Model organisms and developmental biology

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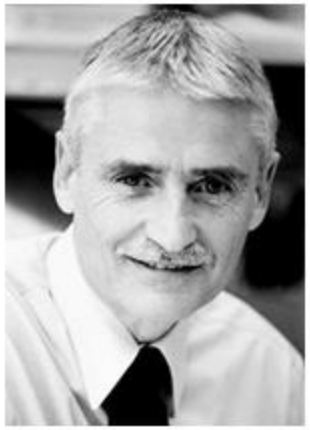
Sea urchin

- Echinoderms, sea urchin, starfish, sea cucumber.
- No fresh water or terrestrial specie.
- Echinoderms are deuterostomes and coelomates, more closely related to vertebrates than *Drosophila* and *C. elegans*.
- 1875, Oscer Hertiwig, fertilization.
- 1891, Hans Driesh, separate the embryo to individual cells after the first cleavage.
- 1983, Tim Hunt, cyclin.

The early development of sea urchin embryos is highly synchronous.

The Nobel Prize in Physiology or Medicine 2001



Leland H. Hartwell

Tim Hunt

Sir Paul M. Nurse

The Nobel Prize in Physiology or Medicine 2001 was awarded jointly to Leland H. Hartwell, Tim Hunt and Sir Paul M. Nurse *"for their discoveries of key regulators of the cell cycle"*.

