BIO 221
Invertebrate Zoology I
Spring 2007

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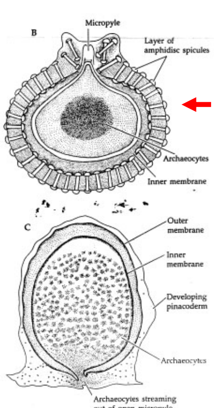
http://www4.nau.edu/isopod

Lecture 8

Reproduction and Development

1.Asexual reproduction:

a. Is the primary form of poriferan growth.
b. Allows considerable regenerative ability.
c. Budding and fission are common.
1. Relative abundance changes with season in many species.



Reduction Bodies

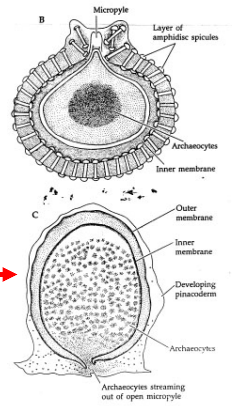
1. Marine sponges produce them when environment becomes unstable.

Gemmules - freshwater sponges

1. Resistant structures containing *archaeocytes*

2. Formed in cold weather, regenerate when conditions are warmer.

3. Possible genetic recombination"



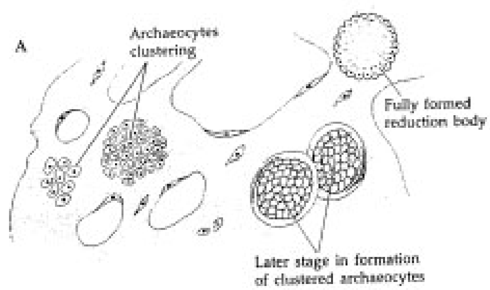


Figure 11

A, Reduction bodies (= gemmules) forming in a marine sponge. B, A gemmule (section) of a freshwater sponge (Spongillidae). C, A gemmule (section) of the freshwater sponge *Spongilla* in the process of hatching. Note the absence of amphidiscs at this point in time. (A from Bayer and Owre 1968; B, C after Hyman 1940.)

Reproduction and Development

2. Sexual Reproduction

a. Is highly variable.

b. Most species are *hermaphroditic*.

1. Often exhibit *sequential hermaphroditism*.

a. *Protandry*: male structures develop first.

b. *Protogyny*: female structures develop first.

2. Some species alternate.

a. Some species are *gonochoristic*.

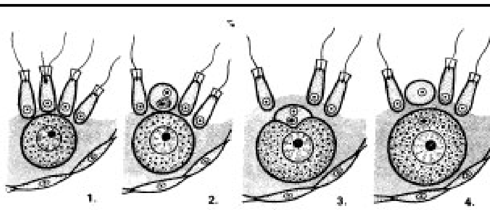
b. Some populations are mixed.

Gamete Production

a. Because sponges are sessile - sperm are released into the water.

1. Often done synchronously
2. Produces "smoking sponges"

b. sperm are captured by choanocytes - transported to eggs.



Fertilization is internal in almost all sponges. Sperms released into the surrounding water enter another sponge through the incurrent openings and canals, but cannot directly reach the egg cells, which are buried in the mesohyl. Instead, the sperms are brought to the eggs by collar cells. **1.** Sperm enters a collar cell. **2.** The sperm loses its flagellum and is enclosed in a vesicle. The collar cell loses its collar and flagellum, becomes rounded, and approaches an underlying egg. **3.** The transformed collar cell attaches itself to the egg. **4.** The sperm is transferred into the egg, and the collar cell departs. In some sponges, the collar cell is incorporated into the egg. (Based mostly on Tuzet and Paris)

Poriferan Development

Cleavage divisions -->multicellular swimming larva.

1. *Amphiblastula* larva:

a. A partially ciliated larva characteristic of Class Calcarea.

b. Begins as a ball of ciliated cells: a *coeloblastula*.

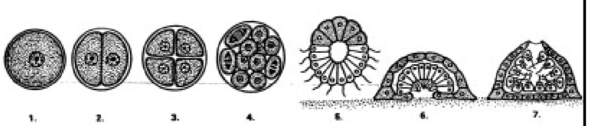
Development - Calcarea

1. Coeloblastula either undergoes inward migration of cells which later become choanocytes.

2. Or, develops internal cavity with flagella, forming a *stomoblastula*,

a. Then inverts to form free swimming *amphiblastula larva*.

c. After settling, metamorphoses into an *olynthus* which grows into a larger sponge.



