Indo Pacific blue coral)

d) Pennatulacea (sea pens and sea pansies)

e) Stolonifera (organ pipe coral)

2) Subclass Zoantharia (= Hexacorallia) (more than 8 tentacles - typically 12)

a) Antipatharia (black corals, thorny corals)

b) Scleractinia (=Madreporaria) (stony corals)

c) Corallimorpharia

d) Ptychodactiaria

3. TYPES OF CORALS

A. Most corals are marine (live in salt water)

1) Colonial and solitary corals

2) Most live in shallow water

3) Must have enough light to cultivate their "zooxanthellae" (pronounced: zo-anth-ella)

a) "zooxanthellae" are algae living in a symbiotic relationship with the coral polyps

b) zooxanthellae produce nutrients needed by the coral (will show importance later)

B. **Soft Corals** (Octocorallia)

i. All have 8 tentacles on the polyps

ii. Blue corals, pipe organ corals and gorgonians (whip corals and sea fans)

iii. Not all soft – some have spicules imbedded in skin; others have a fibrous skeleton others produce a carbonate "skeleton."

a. Colonial
b. found in tropical to polar waters
c. usually shallow water but some live in very deep water

C. **Hard Corals**

i. Colonial and solitary

ii. Tentacles: 6 or multiples of 6

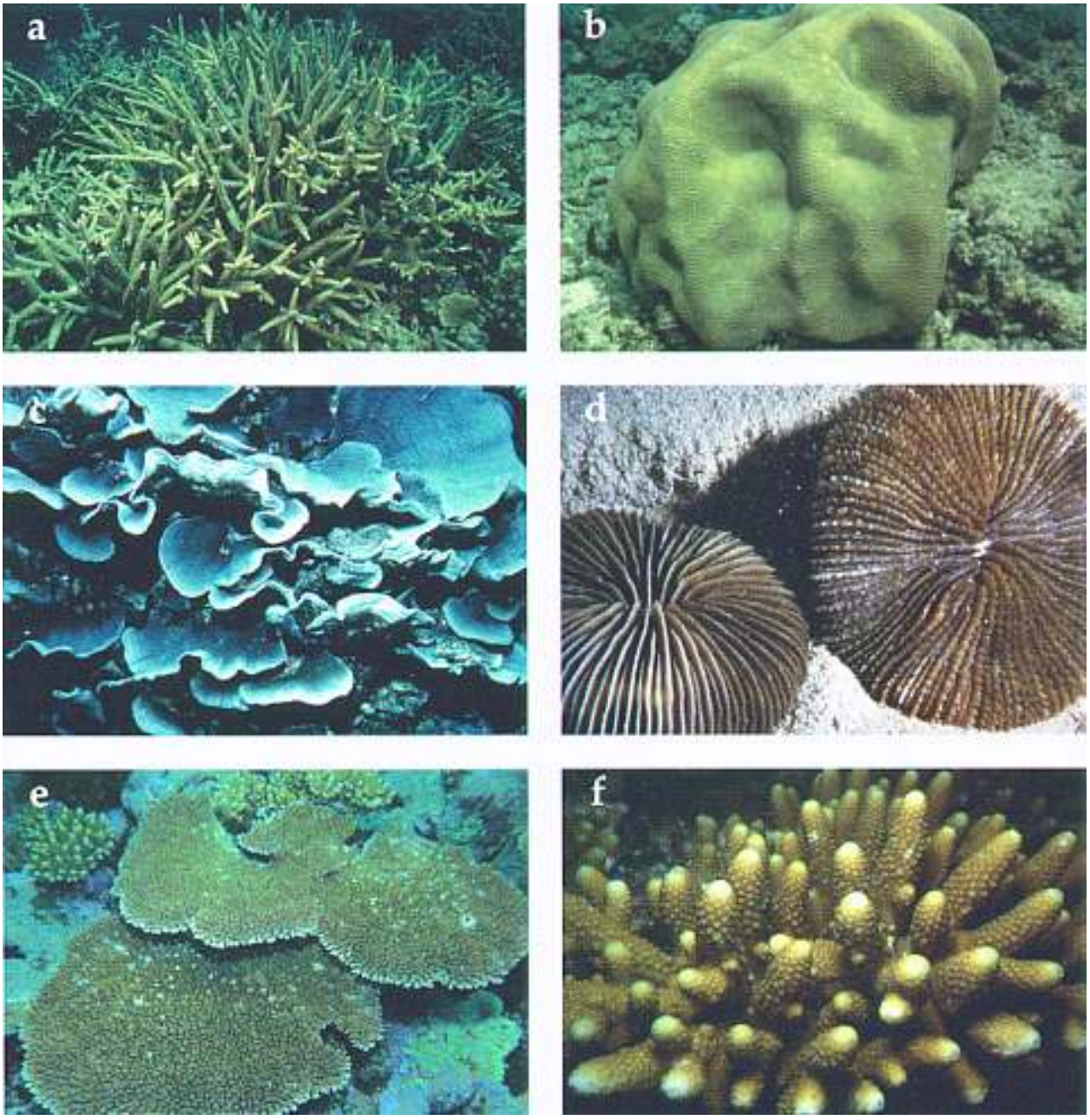
iii. Hard skeleton made of calcium carbonate