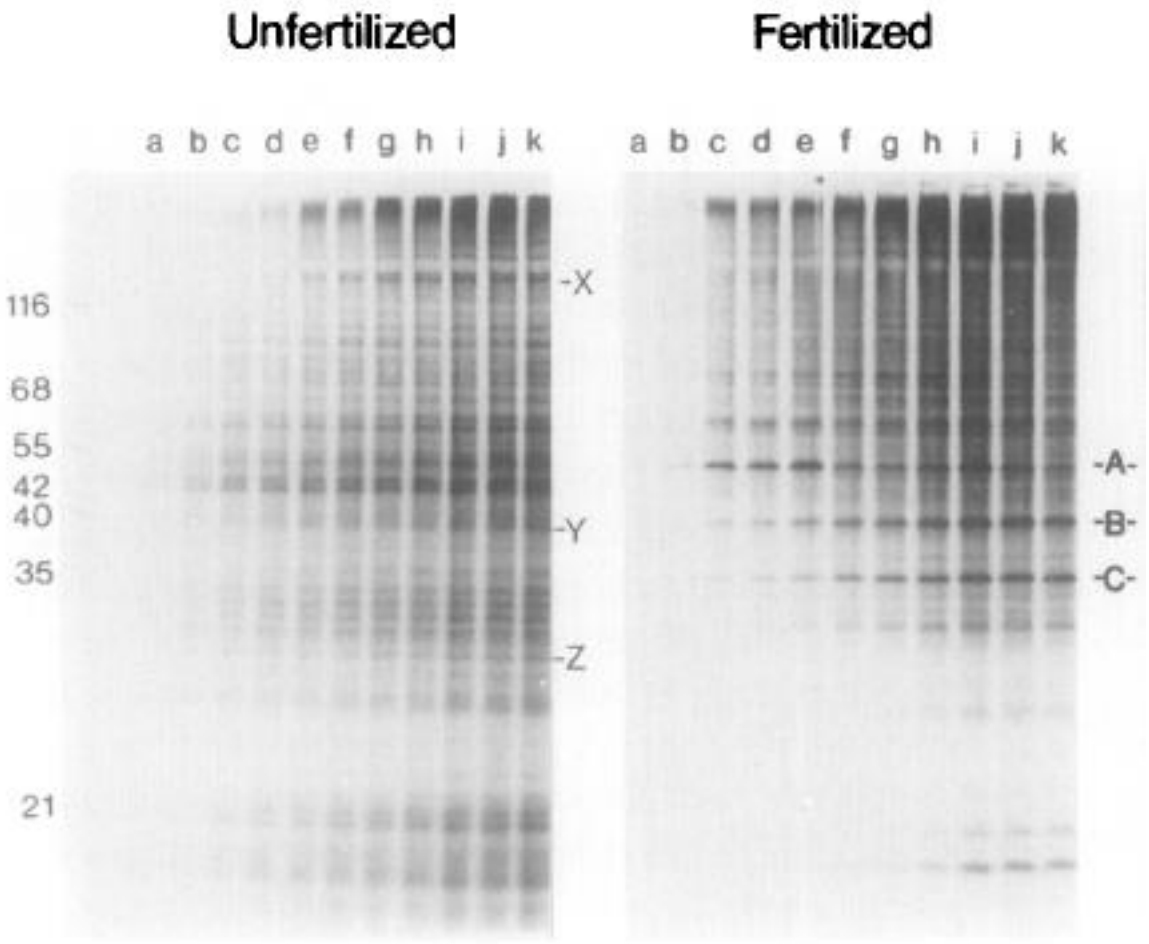


Figure 1. The Patterns of Protein Synthesis in Eggs before and after Activation

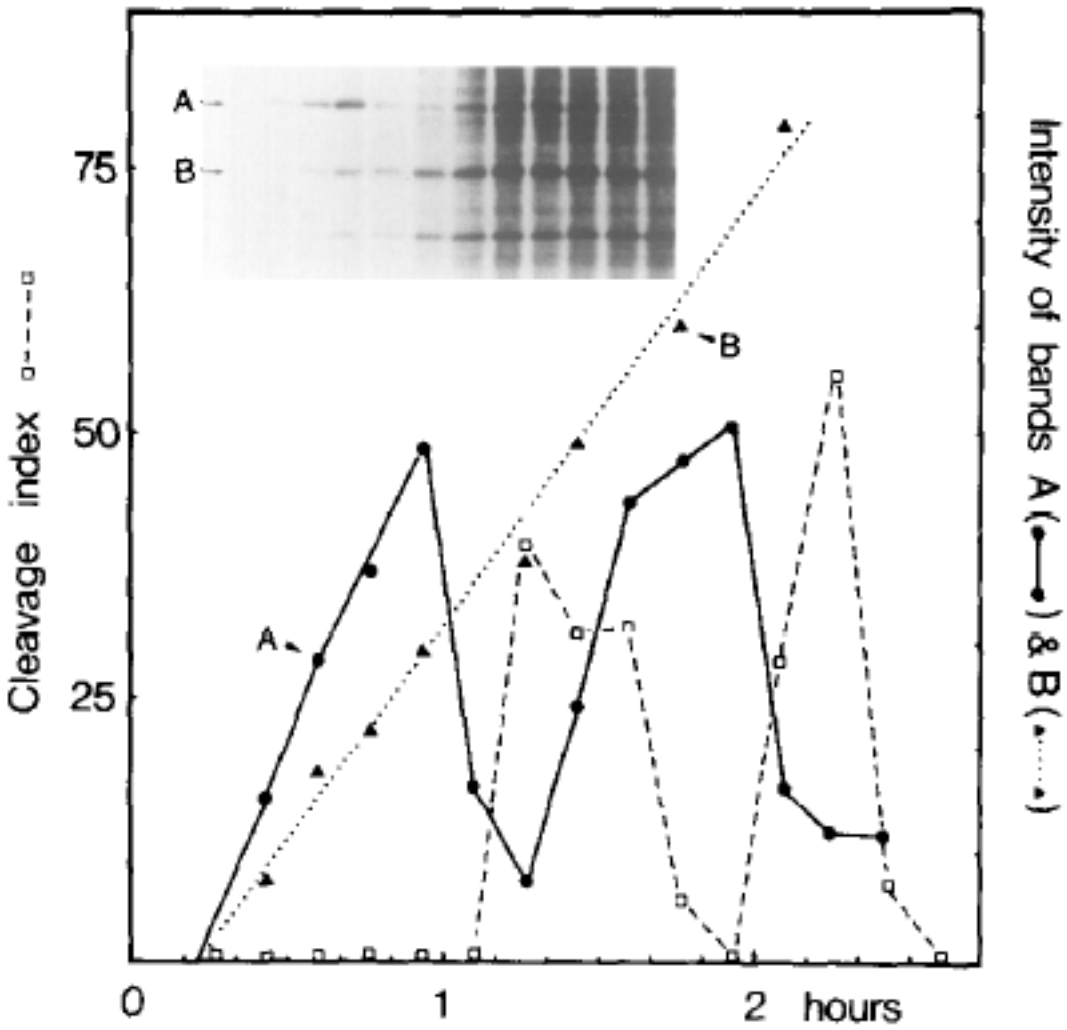


Figure 2. Correlation of the Level of Cyclin with the Cell Division Cycle

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REVIEW

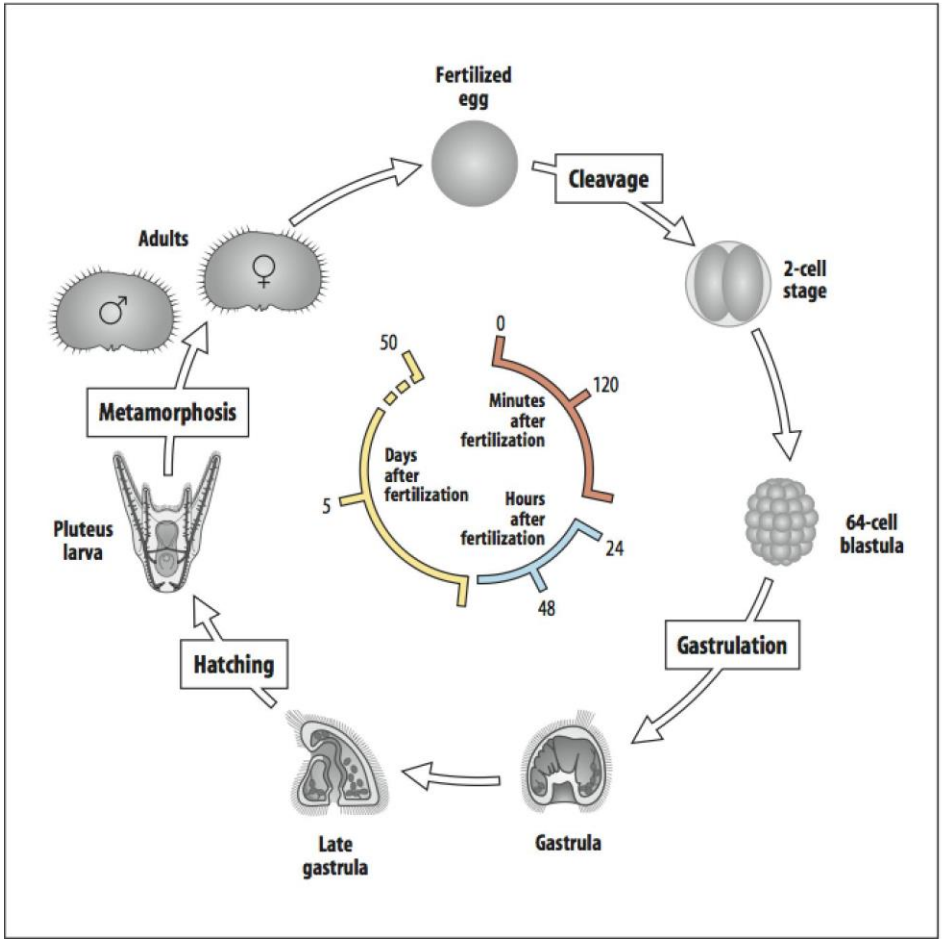
Genomic Insights into the Immune System of the Sea Urchin

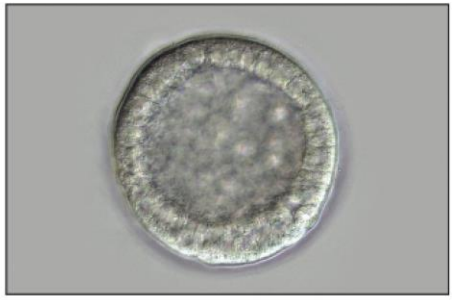
Jonathan P. Rast,[1]* L. Courtney Smith,[2] Mariano Loza-Coll,[1] Taku Hibino,[1] Gary W. Litman[3,4]

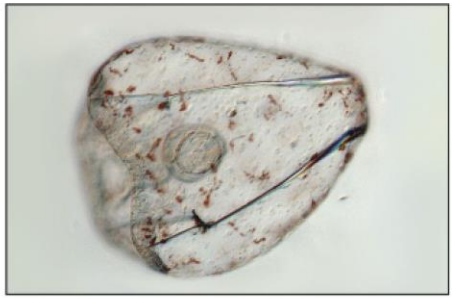
Comparative analysis of the sea urchin genome has broad implications for the primitive state of deuterostome host defense and the genetic underpinnings of immunity in vertebrates. The sea urchin has an unprecedented complexity of innate immune recognition receptors relative to other animal species yet characterized. These receptor genes include a vast repertoire of 222 Toll-like receptors, a superfamily of more than 200 NACHT domain–leucine-rich repeat proteins (similar to nucleotide-binding and oligomerization domain (NOD) and NALP proteins of vertebrates), and a large family of scavenger receptor cysteine-rich proteins. More typical numbers of genes encode other immune recognition factors. Homologs of important immune and hematopoietic regulators, many of which have previously been identified only from chordates, as well as genes that are critical in adaptive immunity of jawed vertebrates, also are present. The findings serve to underscore the dynamic utilization of receptors and the complexity of immune recognition that may be basal for deuterostomes and predicts features of the ancestral bilaterian form.