Early development and metamorphosis of a calcareous sponge. 1. Fertilized egg. **2**. Two-celled stage. **3**. Four-celled stage. **4**. Continued cell division produces a ball of cells. (After Tuzet and Paris) **5**. **Amphiblastula larva**, with hollow interior and half of surface flagellated, settles on anterior end. **6**. Flagellated cells are enclosed (through inversion or overgrowth) by the posterior cells. **7**. Young sponge with lining of collar cells; an excurrent opening has appeared at the free end. (Adapted from P.E. Fell)

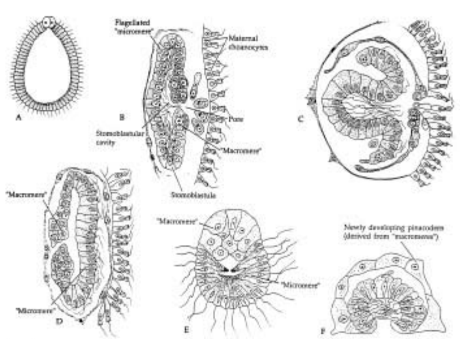


Figure 15

"Coeloblastula" and amphiblastula larvae (in section). A, Typical "coeloblastula" larva with its posterior "macromeres." B–D, During the remarkable process of inversion in *Scypha*, the stomoblastula turns itself inside out to form an amphiblastula larva with externally directed flagella. E, A typical amphiblastula larva (*Scypha*). F, Settled young sponge (*Scypha*) after invagination of flagellated cells. (A adapted from several sources; B–F from Bayer and Owre 1968, after various authors.)

Development - Demospongiae

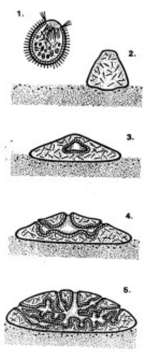
1. *Parenchymula* larva:

a. A completely ciliated larva characteristic of some Calcarea and many Demospongiae.

b. Solid ball of cells with outer flagellated cells.

c. Settles, flaglellated cells migrate inward, forms a *rhagon*.

Development: Demospongiae



Metamorphosis of a demosponge. The free-swimming 2-layered **parenchymula larva** has a solid interior and is flagellated over most of its surface. It settles down on its anterior end and develops flagellated chambers and incurrent and excurrent openings. (After W. Marshall)

Immunocompetence in Lower Phyla

Conditions necessary to demonstrate presence of an immune system:

a. Evidence of antagonism toward foreign substances.

b. Antagonism must be specific toward substance.

c. Future responses must be altered by initial response.

i.e., the system must "remember."

Immunocompetence

Inverts until recently were thought to ***lack*** immunity.

a. Now known to be untrue.

b. Sponges known to aggregate, aggregate with "self".

c. Is this immunity sensu stricto?

Immunocompetence

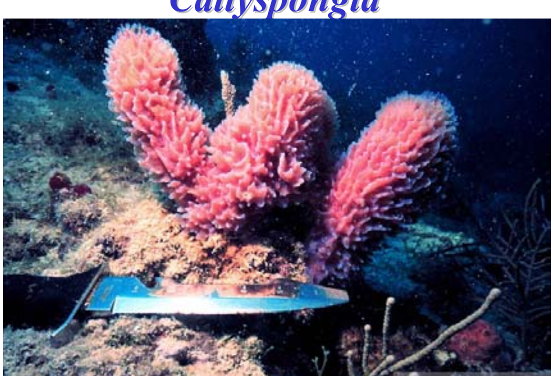
Hildemann et al. 1979 addressed this in *Callyspongia diffusa:*

a. Large purple sponge from Hawaii.

1. Long fingers that interdigitated with itself.

2. But never with other colonies or with other species.

Callyspongia



Experimental Procedure

1. Wired pieces of sponge to plastic plates, 2 pieces of sponge/plate.
   a. From same colony
   b. From different colonies
2. Maintained at 27 C in lab.