iv. Always found in shallow water

iv. All have zooxanthellae so limited to shallow water.

vi. All prefer warmer water but can tolerate cooler water for short periods (from $16^0 - 23^0$ C)

a. Bleaching – if water gets too warm then the corals expel their zooxanthellae



Hard coral morphologies

a: digitate *Acropora* sp., **b:** massive *Goniastrea* sp., **c:** foliaceous *Leptoria* sp.,
d: solitary *Fungia* sp., **e:** table *Acropora* sp., **f:** corymbose *Acropora* sp.

4. FOSSIL HISTORY

A. Most cnidarians have a very poor fossil history
    i. Soft body, very unlikely to produce fossils

B. Precambrian "Ediacara fauna" - ~600 million years old
    i. Fossils reminiscent of Sea pens and jellyfish

C. Oldest true corals are found in Cambrian rocks but are extremely rare until the Ordovician

D. First reefs were not dominated by corals but by algae and sponges.
    i. Early corals were a minor part of the reef

E. Cambrian *Xianguangia sinica* - primitive sea anemone from China
Harklessia yuenglingensis – a coral from Nevada
Cambrophyllum problematicum - a coral from North America –

    i. Middle Cambrian Burgess Shale: *Mackenzia costalis* - sea anemone

F. First coral reefs occur in the Silurian (440 - 410mya)
Dominated by rugose and tabulate corals

G. Modern corals appear at the end of the Triassic
Dominate from the Jurassic

H. Corals are very rare in the Cretaceous - shallow warm sea, but had a muddy bottom

5. REEF FORMATION

A. Corals need:

Sunlight

Clean silt-free water

Prefer constant salinity

B. Will do poorly if:

Brackish water (not as salty as seawater

Cold water

Silty or cloudy water

C. Three kinds of reef:

Fringe reef - Form a long shelf of coral from shore to reef edge

- Form primarily on coasts of arid regions where there is little runoff from rivers (rivers bring in fresh water and also deposit silt)

- Tend to be fairly young structures

Barrier reefs - Form a distance from the coast with a lagoon in between.

- The Great Barrier Reef is the largest reef system in the worlds

Atolls - Form a ring around an island.
- As sea level rises or as a volcanic island subsides, coral dies back in the deeper water and forms a ring marking the spot where the island was.

6. IMPORTANCE OF REEFS

"rainforest of the sea"

Provide living area for many fish species that we in turn catch for food

Huge diversity of species

Protect seacoast from storms and surges

Remove CO_2 from atmosphere to make the reefs structure

7. CORAL REEFS TODAY

Occur in warm waters around the world where temperature is anywhere between 68 to 82 degrees Fahrenheit, and the salinity levels tend to be between 34 to 37 parts per 1000.