Animal immune mechanisms are classified as acquired (adaptive), in which immune recognition specificity is the product of somatic diversification and selective clonal proliferation, or as innate, in which recognition specificity is germline encoded. Collectively, these systems act to protect the individual from invasive bacteria, viruses, and eukaryotic pathogens by detecting molecular signatures of infection and initiating effector responses. Innate immune mechanisms probably originated early in animal phylogeny and are closely allied with wound healing and tissue maintenance functions. In many cases, their constituent elements are distributed throughout the cells of the organism. In bilaterally symmetrical animals (Bilateria), immune defense is carried out and tightly coordinated by a specialized set of mesoderm-derived cells that essentially are committed to this function (*1*–*3*). Overlaid onto this conserved core of developmental and immune programs are a variety of rapidly evolving recognition and

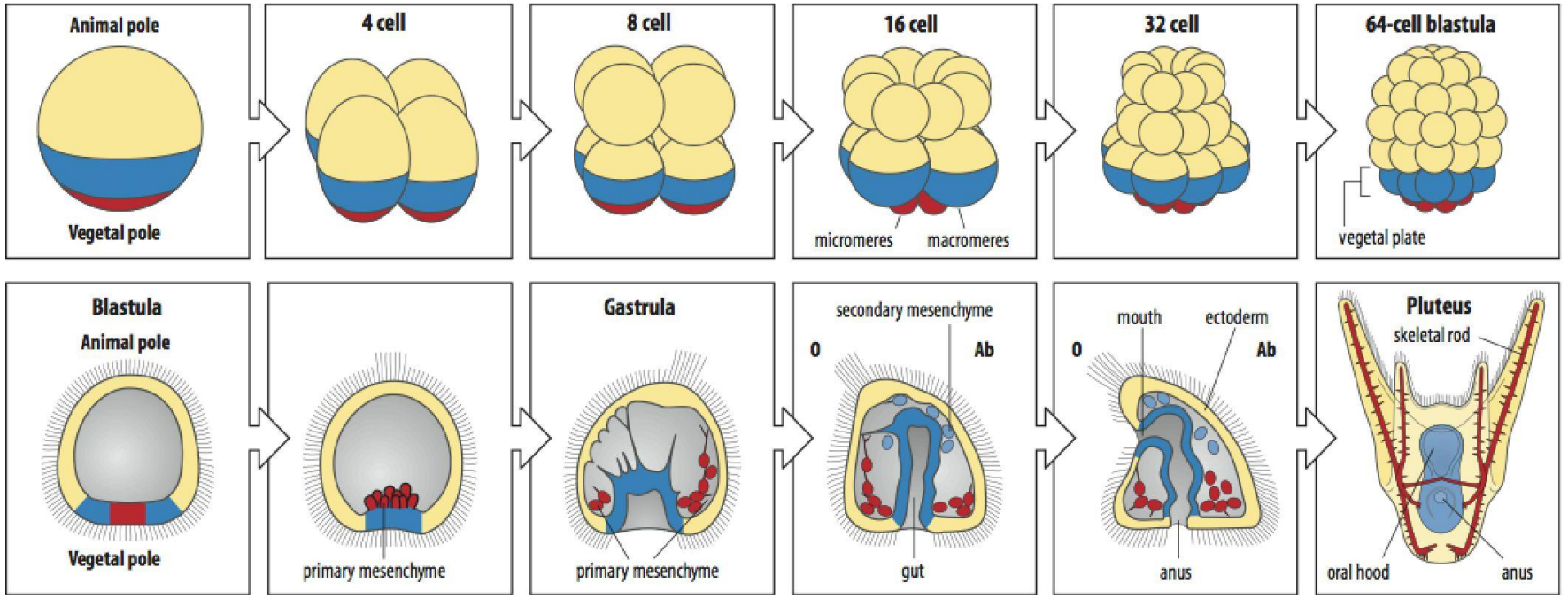
Life cycle of the sea urchin *Strogylocentrotus purpuratus*