Hildemann et al. 1979. *Science* 204: 420-422

FOCUS TABLE 4.1 Reaction Times of *Callyspongia diffusa* Fragments to Each Other

1 Source of Individuals Tested	2 Days to React in First Test (median ± one standard deviation)	3 Number of Pairs Tested	4 Days to React in Second Test (median ± one standard deviation)	5 Number of Pairs Tested
A & B	9.0 ± 1.9	24	3.8 ± 0.9	10
A & C	6.9 ± 6.9	30	4.2 ± 1.3	13
B & C	7.2 ± 2.2	21	4.0 ± 1.2	11

Note: For each test, sponges were collected from two different locations (A, B, or C) and placed in close proximity. Tissue death at points of contact was clearly visible in a little over one week, on average (column 2). When the pairs were reexposed following a 12-day separation, the tissue-toxic responses occurred even more rapidly (column 4). For example, the median response for individuals collected at points A and B required about nine days in the first encounter but less than four days in the second encounter. The faster second response clearly was a consequence of prior experience, indicating that these sponges have an immune memory system.

Summary of Results I

1. Same colony sponges ***always*** fused.
2. Different colonies ***never*** fused.
   a. Discoloration, etc. among allogenic individuals.

Summary of Results II

3. When allowed to rest after introduction,

a. *toxic reactions occurred more rapidly than before.*

Evolutionary Context

1. Why be able to do this?

a. Avoid competition

b. Avoid colonization by non-relatives

1. Sometimes inbreeding is not bad.

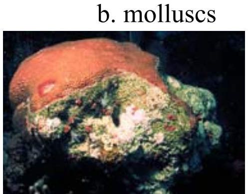
How Widespread?

a. ***Lots*** of encrusting animals do this

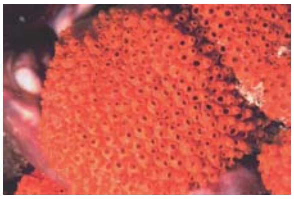
1. Surprisingly, many complex organisms don't:

a. insects

b. molluscs



Tunicates and Urochordates



c. Many people now think that the origins of our immunological responses lie in the recognition of self and non-self among our encrusting chordate ancestors.

d. Much interesting research going on here

Fossil Record

1. Note different groups.
2. Extinctions of other animals similar to sponges

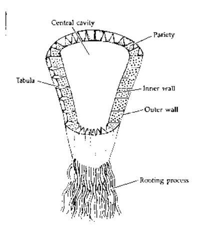
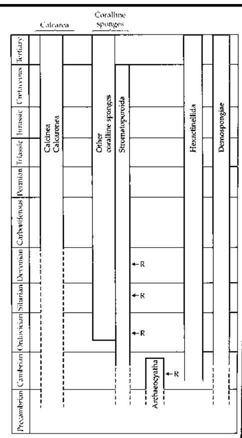


Figure 6.20 A typical archaeocyathan. A vertical section has been partly cut away to show the structure between the inner and outer walls (i.e., vertical parieties and horizontal tabula).



BIO 221
Invertebrate Zoology I

Lecture Exam 1 Review

BIOLOGY 221 - INVERTEBRATE ZOOLOGY
LECTURE EXAM 1 – SPRING 2010

Name ________________________________

Lab Section (circle one): 1 2

NOTICE: Cheating is unacceptable behavior. All books and notebooks must be closed and remain so during examinations. Notes may not be in view while an exam is in progress. A student whose books are open or whose notes may be seen by him/her or by other students, or students who are observed copying information from any source will receive a grade of "F" for that examination OR FOR THE ENTIRE COURSE!

General Instructions: Count the number of pages of this exam; there should be 12 sheets:

Part I consists of 20 fairly difficult multiple choice questions worth three points each. Record your answers in spaces 1-20 of your answer sheet.

Part II consists of 15 somewhat less difficult multiple choice questions worth two point each. Record your answers to these questions in spaces 21-35 of your answer sheet.

Part III; consists of 10 relatively simple multiple choice questions worth one point each. Record your answers to these questions in spaces 36-45 of your answer sheet.

Make sure you have all necessary pages and plan your time well! Write your name and your lab section this exam and on your answer sheet.

Cephalopod eyes (that is, the eyes possessed by octopus and squid) are considered structurally and functionally comparable in many ways to vertebrate eyes (like those possessed by fish, birds, lizards and humans). They are thus often used as an example of:

a. disruptive selection
b. parallel evolution
c. fecundity selection
d. convergent evolution
e. directional selection