Caribbean reefs

Flower Garden Banks

Belize Barrier Reef

Australia's Great Barrier Reef is about 18 million years old in the north and 2 million years old to the south.

Modern reef structures are around 8,000 + years old (sea level increased at end of ice age.)

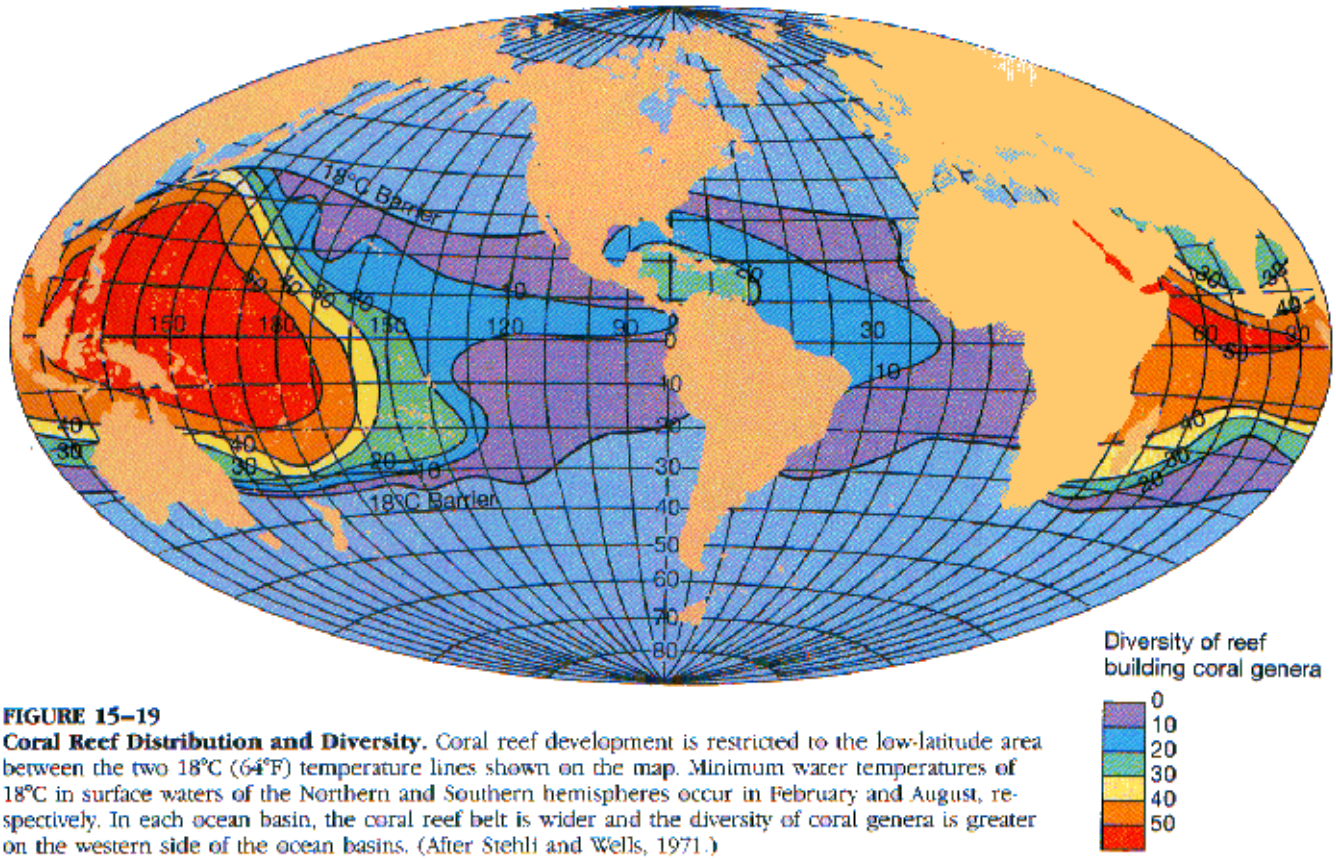
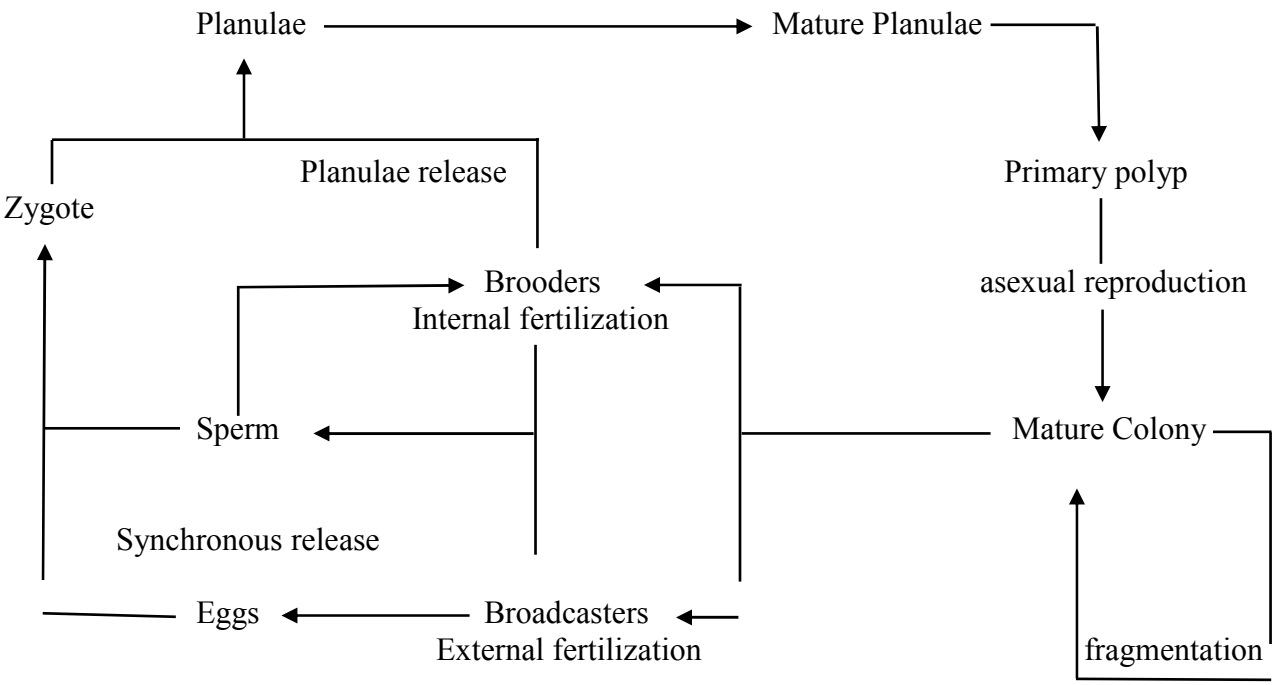