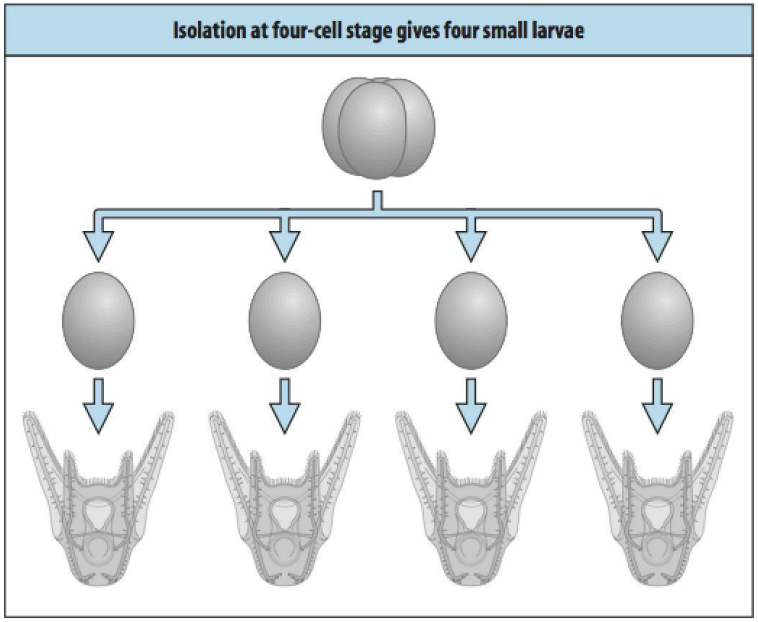


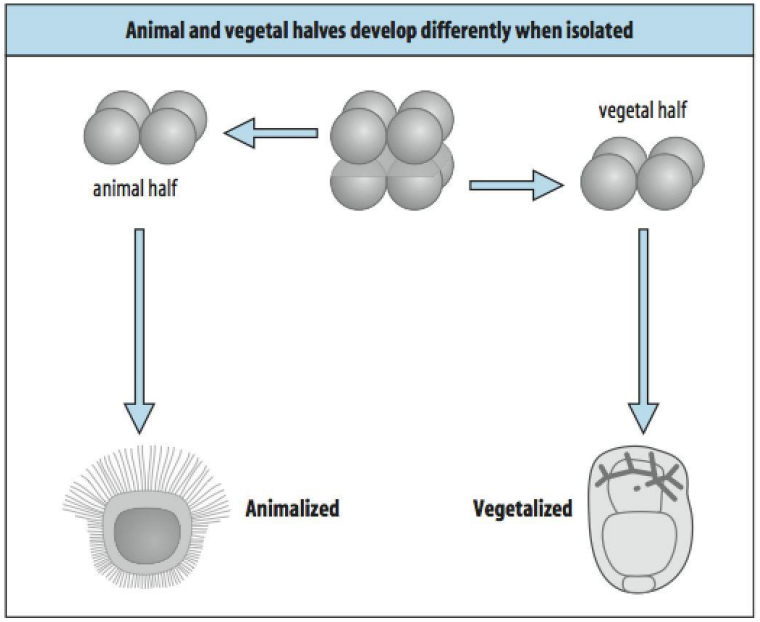


Development of the sea-urchin embryo

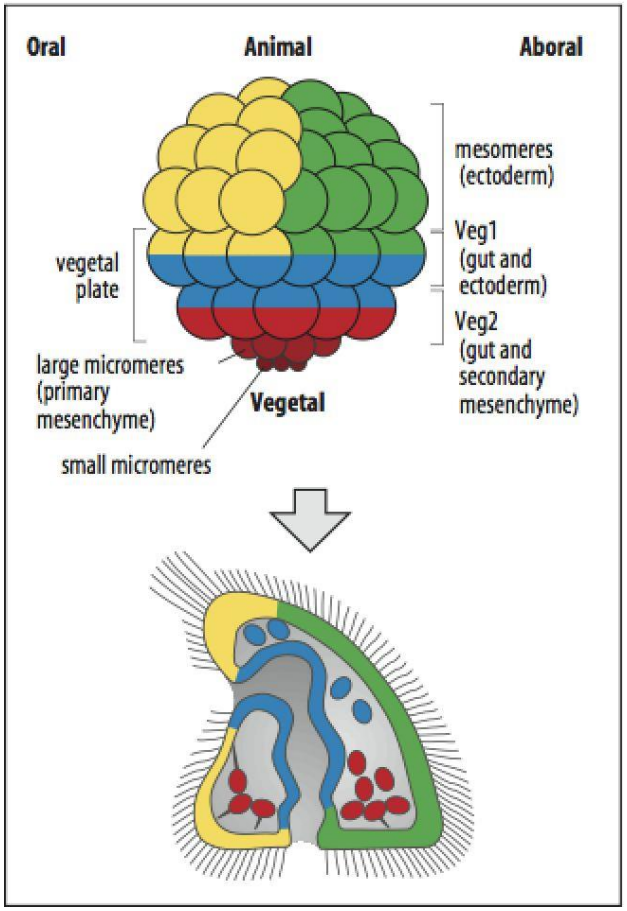


Development of isolated sea urchin blastomeres

