

Quotation: Volvox

The amoeba and the paramecium are potentially immortal...But for *Volvox*, death seems to be as inevitable as it is in a mouse or in a man. *Volvox* must die because it had children and is no longer needed. When its time comes it drops quietly to the bottom and joins its ancestors.

Joseph Wood Krutch, 1956



Colonial Eukaryotes

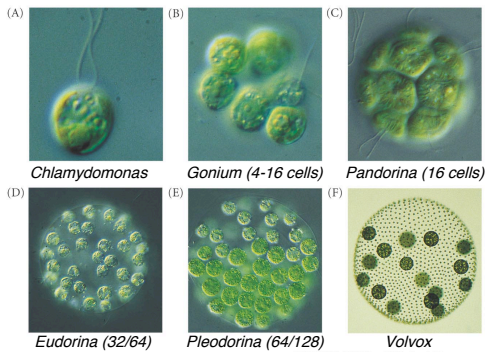
Colonial Eukaryotes - A model for the evolution of multicellularity

The Volvocaceans

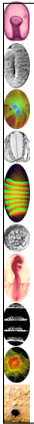
(and a one-celled relative, *Chlamydomonas*)

green algae found in freshwater ponds

Figure 2.11 Representatives of the Order Volvocales (B-F)



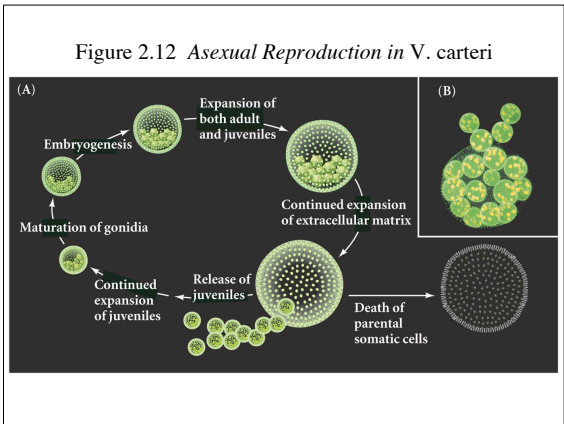
Volvocacean reproduction




Simple Volvocaceans:
every cell can recreate a new colony

Large Volvocaceans (e.g., *Volvox*):
somatic & reproductive cells (**gonidia**)

only some cells produce new *Volvox*



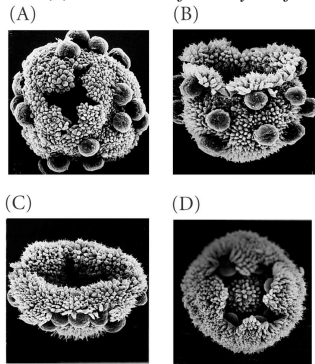
Volvox inversion



Volvox undergoes **inversion** to place gonidia into the interior

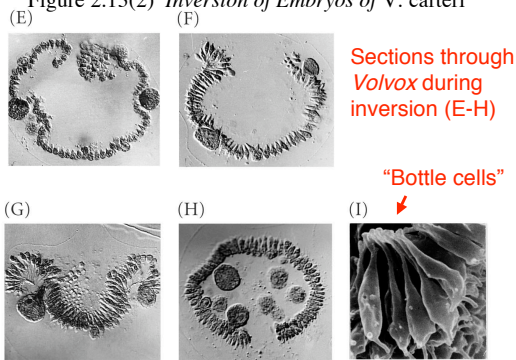
Process resembles gastrulation in animals

Figure 2.13(1) *Inversion of Embryos of V. carteri*



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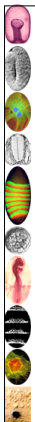
Figure 2.13(2) *Inversion of Embryos of V. carteri*



Sections through *Volvox* during inversion (E-H)

"Bottle cells"

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Dictyostelium discoideum

Dictyostelium:
A part-time multicellular organism

Dictyostelium discoideum
a "cellular slime mold"

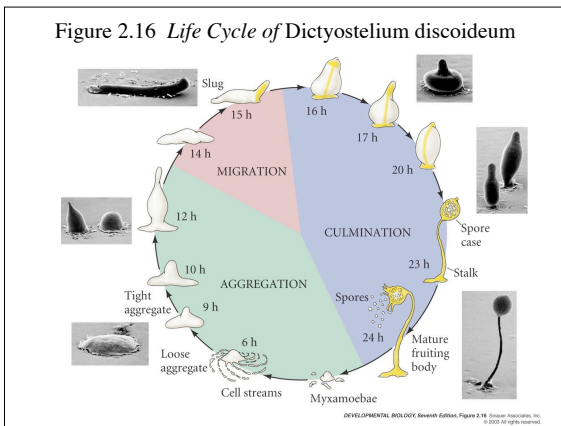
a simple model organism used to study developmental processes

Dictyostelium life cycle intro

With plentiful food, individual *Dicty* (myxamoebae) divide

Starvation signals transformation:

- Cessation of division
- Cell-cell signaling
- Aggregation
- Differentiation
- Morphogenesis



Cell signaling by *Dictyostelium* uses cAMP

Adenine

3'-5' cyclic Adenosine monophosphate / cyclic AMP / cAMP

- more familiar as an *intracellular* signaling molecule

Dicty "chemotactic relay system"

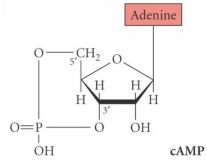
New proteins made

▪ cAMP synthesis:
Adenylate cyclase

▪ cAMP detection: cAMP Receptor (cell surface)