FIGURE 15–19
Coral Reef Distribution and Diversity. Coral reef development is restricted to the low-latitude area between the two 18°C (64°F) temperature lines shown on the map. Minimum water temperatures of 18°C in surface waters of the Northern and Southern hemispheres occur in February and August, respectively. In each ocean basin, the coral reef belt is wider and the diversity of coral genera is greater on the western side of the ocean basins. (After Stehli and Wells, 1971.)

8. CORAL LIFE CYCLES



Hard Coral spawning

coral planula

coral planula

newly settled coral – primary polyp

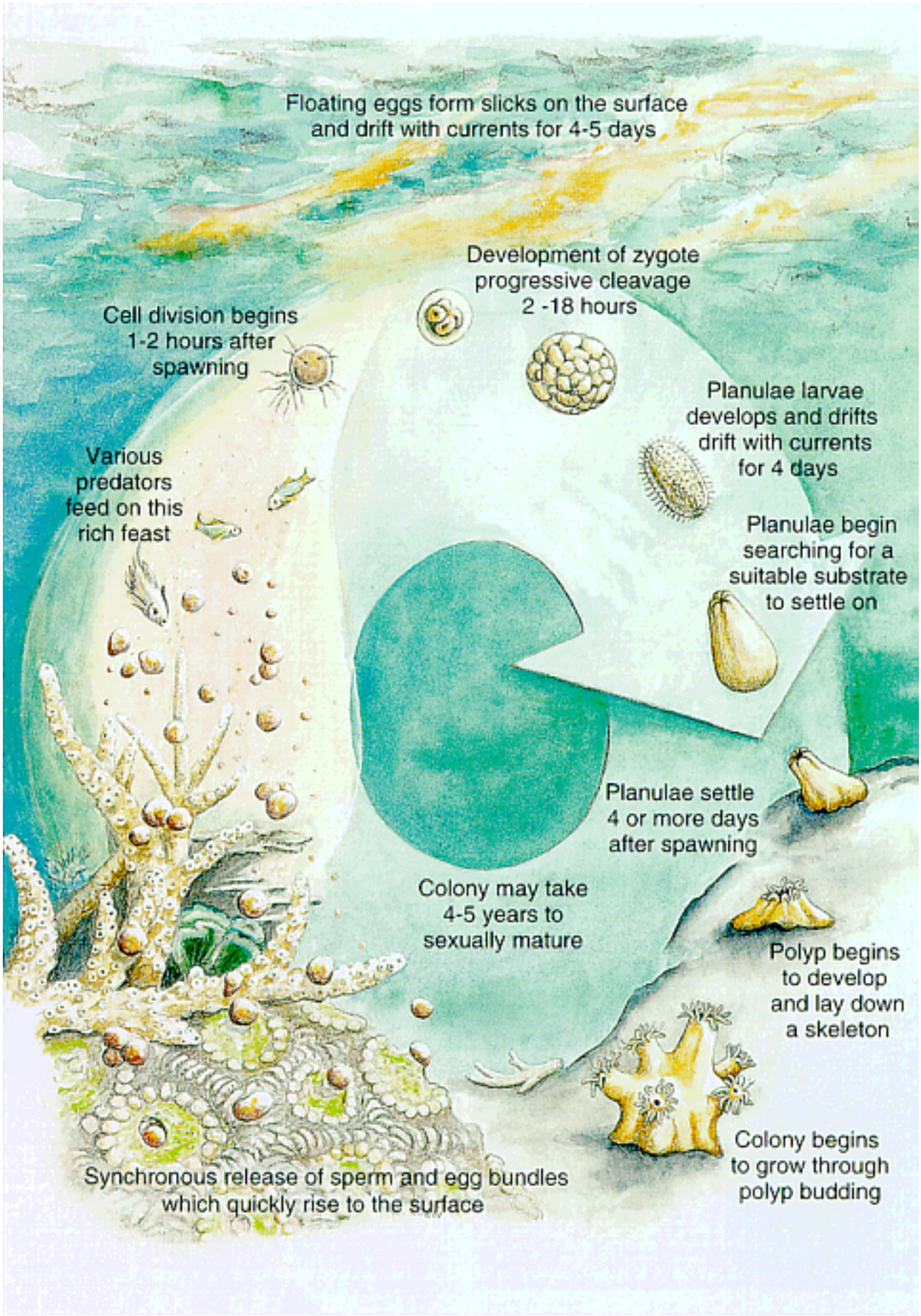


Diagram of polyp propagation via budding

9 - BOTTLE BIOLOGY – Maintaining a Cnidarian Polyp Colony

Materials

- 2- liter soft drink bottle
- Measuring stick or tape measure
- 3' length 1/4 inch aquarium hose
- Sharpie marker
- clear tape (scotch tape works well)
- Live marine algae with sea anemones
  (we will be using the Brown Anemone *Aiptasia*, aka Tube, Glass, or Rock anemones)
- Electric drill
- 1/4 inch drill bit
- small air pump (3 to 5 gallon capacity)
- "air stone"
- scissors