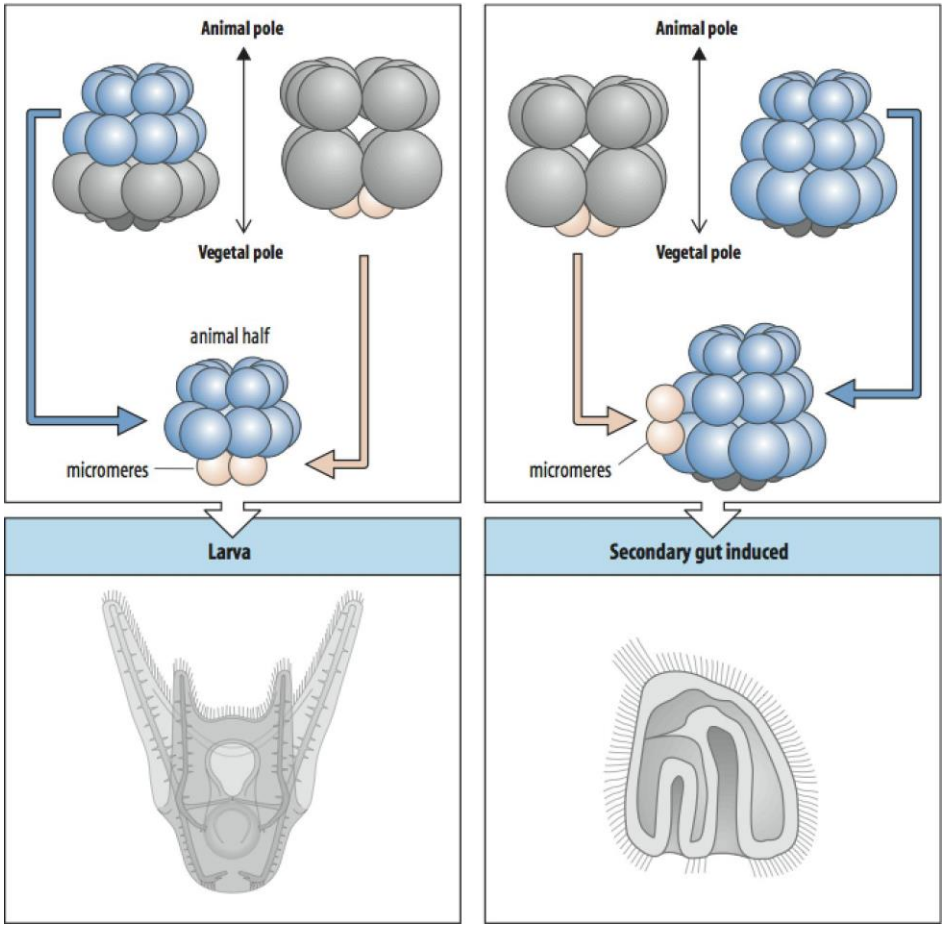




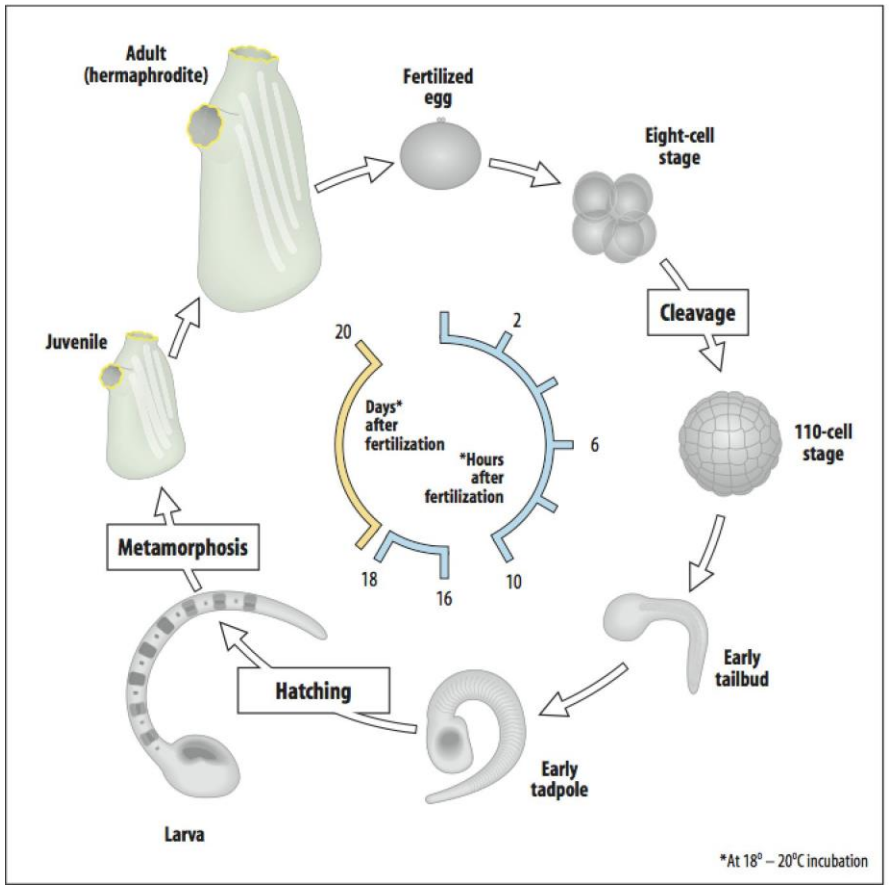
Fate map of the sea urchin embryo

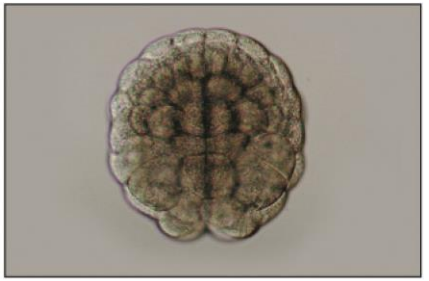