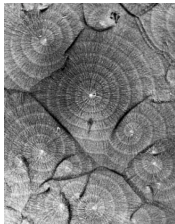
▪ cAMP degradation: Phosphodiesterase (PDE)

▪ fine tuning of cAMP conc: PDE inhibitor

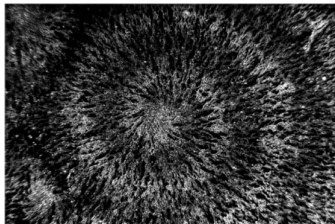


Dicty "chemotactic relay system"

cAMP released in bursts, forms spiral waves
Cells move toward higher conc. of cAMP

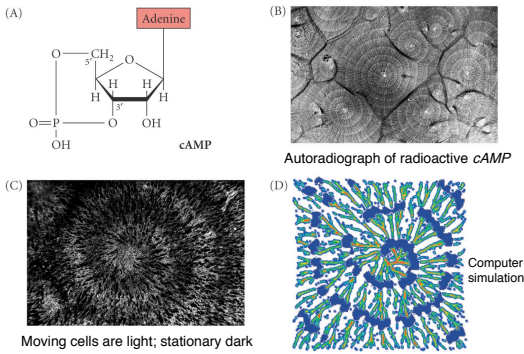


Autoradiograph of radioactive cAMP showing spiral waves



Moving cells are light; stationary dark

Fig. 2.17 Chemotaxis of *Dictyostelium Myxamoebae* Is a Result of Spiral Waves of cAMP

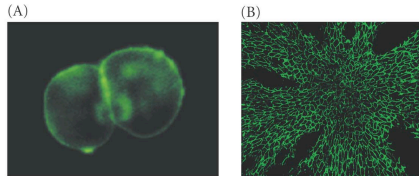


As cells migrate together, aggregation begins

Dicty cells express **cell adhesion molecules (CAMs)** to stick together

Dicty CAMs are cell surface **glycoproteins**

Fig. 2.18 Three Cell Adhesion Molecules of *Dictyostelium*



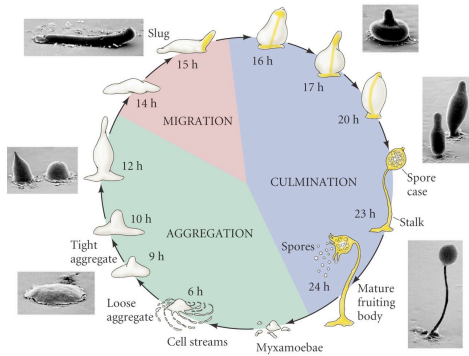
A. gp24 protein - 10 hrs after cessation of cell division

B. gp80 protein in streaming myxamoebae

C. gp150 protein - first on prestalk cells to help sort?

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Figure 2.16 Life Cycle of *Dictyostelium discoideum*



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Dicty specifies cell types

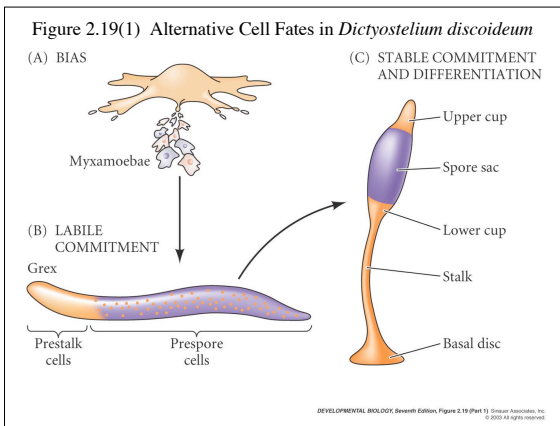
The multicellular **slug** migrates
(slug is aka grex or pseudoplasmodium)

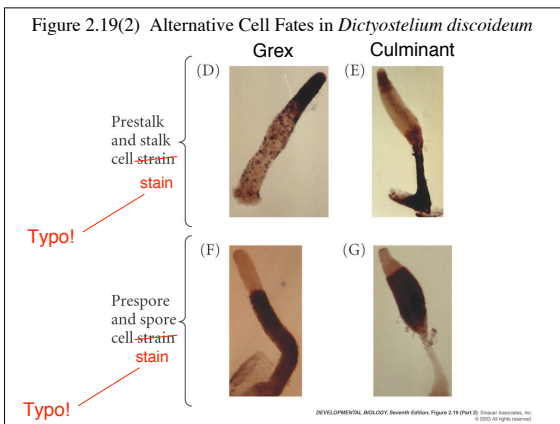
Location of *Dicty* cells in slug affects
future cell type:

Front 20% of cells become **prestalk**

Back 80% of cells become **prespore**

Development is **regulative** - cells can
change fates if circumstances change





Factors regulating cell fate

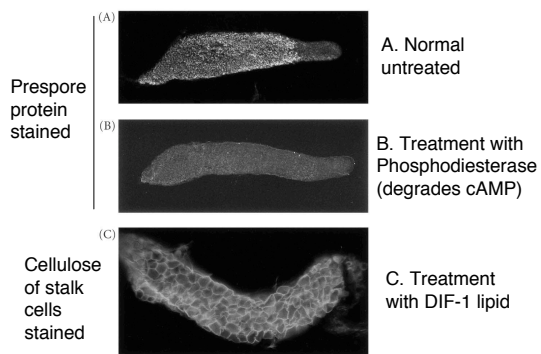
Stalk: low ammonia

DIF-1 lipid

Spore: high cAMP

spore differentiation factors:
SDF1, SDF2

Figure 2.20 Chemicals Controlling Differentiation in *Dictyostelium*



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