Instructions

1. Drill 1/4 inch hole in the bottle lid
2. Draw a line around the bottle 8 inches from the bottom
3. Make sure to draw a mark on the line for later alignment
4. Carefully cut along the line. You may have to pierce the bottle with a knife to start the cut
5. Using a Sharpie mark the bottle 6 inches from the bottom. This will be your fill line.
6. Pull a loose tennis ball - sized chunk of algae and insert into the bottle
7. Fill the bottle with sea water to the 6-inch mark.
8. Line up the alignment marks on the bottle. Secure the bottle top with tape. You may want to tape a small section first just to hold the top in place to make it easier to tape the rest of the top on.
9. Push the 1/4 inch tube through the hole in the bottle top.
10. Plug in the air stone
11. Screw on the bottle top
12. Press on the tubing so it is about half way to the bottom
13. Connect the air pump.

Care of the mini aquarium

1. **Do not attempt to keep fish in this tank. The water volume is so small the chance of fish surviving in this tank are very low.**

2. Put the tank in bright indirect sunlight or where it can get direct sunlight for only a short period of time. There must be enough light for the algae to carry on photosynthesis, but not so much that it can damage the plants and animals.

3. You will not have to feed the tank as the algae can use light to photosynthesis. The small sea anemones have a symbiotic relationship with algae that lives in their tissues. These algae provide the anemones with nutrients they need to survive. If you wish you may put a few brine shrimp in the bottle to see what happens. **Do not over feed the tank** as the water will get polluted and could harm both the algae and the anemones.

3. Add only fresh water to the tank. Only fill to the fill line. As water evaporates, salts become more concentrated. By adding fresh water, the salt concentration stays at tolerable levels for both the algae and the anemones.

10- HOME/CLASSROOM REEF AQUARIUMS

References:

The Reef Aquarium (Volume One and Two) by Charles Delbeek and Julian Sprung
- the best (with some argument) Perhaps the most comprehensive reference available.
-Downside-- probably the most expensive at $80 per volume but can be found in the library

Natural Reef Aquariums by John. H. Tullock
- a mid-range book about $30
- a good resource --- covers many approaches to reef aquarium set up, information is reliable and water quality charts etc. are very useful.
- Downside-- the information is a little odd in it's organization.

The New Saltwater Aquarium Handbook by George C. Blasiola II
- a very basic pet shop type book this one has all the necessary information one will need for around $8.00
- Downside-- the aquarist will want more complete information fairly quickly

BEST REEF SET UP INFORMATION WEB SITE
www.garf.org - check out the "bullet proof reef" section

Setting Up a Reef Aquarium

It is possible to set up a "nano-reef" aquarium in as little as two gallons of water this approach is discussed in the above resources. The following recipe is for an aquarium of 55 gallons-- it can be amended up or down depending on the aquarium size but if your aquarium is less than 30 gallons it it best to research the Nano-reef approach.

THE TWO MOST IMPORTANT INGREDIENTS OF A SUCCESSFUL REEF AQUARIUM ARE TIME AND PATIENCE

A reef aquarium adage is "nothing good happens quickly." This is one reason folks believe that reef keeping is difficult. There is no instant gratification in reef keeping. However, unlike what most books and "experts" may tell you, it is possible to set up a very stable reef environment that does not require regular water changes so long as the proper steps are taken during set up and proper development time is allowed.

A reef aquarium needs three elements, Clean cycled water, water movement, and good lighting.

Materials

An aquarium (tank) - most commercial aquariums are fine. A glass cover on the aquarium will prevent excessive evaporation.