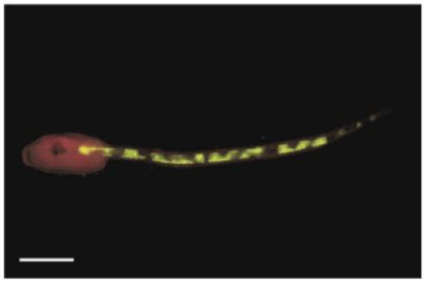
The inductive action of micromeres



Ascidians

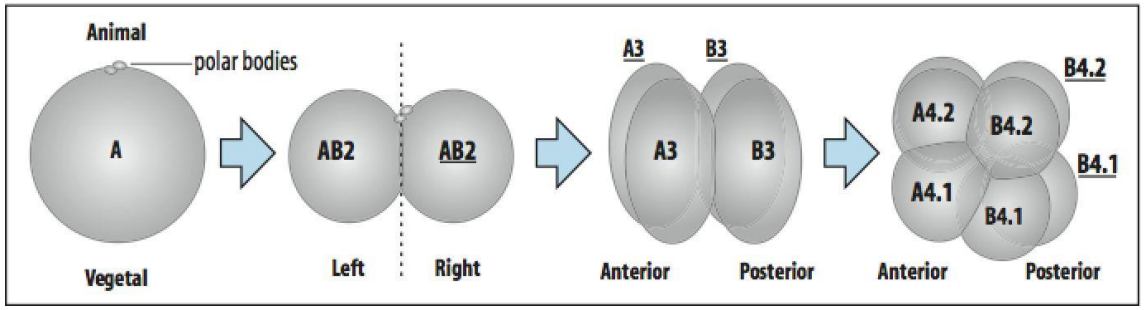


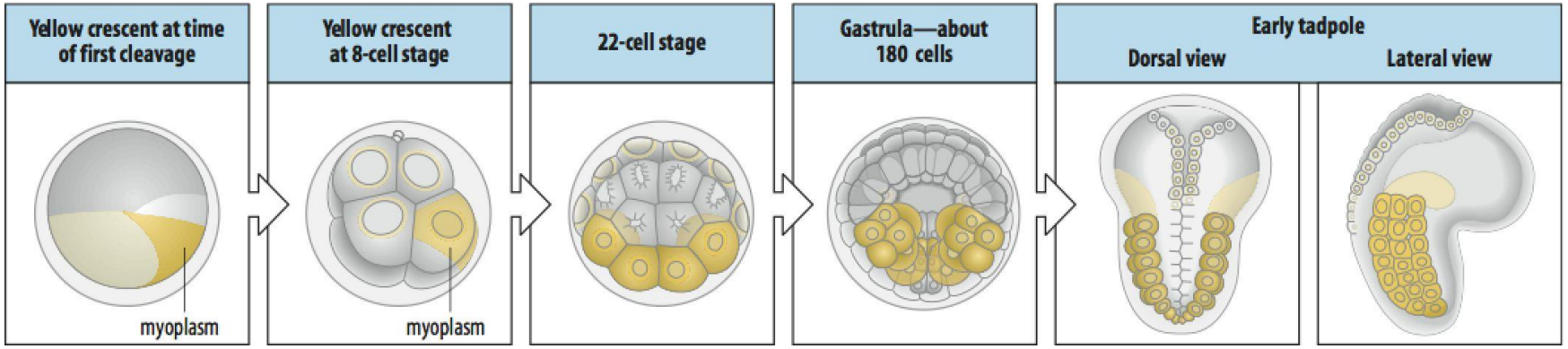


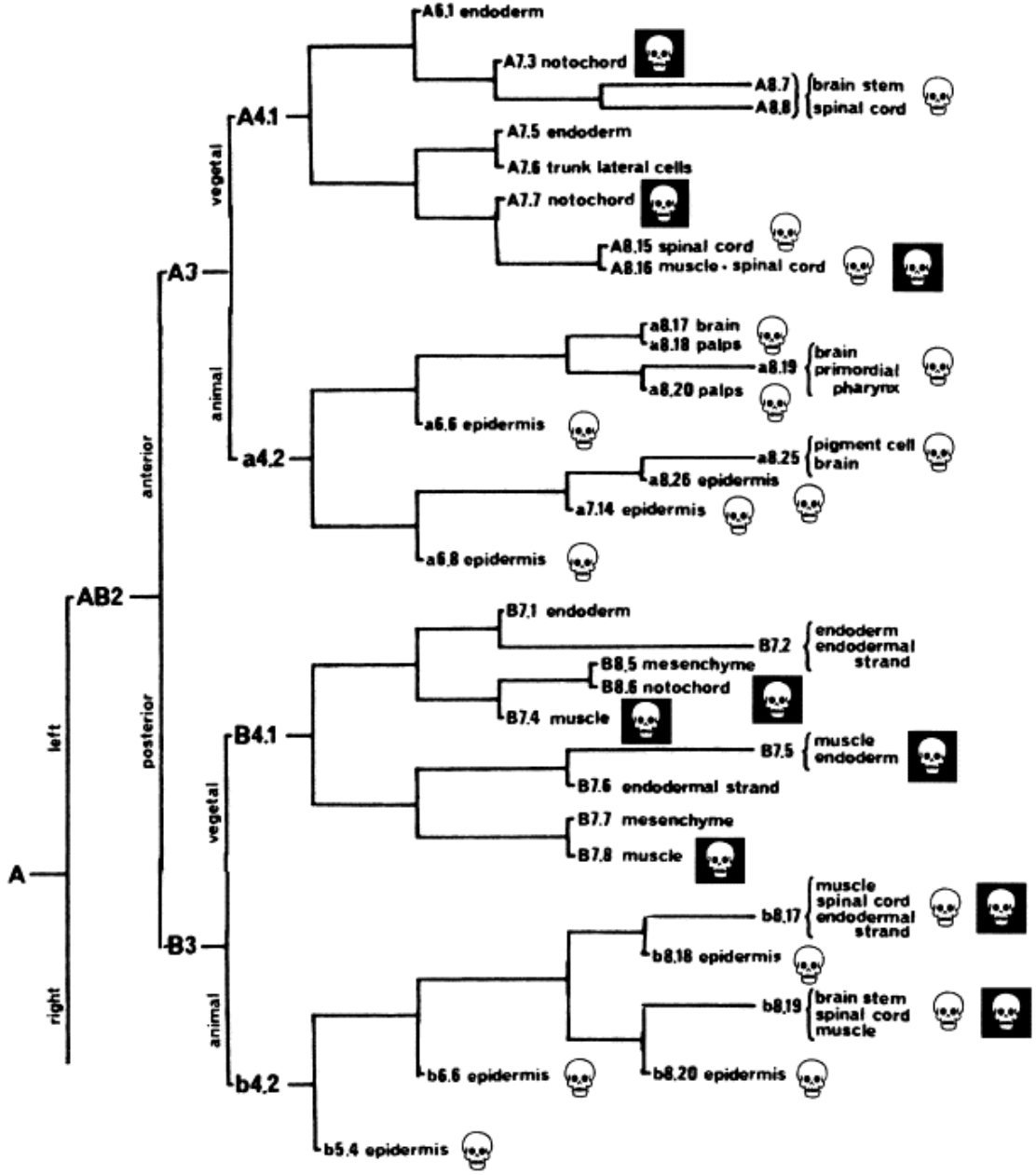


Sea squirt, sessile marine animals. Urochordates

Cleavages and cytoplasmic determinants







N. Satoh, Developmental Biology of Ascidians, Cambridge University Press, 1994

Thanks!