Sea Salt - most commercial brands are fine-- be sure it's labeled "no nitrates or phosphates"

Filters - I use no filters at all for this system but if a "power filter" (side mounted) comes with your tank you may use it but unlike the included instructions you will not change the filter pads very often (I never change mine)

Substrate - usually crushed coral or a combination of aragonite and crushed coral are best at 3" to 6" depth

Pumps - to move the water around

Heater - a good reef temperature is 78º +/- 2º (place your aquarium where it will not get too warm in summer

Protein skimmer (**foam fractioner**) -- These run from $10. to $1000.00. A very conservatively stocked system can do without a skimmer, if great care is taken-- A mid-range skimmer is highly recommended

Lighting - Adequate lighting for soft corals can be achieved using two standard 4' shop lights and flourescent tubes-- ideally at least one of the four tubes should be an actinic light (available in pet shops) Hard corals (and hard to keep soft corals) need metal halide lighting which is fairly expensive.

Liverock - a good reef has 1.5 to 2.5 pounds of live rock per gallon-- for this recipe 1.5 is OK. Imported liverock runs $6.00 to $12.00 per pound (80 lbs at $6 = $480.) But live rock can be created

It is possible to purchase "base rock" locally which is much more cost effective or you can grow your own. To grow your own you need to use the most porous rock you can find that doesn't float. Make sure the rock does not contain heavy metals or other pollutants. Use your porous rock for almost all your 80 lbs and then add just one or two pounds of locally purchased live rock (at the right time.)

Set up

Set up your tank. Be sure the stand or table the tank is on will handle the weight.

Add the substrate with or without a plenum. A plenum is placed on the bottom of the tank. It can be any plastic material covered with screen (do not use metal screening) that will keep your substrate suspended about an inch above the bottom of the tank. If you're using a plenum add about 1 to 2 inches of substrate on top on the plenum and then another layer of screen on top of this layer. On top of the screen layer add the rest of your substrate.

Start adding rock and salt water - until your aquarium is full

add heater

You will not need lights for a while.

If you have a test kit, begin testing your water until you see that the nitrogen cycle has run it's course. In a week or two you may add a small damsel fish or two. This helps the cycle proceed. (the process can also be done without fish- using ammonium chloride- ask for details)

Also check PH levels

Whether you're using test kits or just the "sniff and eyeball" method of checking your water, your going to wait at least six (6) weeks before proceeding. At six weeks add your small amount of store bought Live Rock. You can put on your lights at this time. It's a good idea to put your lights on a timer. You can add a couple more fish if you wish. Remember that this is a reef environment set up for corals. You will not want a big fish population. Some reef aquariums have no fish at all.

At eight weeks, if everything is looking good, add some non-sessile invertebrates and a couple of very hardy soft corals. Usually mushroom corals are used and sometimes anemones (remember that some corals and some anemones don't get along-- in fact some corals don't get along and get into invisible chemical warfare in your tank-- so check before you buy).

When your aquarium is **a year old** you can start designing your own Reef environment selecting the specific corals and invertebrates appropriate to the reef area you are seeking to duplicate.

This is just one of many approaches to aquarium keeping

If you run into problems - don't give up - ask an aquarist, in person or on line, there are many Q&A web sites.

Leroy Stradford - refassign@comcast.net

11. NM SCIENCE STANDARDS ADDRESSED

12 - RESOURCES

Coral Reef Adventure Educator's Guide - http://www.coralfilm.com/edu.html

On-line Coral Identification - http://www.arkive.org/coral/Coral/identifying_corals.html

Corals of the World, 2000, John Edward Norwood Vernon, Australian Institute of Marine Science and CRR Qld Pty Ltd, ISBN numbers: Vol 1: 0 642 32236 8, Vol 2: 0 642 32237 6 Vol 3: 0 642 32238 4

Caribbean Reef Invertebrates and Plants, 1988, Patrick L. Colin, T.F.H. Publications, ISBN 0 866 22875 6

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